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Executive Summary

This interim technical report on the feasibility and functional structure of the Geological Service for Europe delivers a foundation for further stakeholder discussion, needs analysis, and refinement of assessment of the best model for a sustainable Geological Service for Europe (GSE). The work presented here was carried out in the first eleven months of the Geological Service for Europe project (GSEU) and is based on discussions within the GSEU network, as well as with stakeholders including EU institutions, organisations with structures considered potentially compatible with a future GSE, the European Commission, researchers, and industry.

We first explore the role of a sustainable Geological Service for Europe, particularly in contributing to successful implementation of the European Green Deal, and the fundamental objectives and operational components of such a Geological Service. These include delivering harmonised geoscientific/subsurface data, information, and knowledge; a pan-European expert network; recognition as the geoscientific reference partner for the European Commission; informing and supporting sound policy; and providing a proactive and responsive science-policy service. We then present the operational components essential to a GSE, including permanent access to a harmonised data inventory (the European Geological Data Infrastructure - EGD I); knowledge hub and decision support systems; the EU International Centre of Excellence on Sustainable Resource Management; and on-demand access to other geoscience-policy expert services.

We review seven potential operational models based on existing organisational structural types and using case studies, each of which have benefits and risks in terms of financial and legal stability, budget level and funding sources, research vs policy-oriented activities and services, and strategic orientation. We conclude by proposing an interim roadmap, incorporating key elements of the analysis of both what a GSE should be and the potential practical models for its implementation, taking into account lessons learned from our analysis of the different models. This report serves as a basis for a more in-depth needs analysis of GSE stakeholders and for the implementation of initial actions to strengthen the case for establishing a sustainable GSE.

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1. Introduction

1.1. Background

The primary strategic goal of the Geological Service for Europe project (GSEU) is to establish a common concept and vision for a sustainable Geological Service for Europe (GSE). Under task 9.3, this concept and vision is being developed through analysis of the governance, financial, and operation models that will allow effective implementation of such a service. This first, interim, deliverable from WP9, task 3, presents initial analyses based on stakeholder discussions within the EuroGeoSurveys (EGS) and GSEU network, the broader research community, and with stakeholders from the EU institutions and industry. This report presents a broad framework for the key elements of the purpose, structure, scope, and operations of a GSE. This is followed by an overview of a range of organisational structures and their governance models, as well as presentation of illustrative case studies, with a first-order assessment of their general applicability and of key elements important in framing a model for a future sustainable GSE. Finally, these various elements are drawn together to identify key objectives and actions for an interim roadmap to progress towards the establishment of a sustainable GSE.

This deliverable is an interim report, the purpose of which is to establish a starting point for discussion with key stakeholders to further evaluate stakeholder views, particularly policy needs, regarding a GSE, as a foundation for further refinement and development of the required analyses to target the most suitable model for a GSE, while also highlighting interim actions that can be implemented during the GSEU project to accelerate progress towards establishing a sustainable GSE.

1.2. Connections with Policy

The GSE shall support the EU in its transition to a low-carbon, climate-neutral, resource-efficient and biodiversity respecting economy, taking into account the United Nations 2030 Agenda and the 17 UN Sustainable Development Goals (SDGs). The support will be in the areas of intervention where Geological Surveys have the science, research capacity, data and expertise needed to provide science-based policy support services. A GSE will bring added value in:

- Strengthening the impact of subsurface R&I in developing, supporting and implementing EU policies and supporting the uptake of innovative solutions in industry and society to address global challenges
- Creation and diffusion of new and existing high-quality knowledge, skills, technologies and solutions to global challenges
- A single open access gateway to geoscientific data at European level, establishing a common European Geological Knowledge Base Platform that can provide tailored information to EU Institutions and Agencies, partner institutions and stakeholders
- Support to other policy implementation activities (such as cooperation between EU and other continents / countries).

A sustainable Geological Service for Europe will create seamless and more efficient means by which the Geological Surveys community can deliver policy-relevant geoscientific information. The scope for

application of geoscientific data towards EU policy and legislative acts can be seen in Table 1, categorised under the thematic goals of the EGS Strategy.

A few examples can be clearly seen in the following:

- **INSPIRE Directive:** EGS has a dedicated Spatial Information Expert Group to ensure INSPIRE compliance in all the work undertaken by the organisation, and the EGDI platform was designed to be able to host INSPIRE compatible datasets
- **Water Framework Directive:** National and regional Geological Surveys are active in implementing the Water Framework Directive and its daughter Directives (e.g., groundwater, floods). EGS is actively involved in the “Working Group Groundwater” of the Common Implementation Strategy (CIS) for the Water Framework Directive, through its Water Resources Expert Group
- **CCS Directive:** National and regional Geological Surveys played a significant role in the preparation and implementation of the CCS Directive. That early engagement was solidified in continuous activities through the EGS GeoEnergy Expert Group, including projects with particular focus on CO₂ storage
- **Critical Raw Materials and Net Zero Industry Acts:** implementation of a number of Articles under the proposed CRM and NZI Acts would require the direct involvement of the national and regional Geological Surveys, including in the areas of land use planning, national exploration programmes, subsurface storage assessments and mapping, assessments of the potential recovery of critical and strategic raw materials from extractive waste, supporting the European Critical Raw Materials Board and its sub-groups, and supporting domestic training programmes amongst others.

1.2.1. Legal frameworks supported by current EGS and potential future GSE activities

Table 1. EU strategy, policy, and legislation supported by potential future GSE activities, categorised according to the four goals of the EGS Strategy

Resourcing Europe: supporting the sustainable use and management of natural and strategic resources	The Subsurface in Europe's Digital Twin: enabling the digital transition and supporting open science
Roadmap to a resource efficient Europe (COM(2011) 571 final) Circular economy action plan (COM(2020) 98 final) Regulation (2023/79/EC) Critical Raw Materials Act (proposed) Critical Raw Materials Action Plan (COM(2020) 474 final) Strategic Partnership between the European Union and Ukraine on raw materials and batteries	Inspire Directive (2007/2/EC) Maritime Spatial Planning Directive (2014/89/EU) Regulation (EU) 2021/696 establishing the Union Space Programme and the European Union Agency for the Space Programme Regulation (2022/868) Data Governance Act Regulation (COM 2022/47) Data Act (proposed)
Energy Transition and Decarbonisation: supporting the clean energy transition and the battle against climate change	Safety, Security and Wellbeing: supporting climate change mitigation and adaptation, mitigation of natural and man-made subsurface related hazards and reduction of water and soil pollution
Regulation (2009/31/EC) CCS Directive Industrial Emissions Directive (2010/75/EU) and its implementing decisions National Emission Reduction Commitments Directive (2016/2284/EU) Regulation (EU) 2018/1999 on the governance of the energy union and climate action Renewable Energy Directive (2009/28/EC) and recast ((EU) 2018/2001) Regulation (EU 2019/2088) EU Taxonomy A New Industrial Strategy for Europe (COM(2020) 102 final) REPower EU Plan (2022) Green Deal Industrial Plan (2023) Regulation (2023/81/EC) Net Zero Industry Act (proposed)	Drinking Water Directive (98/83/EC) Water Framework Directive (2000/60/EC) Bathing Water Directive (2006/7/EC) Groundwater Directive (2006/118/EC) Common agricultural policy (COM(2018) 393 final) Environmental Quality Standards Directive (2013/39/EU) Floods Directive (2007/60/EC) Habitats Directive (92/43/EEC) Long-term strategy 'A clean planet for all – A European strategic long-term vision for a prosperous, modern, competitive and climate neutral economy' (COM(2018) 773 final) Nitrates Directive (91/676/EEC) Regulation (EU) 2017/852 on mercury Thematic strategy for soil protection (COM(2006)231 final and its revision (scheduled for 2021)) Urban Waste Water Treatment Directive (91/271/EEC) Soil Health Law (upcoming)
Cross-thematic	
2030 agenda for sustainable development and its Sustainable Development Goals (SDGs) (all of them) Climate Monitoring Mechanism Regulation ((EU) 525/2013) and implementing/delegated acts EU strategy on adaptation to climate change (COM(2021) 82 final) European Climate Law (Regulation (EU) 2021/1119) Green infrastructure strategy (COM(2013) 249 final) Integrated maritime policy (Regulation (EU) No 1255/2011) Marine Strategy Framework Directive (2008/56/EC) Urban agenda for the EU (Pact of Amsterdam 2016)	

1.3. Links with EuroGeoSurveys Strategy

Following calls from the European Parliament to assess the need for an EU Geological Service¹, EuroGeoSurveys established its current Strategy in 2013 with the vision to create a legally mandated Geological Service for Europe as the scientific reference partner of the EU, delivering knowledge of the Earth's subsurface environment and resources as the foundation of a sustainable future for Europe. The EGS mission is to enable sustainable and responsible use of the Earth's subsurface environment and resources, which is enabled through a series of thematic strategic goals and associated actions.

Over the past years EuroGeoSurveys has made significant steps towards developing pan-European geological data and information services on geology, raw materials, geo-energy resources, groundwater and soils, and natural hazards, amongst others. The GeoERA programme (2017-2022) was a milestone in demonstrating the capacity of the community of European Geological Surveys to collaborate on a variety of thematic projects simultaneously, all with a strong stakeholder interest and contributing towards the further development of the European Geological Data Infrastructure (EGDI).

To make sure such services remain complete, up-to-date, reliable and of high quality, it is necessary to ensure a clear legal foundation that can enforce the delivery of national data to the central service and support the central organisation of infrastructure and capacity, of which EGDI is the cornerstone. EuroGeoSurveys' Strategy defines four thematic goals, reflected also in its Strategic Research and Innovation Agenda. These goals are (i) Resourcing Europe, (ii) Energy Transition and Decarbonisation, (iii) Enhancing Safety, Security and Wellbeing, and (iv) The Subsurface in Europe's Digital Twin. Concrete actions toward these goals are already implemented through the GSEU project and will in future also capture the broader activities of EuroGeoSurveys that relate to soil health, green cities, subsurface infrastructure, geoheritage, and strategic international partnerships beyond the EU.

1.4. What challenges will a Geological Service for Europe address?

A key focus for the Geological Service for Europe is to continue developing and make permanently available pan-European geological data and information services for the sustainable and safe use of our subsurface resources. The availability and accessibility of those resources – geothermal heat, pore space, metals, rocks and industrial mineral resources, building resources, or healthy soils and groundwater – is determined by a complex interplay of geological factors, as are the impacts on our living environment of exploiting those resources. A common thread in this project is therefore innovation in ways in which subsurface information is conceptualised, organised, visualised, delivered and translated to the needs of a wide range of audiences, and the methodologies to achieve this. This is primarily a spatial data and information challenge.

The Geological Service for Europe will address:

1. The need for up-to-date, multi-thematic, harmonised data, information, and knowledge to inform Green Deal-related policy development and implementation that requires an understanding of the nature, architecture, composition, and processes operating on and in the European subsurface (e.g., mineral resources, energy, water). This data will be able to act as a catapult

¹ An effective raw materials strategy for Europe. European Parliament resolution of 13 September 2011 on an effective raw materials strategy for Europe (2011/2056(INI)).

to innovative and flexible services such as predictability/prospectivity/favourability mapping of critical and strategic raw materials.

2. The need for rapid timely expert advice on a range of policy matters related to the Green Deal including, e.g., critical and strategic raw materials, subsurface storage (carbon dioxide, hydrogen, compressed air, heat, gas, nuclear waste), renewable energy (geothermal), groundwater quality and quantity, natural/anthropogenic hazards (landslides, flooding, coastal erosion), offshore infrastructure (wind farms).

Specifically, the Geological Service for Europe will provide data, information, knowledge, and expert advice that can enable more effective implementation of EU regulations, directives, strategic initiatives and international partnerships such as those outlined in Table 1.

Geological Survey Organisations (GSO) expertise goes beyond the traditional focus on geo-resources (energy, mineral, and water resources) and natural hazards, with vast experience in the fields of geochemistry, Earth observation, marine geology, urban geology and geoheritage. The relevant Expert Groups of EuroGeoSurveys demonstrate that such expertise is well established and coordinated across Europe, providing a solid base for the GSE to address wider cross-thematic issues surrounding subsurface spatial planning, and involve other relevant players from academia, research institutes, industry and SMEs.

1.5. Geological Service for Europe in the Marketplace

There are many public administration and research bodies that can deliver partial data and knowledge relevant to achieving the Green Transition. Even considering only the surface and subsurface, there are still many organisations that have some relevant data and knowledge. However, there are several key features of the network of Geological Survey Organisations (GSOs) that collectively define a unique and strategically important role for a collaborative Geological Service for Europe. Unlike other organisations or research bodies that collect data and knowledge of the surface and subsurface:

1. The GSOs have the national mandates to collect, archive, deliver, and advise on the European subsurface. In many cases, this mandate has been in place for decades to more than a century, resulting in accumulation of a large store of data and knowledge of the subsurface.
2. The GSOs have a multi-thematic focus, usually encompassing some combination of mineral resources, energy, groundwater, geohazards, and geospatial data, that enables a holistic understanding of the subsurface environment and resources and the way that these resources interact and can best be prioritised and managed.
3. The GSOs have close national-level links to policy, government, public authorities, research institutions, and civil society, allowing access to a broad network of expertise relevant context of national factors that influence EU-level understanding and management of the European subsurface.

1.6. Contributions of a Geological Service for Europe to Bottlenecks

To achieve the main goal of the GSEU project – the establishment of a functional and fit for purpose Geological Service for Europe – it will be crucial to identify and incorporate solutions towards the main bottlenecks being faced by both policymakers and industry stakeholders in their sectors, which may be

lessened through the provision of specific data needs or services that are currently lacking or inadequate. A key objective (see section 3) of a sustainable GSE is the provision of easily accessible geoscience data and expertise to inform sound policy. To achieve this objective, we need to identify existing bottlenecks limiting access to applied geoscience data and expertise that is required for sound policy.

Discussions held between GSEU project representatives and stakeholders from the European Commission, research and industry indicate broad consensus that high-quality, up-to-date geoscientific (subsurface) data and expertise is necessary for better informed policy. There is also broad consensus that access to these services is often not easily reachable, available on demand, in the appropriate detail, language, or format. Currently, e.g., different DGs seek science-based policy advice from a range of sources, including research findings from Horizon Europe-funded projects, high-level working groups, expert advisory boards, panels, or groups, EU agencies, Member State ministries, specific specialist associations or organisations, or individual experts. Often the data and knowledge are fragmented, not harmonised at European level, delivered in too much or too little detail, biased, or not available in the correct time frame for policy needs. In the case of geoscientific data, datasets are commonly also considered in isolation from one another, e.g., prospective regions for hydrogen storage may not consider other relevant factors that should be managed and prioritised for effective policy-making, such as nature preservation, agriculture, infrastructure, carbon storage, or groundwater management.

