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

Technical review report for project MINTELL4EU

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:	Mineral Intelligence for Europe
Project acronym:	MINTELL4EU
Project reference number:	GeoE.171.016
Project topic:	Raw Materials
Project specific topic:	RM1–Improving and sustaining the Raw Materials Knowledge Base by periodically delivering a Minerals Yearbook and Inventory Information System
Lead partner:	GEUS Geological Survey of Denmark and Greenland
Project website:	https://geoera.eu/projects/mintell4eu7/

☐ Technical review report
☒ Final review report

Period covered	01/01/2020 – 31/10/2021
Review meeting date	01.12.2021; start at 13:30

Contributor:	Role:	Approved on:
Barbara Simić	Monitoring and reporting officer	2.12.2021
Aleksandra Trenchovska	Monitoring and reporting officer	2.12.2021
Meta Dobnikar	Scientific reviewer	6.12.2021
Jasna Šinigoj	Scientific reviewer	6.12.2021
Matija Krivic	Scientific reviewer	6.12.2021
Antje Wittenberg	Theme coordinator	16.12.2021
Harikrishnan Tulsidas	GeoERA Stakeholder	20.01.2022
Christoph Gauert	GeoERA Stakeholder	31.12.2021

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 the submitted MPPR and FPPR.

	Yes	Partially (comment needed)	No
PROJECT MANAGEMENT			
Has the MPPR / FPPR report been submitted on time?	☒	See comment no. 1	☐
Have there been any changes in project partnership?	☒	See comment no. 2	☐
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)	See comment no. 3	☐
DELIVERABLES and MILESTONES			
Have the planned deliverables for the period been submitted on time according to timeline in Project Agreement?	☐	See comment no. 4	☒
Have the planned deliverables for the period been completed (from MPPR / FPPR, sheet 4)	☒		☐
Have any changes to deliverables occurred (type/ dissemination level)? (from MPPR / FPPR, sheet 4 and 5)	☒	See comment no. 4	☐
Have planned milestones been achieved for the reporting period? (from MPPR / FPPR, sheet 4)	☒		☐
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 occurred in the project, with impacts on project outputs?	☐		☒

In case of deviations, has 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?	☒		☐
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)	☒	See comment no. 5	☐
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)	☐		☒

***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:

The MINTELL4EU project supports the overall objective of GeoERA - to integrate the information and knowledge of European GSOs on natural resources to contribute to sustainable use and management, among others. The European Commission advocates an approach to explore the possibilities of expanding the extraction of raw materials within Europe in order to reduce dependence on raw material imports. Against this background, the work carried out under MINTELL4EU is extremely important, as this project has worked to expand and improve European raw material information to support decision-making by governments and industry. The project builds on previous projects that have all contributed to the creation of a harmonized European knowledge base on raw materials, such as Minerals4EU and EURARE from the Framework Programme 7, ProSUM, SCRREEN. MICA and ORAMA from Horizon 2020, RESEERVE funded by EIT RawMaterials, and even older, PROMINE and EuroGeoSource. MINTELL4EU has expanded this data collection and worked to further harmonize and optimize data and automate data collection to facilitate regular updating of comprehensive and reliable information across borders. All data are, all published in the electronic Minerals Yearbook and the Minerals Inventory and are available through the European Geological Data Infrastructure (EGDI). The success of this project, its significance and impact are outstanding. The project consortia will strive to sustain the results and continue to collaborate by seeking joint funding for future activities, involving more countries as data providers and perhaps even extending to the private level.

The Covid 19 epidemic had an impact on the progress of the MINTELL4EU project. In December 2020, the project was extended by 4 months, from 30.6.2021 to 31.10.2021. The postponed project activities were appropriately communicated to the GeoERA Executive board, which has reviewed and approved the changes in terms of achieving the project outcomes. A detailed list of changes is part of the project documentation in the project plan History of changes.

The project management structure was well defined and efficient. The pandemic situation required a high degree of flexibility of the partnership and adaptability of their involvement in the project activities. Overall, the project consortia spent slightly less than the planned budget as a result of the pandemic constraints. Nevertheless, the set goals and objectives were achieved overall.

