Managing Urban Shallow geothermal Energy

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Guideline on targeted communication to stakeholders on shallow geothermal use in urban areas – initial version

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General description of the deliverable in the application

The strategy acts as a guideline for targeted stakeholder communication and training by the project team in the pilot areas. It will be connected to deliverable D.3.2 (Guideline for integrating and managing the use of SGE in urban areas) and be tested in the pilots. It will include concepts and templates for stakeholder interviews, joint brainstorming activities (e.g. performing SWOT analyses) and knowledge transfer activities. The final version of the strategy, tested in the pilot areas of MUSE, will be published for enabling transfer of knowledge to other urban areas in Europe.

Version

Version	Description
31-08-2021	Initial version applied to the MUSE pilot areas
23-11-2021	Updated version including lessons learned section

List of abbreviations

Abbreviation	Full name
GSO	Geological Survey Organisation
SGE	Shallow Geothermal Energy

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1 INTRODUCTION

1.1 Description of the deliverable according to the MUSE application form

This document contains a guideline for targeted stakeholder communication through the project team in the MUSE in a twofold approach:

1) At a local to regional level at the MUSE pilot areas;
2) At an international level addressing international organizations including EU institutions, EuroGeoSurveys and Geological Survey Organizations outside MUSE.

The guideline is strongly connected to deliverable D.3.2 ("*Guideline for integrating and managing the use of SGE in urban areas*") and was tested in the pilot areas. It includes concepts and templates for stakeholder interviews, joint brainstorming activities (e.g. performing SWOT analyses), focus group workshops and knowledge transfer activities like surveys and trainings (webinars as well as physical events).

The elaborated strategy will be published for enabling transfer of knowledge to other urban areas in Europe and other Geological Survey Organizations dealing with shallow geothermal energy management.

1.2 Background

1.2.1 Motivation

Linked to mapping resources and other aspects linked to the use of shallow geothermal energy, MUSE also addresses policy aspects related to the management of shallow geothermal energy in urban areas. Still, shallow geothermal is affected by various non-technological and administrative hurdles limiting its technological application as well as its efficient and environmental friendly use. Bringing this technology forward to a European scale requires active involvement of various local and international stakeholders. For that reason, all thematic work packages are linked to targeted stakeholder engagement regarding the different boundary conditions and constraints for managing the use of shallow geothermal in the 14 MUSE pilot areas. Emphasis is also given to the already existing and required future role of Geological Survey Organizations (GSOs) in the context of managing shallow geothermal energy in urban areas. Moreover, stakeholder involvement enhances the impact and long term sustainability of the scientific activities performed and results achieved in MUSE.

Taking these aspects into account, this document intends to provide a practical guideline on stakeholder interaction for GSOs in the context of urban shallow geothermal energy use. It will also summarize the experiences gained in the GeoERA MUSE pilot areas.

1.2.2 *Lessons learned from previous activities inside the MUSE team*

Experiences gained from the EU Interreg Central Europe project **GeoPLASMA-CE** (www.geoplasma-ce.eu) revealed that it is crucial to involve stakeholders in an early stage of a scientific work- and decision finding process in order to ensure that the planned outcomes are relevant and adaptable. In GeoPLASMA-CE, various channels have been tested for engaging stakeholders. The communication tools need to be selected regarding the needed level of anticipation. While digital online surveys may reach a high number of participants at a low level of interaction, direct interviews, which require a significant amount of time ensure a high level of direct interaction.

The MUSE partner P03 ICGC is co-leading the activities of the "**Geothermal Working Team (GTG)**" inside the "Energy Efficiency Cluster of Catalonia" for several years and is very much experienced with stakeholder interaction. P03 ICGC points out that stakeholder interaction should consider a probably low level of technical understanding of stakeholders outside the geoscience sector (e.g. architects, energy planners or municipalities). Considering this, stakeholder interaction should aim at identifying the required interfaces to translate geoscientific basic knowledge and data for their daily work needs. "Stakeholder communication will surely have more effects if the MUSE products are globally framed within all the technological and economic aspects that entails the implementation of the SGE in a HC (heating and cooling) project" (Ignasi Herms, ICGC). This includes, among others, technical solutions to implement shallow geothermal energy into hybrid- or multivalent energy supply systems and associated costs linked to it.

Partner P04 HGI-CGS was involved in stakeholder communication in the framework of the national scientific project **GeoMapping** (2014 – 2017). The project involved local stakeholders from communities and the educational sector to raise the awareness and train on the use of shallow geothermal energy in Croatia. The interaction based on testing- and demonstration borehole heat exchangers, which were implemented at different locations. The work inside GeoMapping revealed that it is important to identify the questions stakeholders to the geoscientific community on the use of shallow geothermal – these questions might very much differ from the questions expected by geoscientific experts. Similar to the experiences gained in Catalonia, economic aspects of using shallow geothermal energy are very important for local decision makers. GeoMapping also revealed that it is very important to involve the educational sector starting at schools to raise awareness on the use of shallow geothermal as young students are the next generation of decision makers.

Partner 08-RBINS-GSB performed stakeholder interviews and knowledge transfer workshops in the framework of the **BRUGEO** project to promote the use of geothermal energy in the Brussels-Capital Region for heating and cooling applications in buildings or for energy storage. This project is of special interest for GeoERA MUSE as it addresses the use of shallow geothermal in an urban area. Special attention has been

paid to the communication of geoscientific data to the lay public for a better understanding of the subsurface of Brussels.

Partner P13 PIG-PIB was involved in stakeholder interaction in the projects **Geothermal4PL** (https://www.pgi.gov.pl/en/geothermal4pl-2.html), **Transgeotherm** (http://www.transgeotherm.eu/), **GeoPLASMA-CE** as well as in the ongoing project **MPGN**. The targeted communication activities were focused on local workshops and trainings, stakeholder surveys as well as networking and interlinking activities between stakeholders in the field of shallow geothermal energy. PIG-PIB points out that the selection of communication channels, and communication aims need to be tailored for the interest and needs of the different target groups – approaching all stakeholders with the same topics and communication tools might reduce the success and impact of the efforts made. Moreover, targeted stakeholder communication should also aim at transferring tailored messages from the project team (group of scientists) to each type of target group.

MUSE adapted and further developed these lessons learned from the above mentioned previous projects for promoting efficient and sustainable management approaches for shallow geothermal energy in European urban areas supported by GSOs.

1.2.3 The current role of Geological Survey organisations in managing (urban) shallow geothermal energy

The subsequent summary of the current role of GSOs concerning the management of urban shallow geothermal energy use refers to a GeoERA MUSE partner survey performed in the period between January and April 2020. It covers feedbacks received from Austria, Belgium, Croatia, Poland, Slovakia, Slovenia and Spain / Catalonia.

The main observations are listed below:

- None of the involved GSOs is involved in licensing or formal data assessment or maintenance related to permits of shallow geothermal energy use (e.g. official registers of installations),
- None of the involved GSOs is legally responsible for management of resources or management of use,
- The involved GSOs provide general geoscientific inside the regular competences, which could be used for planning and managing shallow geothermal use. Some GSOs have a defined formal role in communication and dissemination of information on resources and limitations of use related to urban shallow geothermal. Previous national as well as international research projects led to the elaboration of maps and digital information systems related to the use of shallow geothermal energy. In most cases GSOs took the initiative to set up such research projects,
- Most of the involved GSOs provide consultancy and scientific advice for public authorities or public agencies dealing with the use of shallow geothermal energy,

which is very often related to strategic cooperation based on initial research projects. Some of the involved GSOs prepared guidelines referring to resource and limitation of use maps. Most of the involved GSOs are also offering scientific consultations to private entities at market conditions,

- Most of the involved GSOs also lack of formalized access to geoscientific data linked to the regulation of shallow geothermal energy use (e.g. data from licensing procedures or obligatory monitoring). In most cases, exploration and licensing data delivered to GSOs refer to other legal obligations defined in geological data-, mining or water acts without any specific address of shallow geothermal.

To sum up and conclude, the current roles of SGO regarding the management of urban shallow geothermal are not entirely clear for the following assumed reasons:

- The management of shallow geothermal energy is under regulated in many countries as the technology was introduced to the heating and cooling market just a couple of years ago. As consequence, shallow geothermal energy is co-managed by legal acts without a clear focus on this technology,
- Shallow geothermal energy is managed in most cases by local authorities, which do not have a strong formal link to national or federal GSOs,
- There is still a low level of awareness on policy- or public decision makers on the relevance of managing shallow geothermal energy use, which requires the systematic assessment and maintenance of subsurface data from obligatory licensing and monitoring procedures.

1.3 Objectives

Targeted communication related to GeoERA MUSE aimed at:

i. Support and active dialogue with stakeholder on the current possible future strategic role of shallow geothermal to support climate and energy strategies in the MUSE pilot areas,

ii. Identify measures in cooperation with stakeholders how to better integrate shallow geothermal in regional strategies and actions (e.g. RAP, SEAP),

iii. Raise awareness among stakeholders on existing gaps and hurdles towards an efficient und sustainable management of shallow geothermal in urban areas in Europe,

iv. Raise awareness towards the technological options linked to shallow geothermal use in cities,

v. Initiate strategic cooperation with stakeholders for enhancing the impact and the sustainability of the outcomes of MUSE,

vi. Support transfer of knowledge from geoscientists inside MUSE to stakeholders not so familiar with geosciences,

vii. Support a transfer of knowledge between countries of well established-, emerging and juvenile markets for sallow geothermal,

viii. Discuss the required and expected role of Geological Surveys in managing shallow geothermal in urban areas,

ix. Support the elaboration of management strategies in the GeoERA MUSE WP3.

The targeted stakeholder communication inside MUSE will have a special focus on the following project Tasks:

- Task 3.2: Joint criteria for managing efficient and low impact SGE use in urban areas based on a so called management cycle;
- Task 3.3: Integrating SGE into European urban heating and cooling strategies and action plans.

Stakeholders will be involved into the preparation and review process of the deliverables linked to these tasks. Moreover, the targeted stakeholder communication may also be linked to dissemination activities to promote the outputs and products of MUSE and to enable a transfer of knowledge.

MUSE defined the following **targeted communication targets** according to the application form of the project:

- At least 14 communication activities (e.g. consultation meetings, trainings or workshops) addressing local stakeholders in the pilot areas;
- There was not target set for communication with stakeholders outside the pilot areas. However, MUSE aims at least 2 targeted communication activities outside the pilot areas addressing international and EU stakeholders as well as multipliers for other regions (e.g. geological surveys not involved in MUSE or universities).

