Establishing the European Geological Surveys Research Area to deliver a Geological Service for Europe

Technical review report for project MUSE

This report is part of a project that has received funding by the European Union's Horizon 2020 research and innovation programme under grant agreement number 731166.

INTRODUCTION

Technical review report is part of GeoERA's Monitoring and evaluation process for co-funded projects (*hereinafter: project*). The aim of a technical review is to assess the work carried out under the project over a certain period and provide recommendations. Such technical review evaluates the project reports and deliverables, the proper use of resources, the management of the project and the expected impact.

Technical review report consists of four sections, each representing one level of monitoring and/or evaluation of the project:

Level	Monitor / Reviewer	Input	Aim
1 – Monitoring of progress indicators	Monitoring and reporting officer (GeoZS)	MPPR* FPPR**	Monitoring of the effectiveness of implementation of selected projects with respect to finance, time and administration.
2 – Scientific review	Reviewers (GeoZS)	Submitted deliverables MPPR FPPR	Quality review of the deliverables and review of achieving scientific and professional goals.
3 – Review of the theme progress	Theme coordinators	MPPR FPPR	Review of achieving theme objectives.
4 – GeoERA Progress evaluation	Stakeholder Council member(s)	Sections 1 and 2 of this report Review meetings	Overall project progress and general recommendations.

*MPPR = Midterm Project Progress Report (see PI doc no 2)
**FPPR = Final Project Progress Report (see PI doc no 2)

Monitoring and evaluation process:

M0 = End of reporting period
M1 = Submitted (Final) Project progress Report (MPPR / FPPR)
M2 = 1 – Monitoring & 2 – Evaluation
M3 = 3 – Evaluation of the theme progress
M3 = (Final) Review Meeting & 4 – Progress evaluation

Each project will be reviewed twice: for first project period M1-M18 – Technical review report, and second project period M19-M36 – Final review report.
Technical review report is based on Horizon 2020 templates but adopted to GeoERA needs. Technical reviews of projects shall be carried out on a confidential basis.

GENERAL INFORMATION

ERA-NET Cofund Grant Agreement:	731166
ERA-NET Cofund acronym:	GeoERA
Call identifier:	H2020-LCE-2016-2017/H2020-LCE-2016-ERA
Project full title:	Managing Urban Shallow geothermal energy
Project acronym:	MUSE
Project reference number:	GeoE.171.006
Project topic:	GeoEnergy
Project specific topic:	GE2-Geothermal energy
Lead partner:	GBA Geologische Bundesanstalt (Geological Survey of Austria)
Project website:	https://geoera.eu/projects/muse3/

☒ Technical review report

☐ Final review report

Period covered	01/07/2018 – 31/12/2019
Review meeting date	06.02.2020, concise 20.03.2020

Contributor:	Role:	Approved on:
Barbara Simić	Monitoring and reporting officer	24.02.2020
Maja Ilić	Monitoring and reporting officer	25.02.2020
Joerg Prestor	Scientific reviewer	03.03.2020
Jasna Šinigoj	Scientific reviewer	11.03.2020
Matija Krivic	Scientific reviewer	10.03.2020
Serge van Gessel	Theme coordinator	16.03.2020
Thomas Crafford	Stakeholder Council member	NA
Philipe Dumas	Stakeholder Council member	14.04.2020

1 LEVEL 1 – MONITORING OF PROGRESS INDICATORS

In this section the project is monitored "remotely" on the basis of the respective reports. This part is filled in by Monitoring and reporting officer with aim to monitor the effectiveness of implementation of the selected projects with respect to finance, time and administration, based on submited MPPR and FPPR.

	Yes	Partially (comment needed)	No
PROJECT MANAGEMENT			
Has the MPPR / FPPR report been submitted on time?	☒		☐
Have there been any changes in project partnership?	☐		☒
Has the project management been performed as required?	☒		☐
Has the collaboration between partners been effective?	☒		☐
Do you identify evidence of underperforming partners, lack of commitment or change of interest of any partners?	☐ (see comment)		☒
DELIVERABLES and MILESTONES			
Have the planned deliverables for the period been submitted on time according to timeline in Project Agreement?	☐	See comment no.1	☒
Have the planned deliverables for the period been completed (from MPPR / FPPR, sheet 4)	☒		☐
Have any changes to deliverables occur (type/ dissemination level)? (from MPPR / FPPR, sheet 4 and 5)	☒	See comment no.2	☐
Have planned milestones been achieved for the reporting period? (from MPPR / FPPR, sheet 4)	☐	See comment no.3	☒
Have the project partnership identify any difficulties achieving any of the deliverables / milestones?	☒		☐
DEVIATIONS (from MPPR / FPPR, sheet 5)			
Has the project partnership identify any deviations that will not affect projects outputs?	☒		☐
Have any deviations occur on the project, with impact on project outputs?	☐		☒
In case of deviations, have the project adopted corrective measures?	☒		☐
DISSEMINATION, COMMUNICATION			
Has the project adopted its dissemination plan?	☒		☐