The developing vision of a GSE directly tackles many of the bottlenecks that currently prevent effective application of geoscience/subsurface data to policy, namely:

- **Access to data:** EGDI provides open access to large numbers of geoscientific datasets.
- **Availability of data:** GSEU is developing comprehensive new pan-European geoscientific datasets (e.g. Deliverables 2.5-2.8 on European onshore and offshore CRM resource evaluation, and Deliverables 3.3-3.4 on Sustainable Geo-Energy Capacities potential).
- **Relevance at EU level:** All data delivered via EGDI and through the GSE is, can or will be harmonised at EU level (mainly from sustainable national sources) according to INSPIRE and other standards.
- **Fragmentation and lack of connectedness of data:** The Knowledge Hub will harness the power of semantic technologies to deliver cohesive and accessible knowledge. It will also maintain connections with other relevant European and potentially global data spaces.
- **Timely data and advice:** A central component of a GSE is timely access to expert advice.
- **Sense-making:** Co-creation of policy-relevant tools and services will ensure data and knowledge delivered is at the right detail and level for the policy needs.
- **Connecting and prioritising related policy needs:** The holistic nature of geoscience itself – dealing with all aspects of knowledge of the subsurface, including water, minerals, energy, hazards – requires that geoscientists are multidisciplinary and able to understand complex natural systems. This expert knowledge will be combined, via GSE and EGDI – with the ability to predictively model subsurface processes in 3D and 4D to allow effective prioritisation and sustainable management of subsurface resources, crossing multiple policy areas interconnected via the Green Deal.

1.7. Economic value of a Geological Service for Europe

It is generally recognised that the work of Geological Surveys is of benefit to society. However, the specific economic value to society is difficult to quantify. A number of studies have looked at various

ways of comparing cost to benefit ratios on the production and availability of geological information, with varying results, but all concluding a net economic value to society. A comprehensive overview of such studies was most recently analysed by Häggquist and Söderholm (2015), who reviewed past research on the economic value of geological information and other earth observations as well as related products, services and infrastructure. They show that there are significant economic benefits attached to the generation of this type of public information. The value of geological information has typically been measured in terms of avoided costs resulting from the information provided. While past studies showed favourable to very significant benefit-cost ratios, with the resulting benefits affecting a number of different users, the methodologies used differ across studies, as do important assumptions on sectors evaluated as well as on discount rates. The review by Häggquist and Söderholm does not come to a conclusive cost-benefit figure, but rather demonstrates that across a variety of approaches and methodologies the benefits of initial investment, although variable, remain clear. As an example, one of the studies reviewed by Häggquist and Söderholm (2015) looked more specifically at the products and services provided by Geological Surveys (Ovadia, 2007), which came to a cost to benefit ratio that is in the orders of magnitude of 10^2 to 10^3 .

In the Netherlands, the recently implemented Law on the Key Register of the Subsurface (National Key Registry of the Subsurface Act, 2015) obliges all public bodies to submit all shallow subsurface data they acquire (including data on soils, groundwater, geomechanical properties, borehole sedimentology, and permits) to a central repository, in standardised formats. The law also makes the use of these data, as well as national subsurface models based on them, obligatory. Several societal cost-benefit analyses were performed both before and during implementation of the Law, which invariably showed return on investment times of no more than a few years for all parties involved (including the responsible ministry, provinces, municipalities, water boards and infrastructure agencies), even in a situation where a national subsurface database (the DINO database managed by the Geological Survey of the Netherlands) was already available.

Other specific studies, such as that on the economic and social value of the MAGNA Plan (Geological Map of Spain, 1:50.000 scale), have consistently demonstrated the excellent returns on the public investment through savings made by the various users of geological maps and wealth of information they provide (García-Cortés, 2005). More quantitatively, a study of the economic value of the complete 1:50,000 geological map coverage of Korea concluded expected total benefits, in the fields of health, environment, finance, and security, of 11–16 times their cost (Kim et al., 2006).

Specific to mineral raw materials, a number of studies have been undertaken internationally to assess the economic benefits of the provision of pre-competitive geoscientific data to the minerals exploration and mining sector (e.g., regional geophysical datasets, geological mapping, geochemical surveying). Duke (2010), assessing the Canadian situation, explains that such provision of data attracts exploration investment by identifying areas of favourable mineral potential and increases exploration efficiency (5–20% cost reductions) and effectiveness (40–280% increase in targets identified). This results in improvement in returns on private investment and increasing government revenue through royalties and taxes (ca 5-fold over the medium term). However, the economic value to national governments and to society more generally is not just in direct taxes and royalties, but also in other factors including increased construction activity, employment, and broader social impacts. In their analysis of ten years of state government funding of the Exploration Incentive Scheme, operated through the Geological Survey of Western Australia, Fogarty (2021) estimated a total return to Western Australia of \$31 for each dollar spent.

2. Goals and Objectives – the Fundamentals of a Geological Service for Europe

The objectives of a future GSE, outlined below, require that the GSE is *sustainably funded*. At present, EuroGeoSurveys (the association of the Geological Surveys of Europe) is funded through a combination of membership fees and project funding. Project funding varies from year to year, is typically relatively low-level funding and lasts for periods of 2 to 4 years. This is an unsustainable funding base on which to deliver the vision of being the EU's scientific reference partner to deliver knowledge of the subsurface. It does not allow for the reliable and responsive allocation of appropriate expertise and other resources that would be required (as detailed throughout this document). Secured funding, ideally permanent, but at least under long term renewable frameworks (ca 10 years) must be available to cover:

- The basic operational costs of the GSE organisation and its administrative, financial, technical, and expert staff.
- Appropriate level of salary allocation for time required by participating GSO experts for, e.g.,
 - responding to rapid turnaround advisory requests from the European Institutions
 - delivering on agreed ongoing or ad-hoc tasks including data collection, analysis, standardisation, harmonisation, and delivery, research, and reporting.

The following outline of the key objectives of a GSE within this chapter are based on the assumption of sustainable funding.

While the most appropriate organisational framework for a Geological Service for Europe is yet to be assessed, the fundamental objectives of such a service are more readily defined. These fundamental objectives, outlined below, are based on many years of discussion within the EuroGeoSurveys network and with external stakeholders, centring around the vision of EuroGeoSurveys – for the Geological Service for Europe to be a scientific reference partner of the EU, delivering knowledge of the Earth's subsurface environment and resources as the foundation of a sustainable future for Europe.

To achieve this vision, EuroGeoSurveys has defined four thematic goals:

1. **Resourcing Europe:** supporting the sustainable use and management of natural and strategic resources.
2. **Energy Transition and Decarbonisation:** supporting the clean energy transition and the battle against climate change.
3. **Safety, Security and Wellbeing:** supporting climate change mitigation and adaptation, mitigation of natural and man-made subsurface related hazards and reduction of water and soil pollution.
4. **The Subsurface in Europe's Digital Twin:** enabling the digital transition and supporting open science.

To support the vision and goals of a sustainable Geological Service for Europe, we define five measurable objectives that are required, regardless of the organisational framework selected.

2.1. Objectives of a GSE

2.1.1. Harmonised geoscientific/subsurface data, information, and knowledge

The *GSE must deliver harmonised high quality geoscientific/subsurface data, information, and knowledge*. To achieve the vision of delivering such knowledge as the foundation of a sustainable future for Europe, the data, information, and knowledge must be FAIR (findable, accessible, interoperable, and reusable) and harmonised at pan-European level. If data are fragmented (e.g., sourced from country-level) and not harmonised, it is difficult – and at the very least time and resource intensive – to use such data to effectively and reliably inform policy with science at EU level. The EU has focussed considerable resources on building the legislative framework and community of practise for sound data governance, sharing, and harmonisation (e.g., the Data Governance and Data Acts, the INSPIRE Directive, the Green Deal Data Space, DestinE). EuroGeoSurveys has long been aware of the need for up to date, high quality, harmonised subsurface data to achieve the Green Deal, e.g., critical and strategic minerals data, groundwater quality and quantity, etc., and has already made considerable progress in developing such datasets through many data harmonisation projects in over last one to two decades. However, water, energy, minerals, underground urban and transport infrastructure, storage, soils, and natural and man-made subsurface hazards all interact in the same subsurface space. Thus, the harmonised data themselves are not enough. The GSE must also deliver the information and knowledge required to understand how, where, and why the physical systems in the subsurface interact with each other in three/four/five dimensions and through time, and how subsurface use can be prioritised and sustainably managed. EuroGeoSurveys has already invested a large amount of resources into the development of the European Geological Data Infrastructure (EGDI), through which many National GSOs have made an ongoing commitment to harmonisation of data at European level. Through GSEU, EGDI will be transformed into a Knowledge Hub. EGDI has the potential, with ongoing development and support, to be transformed into a data platform that will support EU-level sustainable management and prioritisation of multiple types of subsurface resources (energy, storage, water, minerals, infrastructure) that are currently considered separately from one another and by distinct Directorates General or other EU institutions and EU or national authorities. The development of EGDI must be continued and its data maintained as an integral component and a scientific core of the GSE, to achieve the vision of delivering knowledge as the foundation of a sustainable future for Europe.

2.1.2. Pan-European expert network

The *GSE must actively involve and maintain a pan-European expert network*. Expert knowledge and experience is required to take the steps from delivery of high quality, up to date data, to transforming this to actionable policy advice. The strength of EuroGeoSurveys is its foundation in geoscientific thematic expert groups who share knowledge and best practises, building the competence of the community as a whole. Through such a network, EuroGeoSurveys benefits from the national-level data and expertise available through each of the member National Geological Survey Organisations (NGSOs) and some of their regional Geological Surveys, and the collective European perspective that is possible by pooling their data, knowledge, and resources. This is possible only through the shared commitment to an overarching view that working together as an expert community benefits all, and without which achieving the Green Deal would be impossible. The GSE must retain this expert network that must also continue to be grounded at the national level (the NGSOs), while interacting at EU level and working toward EU level outcomes.

2.1.3. Geoscientific reference partner for the European Commission

The *GSE must become the geoscientific reference partner for the European Commission*. To effectively develop and implement diverse Green Deal-related EU policy, strategy, and legislation (e.g., the Critical Raw Materials Act, the Net Zero Industry Act, the Groundwater Directive, the CCS Directive, the Soil Health Law), the European Commission must have reliable access to key reference partners who can deliver the required data and expertise. While other national, sub-national state organisations and EU public authorities and research institutions also deal with aspects of the Earth's surface and subsurface environment, it is only the NGSOs who have the national mandates for gathering and delivering data and knowledge that deal with the entire subsurface, e.g., handling data and knowledge related to minerals, energy, water, geohazards, subsurface infrastructure, soils, urban geology, storage of energy, fuel, and carbon, management of land and subsurface use, and more. In addition to having a holistic overview of most or all of these aspects of the national subsurface, NGSOs are mandated this task on a permanent basis (rather than being prone to project-based funding as are university departments or research institutes) and have been doing so commonly for many decades. This longevity of operation has, for many NGSOs, resulted in a consolidation of their physical and human data and knowledge of the structure and composition of the subsurface in their respective Member States. No other types of organisations have this complete picture of the European subsurface and the necessary level of multidisciplinary expertise to put it together at Member State level.

EuroGeoSurveys, as a member organisation of 37 NGSOs of Europe, benefits from both access to this national level data and expertise as well as the commitment, through EGS, to collaborate and to deliver pan-European harmonised data, information, and knowledge to support sound EU policy relating to the European subsurface. Without this EU-level harmonised subsurface data, information, and knowledge, the Green Deal will not be achieved. Thus, it follows that the GSE, as an expansion to the existing role of EGS, must take up the role of geoscientific reference partner of choice for the European Commission.

2.1.4. Inform and support sound policy through proactive and responsive science-policy service

The *GSE must inform and support sound policy*. The vision of EGS is for the Geological Service for Europe to be the scientific reference partner of the EU, delivering knowledge of the Earth's subsurface environment and resources as the foundation of a sustainable future for Europe. To achieve this vision, the scientific knowledge of the subsurface delivered by the GSE must be effectively translated into policy. Therefore, a primary objective of the GSE is to effectively inform and support sound policy with up-to-date, accurate, high-quality data and analyses on the European surface and subsurface, in output formats that facilitate decision-making.

As such, the *GSE must provide a proactive and responsive science-policy service*. At present, similar services provided by EGS to the European Commission depend on the availability of largely volunteer (e.g., for Commission expert working groups) or time-limited project-funded services (e.g., through Horizon Europe). The GSE must deliver services that are proactive, delivering data, information and knowledge that can anticipate the needs in the context of the EU policy agenda and geopolitical framework. These services must also be available on demand, again requiring more structured and permanently funded access to data and expert services than what is currently possible with the existing structure and resources of EGS.

2.1.5. Public Geoscience Communication as Policy Service

The *GSE must be a visible and trusted partner* in the public debate on the valorisation of the subsurface. Geology receives very little attention in basic education, not just in Europe but globally (e.g., Boatright et al., 2019; Bonaccorsi et al., 2020), leaving the general public susceptible to forming incorrect perceptions of subsurface solutions. Given the multi-thematic nature of applied geology, the public opinion will be influenced by views of diverse stakeholders, often directly through social media, or indirectly through mass media. In any of these cases information is rarely objective or expertise-based. EGS has high-level expertise on all relevant and often related themes, and GSE will centralise and develop communication expertise to allow assisting in maintaining or restoring justified public support for subsurface policy. An example of the policy need for this service is the position of the European Council in its negotiating position regarding the Critical Raw Materials Act, having recommended that the Act “creates a sub-group within the board to discuss issues related to public knowledge and acceptance of critical raw materials projects” (European Council, 2023). Such a sub-group requires geoscientific expertise, which the GSE can provide, and which is also needed more generally in regard to providing sound and effective communication of the relevance of geoscientific knowledge to achieving the SDGs (e.g., Scown, 2020) and net zero (e.g., Gardiner et al., 2023).

3. Operational components of a Geological Service for Europe

Operational components are the essential elements that embody the purpose of the Geological Service for Europe. They serve two main goals: firstly, to foster a shared vision encompassing all geological aspects beyond national boundaries, and secondly, to contribute to the consolidation and growth of the European Geological Surveys community.

3.1. Permanent Access

One of the primary objectives of the Geological Service for Europe (GSE) is to develop and maintain up-to-date, high-quality data that is readily available. Instead of fragmented information, both in terms of themes and geography, it is essential to provide this information in a harmonised and coherent manner at the European level.

Traditionally, accessing information services related to earth sciences required expert knowledge on the part of the user who consulted the databases. However, with advancements in web development, the consultation of geological information has become more accessible to all types of users. The Knowledge Hub, for instance, should enable users to access information without the need for in-depth knowledge of the database or specialised terminology related to inventories.

Additionally, decision support systems serve as valuable tools for individuals responsible for land use planning, natural resource management, and other subsurface activities. These systems assist in making informed decisions by providing relevant data and analysis.

Overall, the GSE aims to ensure the availability of comprehensive and user-friendly information services, promote accessibility to geological data, and support decision-making processes in various fields related to the Earth's subsurface.