The targeted communication activities are linked to milestone M11 “Stakeholder workshops and trainings in the urban pilot areas”, which is due until project month 35 (March 2021).

1.4 Scope and content of the guideline

This guideline supported targeted stakeholder communication related to the use of shallow geothermal energy in urban areas. It provides a common framework and guidelines how to define and implement a stakeholder communication strategy and demonstrates it in the GeoERA MUSE pilot areas.

The MUSE partners picked the appropriate tools for their respective pilot areas although some actions are mandatory to be applied by all in order to make the achieved outcomes comparable to each other.

The guideline consists of two major parts:

- Chapters 1 to 2 describe the developed concepts and provide preliminary guidelines on how to perform targeted stakeholder communication.
- Chapters 3 to 4 includes feedbacks and lessons learned from the activities executed in the 14 MUSE pilot areas.

1.5 Approach

1.5.1 Overview

The set-up of the guidelines on targeted communication with stakeholders includes 3 phases of preparation:

- **Conception phase (project months 1 to 18):** Setting up the draft guidelines based on the experiences of previous projects and the outcomes of a group work during a MUSE meeting in Cardiff in March 2019. The draft guidelines were distributed to the involved project partners and submitted to GeoERA as an internal deliverable.

The outcome of the conception phase is represented by the initial guideline document (version 1 of deliverable D 5.7), which will not be published.

- **Testing phase (project months 19 to 30):** The partners apply the guidelines and perform the stakeholder communication in the MUSE pilot areas as well as on an international level. The outcomes were afterwards reported to the coordinator of targeted communication.

- **Review phase (project months 30 to 36)**: The initial draft guidelines were adapted and complemented by the lessons learned through the activities in the pilot areas. The final guideline will be submitted to GeoERA as a public deliverable.

1.5.2 Input from previous projects

GeoPLASMA-CE (Central Europe): The targeted stakeholder communication inside MUSE capitalized from the stakeholder activities inside the EU Interreg project CE177 GeoPLASMA-CE by adapting the following instruments and approaches:

- *Stakeholder contact list*: The stakeholder contact list was established in the beginning of targeted communication activities and was accompanying the whole interaction process. It was regularly updated and also covered an overview on the level of interaction received by the involved stakeholders. In GeoPLASMA-

CE, unfortunately not enough attention was paid on stakeholder analyses (e.g. who are adapters, who are the decision makers and who are the multipliers?).

- *SWOT analyses on the strategic role of shallow geothermal in the framework of stakeholder interviews*: The SWOT analyses developed in MUSE aimed at analyzing expectations of stakeholders towards the technology and at identifying prejudged opinions regarding threats and weaknesses. The direct interview also aims at raising awareness and initiating strategic cooperation between the MUSE project team and local stakeholders. Moreover, in GeoPLASMA-CE were also asked to identify the present and expected future relevance of shallow geothermal energy referring to different sectors of application (e.g. single-family homes, commercial buildings etc.). The answers given from 6 different pilot areas were afterwards plotted in joint graphs (see also Figure 1) and interpreted towards the current and future strategic role of shallow geothermal in the heating and cooling sector.
- *Self-assessment sheet on the market readiness for shallow geothermal use*: In a joint position paper prepared and published by GeoPLASMA-CE (download the document here), six major barriers were identified, which hinder a significant market diffusion of shallow geothermal in central Europe. Linked to this, the final page of the position paper offers a simple self-assessment sheet on evaluating the market readiness on shallow geothermal.
- *Direct stakeholder consultation on multiple levels for involving them into the design of strategies and technical outputs.* The performed activities included surveys on required geoscientific parameters to be shown on web based information systems, surveys on quality criteria for an efficient and sustainable shallow geothermal energy use as well as personal interviews (in most cases linked to the above mentioned SWOT analyses) and joint drafting and review of strategy papers. Direct stakeholder consultation in GeoPLASMA-CE aimed at two major goals: 1) raise awareness and 2) initiate future strategic cooperation and initiate interdisciplinary networks.
- *Transfer of knowledge* was focused on trainings how to use the main technical outputs of GeoPLASMA-CE (web based information system, catalogue of success criteria of an efficient, environmental friendly and sustainable use of shallow geothermal energy and local strategies to integrate shallow geothermal). Moreover, transfer of knowledge was also related to communicate existing good practice examples of shallow geothermal energy installations from the pilot regions addressed to stakeholders.

GeoMapping (Croatia): MUSE intends to capitalize the approach of involving the educational sector into the targeted stakeholder communication for knowledge transfer and raising awareness by the following means:

- *Local stakeholder workshops, linked with field trips to cases studies and demonstrators of the technology*: GeoERA MUSE partners will be encouraged to cooperate with high schools and universities to organize knowledge transfer and discussion workshops to interact and train the next generation of researchers and decision makers. These workshops can be linked to group works and small student projects, preferably linked to existing case studies to enforce an active involvement of students. Moreover, the workshops should host panel discussions moderated by students or teachers.

Geothermal4PL, MPGN (Poland): These projects put a strong effort on direct communication and building up competence networks by strategic cooperation. GeoERA MUSE may capitalize from this approach by:

- *Direct interviews and consultation meetings* with important stakeholders (high degree of multiplication and adaption) to create networks;
- *Collaborative local events including trainings* co-organized by such stakeholders.

Geothermal Working Team (GTG) integrated into the Energy Efficiency Cluster of Catalonia, Spain: The GeoERA MUSE partner P03 – ICGC was a co-founder of this cluster of interest and expertise on geothermal energy use in Catalonia, which acts as the Catalan Geothermal Association and integrates more than 40 entities of the 150 total members. GeoERA MUSE may benefit from this cluster regarding the following activities:

- *Initiating strategic cooperation with stakeholders outside geosciences (e.g. municipalities, province governments, local energy agencies)*,
- *Organization of targeted knowledge transfer workshops,* which aimed at providing a better understanding of subsurface implications on the installation and operation of shallow geothermal energy uses.

1.5.3 Activities performed for designing the targeted communication strategy and guidelines

Setting up a preliminary mind map: The experiences gained in GeoPLASMA-CE and the general concept of targeted stakeholder communication according to the application of GeoERA MUSE were compiled to a preliminary mind map, which was presented to the MUSE team during the partner meetings and workshops in Cardiff from 26 to 28 March 2019 (see also Figure 2). It contains the topics to be addressed and the target groups to be involved, the instruments and working steps to be applied, the linking to the other thematic work packages inside MUSE as well as the planned outputs. The preliminary mind map was put to discussion during a dedicated workshop in Cardiff and was the basis for a joint group work to complement the overall concept.

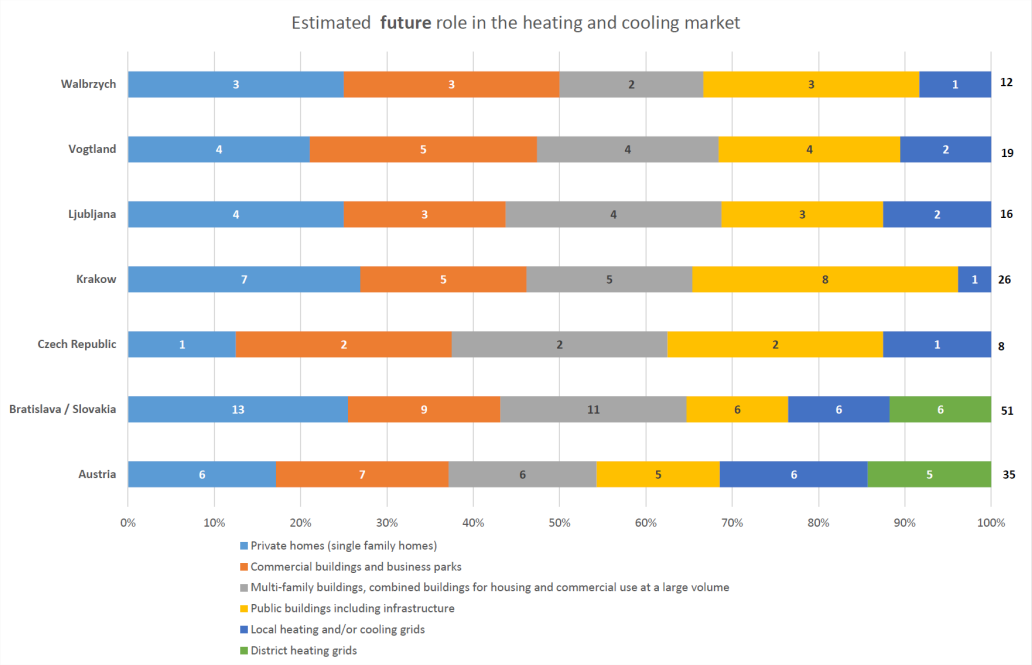


Figure 1: Expected future relevance of shallow geothermal use in different field of applications at 7 different regions in central Europe (project GeoPLASMA-CE). The graph shows the normalized ratings of relevance given by stakeholders for each pilot area.

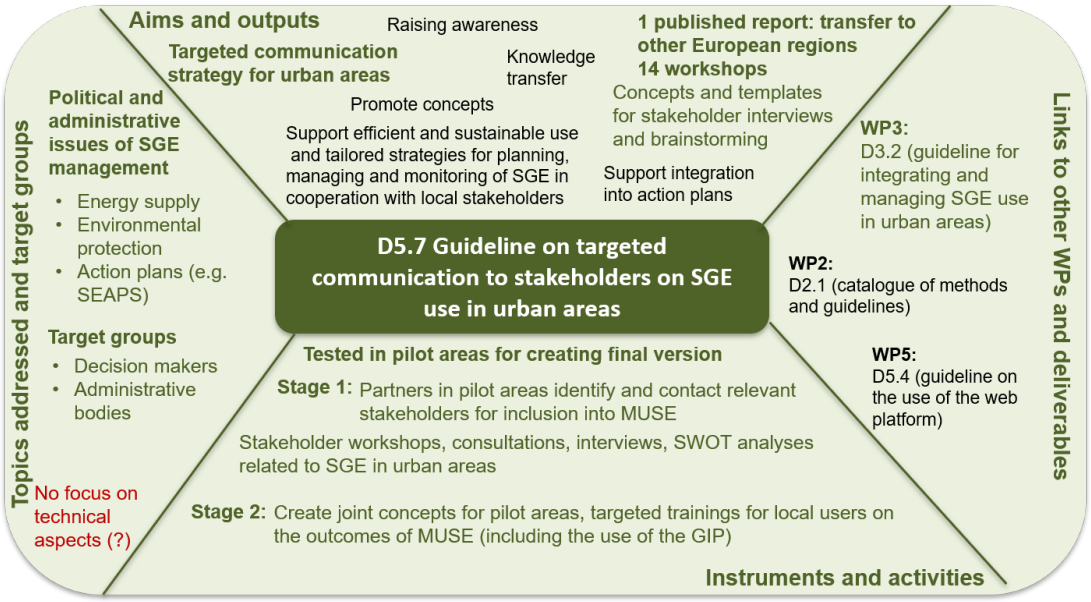


Figure 2: Preliminary mind map on targeted communication inside MUSE.