Have the planned dissemination activities been completed for the reporting period? (from MPPR / FPPR, sheet 6)	☒		☐
Have the partners' disseminated project results and information adequately?	☒		☐
Is the project following dissemination plan?	☒	See comment no.4	☐
Is the project interacting in a satisfactory manner with other GeoERA projects?	☒		☐
Is the project interacting in a satisfactory manner with national/international bodies?	☒		☐

FINANCE			
To the best of your estimate, have the resources used been utilised for achieving the project? (according to MPPR / FPPR, sheet 9)	☒		☐
To the best of your estimate, have the resources used been in a manner consisted with the principle of economy, efficiency and effectiveness? *	☒		☐
Are there any major deviations in the budget consumptions from the financial plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☐		☒
Are there any major deviations in the Person - Months consumptions from the plan? (zero consumption in M18; deviation from plan exceeding 20% in M36)	☐		☒
Are any budget modifications for the project needed? (from MPPR / FPPR, sheet 5)	☐	See comment no.5	☒

***The principles of economy, efficiency and effectiveness** refers to the standard of "good housekeeping" in spending public money effectively. Economy can be understood as minimising the costs of resources used for an activity (input), having regard to the appropriate quality and can be linked to efficiency, which is the relationship between the outputs and the resources used to produce them. Effectiveness is concerned with measuring the extent to which the objectives have been achieved and the relationship between the intended impact and the actual impact of an activity. Cost effectiveness means the relationship between project costs and outcomes, expressed as costs per unit of outcome achieved.

Comments (highlighting the project progress) / deviations / recommendations:

Comment no.1: In the first reporting period 6 deliverables were due:
1 deliverable was submitted on time
2 deliverables were submitted with eligible delay (amendment 1)
3 deliverables are postponed into the second reporting period (amendment 1)
Comment no.2: Changes to deliverables:
D3.1: postponed from M18 → M21
D5.3: postponed from M9 → M19
D5.7: postponed from M8 → M19

The changes have no impact on the project outputs.
Comment no.3: Milestone 5: Beta-version of the web platform ready to use is in delay, also due to delays in the IP project, original deadline M18.
Comment no.4: D5.7 Guideline on targeted communication to stakeholders on shallow geothermal use in urban areas has been postponed from M8 → M19, due to: Experiences gained from the final stakeholder consultation in the project GeoPLASMA-CE will be considered in the guidelines; the GeoPLASMA-CE stakeholder consultation process will end in January 2020.
Comment no.5: Some minor deviations within the partner budgets are expected, project amendment is not needed.

MUSE addresses measures to enhance and manage sustainable and efficient use of shallow geothermal energy in European urban areas for promoting green energy uptakes. The project builds on finalized Interreg projects and connects GeoERA with other European funded projects. Some MUSE deliverables were directly connected to project GeoPLASMA-CE (Interreg Central Europe), which was prolonged in duration and consequently pushed some of MUSE deliverables in delay. With support of MUSE ”project office” the delay has been identified in time and corrective measures have been adopted. The risk of delay with impact on the Project plan is therefore minimised.
Dissemination plan has been adopted and followed in the first reporting period. The project’s networking with non-GeoERA projects is encouraged. MUSE project team identified stakeholders and are approaching and interacting with them on regular basis. The way the project shares the knowledge is a good case scenario, the proposition to present the communication and dissemination activities and methods to other GeoERA projects has been given. The assessment of these activities is therefore 5 – overachiever, because the project team exceeded the expectations toward these activities.
Overall financial consumption at the end of first reporting period is 43 %, which is a bit low. According to the project plan, the majority of activities will be done in the second reporting period, consequently the financial consumption will increase.