A detailed and targeted communication and dissemination plan was adopted and a description of the activities with timetable was provided. The project's communication and dissemination activities followed the plan and in the end the partnership exceeded the set objectives. The way the project incorporated the

communication channels from the previous projects and disseminated its results is a good case scenario.

Comment no. 1: The Final Project Progress Report was submitted on time in draft form. Partners still have the opportunity to recalculate their financials by the end of the calendar year to include the final data, so minor variations can be expected. The changes will not affect the content of the project.

Comment no. 2: During the implementation of the project there were two changes in the partnership: partner 3 IGME-Gr Institute of Geology and Mineral Exploration was renamed to partner HSGME Hellenic Survey of Geology and Mineral Exploration. Later, partner IGME-Sp Geological Survey of Spain was integrated into CSIC Agencia Estatal Consejo Superior de Investigaciones Científicas. None of the above changes had an impact on the ability of the project to achieve its objectives and outputs.

Comment no. 3: The partnership has identified underperforming partners, data providers, who have not delivered what was expected of them. These same partners, on the other hand, have reported full effort and financial participation.

Comment no. 4: Due to the pandemic situation, some activities were delayed and deliverables had to be submitted later than planned. The revised dates were communicated to the Monitoring team and the GeoERA Secretariat by amending the project plan.

The deliverable changes in the project implementation period are:

Reporting period 1:
D3.1 postponed from M 12 (30.6.2019) → M15 (30.9.2019)

Reporting period 2:
D3.3 postponed from M24 (30.6.2020) → M33 (31.3.2021)
D3.4 postponed from M24 (30.6.2020) → M34 (30.4.2021)
D5.3.2 postponed from M26 (31.8.2021) → M39 (30.9.2021)
D1.5 postponed from M30 (31.12.2020) → M39 (30.9.2021)
D5.4 postponed from M30 (31.12.2020) → M38 (31.8.2021)
D5.5 postponed from M30 (31.12.2020) → M32 (28.2.2021)
D5.6 postponed from M30 (31.12.2020) → M32 (28.2.2021)
D5.7.2 postponed from M30 (31.12.2020) → M39 (30.9.2021)
D4.1 postponed from M32 (28.2.2021) → M39 (30.9.2021)
D4.2 postponed from M32 (28.2.2021) → M39 (30.9.2021)
D4.3 postponed from M34 (30.4.2021) → M39 (30.9.2021)
D2.1 postponed from M35 (31.5.2021) → M39 (30.9.2021)
D1.3 postponed from M36 (30.6.2021) → M40 (31.10.2021)
D3.1 postponed from M36 (30.6.2021) → M39 (30.9.2021)

Comment no. 5: Some project partners spent 20% more than their planned budget, others spent less than 80%. The partner that has exceeded their budget is NGU. Partners that spent less than their planned budget are: BGR, LGRB, SGU and GBA. The consumption of man-months followed the EUR consumption.

The project has coped well with the negative external factors and has overcome its challenges in such a way that it has achieved its planned objectives and project results. For this reason, the project is rated "excellent" at level 1 and thus receives a rating of 4 - Objectives and targets fully achieved.

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)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives)

Summary of dissemination activities:

	SCIENTIFIC COMMUNITY	GENERAL PUBLIC	POLICY MAKERS	EUROPEAN INSTITUTION	NATIONAL INSTITUTION	REGIONAL INSTITUTION	INTERNATIONAL INSTITUTION	LOCAL INSTITUTION	PRIVATE COMPANIES	OTHER	Total Target Group reach
EVENTS	245		10	50	10	10	5		5		335
MEETINGS	750		36	14	552						1352
ONLINE_MEDIA	7300	7300									14600
PUBLICATIONS	124923	250	900	220	275	275	50	110	160	200	127363
Total	**133218**	**7550**	**946**	**284**	**837**	**285**	**55**	**110**	**165**	**200**	**143650**

	ABSTRACTS	BLOG	CONGRESS	INTERNAL PROJECT MEETING	LEAFLET	MEETING	MEETING WITH OTHER GEOERA PROJECTS	MEETING WITH OTHER PROJECTS	NON SCIENTIFIC PUBLICATION	ORAL PRESENTATION	OTHER	POSTER	SCIENTIFIC PUBLICATION	TWITER	WEBSITE	WORKSHOP	Total
EVENTS			1													2	3
MEETINGS				40		9	12	1									62
ONLINE_MEDIA		17												17	1		35
PUBLICATIONS	16				1				2	32	1	3	1				56
Total	**16**	**17**	**1**	**40**	**1**	**9**	**12**	**1**	**2**	**32**	**1**	**3**	**1**	**17**	**1**	**2**	**156**

Are the dissemination activities adequate?