Joint group work during the Cardiff meetings and workshops, March 2019: The interactive group work followed the "World Café" approach and consisted of 3 stations of different topics and tasks to achieve:

- Concept of the stakeholder process itself regarding (1) aims, (2) target groups to be involved and (3) communication channels to be applied;
- Test of the SWOT analysis;
- General structure of the guidelines and reports on stakeholder interaction.

The outputs were summarized in posters and presented in a final plenary round. The outcomes of the group work are shown in the tables below.

Table 1: Outcomes of the group work on the stakeholder process.

Aims	Target groups	Communication channels
Familiarization with shallow geothermal trough engagement	▪ Local councils and municipalities, planners ▪ Developers, drillers, installers ▪ Government (policy makers)	Identifying the right persons and (hidden) champions ▪ Face to face meetings ▪ 'their place' workshops ▪ Present local examples of use ▪ Trainings Clear messaging
Influence and change behavior at policy- and strategy levels	▪ Policy makers, politicians ▪ Investors, planners, installers, architects, engineers	▪ Face to face meetings ▪ Local events (contributions to and / or active organization) ▪ Social media
Raise awareness and knowledge	▪ General public	▪ In house presentations at schools and 3rd level educational seminars ▪ Social media and conventional media (radio, TV shows) ▪ Dedicated exhibitions (e.g. in museums) ▪ Promote fact sheets on good practices (exhibit

		achieved CO^2 reductions)

Table 2: Outcomes of the group work on the SWOT analysis addressing shallow geothermal use.

Strengths	Weaknesses
▪ Low OPEX ▪ Good image, high level of public acceptance ▪ Low space consumption, no visual impact, can be installed everywhere ▪ No noise (compared to aerothermal heat pumps) ▪ High COP	▪ High CAPEX ▪ Low visibility (“out of sight – out of mind”) ▪ Need for retrofitting (of the heating system)
▪ Incentives for renewable energies (RES) ▪ Combining with other RES ▪ Reduce CO2 footprint ▪ Achieving security	▪ Competitive renewable technologies addressing the same field of application ▪ Lack of education and awareness ▪ Low performance systems leading to a negative image (wrong planning or installation) ▪ No penalties on ongoing use of fossil fuels
Opportunities	**Threats**

Based on the SWOT analyses, the MUSE team derived strategies to support shallow geothermal energy during the joint group work. The outcomes are shown in the table below:

Table 3: Derived strategies to promote the use of shallow geothermal.

Matching strategies: Strengths vs. opportunities	--
Neutralizing strategies: Strengths vs. threats	Educate municipalities and council planners on the advantages of SGE use Promote the inclusion of SGE into spatial energy plans

Transformation strategies: Weaknesses vs. opportunities	Dedicated technological research to lower CAPEX Reduce installation costs by joint use of shallow geothermal systems (benefit from economic scaling) Promote the use of SGE in buildings, which need to be retrofitted Make shallow geothermal energy more visible to stakeholders (e.g. show amount of CO2 and electricity saved at installations)
Defense strategies: Weaknesses vs. threats	Provide trainings on an efficient and sustainable use of shallow geothermal to raise knowledge

The group work addressing the concept and set-up of the guideline as well as the reports on targeted stakeholder communication led to the following outcomes:

- Internal surveys addressing the MUSE team to perform a stakeholder analysis: what are the expected needs and interests of the different target groups and how can they be effectively addressed and involved. By doing so, the guideline should offer specific approaches for main target groups;
- The guidelines should ensure a high level of interaction between scientists and stakeholders outside research. Support long term relations and strategic cooperation instead of single activities;
- The guidelines should address investigating the role of SGE in comparison with competitive energy sources and RES. Which tools might be helpful for decision makers to identify the suitable technologies at a certain location?
- The guideline should offer common concepts and basic templates for stakeholder interaction to make the outcomes comparable and transferable;
- The targeted communication tools should also consider social media channels and make use of helpful MUSE products like the fact sheets on the pilot areas and best practice examples;
- Stakeholder interaction should also include onsite visits and field trips to existing installations.

Internal partner survey, January to April 2020: The survey aimed at:

- Assessing the already available experiences inside GeoERA MUSE concerning targeted stakeholder communication,
- Prioritization of communication objectives and topics addressed,
- Collecting preferred communication channels and instruments to be applied in GeoERA MUSE,
- The current role of the GSOs involved in GeoERA MUSE concerning management of urban shallow geothermal energy use.

The questionnaire was answered by the following GeoERA MUSE partners (in total 7 of 16 partners participated):

- P01 – GBA (Austria)
- P03 – ICGC (Spain / Catalonia)
- P04 – HGI-CGS (Croatia)
- P08 – RBINS-GSB (Belgium)
- P09 – GeoZS (Slovenia
- P13 – PIG-PIB (Poland)
- P14 – SGIDS (Slovakia)

The full questionnaire is shown in **Annex 1** of this document.

GeoERA workshop on targeted stakeholder communication, November 10, 2020: This workshop was organized by the GeoERA projects MUSE, HIKE and Geoconnect3d and was addressed the following topics of stakeholder communication:

- *Drafting a stakeholder interaction strategy – which steps are necessary and which tools are available?*
- *Choosing the right stakeholder instruments to reach your communication goals*
- *Special focus – electronic tools for stakeholder interaction in times of travel and meeting restrictions*

The first part of the workshop covered 4 introductory talks by Serge Van Gessel (GeoERA Hike - intriduction), Gregor Goetzl (GeoERA MUSE – setting up a stakeholder communication strategy), Renata Barros (GeoERA Geconnect3d – digital stakeholder interaction) and Patrick Wall (EuroGeoSurvey Secretariat – interaction with policy makers). The second part of the workshop covered interactive sessions including hands on trainings on the topics presented in the introductory talks in three separate online rooms.

The draft communication strategy developed in GeoERA MUSE was presented and discussed during this workshop. Feedbacks received from the participants were

afterwards considered in the finalization of the draft guideline. The documentation of the workshop is listed in the electronic **Annex 2** of this document.

Online toolbox for defining the targeted communication strategy and impact reporting (spring 2021): The online toolbox in table format covered all aspects of defining a targeted communications strategy with stakeholders and was developed by P1 – GBA. The toolbox consists of 3 main levels 1- communication objectives, 2- stakeholder mapping, 3-communication channels and 4- summary of activities and impact report. The tables are linked to each other via drop down list in the consecutive order of answering them to define a detailed communication plan. As the tool was created in the final stage of the project running time it was not used for monitoring the activities during the project but to report the achieved impact. In total, feedback were received for 8 MUSE pilot areas (see also chapter 3).

Chapter 2 will provide a detailed overview in the structure of the toolbox – the toolbox itself can be accessed in the **electronic Annex 3**.

Preparation of the draft guidelines and instruction to the GeoERA MUSE team: The draft guideline including all templates for stakeholder interaction have been prepared by P01 – GBA after the GeoERA targeted communication workshop in November 2021. The draft guideline and its Annexes had been sent to the GeoERA MUSE team in summer 2021 for review and testing in the pilot areas. Due to the ongoing CoViD-19 pandemic, the testing and application phase of the targeted stakeholder communication in the pilot areas needed to be significantly shortened and reduced.

Updated guideline – compilation of feedbacks and conclusions: The GeoERA MUSE project teams provided a questionnaire based feedback on stakeholder interaction activities, which were collected by the end of September 2021 and summarized in the chapters 3 and 4 of this document.

2 GUIDELINE FOR TARGETED COMMUNICATION AND STAKEHOLDER INVOLVEMENT IN GEOERA MUSE

2.1 Introduction

A communication strategy addresses the following key question:

Who to address on what for which purpose, how and when?

Answering this simplified questions leads to a targeted communication strategy and communication plan. In this chapter, all necessary preparational steps are briefly described and showcased based on the activities of GeoERA MUSE. The updated communications strategy was organized via an online toolbox, which can be accessed in the electronic **Annex 3** of this report.

2.1.1 Why is targeted stakeholder communication important?

The main general goals of science is to gain new knowledge, which brings benefits to society. Considering the latter, the right way of communication with the beneficiants of research is crucial, even during the researc process itself. In reality, researchers tend to communicate inside their preferred ”scientfic bubble” by means of communication channels (e.g. scientific publications not reaching the broad society) as well as by means of commnication style (problem focused technical language) and target audence (other scientists). In contrast, relevant stakeholders, which are in charge of adapting scientific findings prefer other communication styles inside their ”stakeholder bubble”, which can be characterized by solution based simple language rather containing emotional than evidence based messages. The prefer clear instructions and advise than theoretical considerations.

Bridging the gap between these two bubbles is very important to avoid lose-lose situations for both sides, such as:

- Low impact of research outcomes due to lack of adpatable solutions offered to stakeholders,
- Research otucomes end up in the drawer due to lacking attention and awareness by stakeholders,
- Lack of research fundings due to missing strategic cooperation with relevant sakeholders,
- Prejudged and biased opinions of stakeholders due to unsifficient knowledge transfer from scientists.

As indicated in the subsequent Figure 3, targeted stakeholder communication may help to create win-win situations between scientists and sakeholders, who pick up findings and in turn comunicate their needs towards research. As a consequence, research

activities can be more effective, adaptible and sustainable when it comes to funding, new resaerch objectives and impact.