Project management structure is well defined and efficient. Project team recognises minor delays and is showing outstanding work with MUSE project office support to partners with implementation of project activities. No challenges in achieving project outcomes are recognized, the project lead provides good support to partners with implementation of project activities.

Overall assessment of the project:

☐ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives; however corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule)

Summary of dissemination activities (detailed activities are annexed to this report):

Activity	Target audience	Number of people reached
Publications	General public	1000
Events	Scientific community	414
Meetings	EU institution	220
Meetings	Non-EU institution	70
Media	General public	500
Media	Non-EU institution	500
		2.704

Are the dissemination activities adequate? (link to GeoERA WP5)

☒ 5 - **Overachieved** (the projects dissemination activities have exceeded expectations)

☐ 4 - **Excellent** (the projects dissemination activities have fully achieved its expectations)

☐ 3 - **Good** (the projects dissemination activities are adequate; however, some additional activities are needed)

☐ 2 - **Acceptable** (the projects dissemination activities need corrective actions; additional activities are needed)

☐ 1 - **Unsatisfactory** (the project has failed to disseminate)

Cummulative financial statement:

	Person months	Total eligible costs	Reimbursement rate	GeoERA contribution	In-kind contribution
Plan	192,04	1.313.258	29,70%	390.023	923.235
1st period consumption	85,13	567.567	29,70%	168.567	399.000
2nd period consumtion					

2 LEVEL 2 – SCIENTIFIC REVIEW

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by reviewer with aim to review the quality of the deliverables and review of achieving scientific and professional goals. Scientific review is based on submitted deliverables and reported Impact statement in MPPR/FPPR.

Impact statement (from MPPR / FPPR, sheet 8):

MUSE addresses measures to enhance and manage sustainable and efficient use of shallow geothermal energy in European urban areas for promoting green energy uptakes. According to the MUSE project application, the following activities have been planned to maximize the impact of the project: C-D-E plan: The preliminary C-D-E plan submitted at the project application, was further developed during the initial phase of MUSE and is updated on a regular basis. The C-D-E plan plans and monitors all activities related to external communication. Web platform on the use of shallow geothermal energy: a dedicated web interface addressing shallow geothermal energy inside EGDI is currently developed. The general concept of it was communicated to the IP team via the MUSE White Book (D 5.1). The web interface will be ready for external use by the end of 2020. Developing of joint quality standards and approaches for managing shallow geothermal energy use: In the first reporting period, the different approaches and methodologies for mapping resources and limitations of use have been assessed inside the MUSE team and are currently harmonized to a joint catalogue of methods. Furthermore, different management approaches and management requirements associated to the use of shallow geothermal energy have been assessed and compiled to a catalogue of management approaches, which will be finalized in the second reporting period. The MUSE team also assessed and is currently evaluating the legal framework for the use of shallow geothermal energy. A joint evaluation will be published in the second reporting period. Identifying and promoting promising concepts and approaches how to use shallow geothermal: In the first reporting period, fast sheets on the geoscientific and market related conditions for the use of shallow geothermal have been created for all 14 MUSE pilot areas. The fact sheets are published at the MUSE website. in 2019, the MUSE team started to collect good practice examples on the use of shallow geothermal energy in all pilot areas. The good practice examples will be published on the MUSE EGDI web interface as well as on the MUSE website. Targeted stakeholder communication: Currently joint guidelines on targeted stakeholder communication are developed. Targeted communication intends to raise awareness towards the use of shallow geothermal, management aspects to ensure sustainability and efficiency and role Geological Survey Organizations should play in managing urban shallow geothermal use. Targeted stakeholder communication will include interviews, focus group workshops and trainings / events for targeted audiences on a regional to national level (under the responsibility of each MUSE

partner) and on an international level (joint coordination of the MUSE team). The focus on stakeholder communication will be put in 2020.
Knowledge exchange and capitalization: In the first reporting period, MUSE contributed to 4 knowledge exchange activities and already initialized one follow-up initiative in terms of the COST Action CA18219 Geothermal - DHC, which addresses the inclusion of geothermal energy (deep and shallow geothermal) in heating and cooling grids. Furthermore, strategic cooperation was initialized with other European networks like JPI, EGEC, RHC and IAH. In 2021, MUSe aims to co-host the European Shallow Geothermal Energy event, which will likely take place in Warsaw in spring 2021.