☒ 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)

☐ 2 - **Acceptable** (the projects dissemination activities are acceptable)

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

Cummulative financial statement:

	Person months	**Total eligible costs**	**Reimbursement rate**	**GeoERA contribution**	**In-kind contribution**
Plan	**462,30**	**2.847.630,21**	**29,7 %**	**845.746,14**	**2.001.884,07**
1st period consumption	204,20	1.003.055,42	29,7 %	297.907,46	705.147,96
2nd period consumtion	300,61	1.582.796,78	29,7 %	470.090,64	1.112.706,14
TOTAL	**504,81**	**2.585.852,20**	**29,7 %**	**767.998,10**	**1.817.854,10**

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):

The overall and most important impact of MINTELL4EU is that it offers a comprehensive mineral resource data platform for European primary and secondary mineral resources, including a user-friendly portal. This provides easy accessible and vital information for stakeholders and policy makers, for planning, investments, etc. Through close cooperation with EGDI, the sustainability of the database MIN4EU after GeoERA, the data collection routines, the network with IT-staff and raw materials specialists at the geological surveys across Europe are supported. EGS is currently working on a proposal for a Horizon Europe Coordination and Support Action to establish a Geological Service for Europe and if granted this will ensure the sustainability of EGDI (and therefore also MIN4EU) for the next five years. It is also the hope that the resulting Geological service will ensure this in the time after that.
More and further harmonised data on mineral occurrences and mines have been added to the MIN4EU database and are now made available across Europe (e.g. new data from six West Balkan countries, Luxembourg and the German State Baden-Württemberg besides from updated information from already existing data providers) adding to the Minerals Inventory, enabling better estimates of the raw materials potential in Europe. Updated data in the electronic Minerals Yearbook have been integrated with the Minerals Inventory, and all data are now stored in the central database MIN4EU. The electronic Minerals Yearbook is included in the EGDI platform making it easier and more user-friendly to view the data. Moreover, the pilot testing of UNFC as a classification system across a number of different commodities and scales across Europe has drawn quite some attention in the UNECE etc. and actually resulted in that eight partners added their resource and reserve data using the UNFC codes.
The visibility of results achieved in MINTELL4EU is even larger through the publication of selected data sets through a couple of dedicated viewers on the Raw Materials Information System (RMIS) made possible through cooperation with JRC. Tests towards sharing data with the European Plate Observing System (EPOS) have also been carried out.
Finally, as mentioned above, MINTELL4EU has worked closely together with the three other RM projects, facilitated by the RM Theme Coordinator. This, as well as the close connection to the MREG group, has enhanced cooperation and maximised project outputs as well as helped in focussing communication and dissemination activities towards the stakeholder society. In addition, the attention from DG GROW shows the interest from one of the main stakeholders of our results.

Expected impact (from Project Agreement):

A comprehensive mineral resource data platform for the European primary and secondary mineral resources, including a user-friendly portal, will provide vital information to governmental and private stakeholders, for planning and investment purposes. This proposal addresses a system, provided by the GeoERA Information Platform, aimed to provide data in a seamless way, using fully parametrizable applications for download and thus facilitating their use/integration in client in-house applications.

Evaluation of deliverables

No.	Title	Status (Approve/ Reject)
D1.3	Management reports (1)	Approved
D1.5	Roadmap for future actions towards full sustainability	Approved
D2.1	Report describing the processes developed for updating the electronic European Minerals Yearbook	Approved
D3.3	Quality control system for harvesting report	Approved
D3.4	GIS database layer illustrating relevant historic mine features	Approved
D4.1	Case study review with practical guidelines/work flows and examples for applying UNFC to European mineral resources	Approved
D4.2	Report on harmonization issues, data gaps and challenges, reviewing also the quality of Pan-European aggregated inventories for selected commodities	Approved
D4.3	Supply data to WP 2, 3 and 5, for inclusion in the European yearbook, resource databases and information systems	Approved
D5.3.2	Report on the integration of the e-Minerals Yearbook into the Minerals4EU database	Approved
D5.4	Review and data exchange prototype(s)	Approved
D5.5	Review and application delivery prototype(s)	Approved
D5.6	Review and dedicated search prototype	Approved
D5.7.1	Description of how data and information from the project are integrated into the Information Platform and guidelines for future maintenance	Approved
D5.7.2	Report on testing of integration into the Information Platform	Approved