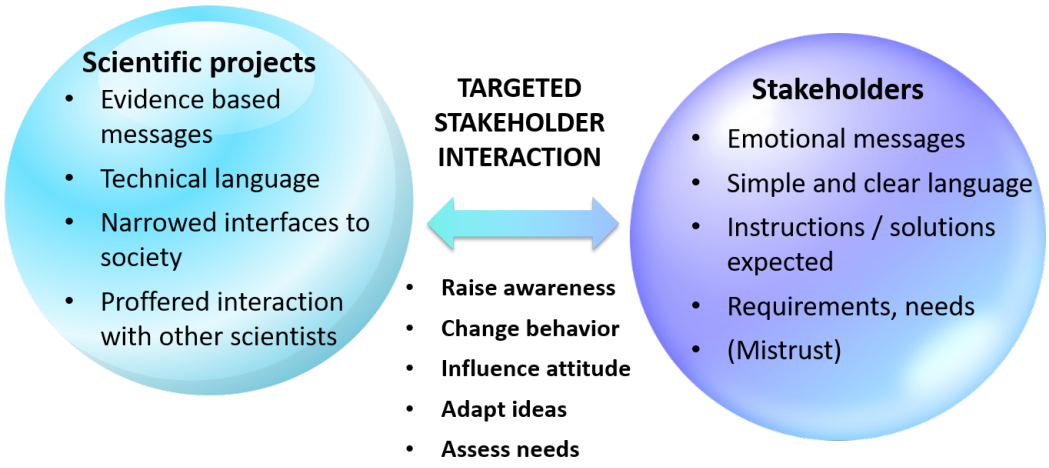


Figure 3: The importance of targeted stakeholder interaction to bridge the gap between scientists and stakeholders "bubbles".

2.1.2 What is the difference between dissemination and targeted stakeholder communcation?

Targeted communication may aim at the following interaction goals:

- Raising awareness,
- Changing behavior,
- Influencing attitude,
- Adapting ideas,
- Assessing needs and arguments,
- Initiating strategic cooperation.

Altough these objectives are also valid for dissemination activities and there is a certain overlapping between dissemination and targeted communication, the main differences can be summarized as such:

Table 4: Difference between dissemination and targeted stakeholder communication.

Dissemination	Targeted stakeholder communication
Addressing an personally unknown, generally larger audience	Addressing known recipients, mostly smaller groups

Focus on unidirectional communication (promotion) and general transfer of knowldge	Focus on bidirectional communicaton (dialogue) on certain purposes apart of pure promotion tailored transfer of knowledge
Level of tailoring rather small during the lifetime of a reserch activity (limited to cummincation channels and messaging style)	Level of tailoring high during the lifetime of a research acivity
Typical channels: scientific articles, presentations, press releases, digital media including social media, flyers or similar media	Typical channels: Workshops, interviews, surveys or trainings.

Both types of activities are listed in Communication – Disseminationa – Exploitation (C-D-E) plans but need to be clearly seperated reagrding the overall science communication strategy. Please note that this guideline will not address general dissemination activities performed in GeoERA MUSE.

2.2 Targeted communication objectives linked to GeoERA MUSE

2.2.1 General considerations

Defining the overall goals and scope is the first step in setting up a targeted communication strategy. Defining the goals and scope refers to the following main aspects:

- Identifying the **objectives** of targeted cmmunocaton – *what do I want to achieve (see also chapter 2.1.1)?*
- Identifying the **content** of targeted stakeholder communication - please note that there needs to be an overal storyline and that **key messages**, which could be formulated as hypothesis to initiate critical discussion, cover more than pure research questions or results as they need to be translated to societal needs.
- Defining **target indicators** in order to enable monitoring of the communication process.

Defining targeted communicaton goals is a dynmic and continuouos process as these may change during the research activity. Ideally, the initial communication goals are already defined during the drafting and proposing phase of a research activity and stated in a preliminary C-D-E plan in cmbinaton with disseminaton goals.

2.2.2 *Input from the preliminary GeoERA MUSE C-D-E plan and initial targeted communication strategy*

The GeoERA MUSE proposal contained the following objectives, planned activities and defined target indicators relevant for stakeholder communication:

Table 5: Initial targeted communication objectives and related key indicators according

Communication objective	Planned measures	Target indicators
Raise the awareness on SGE for decarbonisation of European cities and outline existing gaps and hurdles towards an efficient und sustainable use of shallow geothermal in urban areas in Europe Raise awareness towards technological and legal options	Initiate and active dialogue with stakeholder on the current and possible future strategic role of shallow geothermal	At least 1 international event (e.g. continuation of the European Shallow Geothermal Energy Day[1])
Identify measures and strategies to better integrate shallow geothermal in regional strategies and action plans (e.g. RAP, SEAP)		14 workshops and tranings in the MUSE pilot areas or similar consultation and joint solution drafting activities (e.g. in the framework of interviews)
Promote strategies and actions for enhancing efficient and sustainable SGE in the pilot areas	Assessment of local requirements and expectations (e.g. joint SWOT analyses during interviews and consultations)	
Initiate strategic cooperation with stakeholders for enhancing the impact and the sustainability of the outcomes of MUSE		
Support transfer of knowledge from geoscientists inside MUSE to stakeholders not so familiar with geosciences	Provide expert advice to local stakeholders	

[1] The Shallow Geothermal Energy Day event was initialized in 2019 in cooperation of the EU Interreg project CE177 GeoPLASMA-CE and the European Geothermal Energy Council – EGEC.

Adapt methods, workflows and concepts in other urban areas in Europe	Interact with other research groups relevant for managing urban shallow geothermal outside of MUSE	At least 3 knowledge exchange and transfer activities with other GSOs, GeoERA projecs
Support a transfer of knowledge between countries of well established-, emerging and juvenile markets for sallow geothermal		

In the initial communication strategy according to the GeoERA MUSE application, the following key messages were defined:

> "*Shallow geothermal energy has the potential to significantly support the transition towards decarbonised and self-sufficient European cities";*
>
> *"Efficient and sustainable SGE use requires integrative management and policy concepts";*
>
> *"Existing knowledge and strategies needs to be compiled and harmonised for transfer to other urban regions in Europe".*

2.2.3 Input from the partner surveys

During the partner survey in spring 2020 the MUSE partners were asked to rate the relevance of different targeted communication topics – the feedbacks received are summarized in the table below.

Table 6: Summary of the relevance rating on different communication topics linked to MUSE.

Communication topic	Average relevance and spread (+-) (1.. very low to 5... very high)	Comments provided by partners
Managing efficient and low impact SGE use in urban areas	4.43 ± 1.05*	This topic is more relvant in well established SGE markets Promote the concept of management cycles and the role of GSOs in it – identify the requirements of critical stakeholders in charge for managing urban SGE
Inclusion of SGE into heating and cooling strategies	4.14 ± 0.833*	Identify the opoortunities SGE use may offer to the

		decarbonisation of the urban heating and cooling market Raise awareness among decision makers Initialize strategic cooperation with stakeholders in charge with the development of local strategies
Reducing market barriers and promoting the use of the technology	3.43 ± 1.050*	Promote ways how GSOs can support reducing installation risks and amending the legal framework In general, GSOs have a limited role in this aspect.
Facilitating access to information on resources and limitations of use	4.43 ± 0.495*	Promote the use of digital web information systems supported by GSOs Raise awareness on heating and cooling supply linked to SGE among decision makers (e.g. construction companies) Translate gesocientific data for non geoscientists GSO are in charge to enable low barrier access to geoscientific data
The current and future role of Geological Survey Organizations in managing SGE use	3.83 ± 0.687**	GSO might have an advisory role in planning and managing aspects and an obligatory role in data management in case no local authority is in charge for that and ensures an appropriate data servicing (subsidary role of national GSOs) GSOs might transfer up to date expertis to local authorities
Impact of shallow geothermal energy on the environment (threats, benefits) including assessing prejudged opinions of stakeholders	4.17 ± 1.067**	Raise awareness among stakeholders on sustainable and environmentally friendly aspects on SGE use

		Stakeholder dialogue on adapting the legal framework on modern environmental criteria

*Feedback provided by 8 partners, **Feedback provided by 7 partners

In general, all communication topics offered to the MUSE partners were seen as moderate to highly relevant. Based on the feedback received the communication objectives on ”managing efficient and low impact shallow geothermal energy use in urban areas” and ”facilitating the access on resources and limitations of use” were rated at the highest level of relevance, while the latter one shows a smaller spread indication a higher level of consensus inside the project team. Both topics are very much linked to the work of GSOs in the context of MUSE. In contrast, the communication topic on ”reducing market barriers and promoting the use of this technology” was seen outside the competence of GSOs by the partners. In a similar way, addressing ”the current and future role of GSOs in managing shallow geothermal energy use” was not put on the highest relevance level for different reasons. One the one hand, focus needs to be set first on providing a sound data basis for making management decisions and therefore believe that it is too ealry to discuss the role of GSOs with stakeholders. On the other hand, some of the involved GSOs already have a clearly assigned role which does not need to put to discussion in the moment. Nevertheless, GSO might support the integration of shallow geothermal energy into urban heating and cooling strategies by providing expertis and data management resources to local authorities and decision makers based on the principle of subsidary in case of lacking resources and competences. The topic with the highest spread (level of controversy) on relevance is given by the ”impact of shallow geothermal energy use on the environment”. Some partners, especially in well established and emerging shallow geothermal markets saw a high relevance in promoting environmental safety and sustainability, while partners in premature market see a higher relevance in promoting the technology of shallow geothermal energy use itself.

2.2.4 Tailored communication objectives for the MUSE pilot areas

Table ”1 – objectives” of the MUSE targeted communication toolbox offers to define tailored communication objectives for the pilot areas addressed in the project (see also **digital Annex 3**).

For each pilot area (pre-defined list) the partners could assign overall communication objective types (see also chapter 2.2.1) according to the foloowing classes: *1) Raise awarness, 2) Change behavior, 3) Influence attitudes, 4) Assess needs, 5) Initiate strategic cooperation, 5) Exploitation in general as well as other types not considered so far*. To each objective type, the partners could formulate a tailored communication objective, which is optionally linked to an associated communication message. The

specific communication objective and associated messages can later be used in the consecutive tables of the toolbox for defining activities.