Expected impact (from Project Agreement):

The European Union already faces a rather high degree of urbanisation (74.8% according to the World Bank), which is expected to further increase in the upcoming decades. Therefore, strategies and actions on the uptake of green energy supplies in Europe need to focus on urban areas. Here, shallow geothermal energy (SGE) use for heating, cooling and seasonal storage has the potential to become a key instrument for reducing the dependency on energy imports and lowering emissions by enhancing the decarbonization of the heating and cooling market. Although around two thirds of the total installed capacities and more than 85% of all investments in the European geothermal sector is related to SGE use (European Geothermal Energy Council, Market Report 2015, fifth edition April 2016), these simple and very adaptable heating and cooling techniques still suffer from a lack of visibility and awareness by the general public.
The Market Report 2015 also reveals that the top five nations of SGE use in Europe (Sweden, Germany, France, Switzerland and Norway) account for 69% of the overall installed capacities, thus indicating that SGE use has a large potential in many other countries across Europe. The GeoDH project (http://geodh.eu/) concluded that “more than 25% of the EU population lives in areas directly suitable for deep geothermal district heating”. In contrast, the general suitability of applying SGE methods for low temperature heating and cooling supply is expected to be significantly higher compared
to deep geothermal systems. In general, the application of closed-loop systems is only limited to land-use restrictions (e.g. groundwater protection zones or problematic geological conditions) and already existing subsurface installations. Based on a recent survey in Vienna (Austria), closed-loop systems may either provide or store energy of up to 7,000 MWh/ha/year. Moreover, the entire heating and cooling demand of Vienna referring to the year 2015 could be supplied by closed-loop systems occupying less than only 17% of the available city area (WC-33 project executed by the Geological Survey of Austria).
Taking the above-mentioned aspects into account, MUSE addresses measures to enhance and manage sustainable and efficient use of SGE methods for fostering green

energy uptakes in Europe. The project contributes to the following aims of the Specific Research Topic GE2 and the GeoERA programme in general:

- Delivery of a well-documented knowledge base (catalogue of joint methods and workflows) for local-scale assessment of resources and possible conflicts related to shallow geothermal energy in cities.
- Developing interoperable quality standards and criteria for supervising the whole management circle including exploration and assessment, planning & licensing as well as monitoring of use and related impact on the subsurface, especially on shallow groundwater bodies. In this context, the project especially addresses the problems of mutually interfering SGE installations.
- Developing strategies and related actions (roadmaps), as well as policy tools, for managing and supporting SGE use in cities. This also includes the evaluation of the current legal framework on regulating and support for shallow geothermal energy.
- Identifying and describing proven and promising technical concepts of SGE use for heating, cooling and seasonal heat storage.
- Describing technical and environmental risks related to inappropriate SGE use and providing risk intervention and mitigation measures.
- Demonstrating the developed methods, workflows and concepts in 14 urban pilot areas across Europe.
- Developing modern web-based information- and decision-support systems for investors and regulators.
- Involving local stakeholders in the pilot areas by targeted communication and transfer of knowledge activities to ensure a long-term impact of MUSE with regard to enhancing the use of SGE to reduce greenhouse gas emissions and improve air quality and urban well-being.

After the end of MUSE, all results can be transferred to other Geological Survey Organisations or similar entities to be used in other European urban areas. The comprehensive toolboxes provided by MUSE aim to cover all relevant aspects dealing with possible future SGE use in European urban areas. This is seen as the most important added value of MUSE beside the tailored thematic outputs, strategies and web services for the pilot areas. To achieve these aims, MUSE integrates Geological Survey Organisations from 15 European countries and 14 selected urban areas, which face different geological, climatological and socio-economic settings with regard to the present heating and cooling market, legislation and regulation.

Evaluation of deliverables

Deliverables list status			
No.	Title	Status (Approve/ Reject)	Comments
D1.1	Initial and updated Project Implementation Plans	Approve	/
D1.3	Project leaflet	Approve	/

D5.1	White Book of the web platform related to MUSE	Approve	/
D5.2	Data management plan – version 1	Approve	See below
This deliverable provides a first version of the MUSE Data Management Plan. It is structured according to the guidelines of the Overall GEOERA Data Management following Horizon 2020 FAIR Data and Management Plan. Since GIP-P did not yet provide recommendations and EGDI will furtherly develop, this report could be updated in the future.			
D5.7	Guideline on targeted communication to stakeholders on shallow geothermal use in urban areas		Delayed to period 2 (M8 → M19)
D5.3	Guideline on the delivery of geodata and knowledge related to SGE to the GeoERA Information Platform		Delayed to period 2 (M9 → M19)
D3.1	Report on the current legal framework, procedures and policies on SGE use in selected European cities		Delayed to period 2 (M18 → M21)

Has the quality as a whole been achieved according the objectives? Has the project as a whole been making satisfactory progress?