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)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives)

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

The project has achieved all its objectives and even more. Working closely with ongoing projects and on the basis of previous ones the project achieved to update and upgrade the minerals intelligence database for Europe and united under one comprehensive platform the e-European Minerals Yearbook and mineral resources database including touristic mines. The upgrading of the database is planned within further project towards Geological Service for Europe and harvesting in the period between projects is also assured.
The project clearly presented the obstacles and bottlenecks in data providing as well as in harmonisation procedures that need to be addressed in the future. There were minor deviations in the project, as two of the partners could not provide data as planned and less UNFC case studies were performed as originally planned but this does not affect the objectives of the project. Proposal for UNFC visualisation was developed as an important but not planned addition to the outcomes of the project.

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):

The MINTELL4EU project has supported the overall aim of GeoERA – to integrate European Geological Survey Organisations’ information and knowledge on subsurface energy, water and raw material resources to contribute to sustainable use and management of the subsurface. As mentioned above, MINTELL4EU has worked to improve the European Union Raw Materials Knowledge Base by updating the electronic Minerals Yearbook and by extending the spatial coverage, improving harmonization, as well as by refining data quality in the MIN4EU database. Therefore, the scope described for projects under the GeoERA Programme Specific Research Topic “RM1 - IMPROVING AND SUSTAINING THE RAW MATERIALS KNOWLEDGE BASE BY PERIODICALLY DELIVERING A MINERALS YEARBOOK AND INVENTORY INFORMATION SYSTEM” is fulfilled.

Not only is the electronic Minerals Yearbook updated, data have also been further harmonized (in terms of common code lists with the Minerals Inventory) and transferred to the MIN4EU database to allow automation and sustainability. This enables appropriate and streamlined interfaces towards end users through the EGDI where maps illustrate the potential of combining data from the Yearbook with Minerals Inventory data. Moreover, the geographical coverage of raw materials data in the minerals inventory is extended with the addition of Luxembourg and one German state as well as six West Balkan countries through cooperation with the EIT Raw Materials project RESEERVE. The data quality and harmonization have been addressed via training, workshops and the development of quality assurance tools. Automatised collection (harvesting) procedures have been further developed to ensure correct data acquisition. Furthermore, MINTELL4EU has implemented recommendations from the ORAMA project, including testing the use of the UNFC on European mineral resource data. This provided invaluable information on the readiness of the geological surveys to use this classification system and how the system can provide better harmonization of data and eventually help in providing more accurate Pan-European mineral inventories. Finally, besides sharing data through the EGDI, MINTELL4EU makes selected data sets visible at the Raw Materials Information System (RMIS) via embedded viewers.

Together with the other three GeoERA Raw Material projects, MINTELL4EU has been closely connected to the Expert Group on Minerals Resources (MREG) under the auspices of EuroGeoSurvey. Meetings were held at least twice per year discussing cooperation as well as challenges, paving many roads forward. This interaction has indeed enhanced communication and a successful outcome of MINTELL4EU as well as the other raw material projects. Finally, DG GROW has closely followed the work of

the GeoERA Raw Materials, partly in dedicated meetings, partly by participating upon invitation in biannual meetings between MREG and the GeoERA Raw Materials projects.

Theme objectives:

GeoERA RawMaterials Theme objectives are defined by the Grant Societal Challenges acknowledged by the European Union and the UN SDG. They are descript on a topic-specific basis in the Raw Materials Initiative and policies derived from it (i.e. COM(2008) 699 final; COM(2011) 25 final), in particular:

- the security and sustainability of mineral raw materials supply from EU domestic sources and other sources (primary and secondary) and
- the management of competing uses of the European surface and subsurface.