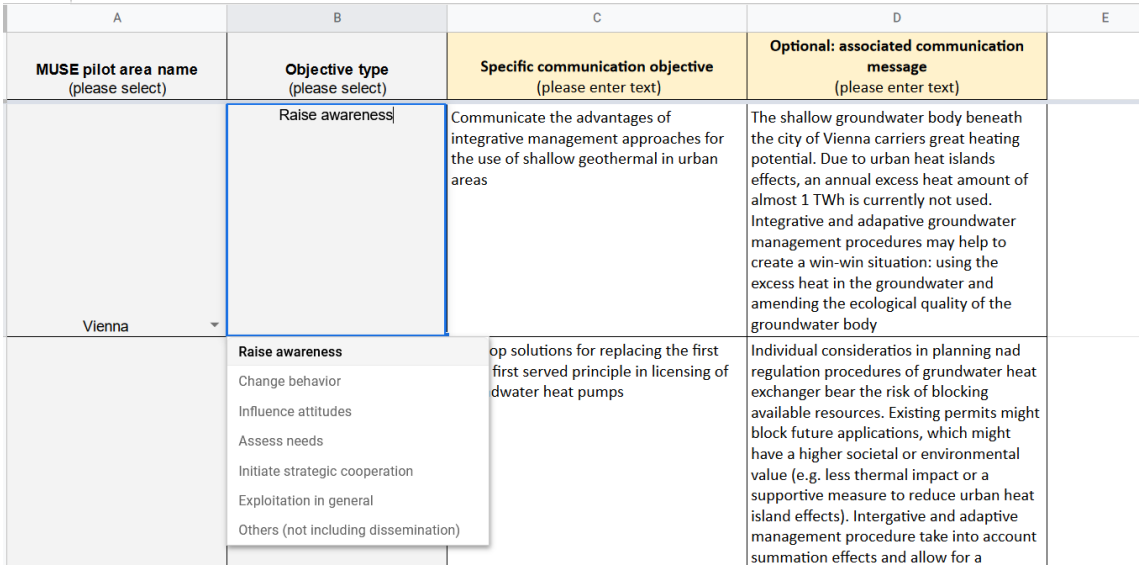


Figure 4: Screenshot of the communication objective planner inside the MUSE toolbox.

The partners reported in total 14 specific communication objectives in the pilot areas. Raising awareness represents the dominating objective type followed by changing behavior, influencing attitudes and seeking strategic future cooperation. From a thematic point of view communicating resources and opportunities linked to shallow geothermal energy use was addressed in most of the defined objectives. Regarding changing the behavior of stakeholders objectives covered the adaption of the legal framework on licensing shallow geothermal energy, especially towards integrative management approaches. Aimed strategic cooperation mentioned for the pilot areas were addressing spin-off projects related to MUSE to close knowledge gaps (e.g. environmental impact of urban heat islands) and integrating shallow geothermal energy into heating and cooling solutions on a community scale.

In the following, examples on associated communication messages are shown for the pilot areas, which complement the basic messages shown in chapter 2.2.2. A detailed overview of the tailored communication objectives is given in the **electronic Annex 3**.

Pilot area Vienna (Austria): *"Individual considerations in planning and regulation procedures of grundwater heat exchanger bear the risk of blocking available resources. Existing permits might block future applications, which might have a higher societal or environmental value (e.g. less thermal impact or a supportive measure to reduce urban heat island effects). Intergative and adaptive management procedure take into account*

summation effects and allow for a prioritization of groundwater uses instead of a chronological prioritization."

Pilot area Cardiff (UK): *"The city of Cardiff, and surrounding cities, have great un-tapped potential for shallow geothermal energy, particularly due to the presence of a shallow gravel aquifer body. This can support decarbonisation of heating efforts and fuel poverty reduction by using high efficency heat pumps for heating and cooling buildings and potentially low temperature and abmbient distict heating networks."*

Pilot area Prague (Czech Republic): *"The city Prague has great unsued potential of shallow geothermal energy at some places (mainly adjacent the river Vltava). The urban centre consists mainly of historic buildings with high energy demands covered by fossil fuel consumption. Some of these buildings are directly suitable for energy retrofitting using shallow geothermal energy."*

2.3 Who to involve – target groups

2.3.1 Overview on different stakeholder groups

In general, stakeholders relevant for interaction should show at least one of the following characteristics:

1) *They adapt and use the outputs of MUSE;*
2) *They are desicion makers relevant for the use of shallow geothermal energy in urban areas;*
3) *They are multipliers of the concepts developed in MUSE,*
4) *They are affected by the outcomes of MUSE*.

In addition, stakeholders are divided into:

A) Stakeholders from the MUSE pilot areas;
B) Other stakeholders covering international and European levels or stakeholders from regions and countries outside MUSE.

A – Overview of stakeholders in the MUSE pilot areas

The subsequent table summarizes and characterizes relevant stakeholders for the pilot areas based on a joint classification scheme, which needs to be applied in the MUSE. The scheme does not include general public and single investors, as they are not in the focus of the targeted communication strategies.

Table 7: Overview of stakeholder groups relevant for the targeted communication in the MUSE pilot areas.

Sector	Target Group	Abbreviation	Role
Public organizations and bodies	Local authorities, municipality departments and councils	LPA	Adapters, decision makers
	National public authorities, national governments, ministries	NPA	Adapters, decision makers
	Sectoral agencies: energy agencies, energy and land use planners, environmental agencies	SA	Adapters, decision makers, multipliers
	Policy makers and politicians	PM	Decision makers
Investors	Energy suppliers (public or private)	ESP	Adapters
	Real estate developers	RED	Adapters, decision makers, multipliers
Users	Planners, consultants and installers	PCI	Adapters, multipliers
	Architects, building constructors and facility managers	ABF	Adapters, multipliers
	Energy consultants	EC	Adapters, multipliers
Research and non-profit organizations	Academic bodies (universities, colleges, research centers)	RD	Adapters, multipliers

	NGOs	NGO	Multipliers
	Interest groups, associations and federations	IG	Multipliers

The clear focus of targeted communication inside MUSE nees to be put on the above listed groups in the pilot areas.

B – Other stakeholders and international organizations

In addition to the activities in the MUSE pilot areas, the stakeholders listed in the subsequent Table 5 are also included into the targeted communication strategy.

Table 8: Overview of stakeholders outside the MUSE pilot areas.

Target group	Abbreviation	Role
All target groups listed in Table 4 outside the MUSE pilot areas	--	Adapters
Geological survey organizations outside MUSE, EuroGeoSurveys	GSO	Adapters, multipliers
International interest groups, associations and federations	IIG	Multipliers
EU institutions and European organizations	EU	Adapters, decision makers, multipliers

2.3.2 Stakeholder mapping based on the MUSE toolbox

Table ”2- stakeholder map” of the MUSE communication toolbox (**see digital Annex 3**) organizes the creation of a general stakeholder map by combing the following information provided by the MUSE partners:

- **Pilot area**: pre-selected list
- **Specific communication objective**: taken from table ”1-objectives”
- **Addressed target group category**: Pre-defined list covering the following goups *– 1) R&D, educational sector, 2) Professionals, industry, 3) Authorities, communities, 4) Policy makers, 5) Interest groups, NGOs, 6) Sectorial agencies, 7) Lay public, societal groups affected / addressed by research performed in MUSE, 8) Consultants, service providers*

- **Addressed organisation:** Name of the organisation involved into targeted stakeholder interaction (no contact persons required)
- **Stakeholder category**: Pre-defined list covering the following goups – *1) Adopter, 2) Decision maker, 3) Multiplier, 4) Affected by the outcomes of MUSE (e.g. residents), 5) any other group mentioned before*
- **Attitude towards urban shallow geothermal**: Indication of the current attitude level between 1… negative towards 5… positive
- **Expected level of influence / impact**: Indication of the impact level between 1... weak to 5... very strong
- **Free text field on comments remarks to the respecitve stakeholder**
- **Qualitative achievements linked to MUSE**: Documentation of achievements for monitoring purposes.

A	B	C	D	E	F	G	H
MUSE pilot area name (please select)	**Specific communication objective** (please copy from 1-)	**Addressed target group category** (please select from list)	**Addressed organisation** (please enter name)	**Type of stakeholder** (please select from list)	**Attitude towards urban shallow geothermal** (1.. Negative, 3.. Neutal, 5...positive)	**Expected level of influence / impact** (1.. Weak, 3... moderate, 5... strong)	**Comments and remarks referring to the respective stakeholder** (Please enter text)
Vienna	Communicate the advantages of integrative management approaches for the use of shallow geothermal in urban areas	Authorities, communities	MA20 (department of energy planning of the city administration of Vienna)	Adopter	4	3	GBA has an ongoing colaboration with this stakeholder; MA20 is a planning and consulting department not directly involved in licensing of provision of incentives; however, this department is in charge of developing energy policies (e.g SEAP for Vienna)
Vienna	Develop solutions for replacing the first come first served principle in licensing of groundwater heat pumps	Authorities, communities	MA45 (department of groundwater management)	Adopter	3	3	The department MA45 is aware of the increasing problem of urban heat island effects in groundwater bodies; in the moment legal instruments are missing to replace first come first served

Figure 5: Screenshot from the stakeholder mapping tool inside the MUSE target communication toolbox.

The stakeholder mapping tool establishes 1:1 interlinkages between communication objectives and specific stakeholders in each line to the table. The MUSE partners, who used the stakeholder mapping tool reported 17 individual stakeholders, which were involved in the targeted communication actvities. The largest target group addresses was represented by local authorities and communities, followed by professionists and members of the R&D sector. The associated communication objectives covered amnedments to regulation procedures towards a better integration of integrative management concepts, tranfer of knowledge concerning the use of shallow geothermal and awareness raising measures including promoting the use of the web map systems produced in MUSE for future planning procedures in the involved pilot areas. The majority of involved stakeholders have a neutral to supportive attitude towards the use of shallow geothermal energy and a moderate to strong impact on achieving the communication objectives. For the detailed feedback provided by the MUSE partners please see **Annex 3**.

2.4 Communication tools and channels

2.4.1 Overview of different channels

Selecting the right communication channels is depending on the following factors:

- Communication objectives,
- Size and interaction level of the target audience,
- Stage of the project
- Available resources.

In contrast to dissemination targeted communication has a bidirectional nature aiming to bring a benefit to the project apart of promoting it. As shown in the subsequent figure, selecting the right communication channel is a consecutive and filtering process limited by the reqired impact (response by the target group) and available resources (budget and time). Starting at a wider target audience stakeholder interaction narrows down the different groups while increasing the level of interaction. Taking this into account targeted stakeholder interaction results in exploitation though follow-up and spin-off activities. For that reason, the MUSE targeted stakeholder strategy also considered exploitation measures.