☐ 5 - **Overachiever** (the project has achieved all objectives and goals for the period and has even exceeded expectations)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals for the period)

☐ 3 - **Good progress** (the project has achieved most of its objectives and goals for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has achieved some of its objectives; however corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule)

Comments (highlighting the project progress) / deviations / recommendations:

This is an abmitious project, significant ambition and contribution for standardisation and accessibility is apparent. The project builds on finalized projects GeoPLASMA-CE and GRETA. The catalogues developed in those projects are now set as standard and will now be updated with more details. The calculations and the methods for parameters will be evaluated and described in the MUSE guidelines, with emphasis on the language – same interpretation – same expresion, diminishing redundancy and complexity. Through EDGI MUSE will build PanEU knowledge system, that can be transferred to other projects or users.

The MUSE management model will consider only geoenergy sources, although other sources exist, e.g. combination in bigger cities, which would also be our recommendation. However, the outcomes indirectly promote the use of GE in the integration with other renewable energy sources.

3 LEVEL 3 – REVIEW OF THE THEME PROGRESS

In this section the project is reviewed ”remotely” on the basis of the respective reports. This part is filled in by Theme coordinator with aim to review the achieved scientific goals in accordance with theme objectives, on the basis of Sheet 3 in MPPR / FPPR – Project contribution to GeoERA project.

Project contribution to GeoERA project (from MPPR / FPPR, sheet 3):

GeoERA-MUSE contributes to the topic GE2 - GEOTHERMAL ENERGY according to the doc no 9 of the joint call by the sub topic "Geothermal energy and groundwater in urban areas". It supports the expected impact of doc no 9 in the following way:
1) Improved and better harmonized European overview of prospective and identified geothermal energy resources: MUSE creates local scale resource maps for up to 14 individual urban pilot areas, which will be published at a later stage at EGDI. MUSE is furthermore promoting concepts for user-friendly data display (e.g. location specific data reports). Please note that MUSE does not produce large scale pan-European maps as questions related to the use of shallow geothermal are always related to small-scale local hydrogeological settings;
2) Provision of a consistent and data-driven knowledge base to aid in the formulation of policy tools and strategies aiming for large-scale geothermal energy developments across Europe: MUSE is developing a methodological catalogue on mapping resources and limitations of use, which will be published at the end of the project. Harmonization includes technical language (joint glossary of terms), which is linked to joint workflows and joint contents to be presented at the EGDI web interface.
3) A further stimulus for green thermal energy uptake in European urban regions: MUSE is currently developing a stakeholder interaction strategy to raise awareness towards an efficient and sustainable use of shallow geothermal in urban areas. The collection of good practices executed in all pilot areas and participating countries moreover aims at promoting state of the art technological concepts and an exchange of technological experiences between well developed and emerging markets in Europe.
4) Increased confidence in the prospectivity and potential contribution of geothermal resources across Europe: This topic will be addressed via stakeholder interviews including SWOT analyses on the use of shallow geothermal in the second half of MUSE.
5) More effective and extended information support of the public-private-policy dialogue on geothermal energy resources in relation to the license to operate and the European Union’s energy and climate targets: MUSE developed a catalogue of different management strategies for the use shallow geothermal energy, which will feed into tailored local strategies in the MUSE pilot areas. The management strategies will be strongly linked to stakeholder interaction for raising awareness and transfer of knowledge (input by the MUSE team) and in turn assessing requirements, expectations and objections (input by stakeholders).