The overarching goal "*Improvement of EU raw material resilience*" is key to all GeoERA RawMaterials projects, whilst the scientific projects are focussing on specific facets of the challenge. GeoERA RawMaterials followed a wider approach considering the high importance of mineral raw materials for our society. All four scientific projects of GeoERA RawMaterials worked closely together to achieve the overall goals and to meet the needs of the stakeholders as much as possible under the given conditions.

MINTELL4EU provides fundamental knowledge and information specifically responding to the demands and challenges addressed by the EC. The goal "*Updating contributions to and augmenting the coverage of the Annual Minerals Yearbook published by the Minerals4EU project*" reverberated these needs and is addressed specifically by MINTELL4EU. Maps, data and information compiled and hosted in EGDI, echoed in the Raw Material Information System (RMIS). It built an important and reliable source of information for the work on criticality.

MINTELL4EU responds to the predefined main goals of GeoERA RM "*Extending, deepening, upgrading the quality of the pan-European primary and secondary continental and marine resources inventory*" through the widely harmonised and INSPIRE compliant dataset of the Minerals Inventory, the e-Minerals Yearbook, and the case studies on UNFC in particular. The D4.2 report is an important contribution bridging the EURMKB and the use and management of resources. The suggestion to visualise UNFC on maps is an innovation in itself. The goal "*Implementation of innovative and efficient approaches throughout the mineral raw materials value chain, with the aim of optimizing the use and management of the resources, while minimizing negative environmental, health and societal impacts*" is also addressed indirectly as the data and maps delivered help users/stakeholders - might they be from administrative organisations, from industry, from academia or an NGO – to improve their procedures (e.g. D3.1, D5.6). The established harvesting system

simplifies the administrative procedures to stay upmost up-to date and allows newcomers to cope up with the procedure developed. The additional deliverable on touristic spots at former mining areas (D3.4) shows a further facet of the raw material value chain that are for the benefit of the local community.

The goal of "*Performing pilot studies supporting exploration and development of mineral raw materials*" is targeted by UNFC pilot studies that are applied for the first time on either local or regional scale in Europe.

The data quality and the quality control compiled in MINTELL4EU has benefited from the close collaboration with the three other GeoERA RawMaterials projects (Eurolithos, MINDeSEA and FRAME) as well as by the interaction with the EuroGeoSurveys Raw Materials Expert Group (MREG). The level of detail and validation of data has been improved significantly, hence.

MINTELL4EU has meet the designated objectives of GeoERA RawMaterials and those defined within the project.

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)

☐ 1 - **Unsatisfactory progress** (the project has failed to achieve critical objectives and/or has no impact on the theme)

Comments / deviations / recommendations:

Right from the beginning MINTELL4EU has worked under close attention of the European Commission that asked for easy accessible and up-to date reliable raw materials data. The close discussion with MINDeSEA and FRAME and the consultation of MREG has been a great asset, leading to a significant improvement of the data in terms of quality and quantity. The database provided is the most reliable and up-to-date freely available (greenfield) mineral information database in Europe. Despite the great successes of MINTELL4EU in terms of spatial coverage, data harmonization, and streamlined data collection process, other obstacles and bottlenecks remain; they are identified and described. The strong cooperation with MINTELL4EU as the central raw material database, and with GIP-P, which connects the information with the EGDI

platform and with EMODNet, shows the interoperability of the data, the exchange of knowledge and the interdisciplinary in its application.

The extensive discourse with the JRC regarding the requested connection to the RMIS, was a very demanding task, especially since the technical solution proposals could only be implemented unilaterally. Nevertheless, the challenge was successfully mastered.

MINTELL4EU made additional efforts to provide information on tourist mines and on the feasibility of UNFC (and its developments). The new knowledge and products, especially related to UNFC, allow an innovative visualization of the code to increase the comprehensibility to the maturity of a project and the associated challenges on for non-experts and is an asset on its own.

MINTELL4EU has made excellent progress in conjunction with the other Theme projects and GIP-P that should be sustained.