3.1.1. Harmonised Data & Information Services and Data Infrastructure

The European Geological Data Infrastructure (EGDI) is the ICT infrastructure that supports the provision of data by the GSE, via projects or directly by the national and regional Geological Survey Organisations, according to European standards and directives on information accessibility. EGDI already facilitates, or will facilitate after the GSEU project, the following information services:

1. EU primary and secondary onshore critical and strategic raw material resources.
2. EU offshore critical and strategic raw material resources.
3. Critical and strategic raw materials predictability mapping.
4. Assessment of Europe's geological characteristics.
5. Centralised data access portal (in EGDI) that unlocks existing and accessible national information on Sustainable Geo-Energy Capacities (SGECs). This includes links to national databases and web services.
6. SGECs online atlas and portfolio: Harmonised and generalised pan-European synthesis and characterisation of known potential for SGECs. It provides a comprehensive inventory of

information on geothermal energy resources, subsurface storage capacities for sustainable energy carriers (hydrogen, heat, and cold), and CO₂ sequestration.

7. Groundwater monitoring database, including visualisation of groundwater levels and groundwater quality data and patterns.
8. Catalogue of vulnerable aquifers for drought assessment and drivers and pressure on groundwater quality assessment.
9. Operational European groundwater level forecasting and event detection system and groundwater quality trend assessment.
10. Pan-European catalogue on key parameters for offshore windfarm siting, supported by sea-basin case studies.
11. Information to optimise siting of offshore windfarms and associated infrastructure, supporting multifunctional use of pan-European marine space.
12. Geological and climate change information to assess and map coastal zone vulnerability.
13. Inventory of geological maps.
14. Conceptual and physical data models for multiscale geological data in 2D and 3D, along with scientific vocabularies.
15. Common workflows and open-source-based toolboxes in 3D geomodelling and visualisation.
16. A showcase of a multiscale 2D-3D model with integrated applied geoscientific attributes.

EGDI serves as a comprehensive platform that enables the provision, access, and analysis of geological data and information at a pan-European level, contributing to informed decision-making and resource management in various sectors.

The Geological Framework to be developed within the GSEU project will describe elements needed to contextualise applied geoscientific data and information by relating them to underlying basic geological 2D and 3D models. These elements include a metadata service about basic geological maps, datasets, webservices and 3D-models of Europe, a multiscale data model which is able to take up various kinds of basic geological and applied geoscientific data, a number of controlled vocabularies which can be attached to this data model (as well as others), and toolboxes for 3D-geomodelling and visualisation.

3.1.2. Knowledge Hub and Decision Support Systems

The Knowledge Hub will play an important role in the European Geological Data Infrastructure (EGDI) by ensuring that the wealth of knowledge and expertise available within the system is not fragmented and disconnected. Instead, it enables the organisation and accessibility of this knowledge using a semantic Knowledge engine.

By leveraging the semantic Knowledge engine, the Knowledge Hub facilitates the integration and structuring of diverse pieces of information within the EGDI system. It allows for the establishment of meaningful connections and relationships between different data sources, ensuring a coherent and organised presentation of knowledge.

Through the Knowledge Hub, users can efficiently navigate and explore the EGDI system, accessing relevant information in a structured and interconnected manner. It enhances the overall usability and effectiveness of the system, enabling users to leverage the collective knowledge and expertise within the EGDI framework.

In summary, the Knowledge Hub will act as a central component of EGD, harnessing the power of semantic technologies to transform fragmented information into a cohesive and accessible knowledge resource for users.

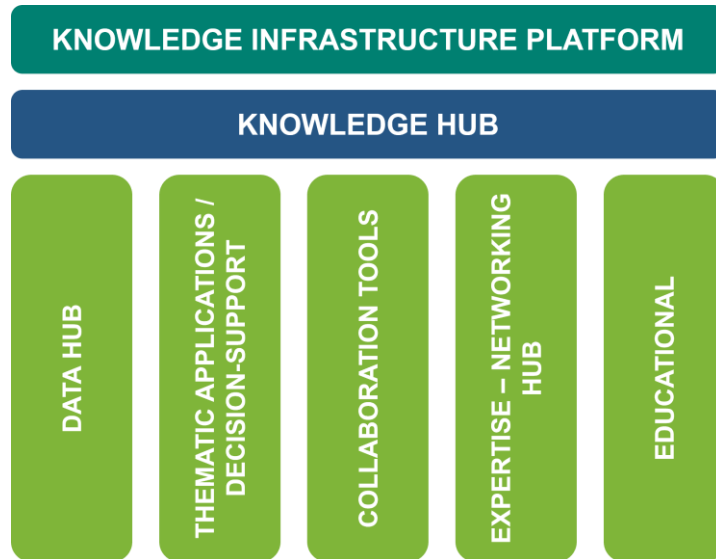


Figure 1. Components of the EGD Knowledge Infrastructure

The Knowledge Hub will form part of the EGD structure and serves as a gateway to facilitate access to other components. It enhances the accessibility and usability of the following components:

1. **Data Hub:** This component focuses on data exchange and access technologies, and supports data science, data engineering, and data warehouse endpoints. The Knowledge Hub helps streamline access to the data hub, making it easier for users to leverage data resources.
2. **Applications:** The Applications component encompasses WebGIS or thematic portals designed to share information, data, and enable big data analysis. The Knowledge Hub contributes to the seamless integration and utilisation of these applications, ensuring efficient access to information and facilitating analysis.
3. **Collaboration Tools:** Collaboration Tools within EGD enable the sharing of documents, models, and methods among users. The Knowledge Hub complements this by providing a platform for organizing and accessing these shared resources, fostering collaboration and knowledge exchange.
4. **Educational Facilities:** EGD includes educational facilities that support end-users and thematic domains in sharing and transferring knowledge. The Knowledge Hub plays a role in facilitating access to these educational resources, making them readily available to users seeking to enhance their understanding of relevant topics.
5. **Expertise & Networking Hub:** A thematic expert and physical Infrastructure catalogue as well as interactive platform to boost research and Industry community interactions.

The Knowledge Infrastructure Platform is the portal to query and navigate all the Knowledge resources available in the Knowledge Hub.

In addition to the Knowledge Hub's role in accessing other EGD components, it also incorporates decision-support modules focused on specific fields. These modules are integrated into the EGD framework and provide specialised support for decision-making. For example:

- **Online Knowledge and Competence Hub:** This digital portal offers information and tools to support the appraisal and evaluation of Sustainable Geo-Energy Capacities (SGECs) in Europe. It is organised by theme, searchable, and structured using embedded vocabularies from EGD. The hub provides factsheets, guidelines, and supports decision processes related to SGEC implementation.
- **Multifunctional 2D/3D Decision-Support Module:** This module aids in coastal vulnerability classification (on-shore-offshore) and the optimisation of windfarm siting. It considers the complementarity (win-win) and competing use of space, utilizing agreed input standards and protocols. The Knowledge Hub facilitates access to this decision-support module, enabling users to leverage its capabilities in decision-making processes.
- **EU International Centre of Excellence on Sustainable Resource Management (EU ICE-SRM) IT Platform:** Will be developed to support the work of the EU ICE-SRM as an interactive knowledge hub and will present a one stop shop for stakeholders with all available information including links to persons/institutions to provide further, more detailed information if necessary.

By incorporating these decision-support modules within the EGD framework and ensuring their accessibility through the Knowledge Infrastructure platform, EGD aims to enhance decision-making capabilities and promote efficient utilisation of geological data and information.

3.1.3. EU International Centre of Excellence on Sustainable Resource Management

An EU International Centre of Excellence on Sustainable Resource Management (EU ICE-SRM) will be established during the course of the GSEU project and become an integral part of the future GSE, dedicated to supporting EU, Member State, regional and national policies and stakeholders in achieving their path towards 17 Sustainable Development Goals (SDGs). The EU ICE-SRM will focus on capacity building and promotion of the United Nations Framework Classification (UNFC) and United Nations Resource Management System (UNRMS), facilitating the dissemination of information on natural resources, including minerals, geo-energy, and groundwater. It will operate in alignment with the FAIR data principles and in adherence with UNFC and UNRMS.

The EU ICE-SRM will offer the following services and initiatives:

1. **Capacity building and promotion:** EU ICE-SRM identifies existing expertise in the field of UNFC/UNRMS, engages relevant stakeholders, and plans and implements educational workshops and training courses. The centre also promotes the implementation of UNFC/UNRMS in the context of mineral, geo-energy and groundwater resources, to support policy decision-makers in sustainable resource management at national, regional and EU level.
2. **Establishment and maintenance of networks:** an EU ICE-SRM builds and sustains robust networks of experts, partners, and stakeholders, to become a knowledge hub for UNFC Resources and sustainable resource management, primary stakeholders being GSO partners implementing the GSEU project.

3. **EU ICE-SRM IT Platform:** will be developed to support the work of the EU ICE-SRM as an interactive knowledge hub and will present a one stop shop for stakeholders with all available information including links to persons/institutions to provide further, more detailed information if necessary.

By leveraging partnerships, expertise, and educational initiatives, the centre aims to enhance the understanding and application of UNFC/UNRMS principles in the field of natural resource management.

3.2. Services on Demand

National and regional Geological Surveys play a crucial role in responding to inquiries from public authorities, amongst others, regarding their specialised areas. These entities are responsible for delivering reliable and sound scientific and technical information. The criteria provided by these services can be used to support both technical and policy implementation decisions.

While national challenges pertaining to the management of natural resources and subsurface space are typically addressed at the national level, they also have European and potentially global implications and can require cross border management of subsurface use (and planning). An exemplary response to these challenges is reflected in the European Critical Raw Materials Act, a legislative proposal aimed at ensuring a secure and sustainable supply of critical and strategic raw materials in support of the twin transition towards a green and digital economy.

To address such challenges, the GSE will have the capacity to collaborate with experts from various European countries on an ad hoc basis, to address specific requests and combine the best parts of national tools, standards and protocols. This collaboration takes two primary forms: white papers and reports.

Through the production of white papers and reports, the GSE will collaborate with leading experts from across Europe to meet the specific needs and challenges related to natural resource management, subsurface utilisation, and the objectives outlined in the European Raw Materials Act.

3.2.1. White Papers

White Papers are comprehensive documents that present expert analysis, evaluations, and recommendations regarding specific topics or issues. They serve as authoritative references for decision-makers in formulating policies and strategies. By leveraging the expertise of professionals from different European countries, the GSE can contribute to the development of white papers that address the challenges associated with natural resource management and subsurface utilisation.

The European Commission develops white papers proposing EU actions in specific areas. They often follow the publication of green papers, which initiate a consultation process at the EU level. White papers serve the purpose of initiating debates and discussions with the public, stakeholders, the European Parliament, and the Council, with the aim of reaching a political consensus.

The GSE can play a valuable role in supporting the EC in the various stages of white paper preparation, by providing the necessary scientific and technical foundation for policy proposals, backed up by impartial expert insights and essential data. During the preparation phase of a white paper, the GSE can provide scientific evidence, research findings, and expert analysis with regard to the subsurface

related aspects of the proposed policies. This contribution helps ensure that the policy proposals are grounded in a sound scientific-technical basis, enhancing their credibility and effectiveness.

In summary, the GSEU's involvement in the preparation of European Commission white papers strengthens the scientific underpinning of policy proposals, facilitates informed debates, and contributes to the development of effective and evidence-based policies at the EU level.

3.2.2. Reports

Reports are concise documents that provide detailed information, findings, and insights on specific subjects. The GSE will be able to develop tailored reports to address specific needs and requirements, providing targeted expertise and analysis to assist decision-making processes.

The implementation of this GSEU project involves the production of several reports that provide insights into the type of documentation that could be requested from the GSE on demand. These reports serve as examples of the targeted nature of the scientific documentation that the network of experts is capable of producing.

Some examples address:

- **European onshore primary and secondary CRM resources:** A major goal of the GSEU project is to re-evaluate European resources in primary CRM and mining wastes, building on past and on-going project outputs, to fill the gaps in data and information at European level. This report will assess the geological potential for CRM resources at European scale, based on CRM deposits and occurrences knowledge acquired and compiled in the pan-European MIN4EU database.
- **European offshore CRM resources:** This report will assess the potential for CRM resources in European seas. To do so, it will define the principal types/distribution of seabed mineral resources and their associated CRM in the European Seas, identify data gaps in knowledge bases and assessments, analyse present-day exploration and exploitation status, develop and refine the principal metallogenic models for seabed minerals, identify the most prospective areas/provinces in pan-European seas and their CRM-potential.
- **Methodology and guidance for EU-level data harmonisation with UNFC:** The UNFC system is a promising way to compile unbiased, comparable and standardised resource information. It also allows users to measure the maturity of mining projects. In that sense, it is strongly endorsed by the European Commission, and explicitly mentioned in its Critical Raw Materials Act. This report will present the most recent results on using UNFC for primary and secondary raw materials. It will also propose good practices and recommendations to properly serve raw materials data at European level with UNFC.
- **Vulnerable Aquifers:** This report focuses on the assessment of hydrograph similarities using Machine Learning (ML)-driven, feature-based cluster analysis of selected time series. It provides an in-depth analysis of hydrological data, utilizing ML techniques to identify patterns and similarities among hydrographs. The report aims to enhance understanding of vulnerable aquifers and their hydrological characteristics.
- **Coastal Vulnerability Assessment:** This report addresses the geological and hydrogeological parameters necessary for coastal vulnerability assessments. It offers a comprehensive analysis of the factors influencing coastal vulnerability, including geological and hydrogeological

considerations. The report aims to support decision-making processes related to coastal zone management.

These reports are designed to be utilised by both policy makers and specialists in the respective fields, offering accessible information and analysis of the latest data and production of maps related to the subject of interest. The GSEU will leverage its expertise and scientific knowledge to produce these reports, ensuring that they are based on the latest research, data and state-of-the-art information.

Overall, the reports generated by the future GSE will contribute to the dissemination of specialised scientific knowledge and provide valuable resources for decision-makers, researchers, and other stakeholders seeking detailed information and insights in specific areas of geological research and analysis.

3.2.3. Expert advisory services

Geological Surveys, as public entities, are almost all mandated by their governments or regional authorities to maintain the geological inventory and advance the knowledge of geosciences for the benefit of the nation, providing expert analysis and impartial advice based on sound scientific information to national/regional authorities. EuroGeoSurveys, as well as the national and regional Geological Surveys in their own right, have long been represented in high level steering groups, a variety of expert groups and working groups at EU level and have served a number of other international organisations and projects. Cooperation amongst national Geological Surveys of Europe in forming common expert opinions has been ongoing since 1971 following the foundation of the Western European Geological Surveys (WEGS), which evolved into the current non-profit association of EuroGeoSurveys (EGS), set up in the mid 1990's with the express interest of the European Commission following meetings held with then Commissioner for the Internal Market and Industrial Affairs, Martin Bangemann, in 1992. One of the key objectives for EGS when it was established was (and still is) to assist the European Union to obtain joint technical advice from the Geological Surveys of the Member States. This was a crucial step in establishing a two-way flow of communication and information between the European Institutions and the EuroGeoSurveys expert network, who have since contributed towards a variety of critical issues of EU interest.

Since then, EGS and its experts have been actively engaged in a wide variety of expert groups and have been invited to support the EC delegations in various policy dialogues with international partners. This has led to important input from the community towards the development of, as just some examples, the Water Framework Directive, the Groundwater Directive, the European Raw Materials Initiative, the European Innovation Partnership on Raw Materials, the CCS Directive, as well as involvement in EU Raw Materials Diplomacy efforts including policy dialogues at regional level (e.g. EU-Latin America Policy Dialogues on Raw Materials) and developing strategic partnerships with non-EU countries. Most recently, EGS and its experts have developed key input and feedback on the Critical Raw Materials and Net Zero Industry Acts, in the expectation they will play an important role in implementing both Acts.