Theme objectives:

Theme objectives: compliant

- Potential subsurface contributions with regards to energy resources and storage capacities;
    - Part of project objective, results of case study areas presented at midterm
- Potential risks and environmental impacts associated with subsurface use for energy applications;
    - Part of project objective, presented as intermediate result in mid term
- Risks of competition and interference between different uses of subsurface space, including interactions with surface infrastructures, and rewards of synergies.
    - Essential part of project objective, presented as intermediate result in mid term

Theme scope: compliant

- Hydrocarbons including conventional/unconventional oil and gas, gas hydrates;
    - Not in project scope
- Energy derived from solid resources such as coal (including coal bed methane (CBM) and underground coal gasification), lignite, peat, uranium;
    - Not in project scope
- Geothermal energy from hydrothermal and petro-thermal resources, both shallow and deep;
    - Main project scope, results and progress presented
- Capacities for temporary storage of energy carriers (natural gas, hydrogen, compressed air and heat);
    - Part of project scope. Heat/cold storage and interactions
- Capacities for permanently storage of CO2 and other energy effluents.
    - Not in project scope
- Identification and analyses of overlap and interactions between geo-energy resources and areas prone to seismic activity;
    - Not in project scope
- Determination and analysis of potential connections to groundwater and surface water systems;
    - Essential part of project scope and, intermediate results presented

- Identification and analysis of potential interferences as well as synergies/pooling between various geo-energy resources and subsurface uses.
    - Essential part of project scope and, intermediate results presented. Also strong emphasis on development and implementation of policy/stakeholder guidelines

Theme approach and methods: compliant

- Deliverables proposed by geo-energy theme projects should be compatible with a common spatial geological framework defined by the extent, depth, thickness, as well as essential properties of geological intervals containing relevant geo-energy resources and storage capacities.
    - The project follows a uniform presentation of geothermal assessments and standards for urban subsurface management and information systems
- Common state-of-the-art methodologies will be developed and applied with the aim to assess and quantify technically recoverable resources.
    - Part of project scope. Assessment of existing methods included and presented
- Development and demonstration of advanced 3D modelling and assessment activities may be proposed for complex geological configurations typical for specific cross-border regions under the condition that these methodologies have generic value and can be linked to the future objectives of a common spatial-assessment framework.
    - Methods and concepts for 3D subsurface spatial planning in urbanised areas (presented as result/progress)
- The joint call will either ask for final deliverables and methodologies consistent on a transnational to pan European level, or for the demonstration and development in cross-border regions of methodologies that have generic value for future pan-European assessments.
    - The project does not specifically address cross-border modelling, but the regards a common approach for urban areas spread across Europe
- Correlation schemes of cross-border geo-energy resources;
    - This aspect has little relevance in the project scope as the project regards confined urban areas
- Compatible and interoperable model scales/resolutions and geometries;
    - The project regards the local scale of urban areas. The results provide a basis for other urban areas
- Commonly agreed modelling and assessment methodologies.

- Methodologies are generally in compliance with industry standards (geothermal). The project collaborates actively with other (non-GeoERA) projects in the domain of (shallow) geothermal.

Beyond state of art

- Advanced mapping and 3D modelling strategies that allow for regional to pan-European cross-border consistency and integration;
  - Common concepts and strategies are developed in various EU regions rather than cross-border modelling
- Advanced and harmonized resource estimation workflows addressing uncertainty and sensitivity;
  - This aspect is indirectly addressed in resource assessments and technical risks
- State-of-the-art assessment workflows for analysis of potential geologically related surficial and subsurface effects induced by resource exploitation (e.g. subsidence, tremors, etc.);
  - Not in project scope
- Methodologies to objectively weigh interacting or mutually exclusive potential uses of space within the geoenergy theme and across the other themes on groundwater and minerals.
  - This part is specifically investigated (also in collaboration with groundwater projects). In progress

Project-2-Project:

MUSE actively interacts with projects in GeoERA (HotLime, GeoConnect3D, groundwater) and outside (GeoPlasma-CE, GeoTwin, etc.). WP6 specifically addresses cross-cutting issues and capitalising on knowledge inside GeoERA

Has the project as a whole achieved the objectives and expected impact of the theme?

☐ 5 - **Overachiever** (the project has achieved greater impact on project theme and/or other themes than expected)

☒ 4 - **Excellent progress** (the project has fully achieved its objectives and goals towards the theme as expected)

☐ 3 - **Good progress** (the project has achieved most of its impact towards the theme for the period with relatively minor deviations)

☐ 2 - **Acceptable progress** (the project has minor impact; corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or is not at all on schedule and/or has no impact on the theme; corrective actions are required)

Comments / deviations / recommendations:

MUSE progresses in line with the project objectives and thereby follows the theme scope/objectives and GeoERA principles in general as mentioned in the call description.