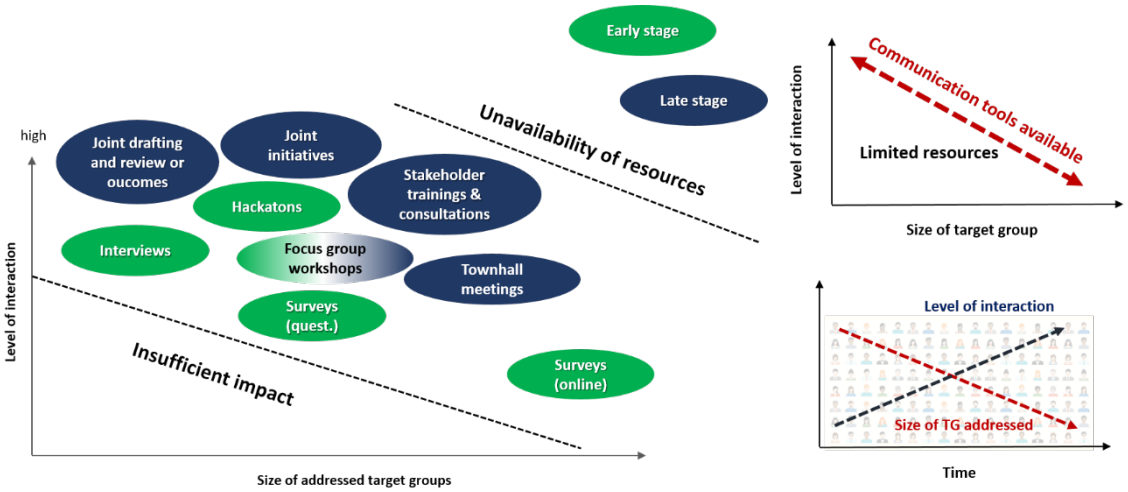


Figure 6: Dependency of communication instruments from the level of interaction, size of the target group and stage of the research process.

In the following, communication channels relevant in MUSE are briefly described:

Stakeholder surveys: Early stage surveys mostly address a wider target group and should consider to prodice low level of efforts to answer them by the participant. Online survey formats limited to answering times below 10 minutes are the most suitable measure to receive a sufficient number of feedback. Moreover, such survey also support

awareness raising and might help to identify participants who have strong interest in the topics addressed for later follow-up communication. However, this only applies to online surveys offering optional contact details input fields. Complex questionnaires might be split up into consecutive of or pyramide style forms. When drafting surveys it is important to find the right balance between closed (nuemrical coded) and open questions in order to derive quantitative indicators. Examples for quantitative indicators are given by the rating of relevance or agreement on a specific message or topic.

Offline file based surveys can be used at a later stage of the communication process addressing those stakeholders who already shown a strong committment in the first round of interaction as answering an offline questionnaire requires more preparational steps by the interviewee to provde her / his feedback.

Interviews and consultation meetings: Personal interviews, either executed via telephone or personal meetings, offers the highest level of interaction with stakeholders but on the other hand requires lots of resources. Personal interviews are therefore limited to traget groups which eihter have a strong impact on the planned communication activities or show a strong interest. In MUSE, the creation of a harmonized interview guideline was intially planned but could not be realized due to pandemic.

SWOT analysis are a strong communication instrument linked to interview series as they offer the possibility to identify opinions of stakeholders and draft joint strategies. In general SWOT analyses consists of two steps. Although initially developed for business models this instrument may also be applied to technological questions such as the use of shallow geothermal energy in urban areas. Answering the Strenghts – Weaknesses – Opportunities – Threats section exhibits the opinion on the stakeholder including prejudged and biased arguments. The second step of the analyses for defining strategies and measures to connect the different elements of the SWOT can be executed in a dialogue style in collaboration of the interviewer and the interviewee in order to identify possible starting points for colaboration. In MUSE, the use of SWOT analyses in personal interviews was recommended.

Focus group workshops aim at initiating a dialogue with different stakeholders inside a specific cluster (e.g. same target group category). These kind of workshops also offer two communication axes – between the organizer and the workshop participants and between the participants. In MUSE, the following design of focus group workshops was recommended: Warm up session having short keynotes from the organizer and selected participants, which should not cover more than 25% of the entire workshop duration. The remaining parts of the workshop was dedicated to group works (in case of a sufficiently high number of participants (at least 10 persons) and a closing plenary discussion round. The focus group workshops aimed for example at discussing opportunities and barriers for adpative management procedures for urban shallow geothermal energy and the possible role of GSOs inside such concepts.

Trainings: Trainings are a helpful channel to transfer knowledge to stakeholders. In MUSE, trainings were planned at the end of the project focusing on the elaborated resource and conflict maps for the pilot areas. Due to the CoviD-19 pandemic trainings could not be offered in person. Digital trainings (webinars) are a suitable tool to subsitute in person trainings although the level of interaction might be lower due to limitations in time.

Town hall meetings represent a strong instrument to interact with stakeholders at very local level. In many cases they are addressing local residents affected by the outcomes of the research activities. Getting into a dialogue with via townhall meetings is important to establish trust and enter a dialogue with stakeholders, who are in a rather geographical then thematic context to the research activities performed. Such activities offer a great opportunity to assess unexpected arguments, especially prejudged opinions and non-evidence based objections. On the other hand townhall meetings also help to understand the requirements to raise the level of acceptance.

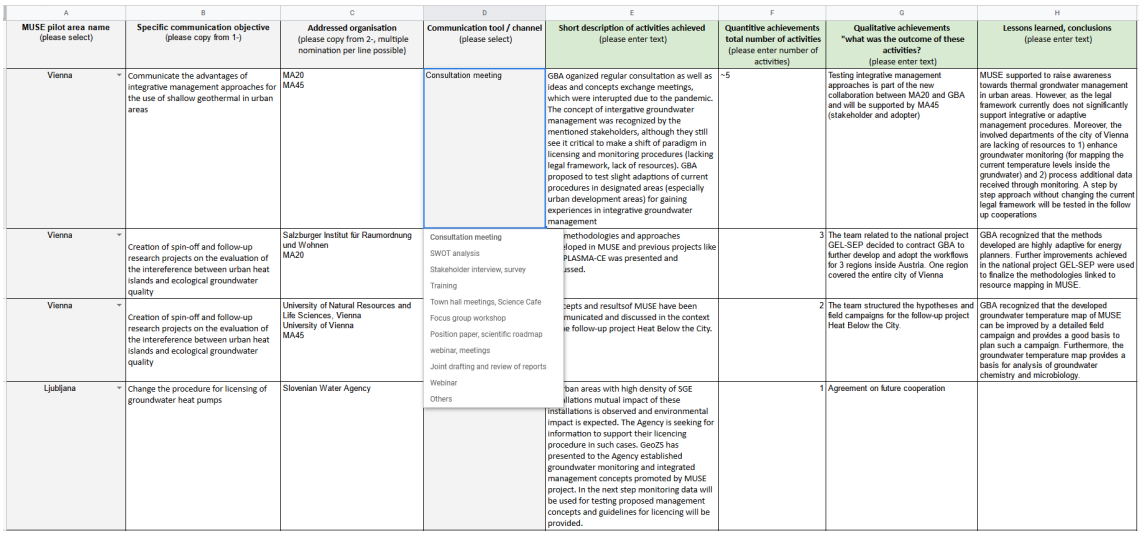
Joint drafting and review of reports and publications is a rather unconventional approach to interact with relevant stakeholders, who have a strong impact on communication activities and show a high level of interest. Involving such key stakeholders into the drafting and review process of major document based outcomes offers great opportunities to 1) include the expert opinion and views of stakeholders, 2) to raise the awareness on the outputs produced and 3) to strenghten the level of interaction by involving them in the group of authors.

2.4.2 Communication channels applied in the MUSE pilot areas

The communication channels applied to the MUSE pilot areas were organized in table “3-communication channels” of the interactive toolbox, listed in **Annex 3**. The planning tools consists of the following elements:

- **MUSE pilot area**: Pre-selected list for assigning the respective pilot area
- **Specific communication objective**: To be copied form table “1-objectives”
- **Addressed organization**: To be copied from table “2-stakeholder mapping” allowing for multiple entries
- **Communication tool / channel**: To be selected from a pre-defined drop down menu offering targeted communication and exploitation channels

The other tables listed in the toolbox aimed at monitoring the achievements in targeted stakeholder communication inside MUSE (see also chapter 2.5).



A MUSE pilot area name (please select)	B Specific communication objective (please copy from 1-)	C Addressed organisation (please copy from 2-, multiple nomination per line possible)	D Communication tool / channel (please select)	E Short description of activities achieved (please enter text)	F Quantitive achievements total number of activities (please enter number of activities)	G Qualitative achievements "what was the outcome of these activities? (please enter text)	H Lessons learned, conclusions (please enter text)
Vienna	Communicate the advantages of integrative management approaches for the use of shallow geothermal in urban areas	MA20 MA45	Consultation meeting	GBA oganized regular consultation as well as ideas and concepts exchange meetings, which were interupted due to the pandemic. The concept of intergative groundwater management was recognized by the mentioned stakeholders, although they still see it critical to make a shift of paradigm in licensing and monitoring procedures (lacking legal framework, lack of resources). GBA proposed to test slight adaptions of current procedures in designated areas (especially urban development areas) for gaining experiences in integrative groundwater management	~5	Testing integrative management approaches is part of the new collaboration between MA20 and GBA and will be supported by MA45 (stakeholder and adopter)	MUSE supported to raise awareness towards thermal grondwater management in urban areas. However, as the legal framework currently does not signifficantly support integrative or adaptive management procedures. Moreover, the involved departments of the city of Vienna are lacking of resources to 1) enhance groundwater monitoring (for mapping the current temperature levels inside the grundwater) and 2) process additional data received through monitoring. A step by step approach without changing the current legal framework will be tested in the follow up cooperations
Vienna	Creation of spin-off and follow-up research projects on the evaluation of the intereference between urban heat islands and ecological groundwater quality	Salzburger Institut für Raumordnung und Wohnen MA20		methodologies and approaches loped in MUSE and previous projects like PLASMA-CE was presented and ssed.	3	The team related to the national project GEL-SEP decided to contract GBA to further develop and adopt the workflows for 3 regions inside Austria. One region covered the entire city of Vienna	GBA recognized that the methods developed are highly adaptive for energy planners. Further improvements achieved in the national project GEL-SEP were used to finalize the methodologies linked to resource mapping in MUSE.
Vienna	Creation of spin-off and follow-up research projects on the evaluation of the intereference between urban heat islands and ecological groundwater quality	University of Natural Resources and Life Sciences, Vienna University of Vienna MA45		epts and resultsof MUSE have been municated and discussed in the context e follow-up project Heat Below the City.	2	The team structured the hypotheses and field campaigns for the follow-up project Heat Below the City.	GBA recognized that the developed groundwater temperature map of MUSE can be improved by a detailed field campaign and provides a good basis to plan such a campaign. Furthermore, the groundwater temperature map provides a basis for analysis of groundwater chemistry and microbiology.
Ljubljana	Change the procedure for licensing of groundwater heat pumps	Slovenian Water Agency		ban areas with high density of SGE ilations mutual impact of these installations is observed and environmental impact is expected. The Agency is seeking for information to support their licencing procedure in such cases. GeoZS has presented to the Agency established groundwater monitoring and integrated management concepts promoted by MUSE project. In the next step monitoring data will be used for testing proposed management concepts and guidelines for licencing will be provided.	1	Agreement on future cooperation	

Consultation meeting
SWOT analysis
Stakeholder interview, survey
Training
Town hall meetings, Science Cafe
Focus group workshop
Position paper, scientific roadmap
webinar, meetings
Joint drafting and review of reports
Webinar
Others

Figure 7: Screenshot of the table "3-communication channels" inside the MUSE toolbox.