Currently, EGS is represented in the following expert advisory bodies:

- EU level: Raw Materials Supply Group (Lead DG: GROW), European Innovation Partnership on Raw Materials High-level Steering Group & Operational Groups (Lead DG: GROW), WFD CIS Working Group Groundwater (Lead DG: ENV), GEO High Level Working Group (Lead DG: RTD).

- International level: EU-Latin America Policy Dialogues on Raw Materials, UNECE Expert Group on Resource Management (including thematic working groups) and its Bureau, UNECE Groundwater Working Group, International Union of Geological Sciences Commission on Global Geochemical Baselines, The Association of Iberoamerican Geological and Mining Surveys – Geochemistry and Marine Geology Expert Groups.
- Project Advisory Boards: "Green Deal Data Space" (GREAT) project (Digital Europe Programme), "Regulation of Groundwater in Telecoupled Social-Ecological Systems" (REGULATE) project.

The GSE intends to take this already important support base a step closer to an EU-mandated advisory role and support service, similar to the invaluable services the national Geological Surveys have been providing to their governments for over 100 years in many Member States.

3.3. Governance Structure

The governance structure of a future GSE will depend on the organisational model selected. However, it is foreseen that elements of the existing structure of EGS are likely to be carried through to the GSE. This proven structure will be supplemented by additional elements that are considered important for a fully functional GSE, in any chosen model. Therefore, the existing structure of EGS is reviewed and additional elements are discussed.

Relevant existing elements of EGS:

Board of GSO Directors: EGS is governed by a board of Directors comprising the Directors of the member GSOs. The Directors of the Geological Surveys involved in the GSE should be represented on the governing board, whether alongside or on behalf of their Member State (if Member State involvement is required in the organisational structure). They provide strategic guidance, contribute to decision-making processes, and ensure alignment between the GSE and the Geological Surveys.

Secretary General: The Secretary General is responsible for the day-to-day management of EGS, its Secretariat and budget. In a GSE, a similar role, possibly an **Executive Director**, is foreseen to lead the Administrative Body referred to below.

Secretariat: The EGS Secretariat is a focal point for the activities of EGS and accommodates the Secretary General and support staff. In a GSE a similar **Administrative Body** is foreseen to manage the day-to-day operations and operating budget of the GSE. This body should comprise contracted staff members to act as the main contacts for internal and external relations, facilitating communications with key stakeholders (primarily the EC), alongside dedicated experts (potentially seconded from participating GSOs) who are capable of responding on short notice to requests from EU institutions.

National Delegates: National Delegates are the main point of contact between each member GSO and EGS. The National Delegate assists their Director in maintaining the daily contact with the Secretary General; assist the Secretary General in the preparation of work programmes, position papers, statements or proposals, and Expert Group staffing; assist in preparing the agenda of the Meeting of the General Assembly and advise on proposals for General Assembly decisions. In a GSE, a similar role is envisaged – a **Geological Survey Reference Point**, responsible for updating information related

to the permanent services and able to mobilise when needed to contribute towards a response to ad hoc requests.

Expert Groups: The EGS Expert Groups are pools of experts selected among the EGS members to assist the Secretariat in carrying out the EGS work programme and/or strategy action plan, as well as promote the contribution of geosciences to European Union affairs and action programmes. In a GSE, we envisage a wider network of experts, possibly including members from outside the GSOs, involved in joint research activities, development and harmonisation of data, sharing best practice, contributing towards reports and white papers.

Additional elements of a GSE would likely also include:

External Advisory / Stakeholders Board to ensure strategic orientation remains relevant and maintain a high level of quality control.

International Scientific Committee to maintain best standards and exchange best practice with international counterparts.

EGDI & Knowledge Hub Management Team with expertise in IT and data management, responsible for overseeing the editing and maintenance of data within EGDI and the Knowledge Hub. They ensure the proper organisation, accessibility, and quality control of the data and metadata.

Data Editing Committee to maintain the EGDI knowledge infrastructure, ensuring its accuracy, relevance, and quality. The committee will consist of subject matter experts appointed by the Expert Groups, working closely with experts in data management, usability, etc. that are involved in the operations of the EGDI & Knowledge Hub. The main mission and objective of the committee is to optimise the knowledge infrastructure to meet the needs of its users and promote reliable and up-to-date information. As this committee is central to the sound operation of the GSE, its function and responsibilities are further outlined below:

- **Content Curation:** The editing committee selects and curates relevant and valuable content for inclusion in the knowledge infrastructure. They assess the information's relevance before adding it to the knowledge infrastructure.
- **Quality Control:** Ensuring the information's accuracy and credibility is paramount. The committee implements quality control measures, fact-checks, and periodically reviews content to maintain a high information standard.
- **Updating and Maintenance:** Knowledge is constantly evolving, and the editing committee must regularly update and maintain the content in the knowledge infrastructure. Outdated or incorrect information must be removed, and new, relevant content must be added to keep the repository up-to-date as well as relevant in a rapidly changing world.
- **User Experience:** The committee considers the knowledge infrastructure users' needs and expectations. They focus on enhancing the user experience, making information accessible, searchable, and user-friendly.
- **Review Process:** The editing committee may establish an internal evaluation to ensure the information meets the required standards before publication.

- **Compliance and Ethics:** They ensure the content adheres to legal, ethical, and copyright guidelines. Plagiarism and intellectual property violations are avoided, and appropriate credits are given where necessary.
- **Identification of Knowledge Gaps:** The editing committee identifies areas of knowledge gaps and works towards filling them with relevant and well-researched content. They may also collaborate with other subject matter experts and researchers to generate new insights.
- **Collaboration and Partnerships:** The committee may collaborate with academic institutions, organisations, and other stakeholders to strengthen the knowledge infrastructure's content and reach.
- **Analytics and Metrics:** They analyse user behaviour and engagement patterns to understand the usage trends, popular topics, and areas that require improvement. This data-driven approach helps optimise the knowledge infrastructure to better serve its audience.
- **Governance and Policies:** The editing committee may help establish governance policies, including guidelines for content creation, updating protocols, and conflict resolution within the infrastructure.
- **Accessibility:** Ensuring the knowledge infrastructure is accessible to all users, including individuals with disabilities, is another essential function. The committee may oversee the implementation of accessibility standards and compliance.

4. Options Analysis – Case Studies

Given the clear need for establishing a Geological Service for Europe, a key question concerns how such a service would be best organised and operate most efficiently. Within this initial interim deliverable, we outline a number of different potential operational structures through which the GSE could be established, along with case studies on closely related existing initiatives. These options will be further analysed in preparation of the final deliverable (D9.9), expected by February 2025, which will focus in on the most likely operational scenario(s) and accompanying governance structure that will be identified in consultation with the EC and key stakeholders.

4.1. Intergovernmental Organisation

4.1.1. Governance

Intergovernmental Organizations (IGOs) are usually established through treaties or agreements between state nations and are usually governed under international law. The IGO members are bound by these agreements, which formalise the structure, function, and purpose of the organisation. IGOs are distinguished from other International Organisations in that the members of an IGO are national governments. Membership can range from as few as two to any number of members.

An IGO has international legal status that may include privileges, immunities, rights and duties that are enshrined in the IGO's charter or statute. An IGO can enter into agreements with other IGOs or with states. Decisions reached within an IGO are not enforceable and the members remain independent. Members do not secede power or sovereignty to an IGO.

There are hundreds of IGOs. Well known IGOs include the United Nations (UN), the North Atlantic Treaty Organisation (NATO), the Organization of Petroleum Exporting Countries (OPEC), and the International Criminal Police Organisation (Interpol). European IGOs include the European Union (EU, which is also in part a supranational organisation), The Council of Europe (CE), the European Free Trade Association (EFTA), the World Trade Organization (WTO), and the Organisation for Economic Co-operation and Development (OECD). Other European IGOs of a similar scientific nature to what is envisaged for a GSE include the European Space Agency (ESA), the European Atomic Energy Community (Euratom), the European Organization for Nuclear Research (Conseil Européen pour la Recherche Nucléaire – CERN), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), and the European Centre for Medium-Range Weather Forecasts (ECMWF). Of these, the six 'Coordinated Organisations,' which are European IGOs with a common remuneration and pension system, are the OECD, NATO, CE, ESA, ECMWF, and EUMETSAT.

4.1.2. Organisational Structure

IGOs typically have an organisational structure that consists of an assembly, in which all members are represented, an executive committee or council, and a secretariat, which performs the day-to-day administrative activities. IGOs may also have subsidiary agencies or groups that perform special functions and that commonly report to the executive or the assembly.

4.1.3. Scope of Operations

IGOs differ dramatically in their number of members, geographical coverage, and areas of activity, e.g., maintaining international peace and security (UN), regulating international trade (WTO), or guaranteeing freedom and security of members through political and military means (NATO) (EPRS, 2020).

4.1.4. Funding

Owing to increased globalisation in recent decades, leading to a proliferation of IGOs, the sources and types of funding available to IGOs has increased in diversity and complexity. Traditionally, funding for IGOs is through membership fees paid by member states. However, more recently contributions from private donors are more common, and in some cases funding from project sources or commercial income. Also, more common in recent years, is that funding from non-traditional sources, including donor contributions, is earmarked for specific activities (e.g., EPRS, 2020). However, this raises potential ethical questions related to private funding (e.g., integrity, conflict of interest, etc.).

4.1.5. Benefits and Risks

The benefits of membership of an IGO can include economic rewards (e.g., North American Free Trade Agreement, NAFTA), political influence (e.g., for smaller nations within the EU or non-EU countries within Europe), security (e.g., NATO), and democracy. Heldt and Schmidtke (2017) argue that the power of IGOs lies in the fields of their tasks, the scope of the issues they address, and their capabilities, with higher levels of power related to a broader scope of issues, financial resources, and their use of financial and human resources. Nilsson (2017) argues that IGOs can play a significant role in system transformation because of their potential to be influential regarding policy areas in which they have authority. IGOs operate with a high level of political support and commonly involve both public and private actors or entities.

Risks to joining the membership of IGOs include the requirement for members to honour IGO decisions that may not align fully with national-level priorities and the requirement to commit resources to participation. In such cases, the direction and operations of IGOs can be at risk if members elect to follow national priorities in preference to those of the IGO (e.g., Donald Trump's stated intention in 2020 to consider withdrawing membership from the World Health Organisation).

4.1.6. Case study – the European Centre for Medium-Range Weather Forecasts (ECMWF)

The European Centre for Medium Range Weather forecasts (ECMWF) is an IGO with 35 state members – 23 member states and 12 cooperating states. The Centre currently employs around 430 staff. The headquarters is in Reading, UK, with additional offices in Bologna in Italy, and Bonn in Germany. The office in Italy was established most recently, in 2021, to accommodate operational issues related to Brexit.

History

The ECMWF was instigated by a COST Action (European Cooperation in Science and Technology) in the late 1960s and early 1970s, which identified aspects of weather forecasting where national measures were insufficient. The ECMWF was established in 1975 based on a Convention first drafted in 1971, signed in 1973, and which came into force two years later. The primary reason for establishing the ECMWF was to pool Europe's meteorological resources to produce accurate climate data and medium-range forecasts. In particular, pooling of considerable financial resources via member



contributions was required to purchase and operate a supercomputer powerful enough to run the numerical models necessary to achieve reliable 10-day weather forecasts, which at that time were beyond state of the art. At the time, no individual EU country had the resources to fund the required technology alone. The UK won a bid to host the Centre based largely on proximity to the UK Met Office and the University of Reading, which had and still has a strong expertise in metrology. The first real-time medium-range forecasts were made in June 1979 and the ECMWF has been producing operational medium-range weather forecasts since August 1979, at first 5 days a week and, since 1980, 7 days a week. Recently, the ECMWF has opened an additional data centre in Italy, and a new office in Bonn, which was mainly to accommodate administrative issues related to Brexit.

Governance

The ECMWF was established by a Convention that came into force on November 1, 1975, amended in 2005 to allow new member states to join from the time of enforcement in 2010. An Act of Parliament is required to join the ECMWF. The member states are those that are party to the Convention establishing ECMWF whereas cooperating states are those who have concluded a cooperation agreement with the Centre.

The decision-making body of the ECMWF is the Council of member states, which meets twice yearly. Each member state has two representatives, one of which must come from the national meteorological service of that state. The other representative can be at Ministerial level and is most commonly from economy or transport. Members of the Council are involved in defining strategy and supply services to ECMWF projects. A representative from the World Meteorological Organization, EUMETSAT, EUMETNET and ECOMET are invited to take part in Council meetings as observers.

The Council's responsibilities include:

- Admitting new members,
- Authorizing the Director General to negotiate and conclude cooperation agreements,
- Adopting strategy and the programme of activities, financial and staff regulations, member financial contributions, and the annual budget,
- Appointing the Director General, and
- Taking decisions regarding property and equipment.

The Council elects a President and a Vice President from its membership, each for a one-year term renewable for only one additional consecutive year. The Director General is appointed by the Council and is the Chief Executive Officer of the ECMWF, with overall responsibility for the Centre.

Organisational structure

The ECMWF has a council of 23 member states. There are 6 committees that report to and advise the Council in relation to science, policy, and finance, and which contribute to the evolution of the Centre. They are:

- the Policy Advisory Committee provides opinions and recommendations on any matters concerning ECMWF policy submitted by the Council
- the Technical Advisory Committee provides the Council with advice on technical and operational matters.
- the Advisory Committee for Data Policy provides the Council with opinions and recommendations on any matters concerning ECMWF data policy

- the Scientific Advisory Committee provides the Council with opinions and recommendations on any of the ECMWF draft programme of activities, drawn up by the Director General and on other scientific matters submitted by the Council
- the Finance Committee provides the Council with opinions and recommendations on financial matters submitted to the Council and exercises financial power delegated by the Council
- the Advisory Committee of Co-operating States provides the Council with opinions and recommendations on the ECMWF programme of activities and budget and other items relevant to Co-operating States or submitted to it by the Council.