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)
☐ 1 - **Unsatisfactory progress** (the project did not meet expectations)

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)

Stakeholder one review:

The EU regards location and spatial distribution data of primary and secondary raw materials as being of vital importance for decision makers in the fields of raw material supply security, environmental management and resource efficiency. Therefore, the MINTELL4EU project aims to improve the European Knowledge Base on raw materials by capturing updated reliable and harmonized information across borders. It has achieved impressive results by integrating European geological information and knowledge of raw material resources to contribute to its sustainable use and management.

It developed processes and was able to update the electronic European Minerals Yearbook w.r.t. production and trade data in time, and to integrate the E-Minerals Yearbook into the MIN4EU database. The UNFC pilot project benefited from solving the problem of using different standards and units of measurements. Spatial coverage of minerals inventory data included historical mining sites.

The development of a quality control system for harvesting reports and of a GIS database layer, illustrating relevant historic mine features, was an important aspect complementing the data display.

The team has succeeded in carrying out a case study review with practical guidelines/work flows and examples for applying the United Nations Framework Classification of Resources to European mineral resources. It has expanded its scope to resources from mine tailings and waste. Thereby data was submitted to a universal classification standard and was supplied for inclusion in the European yearbook, resource databases and information systems.

The comparative analysis of knowledge data platforms versus Raw Materials Information System (RMIS) 2.0 comprised analysis of harmonization issues, data gaps and challenges, reviewing also the quality of Pan-European aggregated inventories for selected commodities. Review and data exchange, application delivery and dedicated search prototype(s) took place.

MINTELL4EU increases the degree of harmonization, communication, and interaction between existing data platforms, aiming at reaching a fully operational and reliable data knowledge management system. It takes into account the RMIS of the European Union thereby fulfilling the European needs. A further achievement is the improvement and common understanding of the INSPIRE-compliant code lists.

The project management has performed well and the collaboration between the partners was effective. The deliverables were submitted and completed, and the milestones were achieved in time. Project results and information were disseminated adequately and project partners interacted excellently with other GeoERA projects and international bodies.

The MINTELL4EU project could be expanded by designing maps targeting the interest of specific stakeholder groups such as the hard rock, aggregates-sand and industrial minerals cement industries. The visualisation of data in the EGDI portal will allow assessment, evaluation and interpretation of genetic and prospectivity aspects of such commodities. This is a longstanding task with the potential for more studies of that kind.

It is recommended that the project, its achievements and opportunities are communicated to political decision makers, especially to economic ministries, regional planning and environment, in order to facilitate the realization of sustainable and environmentally conscious mining projects for various commodities in Europe.

A full coverage of MINTELL4EU has been requested by DG GROW. Consequently, it is recommended that the remaining 15 German regional surveys share their raw material data with MIN4EU in order to complete the mid-European part of the dataset in the near future.

Overall, this very successful project forms a good foundation with easy access to useful and reliable mineral intelligence / data for the whole of Europe.

Stakeholder two review:

The MINTELL4EU project had the objective to integrate European geological information and knowledge on subsurface energy, water, and raw material resources to contribute to its sustainable use and management. The project builds on the results of several projects funded by the EC. The project aimed to provide interoperable and transnational data and information services on raw material resources in Europe and harmonized methods to assess these resources. The project contributed to the geological knowledge base with objective and seamless data, information, and expertise to support European, national and regional policymakers, industry, and other stakeholders in policy and decision-making.

The project received significant attention from the European Commission DG GROW, and four meetings were held to update the Commission regarding the project progress. Despite the Covid-19 situation, all the work packages were ultimately achieved. Several technical papers were published based on the findings of the project.

The project team has done an excellent job keeping the European Minerals Yearbook updated, covering data from 40 counties on production and trade besides from resources and reserve data from 17 counties. Data on up to 60 commodities were included in the yearbook. Several countries reported in UNFC, which helped further with the standardization of the data reporting. UNFC also helped in capturing data, which could be missed otherwise. Exploration data from seven countries are included in the yearbook. The current data is updated up to 2019 and is accessible to policymakers, researchers, and the industry. The team is congratulated for their hard work.