Additionally the review analyses how the project performs beyond the project scope and raises the overall profile of the Energy Theme and GeoERA as a whole, i.e.:

- Developing and actively implementing standards and methods for panEU harmonization in the GSO community that are of value to the Energy Theme and/or GeoERA in general (i.e. beyond the project scope)
- Successfully introducing and implementing innovative and novel methods and standards in stakeholder/science communities leading to wider recognition of the Energy Theme and/or GeoERA
- Stimulating synergies between projects and themes
- Raising the overall impact and recognition of the Energy theme and/or GeoERA though active engagement of stakeholder and science communities
- Opening opportunities for future research and spin-offs including EP-GSE (i.e. possibilities for sustained development of results after project lifetime)

The MUSE project is rated as 'excellent' for the following reasons:

1) Very active and effective engagement of stakeholder communities including practical implementation of results in European urban centers. The followed stakeholder strategy not only affects the project itself but also leads to a wider recognition of the values and benefits GeoERA in general.
2) Strong connection with science community beyond GeoERA

It is recommended to further evaluate and valorise synergies with other GeoERA projects and themes. Initiatives have been announced by the project during the mid-term review meeting.

4 LEVEL 4 – GEOERA PROGRESS EVALUATION

In this section the project is reviewed on the Review meetings, where projects present their overall progress and achievements. This section relates to particular project, broader impact of GeoERA as a whole on policies will be covered at the Final Review meeting with questionnaire and interview with Evaluator.

Based on technical review summaries provided by Sections 1 – 3 of this report, and project presentation on the (Final) Review meeting:

Has the project as a whole been making satisfactory progress according to your own understanding and expectations of the GeoERA project?

☐ 5 - **Overachiever** (the project has exceeded expectations)

☒ 4 - **Excellent progress** (as expected)

☐ 3 - **Good progress** (minor recommendations given below)

☐ 2 - **Acceptable progress** (below expectations; minor corrective action will be required)

☐ 1 - **Unsatisfactory progress** (the project has failed; corrective actions are required)

Overall comments for the project (overall recommendations, modifications, corrective actions, or re-tuning the objectives to optimize the impact or keep up with the State of the Art, re-focusing, or a simple praise)

A general recommendation is to assess the pro and contra of shallow geothermal in the perspective of a heat market, with a level playing field. The main competitor is individual fossil fuel installations, in particular fossil gas boiler.

The specific recommendations are the following:

- The aim should be not only to collect best practices, but also to draft minimum set of standards: the objective is to tend towards recognition of these minimum standards more than a top-down harmonization.
- A proposal must be made for better data colletion; linked with support schemes, with a regulatory but not-bureaucratic constraints…
- On mapping and its methodology, some lessons learnt from deep geothermal should be assessed (> chapter E. KNOWLEDGE SHARING of the ETIP-DG strategic research & innovation agenda (http://www.etip-dg.eu/front/wp-content/uploads/AB_AC_ETIP-DG_SRA_v3.3_web.pdf))
- The fact that a legal framework is evolving has to be taken into account. The project should also assess the consequence of the future implementation of article 23 from the recast RES (2019)

Cooling aspects, in particular free-cooling, should also be considered: legal aspects, calculation methodology…

Stakeholder Mr Thomas Crafford participated at the review meeting and provided recommendations for the projects. Due to personal reasons, he wishes not to participate further in the GeoERA monitoring and evaluation process. The “date of approval” of this document is therefore NA.

Annex 1: Review meeting list of participants

Name	Role	Organisation
Tessa Witteman	GeoERA coordinator	Netherlands Organisation for Applied Scientific Research
Barbara Simić	Monitoring and Reporting Officer	Geological Survey of Slovenia
Jasna Šinigoj	Scientific Reviewer	Geological Survey of Slovenia
Joerg Prestor	Scientific Reviewer	Geological Survey of Slovenia
Serge van Gessel	GeoEnergy Theme coordinator	Netherlands Organisation for Applied Scientific Research
Tom Crafford	GeoERA Stakeholder council member	US Geological Survey
Gregor Goetzl	MUSE Project manager	Geological Survey of Austria
Cornelia Steiner	MUSE Project member	Geological Survey of Austria
Alejandro Garcia-Gil	MUSE Project member	Geological Survey of Spain
Ignasi Herms	MUSE Project member	Institut Cartogràfic i Geològic de Catalunya
Claus Ditlefsen	MUSE Project member	Geological Survey of Denmark and Greenland
Staša Borović	MUSE Project member	Croatian Geological Survey
Concise review meeting 20.03.2020		
Philipe Dumas	GeoERA Stakeholder council member	The European Geothermal energy council