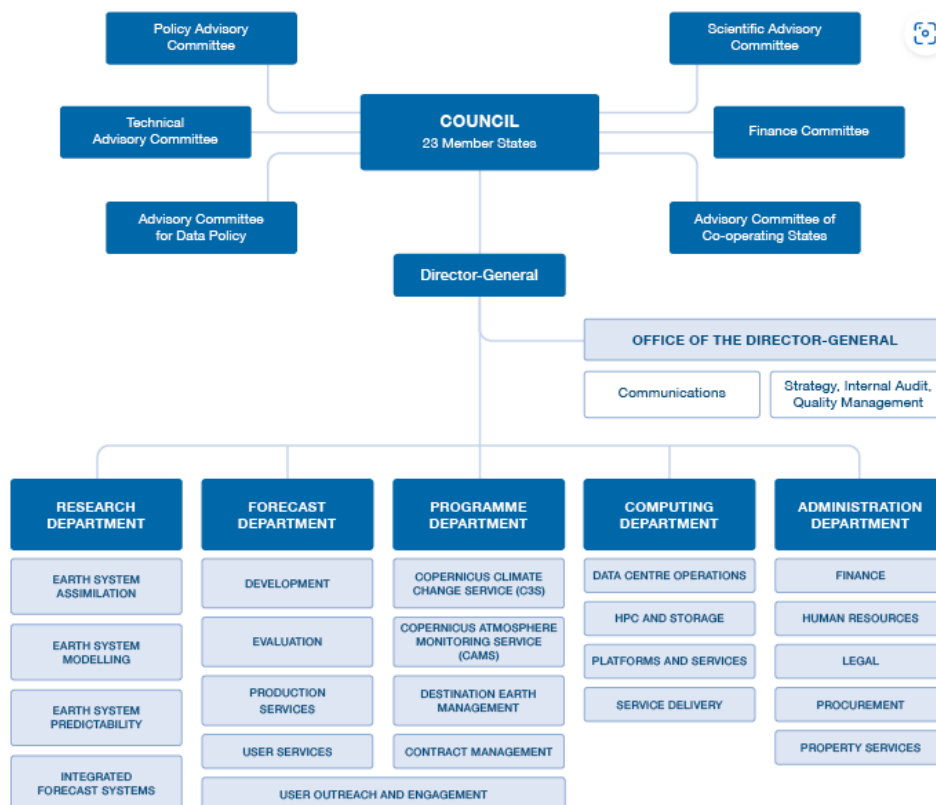


Figure 2. Organisational structure of the ECMWF (source: www.ecmwf.int/en/about/who-we-are)

In addition, the Joint European Weather Cloud Advisory Group, established through decisions of ECMWF and EUMETSAT, reports to the Councils of those two IGOs.

Also reporting to the Council is the Director General, who oversees an office that manages communications, strategy, internal audit, and quality management. Reporting to the Director General are the 5 departments: Research, Forecast, Programme, Computing, and Administration. Of these, the Programme Department was established most recently to manage projects related to Copernicus and other EU-funded projects. Its establishment as a department separate from the Research Department was to manage risk associated with the failure of the medium-term sustainability of the Copernicus projects. In practice, the ECMWF engagement in running two services for Copernicus has proved successful. Prior to Copernicus, ECMWF had around 250 staff. Since involvement in Copernicus was



initiated, ECMWF now has around 450 staff and three locations. The three locations have required the establishment of hosting agreements with those three countries (UK, Italy, Germany), which has required large structural changes to ECMWF.

There has been discussion within ECMWF of the introduction of 'activity nodes', where different ECMWF activities would be carried out at different locations in different member states. This idea, in which ECMWF becomes decentralised, has gained support as the computing requirements for modern weather forecasting models become less expensive and can be handled in smaller or decentralised facilities. Thus, in future, it may be possible to envisage an ECMWF that does not require a key central location for operations.

Scope of operations

The core mission of the ECMWF is to produce numerical weather forecasts and monitor the Earth system, carry out scientific and technical research to improve forecast skill, and maintain an archive of meteorological data. The vision of ECMWF is producing cutting-edge science and world-leading weather predictions and monitoring of the Earth system in close collaboration with the members of the European Meteorological Infrastructure, for a safe and prosperous society.

The ECMWF is both a research institute and a 24/7 operation service disseminating numerical weather predictions to its members and data to their national meteorological services. Priority is given to the operation activities and services with secondary priority to research. The core activities (e.g., forecasting) are done at ECMWF. The ECMWF collaborates with national meteorological and hydrological services and research institutions from member and cooperating states to develop modelling capability, design new products, and evaluate forecast quality. Project work involves contributions from member organisations, who may also participate in exchanges, fellowships, and visits. With the approval of all ECMWF members, member countries may develop optional programmes funded by interested countries. If successful, these programmes can be included in the core work of ECMWF and thereafter funded by all members.

The ECMWF also offers a catalogue of forecast data that may be purchased by commercial customers.

Funding

The budget of the ECMWF is primarily funded by annual contributions from the member and cooperating states. The contribution level is calculated using a scale based on gross national income. Over time, third-party financial contributions have become more substantial. These third-party contributions are mainly sourced from the EU in relation to running two services in Copernicus (climate and atmospheric modelling) and the Destination Earth initiative. This EU funding is generated in 4–5 year cycles. In addition, there is some funding from Horizon Europe projects. The Bonn office of ECMWF was established mainly to enable access to EU funding.

At present there is no limit on the allowed funding from third-party contributions, though there is a possibility that this may come in future if ECMWF becomes more dependent on EU funding rather than member contributions.

While the full data catalogue is available to member states and contributing states, a free subset of the data is also available to all. However, the full data is also available, for a fee, for commercial use, which

has become more important over time. While delivery and handling fees for commercial usage will remain, there is a move toward lowering and ultimately phasing out commercial fees.

In 2021, as an example, the total budget of the ECMWF was 112 million euros, with almost half sourced from Member and cooperating states contributions, slightly less than half from external organisations supporting research and complementary goals of the Centre (mainly the EU), and about 10% from the sale of data and other products.

Benefits

The ECMWF member and cooperating states receive the ECMWF's numerical prediction data in real time for their use in preparing forecasts for end users. They have access to the ECMWF's computing facilities, which include the supercomputing facilities (available to member and cooperating states for 25% of its time). Each member's or cooperating member's access to the supercomputer is proportional to their financial contribution and can be used, e.g., for local or regional forecasting or for research. Members and cooperating members also have access to a large-scale data handling system for storing and retrieving data to perform weather modelling, research, and data mining, a network for transferring large volumes of operational data, and tape storage. In addition, they have access to training, data, and to a joint close connection to the EU, enabling input into shaping relevant directions and priorities.

Relevance to a GSE

The example of ECMWF highlights that an IGO needs a key EU-level service or activity with benefits to all members that cannot be addressed by any one country alone. This service or activity must also not replace but instead complement the activities and services of related national level organisations or agencies. In the case of ECMWF, this service was medium-range weather forecasting, which required a powerful and (for single entities) prohibitively expensive supercomputer.

In the case of a GSE, this key EU-level service is the EGDI – a service that cannot be provided by any one member, requires the input of all, and which has benefits to all members through development of best practices, improving expertise and capacity building, expanding professional networks, and possibly also access to previously restricted data. The relative disadvantage of EGDI, compared with the ECMWF example of a supercomputing facility, is that while both have many direct applications to real world problems, those applications are more difficult to visualise in the case of EGDI. Therefore, the perceived benefit at EU level is more difficult to understand. Everyone understands, at some level, the value of a weather forecast. Few understand, at any level, the value of data reporting groundwater volume fluctuations over time, or the chemistry of agricultural soils, or geological maps and models.

The ECMWF example highlights the need to make the relevance, applicability, and importance of EGDI more visible. Increased visibility could be achieved by developing the 3D data infrastructure already established within EGDI to allow different kinds of data (e.g. geology, water, heat) to be easily visualised and used in 3D. Furthermore, the IGO could require of Member States, and possibly industry, that key data are delivered to EGDI, in much the same way as has been established for the key register in the Netherlands. This would further increase the usefulness and recognition of EGDI as a tool for tackling real world problems and making informed decisions, via a platform in which the meaning of the integrated data is more visible and apparent to non-specialists.

Also relevant to a GSE is the discussion of a centralised compared with a decentralised structure for the organisation. Taking EGDI as the key service, there would be no need for a centralised physical location

from the perspective of operations. Thus, one could consider a decentralised structure in which different NGSOs hosted distinct nodes of operation, e.g., coordination, communication, groundwater, CCS, minerals, urban infrastructure, soils, spatial information, geohazards, geothermal, nuclear waste etc. A decentralised structure would have the advantage of to some degree democratising the IGO activities, as well as maximizing the use of national-level expertise, and providing opportunities for local and regional capacity development. However, care would be needed to ensure coherency and engagement across all nodes. A centralised organisational structure would likely have advantages in ensuring coherency in the activities and direction of the IGO, but would introduce a significant disadvantage in the physical separation of the IGO from the NGSOs. This separation would likely generate gaps in the knowledge and information flow from the national level to the IGO level, which would be a major problem given that the NGSOs are the custodians of the key data and knowledge required at foundational level for an optimal EGD.

**Unless otherwise referenced, the information for this section on ECMWF was drawn from the Centre's website (<https://www.ecmwf.int/>) and from an April 2023 interview with Mr Fabio Venuti (Head of Cabinet, Office of the Director-General, ECMWF).*

4.2. Decentralised European Agency

4.2.1. Governance

Starting in 1975 and particularly from the 1990s, the former EEC and now EU and its Member States have delegated a range of tasks, encompassing regulation, monitoring, and coordination, to discrete European agencies in a process referred to as agentification (e.g., Geradin and Petit, 2004; Groenleer, 2009). EU agencies are specialised bodies established through legislation to respond to specific needs that cannot be satisfactorily addressed at national level and are better achieved by EU level action. There are currently 48 EU decentralised agencies and joint undertakings, which are networked with each other and other organisations through the EU Agency Network (euagencies.eu). The work of the EU agencies (1) reduces the workload of the EC institutions so that they may focus on core functions, (2) separates technical activities, including advisory services, from policy, (3) assigns technical activities to specialists, (4) reduces costs, and (5) ensures neutrality in regard to national interests (Geradin and Petit, 2004). All EU agencies (1) have a key area of specialisation, (2) are comprised of a membership that brings together EU (and in some cases other) European countries, and (3) comprise part of the EU institutional system.

Until ca 2000, almost all agencies were set up on the basis of Article 308 of the European Community Treaty and thus with only a marginal role for the European Parliament. Some of the younger agencies were set up on the basis of different Treaty articles with the European Parliament as co-legislator, thus giving the EP a larger role in the governance and accountability structures of those agencies (Busuioc, 2010). Most (but not all) agencies are not mandated to adopt binding decisions but rather have information and coordination tasks.

4.2.2. Organisational structure

EU agencies often comprise hubs of networks of national agencies and are based in different Member States. The agencies support cooperation between the EU and Member States by pooling specialist expertise and knowledge from the EU institutions and national authorities. All agencies operate under the authority of an executive director who is responsible for day-to-day administration, staff, planning, reporting, and budgetary responsibilities. Agencies also have an administrative or management board, whose members are usually representatives of the Member States. The board establishes guidelines that the agency follows and is responsible for adopting the work program of the agency.

4.2.3. Scope of operations

Agencies generally have a limited mandate and carry out tasks of a technical, scientific, and managerial nature, providing specialised information, management, and cooperation (Geradin and Petit, 2004). To a lesser extent, some agencies have decision-making powers or are quasi-regulatory in nature (Busuioc, 2010).

4.2.4. Funding

The EU agencies are almost entirely funded by the EU general budget, comprising ca 1.5% of the total EU budget, through the multi-financial framework (MFF) (Kaeding, 2020). In some cases, the European Parliament or European Commission can allocate additional funding for specific actions or service-level agreements for activities assigned by specific Directorates General.

4.2.5. Benefits and risks

The organisational sustainability of the agencies is secured through their legislative basis. Likewise, their general budget is reasonably secured via the MFF, although also subject to annual budget proposals to and budget cuts by the European Parliament, in line with macro-economic influences (e.g., Covid, war, etc). As a result of these budgetary ties and legislative framework, the priorities of the agencies are closely linked to changes in EU policy and strategy and the agencies are subject to regular stakeholder evaluation, including by the Council, Commission, and Parliament.

4.2.6. Case study – the European Environment Agency (EEA)

The European Environment Agency (EEA) is an agency of the European Union that delivers knowledge and data to support Europe's environment and climate goals.

History

In 1984, the European Commission proposed an exploratory initiative, 'Coordination of Information on the Environment (CORINE),' which was initiated as a programme and which was aimed at gathering information relating to the environment on priority topics for the European Union (i.e., air, water, soil, land cover, coastal erosion, biotopes, etc.). The CORINE programme operated until 1989 and delivered a final report to the Environment Council, who then proposed maintaining CORINE as a coordination body with the Member States to deliver regular reporting on the state of the European environment. The European Environment Agency (EEA) was established in 1993 and since 1994, the EEA integrated CORINE in its work programme.

Governance

The EEA was founded under Council Regulation (EEC) No 1210/90 of 7 May 1990 on the establishment of the European Environment Agency (EEA) and the European Environment Information and Observation Network (Eionet). This regulation was substantially amended several times, most recently in Regulation (EC) No 401/2009 of the European Parliament and of the Council of 23 April 2009 on the European Environment Agency and the European Environment Information and Observation Network. The EEA is a decentralised agency of the EU. The Agency is governed by a Management Board and Bureau who are mandated to act in the public interest. The Management Board is the key decision-making body of the EEA, overseeing the functioning of the Agency and ensuring alignment with its mission and mandate under the founding Regulation. The Management Board appoints the main bodies of the Agency including the Executive Director and Scientific Committee Members, and for budgetary and planning. The Management Board is also responsible for adoption of the strategy, multi-annual work programme, and budget.

The Management Board comprises:

- One representative from each member country
- Two representatives of the European Commission
- Two scientific experts appointed by the European Parliament

Management Board and Bureau-related documents are available in the register of public documents.

The operation of the EEA is the responsibility of the Executive Director – the legal representative of the Agency – and the Senior Management Team.