The project team did an excellent job extending the spatial coverage with data and creating the MiIN4EU database. All data is available under the Creative Commons license, and it will be of immense benefit to the government, industry and research bodies. The information is available through the EGDI platform, INSPIRE complaint and supported by 36 data providers. Over 60,000 records for mining sites are included. Historical mine sites in the database has a touristic component. The database is shared with RMIS. The system is built with open-source technology, making its long-term sustainability easier. The data will not face commercial lock-in issues in the future, an issue that plague commercial software. The team has developed an automated data harvesting methodology and collects data from 36 providers. It has an error detection tool to ensure the quality of data. There is a plan to continue the maintenance of the database after completing the project. There are some data gaps, with data missing from a few countries.

The United Nations Framework Classification of Resources (UNFC) provides a universal standard for the classification of mineral resources. Nineteen case studies from 9 countries have been completed. UNFC provides a harmonized tool for integrating the European data on minerals. It will provide policymakers with an easy way to understand the data. Using three-number codes, the information regarding the project can be summarised. The team is congratulated for developing a bonus data visualization tool for presenting the project information in a graphical manner, which will also be helpful for policymakers. During the case studies, some data were not available, as the companies held these data confidentially. The case study proves that UNFC could be used as a superior data reporting tool. Two reports, one on the case studies and another on the recommendations, are available. The team is acknowledged for its excellent work.

Integration of results into the GeoERA Information Platform was completed. Delivery of information to the RMIS on how the RMIS can utilize data on primary and secondary raw materials were examined and documented. The needs of the RMIS were considered in terms of pre-computed views for the electronic mineral yearbook (e-MYB) and ProSUM e-stat module. The documentation describes how the RMIS could conduct thematic searches within non-structured knowledge. Dedicated APIs were developed to link the different platforms and the RMIS. However, the suggested solutions eventually turned out not to fit the needs of RMIS, hence in dialogue with JRC another solution was reached with two embedded viewers at RMIS, reflecting the same data as RM maps at EGDI. Integration of the e-Minerals Yearbook in the Minerals4EU database was done, resulting in the MIN4EU database. The team is acknowledged for its excellent work. The data is available in the EGDI platform.

The project has succeeded in bringing comprehensive data on European mineral reserves, resources, and occurrences into a one-stop gateway that includes primary and secondary data. The project used UNFC for data integration and harmonization, a significant achievement. The project also collaborated with other raw material projects under GeoERA. Data and information are shared with RMIS in dedicated viewers as described above, and all data is INSPIRE complaint. The electronic Mineral Yearbook has incorporated a lot of data, but its future is uncertain. The tasks will continue in the CSA and the Geological Service for Europe.

The needs of geoscientific information in the future will be vastly different from the needs of the past. The future society will demand a holistic view of how geoscience connects to sustainable development. Geoscience information for the future should go beyond the traditional siloed, rigid, supply-driven database-oriented approaches to integrative knowledge solutions that are user-focused and transcends disciplines. This project has demonstrated that a new geo-vision could be possible for Europe. The project team is congratulated for their excellent work.

Annex 1: Review meeting list of participants

Name	Role	Organisation
Joop Hasselman	GeoERA coordinator	Netherlands Organisation for Applied Scientific Research
Harikrishnan Tulsidas	GeoERA Stakeholder	UN Economic Commission for Europe
Christoph Gauert	GeoERA Stakeholder	State Office for Geology and Mining Saxony-Anhalt
Barbara Simić	Monitoring and Reporting Officer	Geological Survey of Slovenia
Aleksandra Trenchovska	Scientific Reviewer	Geological Survey of Slovenia
Matija Krivic	Scientific Reviewer	Geological Survey of Slovenia
Meta Dobnikar	Scientific Reviewer	Geological Survey of Slovenia
Antje Wittenberg	Raw Materials Theme Coordinator	Federal Institute for Geosciences and Natural Resources, Germany
Lisbeth Flindt Jørgensen	Project Lead	Geological Survey of Denmark and Greenland
Jørgen Tulstrup	Project member	Geological Survey of Denmark and Greenland
Mikael Pedersen	Project member WP5 lead	Geological Survey of Denmark and Greenland
Tjerk Heijboer	Project member	Geological Survey of Denmark and Greenland
Eimear Deady	Project member WP2 lead	British Geological Survey
Špela Kumelj	Project member WP3 lead	Geological Survey of Slovenia
Kari Aslaksen Aasly	Project member WP4 lead	Geological Survey of Norway
Mark Urvois	Project member WP5 lead	French Geological Survey