In total, 15 different communication activities were selected for the interaction in the MUSE pilot areas. Due to the CoViD-19 pandemic consultation meetings on a bilateral basis or in small groups dominated the applied communication channels. On partner planned a joint information campaign with a local stakeholder on promoting the use of shallow geothermal energy in refurbished buildings (pilot area Ljubljana). Another partner considered the preparation of a scientific position paper on raising awareness among local stakeholders (planners, R&D sector) on the use of the created geoscientific resource and conflict of use datasets inside MUSE on future designing activities for using shallow geothermal energy to store heat (pilot area Linköping). In the pilot areas Cardiff and Linköping, webinars were also considered to transfer expert knowledge towards local stakeholders.

2.4.3 International stakeholder events including knowledge transfer between the MUSE pilot areas

In 2019, the first "Shallow Geothermal Energy Days Event" took place in Brussels. Initiated by the EU Interreg project GeoPLASMA-CE, this event aimed to interlink the R&D sector with various stakeholders in the context of heating and cooling, environmental protection and regional planning to raise the awareness on the use of shallow geothermal and discuss novel concepts and solutions. MUSE wanted to organize the follow-up event 2020 in Barcelona, supported by the MUSE partner ICGC. Due to the pandemic the event needed to shift to an online format organized by the European Geothermal Energy Council (EGEC) with support of MUSE. The overall format of the event consists of a policy summit / session and R&D summit covering keynote talks and joint discussion round. Although after the lifetime of MUSE, the Shallow

Geothermal Energy Days Event 2022 will very likely be organized in Barcelona as a follow-up initiative of the project.

In June 2021, MUSE organized an international workshop on "*Urban geothermal energy use with special reference to shallow subsurface application*" in collaboration with the US Geological Survey. The workshop, which was attended by more than 50 participants, covered a keynote session hosting presentations from MUSE partners, invited speakers and colleagues from US GSOs. The keynote session was complemented by a panel discussion moderated by the coordinator of MUSE. The detailed program of the event is shown in the subsequent figure.

Moderation: Gregor Goetzl (GeoERA MUSE)

3^{45}	Opening of the web room, digital get together
4^{00}	**Opening of the workshop and welcome address**
	Short presentations (15 minutes incl. Q&A)
	Overview of legal framework for shallow geothermal use in Europe (Maciej R. Kłonowski, Polish Geological Institute - National Research Institute, Poland)
	Exploring the need for an adaptive management concept in urban shallow geothermal use (Alejandro Garcia Gil, Geological Survey of Spain)
	The significance of groundwater and underground infrastructures to shallow geothermal system (Yu-Feng F. Lin, University of Illinois at Urbana-Champaign, United States)
	Recent and planned USGS research on thermal energy storage and low-temperature geothermal energy (Erick Burns, U.S. Geological Survey, United States)
	Resource maps - important inputs for management decisions (Cornelia Steiner, Geological Survey of Austria)
	Case study Munich: Investigation of urban groundwater temperatures and the development of a groundwater management tool for the thermal use (Kai Zosseder & Fabian Boettcher, Technical University of Munich, Germany)
6^{00}	**Panel discussion**
	New horizons and challenges for the use of geothermal energy in urban areas.
6^{30}	**End of the workshop**

Figure 8: Program of the GPS 2021 side event on urban geothermal energy use.

The joint workshop led to an ongoing cooperation between individual MUSE partners and colleagues from US GSOs. A submission of a spin-off network project is planned for January 2022.

2.5 Process monitorig

As the targeted stakeholder interaction toolbox was developed at a late stage of MUSE, a detailed process monitoring could not be achieved due to lack in time. However, the

MUSE related targeted communication toolbox covers a summary based documentation of the activities performed and associated achievements.

Table "3-Communication channels" therefore hosts 4 additional columns on progress documentation (see also Figure 7):

- **Short description of activities achieved:** Summary of the use of the different communication channels
- **Quantitive achievements, total number of activities**: Indication of the total number of activities performed for each communication channel selected
- **Qualitative achievements, "what was the outcome of these activities?** Summary description of the impact and achievements reached
- **Lessons learned, conclusions**: Optional statement of lessons learned in using a certain communication channel as well as conclusions for future activities

Some of the conlusions drawn by the partners are shown below. The lessons learned will be picked up in future joint activities allowing for further capitalizing the outcomes of the project.

Pilot area Linköping (Sweden): "*More to do regarding communication and understanding between geologist, engineers and designers on what type of information is most important as to assess a sustainable use and applicability of different types of SGEs with respect to the geological prerequisites.*"

Pilot area Vienna (Austria): "*MUSE supported to raise awareness towards thermal groundwater management in urban areas. However, as the legal framework currently does not significantly support integrative or adaptive management procedures. Moreover, the involved departments of the city of Vienna are lacking of resources to 1) enhance groundwater monitoring (for mapping the current temperature levels inside the groundwater) and 2) process additional data received through monitoring. A step by step approach without changing the current legal framework will be tested in the follow up cooperation.*"

Pilot area Cardiff (UK): "*Geologists are quick to focus on the geology and need to listen carefully to the information needs of the stakeholder and translate the geology into a language they can understand. So local authorities have limited IT systems and can't use GIS, made worse by working from hole during COVID pandemic, so data needs to be shared in a range of formats compatible with local stakeholders' IT and security systems.*"

In order to collect summary impact statements, the MUSE toolbox hosts an additional **table "4- Summary**", which covers the following contents:

- Estimated total number of activities linked to MUSE: Total indicative numbers of performed individual activities either in terms of a range (e.g. at least) of a specific number

- **Individual institutions addressed by targeted stakeholder communication**: Total number of organizations (not persons) involved into the targeted communication activities, separating between the following main stakeholder groups
    - *Decision makers*: e.g. authorities, communities, policy makers
    - *Adopters*: e.g. Public service providers, investors, sectoral agencies, R&D
    - *Multipliers*: e.g. NGOs, inerst groups, sectoral agencies
    - *Concerned*: e.g. residents
- **Qualitative reflection on stakeholder interaction** separated into the main aspects addressed below
    - *Greatest achievements linked to activities in MUSE*
    - *Biggest drawbacks linked to activities in MUSE*
    - *Lessons learned & conclusions*

Table 4 of the toolbox is organized on the pilot area level summarizing all activities in one line per each pilot area. The main outcomes of the activities are described in the chapters 3 and 4.

3 SUMMARY REPORT ON STAKEHOLDER COMMUNICATION

3.1 Introduction

The initial targeted stakeholder interaction strategy covered planned activities on both, regional to national level as well as on international level.

On a regional to national level stakeholder interaction was focused on the transfer of mapping and assessment methods for shallow geothermal energy use in an urban environment, which should later be integrated into management strategies in the pilot areas. Special attention was paid on initiating a dialogue with stakeholders in the pilot areas on promoting the web based information system as well as the produced data layer as a future basis for tailored strategies for planning and managing urban shallow geothermal. Regional stakeholder interaction furthermore intended to promote a better integration of urban shallow geothermal in energy, climate and environmental action plans, such as SECAPs.

On an international level, targeted stakeholder communication focused on raising the awareness on the importance of managing urban shallow geothermal, on the possible role of Geological Survey Organizations (GSOs), on strategic cooperation with international organizations, working groups and platforms as well as on a transfer of knowledge to GSOs outside of MUSE, especially to countries with a juvenile or emerging market of shallow geothermal energy use. International stakeholder interaction also intended to support the integration of shallow geothermal energy mapping inside the portfolio of the addressed Expert Groups inside EuroGeoSurveys, such as the Geoenergy Expert Group, the Groundwater Expert Group and the Urban Geology Expert Group.

In the initial C-D-E plan of MUSE, the following target indicators addressing stakeholder communication were set:

- At least 14 communication activities (e.g. consultation meetings, trainings or workshops) addressing local stakeholders in the pilot areas,
- At least 1 targeted international communication activities addressing international and EU stakeholders as well as multipliers for other regions.

3.2 Regional stakeholder interaction in the MUSE pilot areas

In total, feedback on stakeholder interaction was reported for 8 pilot areas covering more than 41 individual activities (see Table 8 below). The activities performed involved stakeholders from 36 individual organizations. Decision makers in the pilot areas (e.g. local authorities) as well as possible adopters (e.g. public service providers or sectoral agencies) of the MUSE outcomes represent the major target groups involved into the communication activities (75% of all interactions). Multipliers in the pilot areas (e.g.

NGOs or interest groups) were addressed in 25% of the reported activities. No interaction with the target group of stakeholders concerned by the outcomes of MUSE (e.g. local residents) was reported. This is due to the missing relevance of the project outcomes for this target group.

Table 9: **Overview of the targeted stakeholder interaction activities in the MUSE pilot areas.**

MUSE pilot area name (please select)	**Estimated total number of activities linked to MUSE** (specific number or range, e.g.: 10, >3, ~5)	**Individual institutions addressed by targeted stakeholder communication** (please enter estimated number of unique organizations involved)			
		Decision makers: *e.g. authorities, communities, policy makers...*	***Adopters:*** *e.g. Public service providers, investors, sectoral agencies, R&D...*	***Multipliers:*** *e.g. NGOs, interest groups, sectoral agencies...*	***Concerned:*** *e.g. residents...*
Vienna	10	4	2	3	0
Ljubljana	3	1	2	0	0
Prague	2	0	1	1	0
Linköping	7	2	4	1	0
Cardiff	10	6	2	2	0
Glasgow	5	1	2	2	0
Warsaw	4	1	0	2	0

The reported communication activities focused on:

- Discussing the advantages of integrative management approaches for urban shallow geothermal including possible implications on licensing procedure (pilot areas Vienna, Ljubljana, Prague and Linköping),
- Integration of shallow geothermal energy into local strategies and action plans (pilot area Vienna and Ljubljana),
- Communicating the benefits of geological information systems for managing the use of shallow geothermal energy (pilot area Linköping),
- Strengthening future collaboration and developing regional spin-off projects of MUSE (pilot area Vienna),

- Transfer of knowledge and initiation of strategic cooperation with stakeholders to develop best practice guidelines (pilot area Warsaw),
- General awareness raising activities to promote the use of shallow geothermal energy (pilot areas Cardiff and Ljubljana).