Organisational structure

Under the governance of the Executive Director, Management Board, and Senior Management Team, the EEA is organised into seven European Topic Centres (see Fig 3), which are:

1. Administrative Services
2. Biodiversity, health and resources
3. Climate change, energy and transport
4. Communication
5. Coordination, networks and strategy
6. Data and information services
7. Sustainability transitions

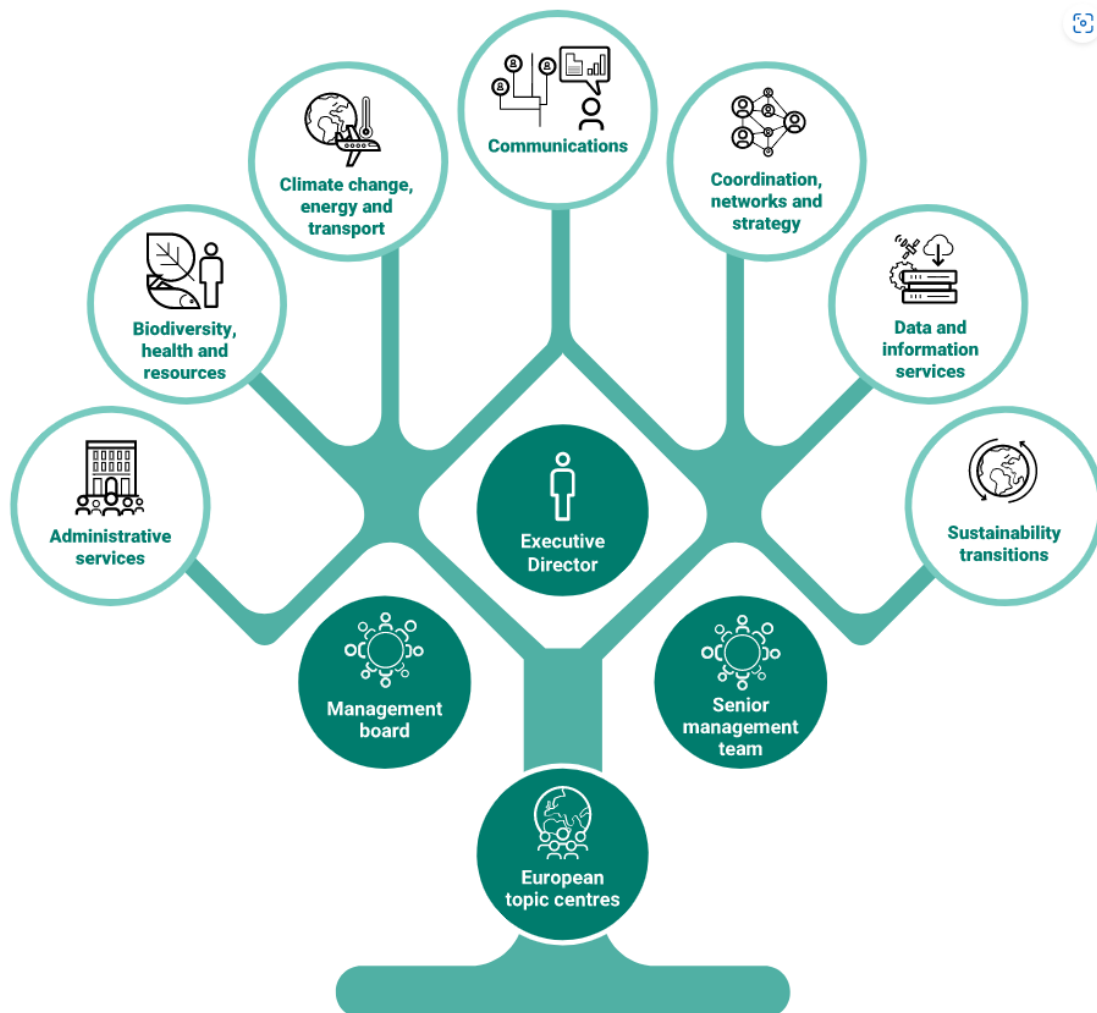


Figure 3. EEA organisational chart, May 2023

(source: <https://www.eea.europa.eu/en/about/who-we-are/governance/organisational-chart>)

The Executive Director is responsible for all operational matters and staffing and works jointly with the Management Board to draft the strategy and the single programming document, which includes multi-annual programming, a three-year outlook, and the annual work programme. The day-to-day management of the EEA is the responsibility of the Senior Management Team, comprising the Executive Director, Heads of Programmes, and a scientific advisor.

Scientific advice is provided by a Scientific Committee, which comprises independent scientists (not exceeding 20 members) from the EEA member countries covering environmental fields relevant to the Agency's areas of activity. The Scientific Committee has three main tasks:

- To deliver an opinion on the EEA multiannual and annual work programmes
- To give an opinion to the Executive Director regarding recruitment of scientific staff
- To provide advice or opinion on any scientific matter concerning the Agency's activity requested by the Management Board or Executive Director

Members of the Scientific Committee are appointed through an open selection process for a four-year term, renewable once. The Chair and Vice Chair of the Scientific Committee are elected from the members.

Scope of operations

The Agency's main task is to provide sound, independent information on the environment. The core tasks are defined in the founding EU regulation and include supporting policy development and key global processes; offering analytical expertise; providing and maintaining an efficient reporting infrastructure for national and international data flows. In collaboration with their partner network (Eionet) they inform decision-makers and the public about the state of Europe's environment, climate change and sustainability issues. The EEA does not engage in compliance and enforcement of EU legislation.

The EEA's overall mandate, established in the Regulation, is to help the European Community and the EEA member countries make informed decisions about improving the environment, integrating environmental considerations into economic policies and moving towards sustainability; and to coordinate Eionet.

The objective of the EEA, defined in the founding regulation, is "to achieve the aims of environmental protection and improvement laid down by the Treaty and by successive Community action programmes on the environment, as well as of sustainable development, the objective of the Agency and of the European Environment Information and Observation Network shall be to provide the Community and the Member States with:

(a) objective, reliable and comparable information at European level enabling them to take the requisite measures to protect the environment, to assess the results of such measures and to ensure that the public is properly informed about the state of the environment, and to that end;

(b) the necessary technical and scientific support."

The mission of the EEA is to "support sustainable development and to help achieve significant and measurable improvement in Europe's environment through the provision of timely, targeted, relevant and reliable information to policymaking agents and the public."

Funding

The EEA is fully funded by the EU with its core annual budget (ca 45 million euro) assigned through the EU budget line on environment, which also funds DG ENV and the EU programme for the environment and climate action (LIFE). The EEA must submit a budget proposal to the European Parliament annually under the MFF, which is a 7-year programming tool. The European Parliament or the European Commission can bring additional budget for specific actions, e.g., Copernicus: the EEA is the authoritative body for one component of Copernicus. The EEA also engages in service level agreements with some DGs of the Commission for specific activities.

Following the Green Deal and Green Transition goals of the EU, the EEA has, since 2019, quadrupled its budget via addition of new services. The budgetary level of these service agreements has risen from ca 20 to ca 100 million euro. This has required a dramatic ramp-up in staffing, doubling the size of the agency.

Benefits and risks

The specific case of the effect of the Green Deal on the EEA illustrates both benefits and risks of agencies as an organisational framework. Being closely tied to EU and EC strategy and policy provides the potential benefit of being the natural recipients of additional budget and responsibility that can grow the organisation. However, the scale of the Green Deal and the resulting additional budget and responsibilities for EEA also presents risks associated with dramatic, rapid changes to the size and scope of work of the organisation, which must be effectively managed.

Relevance to a Geological Service for Europe

It is possible to argue for a sound potential legislative basis for a GSE in the form of an agency regulation, which would secure the mandate, structure, and core budget for the GSE as a sustainable organisation. A GSE agency would, however, then need to navigate and coordinate with a crowded field of EU agencies. Also, one of the key strengths of EuroGeoSurveys and the GSEU project is the ability to draw on national-level geoscientific data and knowledge, as well as national-level influence. An agency structure for a GSE would centralise specialists in a single physical location, risking a weakening of the link with national-level data, knowledge, strategy, and policy that is currently a core strength of EGS and GSEU.

**Unless otherwise referenced, the information for this section was drawn from the EEA website (<https://www.eea.europa.eu>) and from a May 2023 interview with Mr Ronan Uhel (Scientific Adviser – Executive Director Office, EEA).*

4.3. EC Supported Initiative of Joint Cooperation

The case of EMODnet is not a standard organisational and funding structure but rather a one-off initiative in which a network of partners is supported by a dedicated Secretariat funded by the European Commission and in the context of the EU's integrated maritime policy.

4.3.1. Case study – EMODnet

History

The European Marine Observation and Data Network (EMODnet) is a long-term marine data initiative established by the European Commission. It aims to collect, integrate, and provide access to marine data and observations from various European sources.

The history of EMODnet can be traced back to 2009 when the European Marine Observation and Data Network Preparatory Actions (EMODnet Preparatory Actions) were launched. The primary objective of these preparatory actions was to assess the feasibility of creating a pan-European marine data infrastructure.

Between 2009 and 2013, several thematic pilot projects were initiated under the EMODnet Preparatory Actions. These projects focused on specific marine data themes such as bathymetry (seafloor mapping), geology, chemistry, biology, and physical oceanography. The pilots aimed to demonstrate the value of collecting and integrating marine data from various sources to provide a more comprehensive understanding of Europe's seas and oceans.

Building on the success of the pilot projects, the European Commission formally launched EMODnet as a full-scale operational network in 2013. The network was designed to access various marine data, including physical, chemical, biological, and geological parameters.

EMODnet is organised into several thematic portals, each focusing on specific marine data themes. These portals include EMODnet Bathymetry, EMODnet Geology, EMODnet Chemistry, EMODnet Biology, EMODnet Physics, and EMODnet Human Activities. These portals bring together data and information from various national and regional sources, making them freely available and easily accessible to scientists, policymakers, industry, and the general public.

Over the years, EMODnet has expanded its coverage and improved the quality and accessibility of marine data across Europe. It has developed standardised data products, web services, and data visualisation tools to facilitate data discovery, access, and use. EMODnet has also collaborated with other European marine initiatives and programs to enhance data integration and interoperability.

The European Marine Observation and Data Network has significantly supported marine research, policy development, and sustainable management of Europe's seas and oceans. By providing access to high-quality marine data, EMODnet improves our understanding of marine ecosystems, promotes scientific knowledge, and enables evidence-based decision-making.

Governance

DG MARE

DG MARE is the initiator, funder and overall manager of the EMODnet initiative.

EMODnet Secretariat

The EMODnet Secretariat is assisting DG MARE with coordinating and communicating EMODnet activities. <https://emodnet.ec.europa.eu/en/emodnet-secretariat>.

Since 2013, the EMODnet Secretariat is administered by Seascope and hosted at the InnovOcean site in Oostende with support from the Flemish Government.

(Contact details: <https://emodnet.ec.europa.eu/en/contact-details>).

The Secretariat reports to the European Commission DG MARE and the Marine Knowledge Expert Group.

The main tasks of the Secretariat are:

- Strengthen the coherence between EMODnet portals and activities
- Support the governance of EMODnet
- Monitor portal usage and overall progress
- Support communication, dissemination of information and outreach
- Collect feedback from EMODnet users
- Support the development of a European Ocean Observing System (EOOS)
- Maintain and further develop the European Atlas of the Seas

EASME

Since 2015, EASME is the administrative and contractual manager of all new EMODnet contracts on behalf of DG MARE.

EMODnet MoU: <https://emodnet.ec.europa.eu/en/memorandums-understanding>

Contractual partners

Contractual partners perform tasks to develop and maintain EMODnet according to a service contract with DG MARE/EASME. A contractual partner is a member of a consortium responding to such an EMODnet call for tender and granted a contract (or subcontract) to execute the work. Contractual partners sign a contract with the EC, perform tasks according to a proposal and receive financial compensation in return; they attend annual meetings, deliver on specific tasks, provide regular reports, etc.

EMODnet Steering Committee

An EMODnet Steering Committee consisting of EMODnet Coordinators, Secretariat and DG MARE meets at least twice a year to discuss progress, identify issues of common concern and guide the development of the EMODnet Central Portal.

EMODnet User Group

The EMODnet User Group is an advisory body composed of external users from representative organisations belonging to the main EMODnet user communities (private sector, public authorities, scientific community, and civil society).

EMODnet Geology

The project is managed by a Lead assisted by the Steering Group (SG), which consists of the Lead and Project WP Leaders. The actual project lead is PhD Henry Valius from GTK (henry.valius@gtk.fi).

EMODnet Associated Partners

An associated partner is formally recognised as a partner of the EMOD-network without receiving funding, without the need to be a contractual partner in one of the projects and without the need to adhere to associated contractual obligations.

EMODnet associated partnership would be open to both public and private organisations collecting, providing or using marine data and observations, or related services/research, from any country bordering the European seas, and supporting the aims and objectives of EMODnet. Associated members do not have to pay a fee, but need to (i) actively support and implement the core principles of EMODnet; and (ii) provide some level of contribution to EMODnet.

Associated organisations can be both data providers, data users and/or any other kind of stakeholder with a vested interest in learning from / working with other members and supporting the initiative. Associated partners do not have to be based in Europe. Still, they must have some link with Europe. Both individual organisations, associations and/or networks can apply.

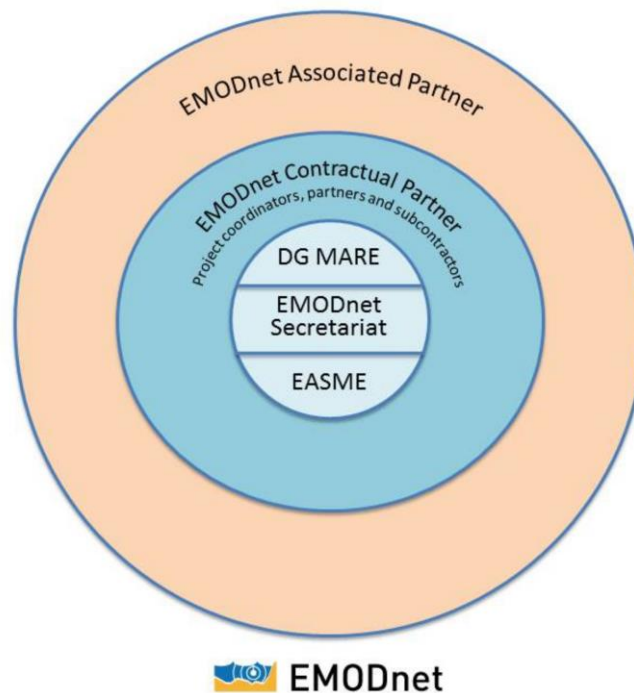


Figure 4: Composition of the EMODnet partnership

(source: <https://emodnet.ec.europa.eu/en/partnership/emodnet-associated-partnership-scheme#tor>)

Scope of operations

The European Marine Observation and Data Network (EMODnet) has a broad scope encompassing various aspects of marine observation and data management. Its primary goal is to collect, integrate, and provide access to marine data and observations from diverse European sources. The scope of EMODnet includes:

1. **Marine Data Collection:** EMODnet aims to gather marine data from multiple providers, including national monitoring programs, research institutes, environmental agencies, industry, and other relevant sources. The network collects data on various parameters such as physical oceanography, bathymetry, geology, chemistry, biology, human activities, and marine ecosystems.
2. **Data Integration and Harmonisation:** EMODnet focuses on integrating and harmonizing diverse datasets to ensure interoperability and accessibility. It aims to overcome barriers related to data format, quality, and standardisation, enabling data from different sources to be combined and analysed effectively.
3. **Data Infrastructure and Services:** EMODnet provides a centralised infrastructure for storing, managing, and serving marine data. It offers web-based data portals and tools that facilitate data discovery, access, and visualisation for scientists, policymakers, industry, and the general public. The network develops standardised data products and web services to support a wide range of applications.
4. **Thematic Portals:** EMODnet is organised into thematic portals, each focusing on specific marine data themes. These portals include EMODnet Bathymetry, EMODnet Geology, EMODnet Chemistry, EMODnet Biology, EMODnet Physics, and EMODnet Human Activities. They provide specialised access to data and information related to their respective themes, enabling users to explore and analyse specific aspects of the marine environment.
5. **Research and Policy Support:** EMODnet supports marine research, policy development, and decision-making processes. By providing access to high-quality and up-to-date marine data, the network contributes to scientific knowledge, ecosystem assessments, and the sustainable management of Europe's seas and oceans.
6. **Collaboration and Networking:** EMODnet actively collaborates with national and international marine initiatives, research projects, and organisations to enhance data sharing, interoperability, and knowledge exchange. The network promotes the harmonisation of data collection and sharing practices across European countries, fostering a collaborative and coordinated approach to marine data management.

Overall, the scope of EMODnet is to establish a comprehensive and accessible marine data infrastructure that enables efficient data integration, supports scientific research, informs policy development, and facilitates sustainable management of Europe's marine environment.