Annex 2: Communication and dissemination activities

Please select activity	Subcategory	Date	Target audience	Number of people reached	Short name of project participant	Author(s)	Link (if applicable)
PUBLICATIONS	PROJECT SPECIFIC PUBLICATION - Project logo	30.06.2018	GENERAL PUBLIC		GBA	Gregor Goetzl	https://geoera.eu/projects/muse3/
PUBLICATIONS	PROJECT SPECIFIC PUBLICATION - Project poster	30.06.2018	GENERAL PUBLIC		GBA, ICGC, HGI-CGS	Gregor Goetzl, Ignasi Herms, Staša Borović	https://projects-gba.geologie.ac.at /index.php/s/DBivtGJ8P5H3CLi
PUBLICATIONS	PROJECT SPECIFIC PUBLICATION - Leaflet	31.01.2019.	GENERAL PUBLIC	1000	HGI-CGS, GBA, NERC-BGS	Staša Borović, Marina Filipović, Cornelia Steiner, David Boon	https://geoera.eu/blog/ muse-leaflet-available-now/
EVENTS	WORKSHOP - Knowledge exchange workshop on "Monitoring of shallow geothermal energy use" in Essen	27-28/11/2018	SCIENTIFIC COMMUNITY	>40	GBA, GeoPLASMA-CE and GRETA projects	Gregor Goetzl, Cornelia Steiner	https://geoera.eu/blog/ the-muse-team-met-in-essen-germany/
EVENTS	CONGRESS - Poster at European Geothermal Congress 2019 in The Hague	11-14/6/2019	SCIENTIFIC COMMUNITY	20	ICGS, GBA	Ignasi Herms, Gregor Goetzl	https://projects-gba.geologie.ac.at/index.php/s/088X2OsTrzKrTHx

EVENTS	CONGRESS - Poster and abstract at Polish Geothermal Congress in Zakopane	23-25/10/2018	SCIENTIFIC COMMUNITY	30	PIG-PIB	Maciej Klonowski	https://projects-gba.geologie.ac.at/ index.php/s/wKHk58j2M5Df6aF
MEETINGS	Meeting with international body - Oral presentation at IEA Annex 52 meeting (UK) in London	25.09.2018	EU INSTITUTION	220	NERC-BGS	David Boon	
EVENTS	WORKSHOP - Knowledge exchange workshop on "Temperature modelling" in Zagreb	23-24/1/2019	SCIENTIFIC COMMUNITY	24	HGI-CGS, GBA, LfU (HotLime)	Gregor Goetzl, Gerold Diepolder, Staša Borović, Cornelia Steiner	https://geoera.eu/blog/knowledge-exchange-workshop-of-muse-and-hotlime-projects-held-in-zagreb/
MEDIA	OTHER - Article in Annual Science Review of BGS	43496	GENERAL PUBLIC	500	NERC-BGS	David Boon	https://www.bgs.ac.uk/annualreport/home.html
EVENTS	CONGRESS - Extended abstract and oral presentation at 2nd congress of geologists of Bosnia and Herzegovina	2-4/10/2019	SCIENTIFIC COMMUNITY	70	HGI-CGS	Staša Borović	
EVENTS	CONGRESS - Abstract and oral presentation at the 6th Croatian geological congress	9-12/10/2019	SCIENTIFIC COMMUNITY	30	HGI-CGS	Staša Borović	

EVENTS	CONGRESS - Paper and oral presentation at Conference "Actual problematics in water supply and sewerage"	23-27/10/2019	SCIENTIFIC COMMUNITY	200	HGI-CGS	Staša Borović	
MEETINGS	Meeting with national body - Oral presentation at GeoERA Kick-off meeting in Austria	14.03.2019	NON-EU INSTITUTION (national, regional, local)	70	GBA	Gregor Goetzl, Cornelia Steiner	
MEDIA	Other - Article in EnergyHQ on Minewater geothermal Winter 2019	01.11.2019	NON-EU INSTITUTION (national, regional, local)	500	NERC-BGS	David Boon	https://projects-gba.geologie.ac.at/index.php/s/lA3V7NEHj6ai8oS#pdfviewer