Due to the ongoing pandemic, most communication activities based on consultation meetings and webinars. In the pilot area Ljubljana, a joint initiative with local stakeholders on promoting the use of shallow geothermal energy in refurbished buildings was initiated. For the pilot area Linköping, a scientific position paper was linked to the activities of MUSE.

As not all partners provided feedback on the activities performed in the pilot areas, the total number of achieved activities is expected to be higher than the reported one. For more detailed information on the activities reported in the pilot areas please see the digital Annex 3 of this report.

3.2.1 Greatest achievements linked to targeted stakeholder communication in the pilot areas

Based on feedbacks received from the partners the following main achievements linked to targeted stakeholder communication can be reported:

Pilot area Vienna (Austria): Methods and workflows of MUSE have been applied for web based information systems in 3 different Austrian states including the pilot areas Vienna in the framework of the Austrian project GEL-SEP. The spin-off project "Heat below the City" on assessing the dependency between groundwater temperatures - groundwater chemistry and microbiology has been granted by local research funds of the city of Vienna.

Pilot area Ljubljana (Slovenia): The concept of integrated management that utilizes information of monitoring will be implemented in urban area with high density of SGE installations. GeoZS established on-line monitoring within the EPOS project (https://zabujelit.geo-zs.si/GLvN.geo-zs.si/#) for that purpose. Information of MUSE project were used for planning and implementation of SGE installations.

Pilot area Prague (Czech Republic): The MUSE project provided a comprehensive set of methods and workflows for the integrative management of shallow geothermal installations in densely populated areas. These documents are essential for the further development of this renewable resource and also for limiting the negative effects of interactions between nearby installations. The produced documents are a solid basis for their future general acceptance.

Pilot area Linköping (Sweden): The field work in the Linköping pilot led to a collaboration between several companies and also evaluation of different methodologies and their applicability to assess the subsurface. The results were presented in an article

in Energies "Multidisciplinary Approaches for Assessing a High Temperature Borehole Thermal Energy Storage Facility at Linköping, Sweden.

Pilot area Cardiff (UK): The meetings and workshop with Cardiff Council led to sharing and implementation of GIS data layers in their local IT servers for use by their city energy planners and visits to demonstration heat pump scheme providing training and fostering future collaboration. A representative of the Cardiff Council also participated and actively contributed to the MUSE partner workshops in Cardiff in March 2019.

Pilot area Glasgow (UK): The MUSE workshop in Cardiff in March 2019 provided Staff from Scotland an opportunity to contribute the learnings from setting up mine water heating research facilities to MUSE. Blogs on DTS measurements and field work provided greater exposure linked to the UKGEOS projects.

Pilot area Warsaw (Poland): MUSE provided for exchange of knowledge between the project partners and creation of a common catalogue of methods and workflows. Those in turn have been applied in a national project with involvement of the MUSE partner PGI-NRI.

Pilot area Brussels (Belgium): The activities performed in MUSE were directly feeding into an initiative to use shallow geothermal energy in the European parliament building. A joint information campaign with the parliament service department was planned but needed to be put on hold due to delays in the construction of the geothermal wells.

3.2.2 Drawbacks and challenges linked to stakeholder interaction in the pilot areas

The biggest challenge in targeted stakeholder communication was given by the CoViD-19 pandemic, which covered the final 18 months of MUSE and did not allow for meetings, trainings and events having a larger number of participants.

Integrative and adaptive groundwater management concepts will very likely play an important role in future urban groundwater management. However, the implementation of such concepts is still very complex and the level of experience in many European countries is rather low. Also financing of such measures is an open issue, which needs to be solved in the future. During the targeted communication with local authorities in the MUSE pilot areas, it became clear that this shift of paradigm concerning the licensing and management of urban shallow geothermal energy use will require an adaption of the legal framework.

Although local stakeholders were quite interested in a better integration of shallow geothermal energy into energy strategies, especially linked to new buildings, reservations were communicated on the use of shallow geothermal in existing buildings and existing heating and cooling networks due to the high temperature levels required in the heating systems and networks. Removing this technological barrier would require lots of financial resources and suitable incentives. On the medium and long term, existing

European programs, such as the renovation wave could significantly help to reduce this technological barrier.

3.3 International stakeholder interaction

International stakeholder interaction focused on strategic cooperation and knowledge sharing events.

MUSE strongly collaborated with the European Geothermal Energy Council (EGEC) by organizing joint events, such as the Shallow Geothermal Energy Day 2020 in December 2020 and by analyzing market data provided by EGEC in WP3. MUSE also interacted with the EU COST Action CA18219 Geothermal-DHC, which addresses the integration of geothermal energy in heating and cooling networks. Chaired by coordinator of MUSE, CA18219 Geothermal-DHC includes some MUSE partners and linked activities on using shallow geothermal energy in low temperature heating and cooling networks to the outcomes of MUSE.

The knowledge sharing and awareness raising events based on collaborations with other GeoERA projects, such as GeoConnected and members of the Geoenergy Expert Group (GEEG) inside EuroGeoSurveys. MUSE partners also participated at the kick-off meeting of the newly founded Urban Geology Expert Group (UGEG) inside EuroGeoSurveys in June 2019 for raising the awareness and initiating strategic partnerships towards geological information systems in urban areas on the use of shallow geothermal. Due to the CoViD-19 no follow-up activities could be organized with UGEG. More information on the knowledge exchange and transfer activities can be found in the MUSE Deliverable "*D 6.2 Activity report on capitalising activities with other project teams inside GeoERA*".

3.3.1 Greatest achievements linked to international stakeholder interaction

In the framework of the Geoscience – Policy – Society (GPS) 2021 online event in June 2021, organized by GeoERA GeoConnected, a strategic cooperation with US Geological Survey Organizations on managing urban (shallow) geothermal energy and underground thermal energy storage was initiated. A shared workshop on urban geothermal energy the 14th of June 2021 linked to the GPS 2021 event led to several follow up meetings for preparing a joint publication (working title "the nexus between groundwater and geothermal energy use") and the submission of a spin-off networking support grant proposal.

The Shallow Geothermal Energy Day 2020 event, organized by EGEC in terms of an online conference was endorsed by MUSE and reached more than 100 attendees. A presentation linked to MUSE was focusing on the importance of new management procedures linked to urban shallow geothermal energy use. The Shallow Geothermal Energy Day 2022 is planned to be organized in Barcelona in cooperation with the MUSE partner ICGC. Due to the support of MUSE this event format is now well established in the European geothermal community.

The efforts on targeted communication inside GeoERA and EuroGeoSurveys also helped to integrate the topic of shallow geothermal energy use in the portfolio of EuroGeoSurveys due to awareness raising activities and the initialization of a scientific dialogue with other relevant Expert Groups.

3.3.2 Drawbacks and challenges linked to international stakeholder communication

As for the interaction with stakeholders in the pilot areas, the pandemic significantly reduced the level of interaction with international stakeholders. The biggest drawback is linked to the Shallow Geothermal Energy Days 2021 event, which was initially planned to be held in Barcelona in September 2021 and which would have focused on the management of urban shallow geothermal. This event needed to be postponed to 2022 due to the pandemic and could therefore not be directly linked to the final activities inside MUSE. International stakeholder interaction did not involve EU organizations (e.g. Joint Research Center) or bodies (e.g. DG Energy) as no opportunities were identified for interaction based on the outcomes produced in MUSE.

Unfortunately, shallow geothermal energy related topics will not play a major role in the planned Coordination and Support Action for establishing a Geological Service for Europe (CSA), which is direct follow-up activity of GeoERA. The reason for that is given in the limited resources and the focus on pan-European datasets to be integrated in the Information Platform (EGDI). For planned follow-up activities linked to MUSE other funding sources need to be found.

4 CONCLUSIONS

The stakeholder interaction led to the following lessons learned on a local level:

Pilot area Vienna (Austria): The methodologies and web maps created in MUSE provide an important basis for future management approaches. The Pandemic in 2020 and 2021 led to a reduction of the activity level and to delays in planned joint initiatives for adaptive groundwater management concepts. Nevertheless, several national spin-off projects were initiated linked to the work done in MUSE.

Pilot area Ljubljana (Slovenia): Despite easily accessible information on web viewer additional efforts have to be made to raise the awareness and interest of stakeholders on SGE as well as on the use of the created tools. They often face specific issues, therefore identification of these specific and tailoring of SGE solutions is required for their successful implementation. This process requires intensive interaction with stakeholders which was limited during the project.

Pilot area Linköping (Sweden): Web based and mobile applications that show relevant geographical data on the geological prerequisites as well as guidelines and recommendations for assessing and permitting SGEs are requested from both decision makers, consultants and industry. The multinational work in MUSE with different national strategies and pilot examples will provide valuable input to how other solutions could be adapted in Sweden.

Pilot area Cardiff (UK): The methodologies developed and cataloged in MUSE provide a very useful tool box for developing geothermal management solutions, and a strong foundation for application of approaches in other areas of the UK and overseas. If there was more time and resource in MUSE we would have implemented more of the methods.

Pilot area Glasgow (UK): The MUSE project highlighted to variety of approaches to geothermal characterization that can be applied in a range of geology typologies.

Pilot area Warsaw (Poland): The methodologies and web based publically available maps resulting from MUSE are crucial for future management approaches and application of SGE technologies within the agglomeration. Despite of the pandemic, the MUSE project team managed to achieve all key activities necessary for project implementation.

On a project level, the initial plan to interlink web based information systems to tailored strategies for all pilot areas was too ambitioned for MUSE as the harmonization of workflows and the preparation of datasets for the pilot areas required more resources than initially assumed. As consequence, only theoretical concepts on adaptive management procedures could be included in the targeted stakeholder communication in most MUSE pilot areas. Follow up initiatives should therefore focus on closing the

remaining gaps between stakeholder interaction and the integration of modern management concepts of urban shallow geothermal energy use.

5 ANNEXES

- **Annex 1**: Internal questionnaire for designing the targeted stakeholder communication strategy
- **Annex 2**: Contribution to the GeoERA stakeholder interaction workshop, organized by MUS, HIKE and Geoconnect3D on the 10th of November 2020: Download link of material– electronic link.
- **Annex 3**: Targeted communication toolbox – electronic link.

6 CHANGE LOG

The updated version includes a summary of the targeted communication activities in the MUSE pilot areas as well as lessons learned.

7 REFERENCES

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