Funding

EMODnet is developed through calls for tender, launched by the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE), primarily for seven projects (lots), each developing and maintaining a data portal which provides access to thematic data and products (<https://emodnet.ec.europa.eu/en/emodnet-themes>).

In addition, several supporting projects are funded through the same mechanism (calls for tender) via service contracts, e.g., for regional data adequacy assessments, to set up a facility to ingest more data into the system or collect specific kinds of missing data.

EMODnet Geology

- The duration of the performance of the contract must not exceed 24 months. It can be extended 24 months automatically unless one of the parties receives a formal notification to the contrary at least 3 months before the end of the contract.
- The price payable under the contract is EUR 2 420 000. The maximum amount covering all purchases is EUR 4 842 000. It includes EUR 2 420 000 for renewal.

Benefits and limitations

The example of EMODnet in using direct grants from the EC to develop and deliver specific services is considered a plausible option due to the flexibility in nature and ability to adapt requirements regularly based on the needs and evolving policy priorities. However, such contracts can be very limited in scope and are often quite targeted, therefore not allowing for wider development and impacts from a potentially wider array of services.

Relevance to a Geological Service for Europe

Service provision can often be provided through specific targeted grants, however the GSE envisaged requires a stronger and more sustainable support structure, ideally established through a legal mandate, that can provide the basis for long-term impacts and on demand information and expertise. In addition, such contracts are generally made with specific EC DGs, whilst the GSE would have products covering areas of interest to multiple DGs. Given the flexibility of this model however, it may be considered an option in combination with other instruments to provide a more complete package.

4.4. European Partnership

European Partnerships are one of the newest funding mechanisms in Horizon Europe, in which the European Commission and public or private partners are brought together with a common strategic vision based on a SRIA and roadmap, to contribute to achieving EU policy priorities by addressing key challenges through research and innovation. There are three types of European Partnerships:

- **Co-funded partnerships** involve EU countries, national and regional research funders, and other public authorities. These partnerships are the successors of the European Joint Programme Cofund and ERA-NET Cofund actions under Horizon 2020. An example is the Water4All – Water Security for the Planet Partnership.
- **Co-programmed partnerships** are partnerships involving the Commission and usually private (but sometimes also public) partners. These partnerships succeed Contractual Public-Private-Partnerships under Horizon 2020. An example is the Clean Hydrogen Partnership.
- **Institutionalised partnerships** are partnerships between the EU, Member States and/or industry. They are long term and focus on the need for integration under the legal framework of Article 187 or 185 TFEU and EIT-Regulation supported by Horizon Europe. They can involve several Member States, bodies established through a Decision of the Council or EIT Knowledge and Innovation Communities. Institutionalised partnerships are only considered in cases where other forms of European Partnerships are not considered appropriate to achieve the objectives, and require the participation of at least 40% of the EU Member States, and if justified by a long-term perspective and high degree of integration. An example is the EU Partnership on Metrology, EURAMET – The European Association of National Metrology Institutes.

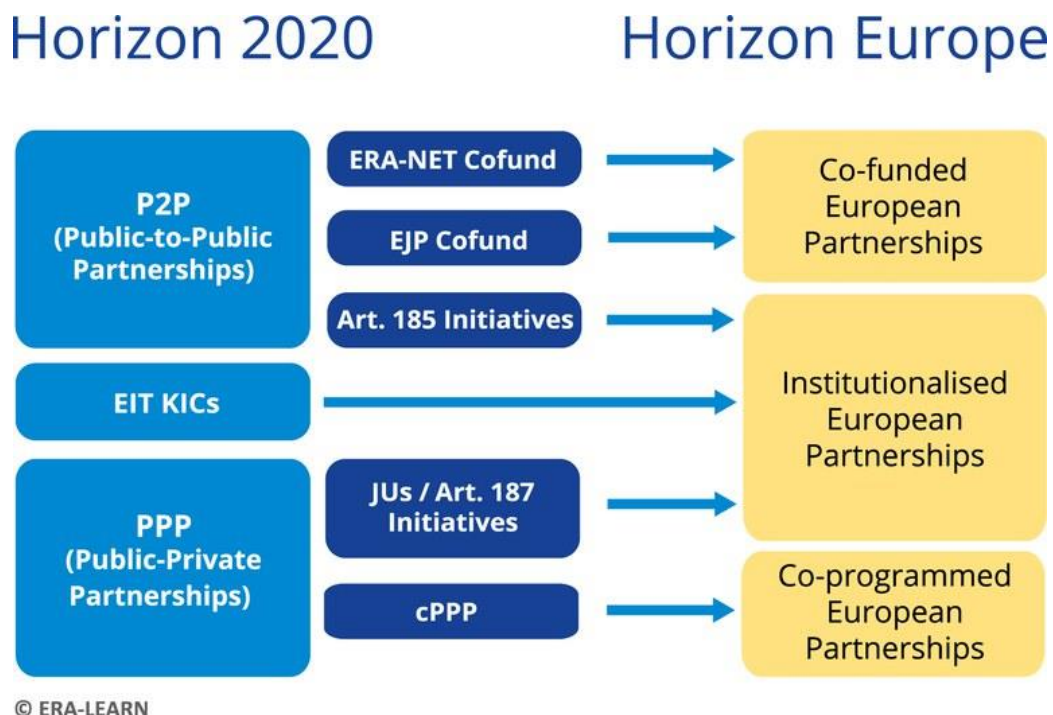


Figure 5. Relationships between partnerships in Horizon 2020 and Horizon Europe
 (source: <https://www.era-learn.eu/partnerships-in-a-nutshell/european-partnerships/historical-development-partnerships-from-fp6-to-horizon-2020>)

Common to all partnerships is the requirement for strategic orientation in line with EU policy, a long-term commitment from partners to mobilise and contribute resources and investments, an annual work programme based on a SRIA and roadmap, and a systemic approach. In terms of legal structure and implementation, the co-funded partnerships are the simplest and the institutionalised partnerships the most complex.

4.4.1. Governance

The governance of the European Partnerships depends on the type of partnership and specific governance models vary between individual partnerships, particularly in the co-programmed and institutionalised partnerships. Co-funded partnerships are generally consortium-based with EC monitoring as defined within a Grant Agreement and Consortium Agreement. Co-programmed partnerships are based on a MoU and contractual arrangements signed by representatives of the partners and the Commission, implemented independently by the partners and by Horizon Europe. Institutionalised partnerships are established through adoption of a Commission proposal (including impact assessment), and implemented by dedicated structures created for that purpose. Programmes implemented under institutionalised partnerships require a Decision by the Council and European Parliament in accordance with Article 185 TFEU, or by bodies established through a Decision of the Council pursuant to Article 187 TFEU, such as Joint Undertakings, or by EIT Knowledge and Innovation Communities, in compliance with the EIT Regulation and the EIT Strategic Innovation Agenda (SIA).

Variations in governance models between individual partnerships can involve, e.g., steering boards, scientific advisory groups, stakeholder fora, and state representative groups. In co-funded partnerships, Member States typically participate in ‘Governing Boards,’ which are the main decision-making bodies in the partnership. Typically, there is a dedicated governance body such as a ‘Call Management Board’ or ‘Call Secretariat’ who is responsible for management of research calls, which form the basis of funding of research and innovation actions through the partnership.

4.4.2. Organisational structure

The organisational structure of partnerships varies and is established by the governing elements of the partnership during its establishment and can include, for example, a Secretariat, a Research Council, Technical Committees, a Coordination Team, and full or observing/associate partners. In co-funded partnerships, partners can include universities, research organisations, bodies with a public service mission at local, regional, national or international level or civil society organisations including foundations and NGOs. Co-programmed and institutionalised partnerships can also involve industry partners.

4.4.3. Scope of operations/activities

The operations and activities of partnerships are defined within a specific thematic area and deliver research and innovation through open calls for proposals, which are in line with EU priorities and the thematic clusters and pillars of Horizon Europe.

4.4.4. Funding

European Partnerships are initiatives in which the EU and private and/or public partners, including national and regional research funders and – in the case of co-programmed or institutionalised partnerships – industry, to pool fund to support the development and implementation of a programme of research and innovation, including market, regulatory and policy uptake.

In co-funded Partnerships, beneficiaries in projects from the calls are typically funded at national level (on the basis of rules agreed by the partners) and co-financing be as high as 50%, but the most common rate is 30%. Co-funded partnerships can be funded up to the end of Horizon Europe (2021-2030). In contrast to ERA-NETs, their precursors in Horizon 2020, it is possible for the co-fund partners to use complementary European Structural and Investment Funds (e.g., European agricultural fund for rural development, European Social Fund, European Regional Development Fund, Recovery and Resilience Facility, the Cohesion Fund, etc.).

In co-programmed partnerships, national and regional funding programmes on a common thematic are again pooled, with an EC top-up. Research and innovation activities under the co-programmed partnerships can be funded up to 60% of the direct costs. Under Horizon Europe, 2021–2030, over 8 billion euro is committed to the co-programmed partnerships.

4.4.5. Benefits and limitations

Benefits:

- no need to establish a new legal entity
- financing secured in the medium-long term

Limitations:

- member states or industry commitment for funding necessary
- uncertainty regarding funding in the next programming period

4.4.6. Case study – European Partnership on Metrology

As European Partnerships are still a relatively new instrument, there is still limited information to base a more complete case study around, however the Metrology Partnership has some key similarities with a Geological Service for Europe. It was established as a public-public partnership and is run by EURAMET, the European Association of National Metrology Institutes, in cooperation with the European Commission, in order to create a sustainable and effective system for metrology at a European level.

This Partnership aims to ensure Europe has a world-class metrology system that:

- Provides metrology solutions, fundamental metrological reference data and methods, offering fit-for-purpose solutions supporting and stimulating European innovation and responding to societal challenges
- Supports and enables effective design and implementation of regulation and standards that underpin public policies that address societal challenges.



Impacts expected for the Partnership include supporting a wide range of policies, commercial interests and advancement of key European challenges. It aims to break new ground by contributing to the development of self-sustaining, coordinated metrology infrastructures, able to continue joint research and innovation after 2030.

History

Since 2007, EURAMET has operated a series of research programmes that enable their members to collaborate with each other and with industry and academia, to solve key challenges of metrological interest. Combined, these programmes have already provided 1 billion euro of support; co-funded by the Member States and the European Commission as part of Framework Programme 7 and Horizon 2020 initiatives.

The European Metrology Research Programme (EMRP) funded 119 joint research projects and nearly 400 additional researcher grants, and the follow-on European Metrology Programme for Innovation and Research (EMPIR) resulted in 243 joint research projects, and the development of a number of European Metrology Networks.

In 2020, following on from EMRP and EMPIR, EURAMET proposed the European Partnership on Metrology to the European Commission for consideration under Horizon Europe. In November 2021, the European Partnership on Metrology was approved and the regulation was published in the Official Journal.

Governance & organisational structure

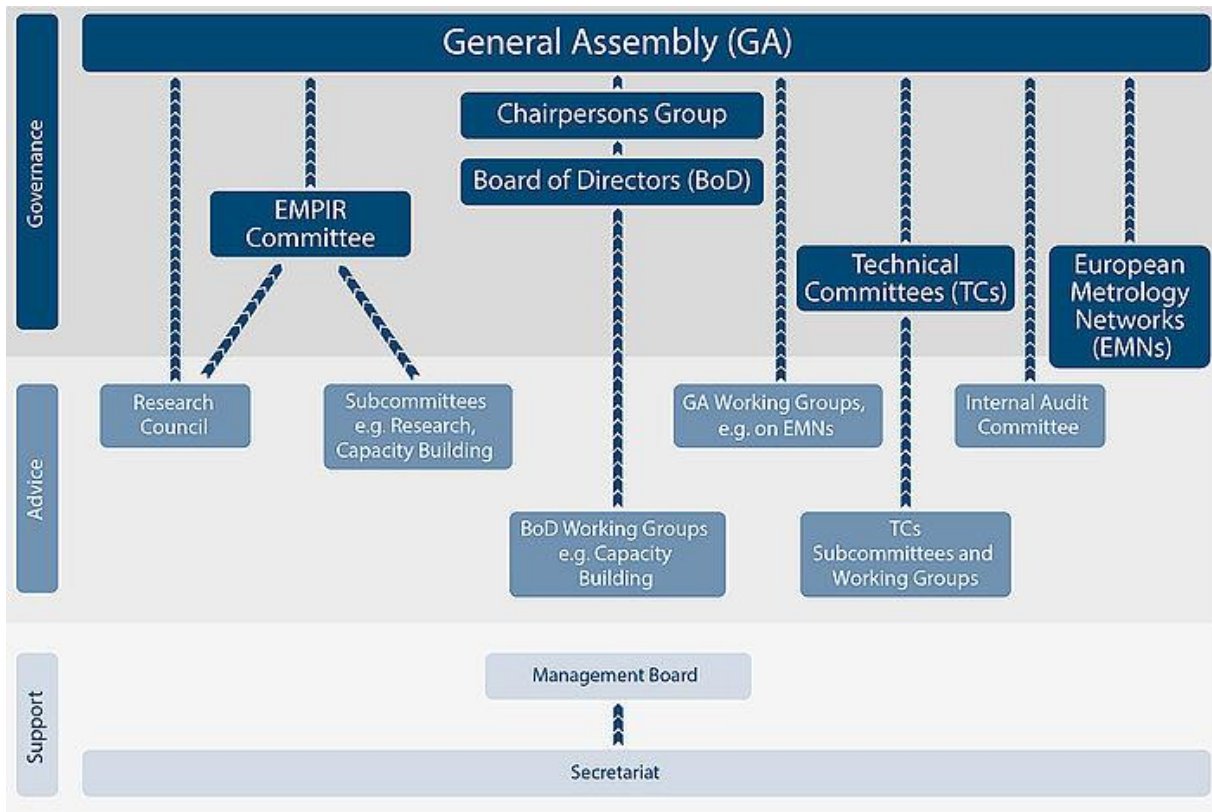


Figure 6: Organisational structure of the EURAMET
 (source: <https://www.euramet.org/about-euramet/organisation>)

The Metrology Partnership is an institutionalised partnership based on Article 185 TFEU. It has three levels of governance: the Metrology Partnership Committee, the Steering Group, and the Secretariat of EURAMET which is responsible for management and operations.

The European Commission and Member States involved are represented on the Steering Group, which is an advisory body of the Metrology Partnership established in accordance with Metrology Decision. It gives advice to the Metrology Partnership on the emerging priorities for metrology research at European level and on how to increase the impact of its research on European industry, economy and society. The group also monitors scientific achievements in specific sectors.

As EURAMET is charged with operational management, the organisational structure is embedded within their own operational and governance structure shown in Figure 6 (source: <https://www.euramet.org/about-euramet/organisation>). Whilst this is the only available representation of the EURAMET organisational structure, it should be noted that the “EMPIR Committee” should be replaced by the Metrology Partnership Committee, as the decision-making body for all matters concerning the execution of joint research programmes for the European Metrology Partnership.

Scope of operations

Metrology, the science of measurement, is a building block for an industrialised and increasingly globalised and digital society: Reliable measurements are essential for innovation in industry, research,



trade and regulation. New societal challenges and emerging technologies increase the need for accurate, precise, and trustworthy measurements and thus for novel measurement capabilities.

The Metrology Partnership will bring together the measurement science community and stakeholders to deliver on global challenges including health and climate, support the European Green Deal, and underpin innovation in industry through collaborative research.

The Metrology Partnership aims to support accelerating the transition towards a green, climate neutral and digital Europe, as well as strengthening the resilience, competitiveness, and economic growth of the European industry.

The expected impact of the European Partnership on Metrology is manifold, as it will support a wide range of policies, commerce and advancement of key European challenges.

The Partnership builds on the progress achieved under the previous European Metrology Research Programmes, and aims to break new ground by contributing to the development of self-sustaining, coordinated metrology infrastructures, with the capacity to continue joint research and innovation after 2030.

Funding

The Partnership will be co-funded by the Member States and the EU (under Horizon Europe) with an expected budget of around 690 million euro (300 million euro of which is EU funding and the remaining co-funded by the participating member states).

Benefits and limitations

The Article 185 TFEU model for a European Partnership can be deemed a suitable model through which to establish a GSE, as a co-funded research programme supported by the EU and Member States involved. Much of the operational structure and wider stakeholder network required to enact a European Partnership is also already in place through the existing operations of EGS. However, it is understood that the European Commission is not in favour of adding to the current Art.185 initiatives in operation. In addition, while research and innovation actions will be a crucial component of the wider operations of a GSE, the primary focus of the European Partnerships on research programming puts into question the amount of resources that might be available towards service provision, data infrastructure management, and policy support.

Relevance to a Geological Service for Europe

An Article 185 TFEU programme with a focus on geoscience has been considered a possibility for over 10 years and continues to be a potential legislative solution to establishing a sustainable GSE. The Metrology Partnership is an interesting comparison to the ambitions of establishing the GSE, in particular the similarities between EURAMET and EGS as non-profit associations representing national public institutions at European level, that already have proven records in joint programming and long-lasting cooperation.

**Unless otherwise referenced, the information for this case study was drawn from the EURAMET website (<https://www.euramet.org/>) and the Metrology Partnership website (<https://www.metpart.eu/>).*

4.5. European Research Infrastructure Consortium

4.5.1. What is ERIC?

The European Research Infrastructure Consortium (ERIC) is a specific legal form that facilitates the establishment and operation of Research Infrastructures with European interest, recognised as an international body or organisation by all EU Member States and, where applicable, associated and third countries, to operate a research infrastructure. Any EU Member State, associated country or third country may be represented by one or more public entities within an ERIC.

The ERIC can be established and operate as either single-sited or distributed infrastructures, allowing the establishment and operation of new or existing Research Infrastructures on a non-economic basis. An ERIC can also carry out some limited economic activities related to this task.

4.5.2. Requirements for an ERIC

- It must be a European joint-venture (also allows the participation of countries from outside Europe);
- The infrastructure is necessary to carry out research programmes and projects;
- It represents added-value in the development of the European Research Area (ERA) and significant improvement in the relevant scientific and technological fields;
- Effective access is granted to the European research community in accordance with the rules established in the statutes;
- It contributes to the mobility of knowledge and/or researchers within the ERA;
- It contributes to the dissemination and optimisation of the results.

4.5.3. Procedures for Establishing an ERIC

Procedures to obtain a formal commitment of a state to become a member or host an ERIC vary from country to country. The stakeholders of future ERICs are advised to work, well in advance, with their national authorities when preparing an ERIC.

4.5.4. Benefits and limitations

Benefits

- A legal capacity recognised in all EU countries;
- Flexibility to adapt to specific requirements of each infrastructure;
- A faster process than creating an international organisation;
- A great flexibility is allowed concerning the rules of functioning;
- Exemptions from VAT and excise duty;
- The liability of the members can be limited.

An ERIC may adopt its own procurement procedures which have to respect the principles of transparency, non-discrimination and competition.

Limitations

- Possible political constraints due to the fact that the members are the Member States;

- Risk of heavier administrative burden for the creation and the functioning of the structure;
- Any amendments of the statutes should be submitted to the European Commission for approval.

4.5.5. Case study: European Plate Observing System (EPOS-ERIC)

EPOS, the European Plate Observing System, is a multidisciplinary, distributed research infrastructure that facilitates the integrated use of data, data products, and facilities from the solid Earth science community in Europe. It aims to establish and underpin a sustainable and long-term access to solid Earth science data and services integrating diverse European Research Infrastructures under a common federated framework.

History

The conception for EPOS came about in 1997 and evolved over a number of years through European and national-funded projects and initiatives which focused on integrating and distributing digital data, until EPOS was approved by ESFRI to be included in the European roadmap for research infrastructures in December 2008. From November 2010 EPOS entered its “Preparatory Phase” (PP) project, funded under the European Commission’s Seventh Framework Programme, which ended in October 2014.

From 2015-2019 EPOS continued with the Implementation Phase (IP) and the establishment of the EPOS-ERIC, agreed by the EPOS Governmental Representatives and the implementation of a technical, legal and governance, and financial framework for all its components, IT architecture and interoperable services that needed to be created. On October 30th, 2018, the European Commission granted the legal status of European Research Infrastructure Consortium (ERIC) to EPOS. The ERIC legal framework provides EPOS with legal personality and capacity recognised in all EU Member States and with the flexibility to adapt to the specific requirements of each infrastructure.

Governance & organisational structure

The EPOS ERIC legal seat is hosted in Rome, at the Istituto Nazionale di Geofisica e Vulcanologia (INGV) headquarter. The ICS Central Hub (ICS-C) is hosted in the United Kingdom (BGS) and France (BRGM) with technical operational support from Denmark (GEUS). EPOS ERIC is currently joined by seventeen countries: Austria, Belgium, Denmark, France, Greece, Iceland, Italy, the Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Sweden and the United Kingdom, and Germany and Switzerland participating as Observers.

The governance and organisational structure consists of multiple bodies:

- The General Assembly (GA) of members is the governing body of the EPOS infrastructure. The GA is composed of representatives of the EPOS ERIC members, with voting rights, and observers, with no voting rights. Moreover, the GA decides on proposals for amending the Statutes, termination of membership or observer status, extension the EPOS ERIC duration period, termination of EPOS ERIC.
- The Executive Director is the legal representative of EPOS ERIC, directly responsible to the General Assembly for all aspects of the EPOS activities, namely the day-to-day management of EPOS ERIC in accordance with the Statutes and the Implementing Rules. The Executive Director is supported by the Executive Coordination Office (ECO),
- The Executive Coordination Office has the central role of coordinating the entire infrastructure including the operation of the integrated (ICS) and thematic (TCS) services. The ECO, led by

the Executive Director, is composed of a Scientific Officer, IT Officer, Capacity Building Officer and Administrative, IT, Management & Operations and Communication Units.

- The Services Coordination Committee, representing all EPOS RI Thematic Core Services (TCS) and the Integrated Core Services (ICS), informs and assists the Executive Director in formulating and executing the EPOS Annual Work Plan by verifying the operational performances of the infrastructure. The Service Coordination Committee fosters harmonisation of data and metadata standards across the TCS optimizing the allocated resources for data archiving and service provision.
- The External advisory boards (Scientific Board and Ethics Board) are in charge of monitoring the quality of EPOS ERIC activities, providing external evaluations on activities development and results achievement. Their evaluation reports and recommendations are discussed annually by the General Assembly.
- The ICS-Central Hub Office is a body in charge of the operational activities performed by the central hub of the integrated core services. This body acts under the coordination of the ECO in addressing the indications of the Service Coordination Committee. The ICS-C is hosted in the United Kingdom (BGS) and France (BRGM) with technical operational support from Denmark (GEUS).

Scope of operations

The EPOS overarching goal is to establish a comprehensive multidisciplinary research platform for the Earth sciences in Europe. EPOS aims to:

- represent a scientific vision and approach in which innovative multidisciplinary research is made possible for a better understanding of the physical processes controlling earthquakes, volcanic eruptions, unrest episodes and tsunamis as well as those driving tectonics and Earth surface dynamics;
- establish a long-term plan to facilitate the integrated use of data, models and facilities from existing, and new distributed research infrastructures (RIs), for solid Earth science;
- adopt appropriate legal solutions to manage distributed pan European Research Infrastructures, securing on a common and shared data policy, the open access and the transparent use of data and guaranteeing mutual respect of the intellectual property rights.

EPOS ERIC is the European Consortium that coordinates the EPOS Research Infrastructure and its Delivery Framework. The ERIC legal framework aims to operate EPOS and provide an effective governance plan to the TCS and the ICS.

The Thematic Core Services (TCS) represent the community-specific transnational governance frameworks where data and services are provided to answer scientific questions and where each community discusses their specific implementation, best practices and sustainability strategies as well as legal and ethical issues. The TCS was designed taking into account the requirements of the different EPOS communities.

The Integrated Core Services (ICS) represent the novel e-infrastructure that will allow access to multidisciplinary data, products (including synthetic data from simulations, processing and visualisation tools), and services to different stakeholders, including but not limited to the scientific community (i.e., users). The key element of the ICS in EPOS will be a central hub (ICS-C) where users can discover and access data and data products available in the TCS and NRIs as well as access a set of services for

integrating and analysing multidisciplinary data. The technical interface between TCS and ICS is the compatibility layer, which guarantees communication and interoperability. The ICS-C single-sited e-infrastructure will include the EPOS portal and its key functions. The ICS-C will also provide access to distributed resources which form the distributed ICS (ICS-d) and include access to supercomputing facilities as well as to visualisation, processing and modelling tools that need not be centralised.

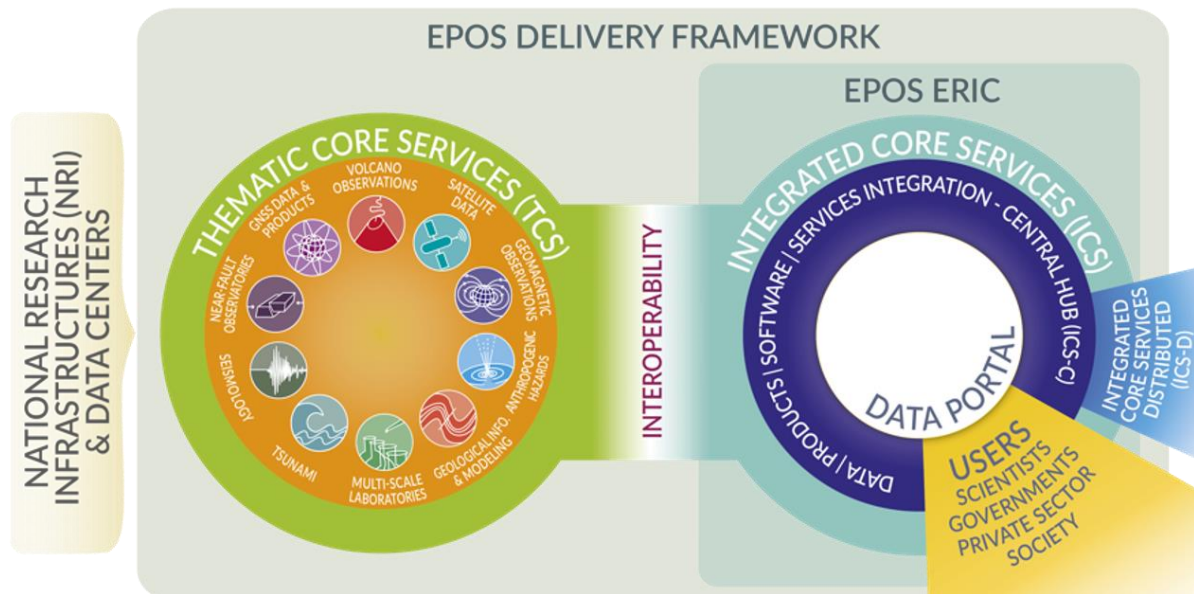


Figure 7. EPOS Architecture (source: <https://www.epos-eu.org/about-epos/what-we-do>)

Funding

The resources of EPOS ERIC consist of the following:

- financial contributions of members and permanent observers (membership fees) according to Annex II of the Statutes
- host contributions of members and permanent observers
- in-kind contributions according to the EPOS ERIC Implementing Rules
- additional voluntary contributions according to the EPOS ERIC Implementing Rules
- grants within limits and under terms approved by the General Assembly
- other resources within limits and under terms approved by the General Assembly.

The annual budget is determined in accordance with calculations set out in Annex II of the EPOS-ERIC Statutes (EPOS ERIC Statutes Amended Version, 23 June 2023), which based on 2017 prices was estimated at €4.4 million per year for the first 5-year period.

EPOS-ERIC was established for an initial period of 20 years, which may be extended by a two-third majority decision of the General Assembly.

Benefits and limitations



In the case of the EPOS ERIC, they achieved long term security for their infrastructure through the establishment of an ERIC. However, it appears they may struggle in maintaining a stable budget as they are reliant on membership fees to generate the majority of their annual budget.

Relevance to a Geological Service for Europe

EGS is an active participant in the EPOS ERIC, coordinating the Geological Information and Modelling Thematic Core Service, providing limited data and information that is already available through the EGDl platform. EGS investigated the possibility of establishing an ERIC for a European geological data service in 2012/2013, but the ERIC instrument was deemed too limited in scope to be able to effectively perform the services the Geological Surveys are capable of providing.

**Unless otherwise referenced, the information for this case study was drawn from the EPOS website (<https://www.epos-eu.org/>).*

4.6. EGS independent initiative

4.6.1. Independent legal entity

Independent legal entity means an entity having a public purpose relating to the state or its citizens that is individually created by the state or is given by the state the right to exist and conduct its affairs. It does not respond to a higher organisation, has its own governance and ways of funding the activities and is independent in the process of decision making. These may be established in any country or territory under varying legislative frameworks, however Belgium is a very attractive jurisdiction for setting up non-profit organisations (NPO's) and will be the focus for this option.

Belgian law recognises four legal forms of non-profit organisations:

1. Non-profit associations (ASBL/VZW): a group of natural persons or legal entities pursuing a charitable goal. The non-profit association consists of at least two persons.
2. International non-profit associations (AISBL/IVZW): a group of natural persons or legal persons that pursues a charitable goal of international benefit.
3. Private Foundations (fondation privée / private stichting): a legal entity created by the allocation by one or several founders of personal or real assets to the implementation of a selfless aim.
4. Foundations of Public Interest (fondation d'utilité publique / stichting van openbaar nut): the same as a Private Foundation, except that they must necessarily be intended to implement a purpose of a philanthropic, philosophical, religious, scientific, artistic, educational or cultural character, and is subject to authorisation by Royal Decree.

As of today, roughly 110.000 NPO's exist, 2.000 of them being international non-profit associations and 380 Foundations of general public interest.

International non-profit associations

Governance

An AISBL/IVZW have non-profit, international purposes which, together with its activities, must be written in statutes – a legal act performed by a notary. Legal personality is granted by royal decree and each modification to the statutes requires a new royal decree. This legal personality, independent of that of its members, has its own rights and obligations. The Members can be paid/compensated to perform specific tasks (administration, etc) but cannot receive any money for just being a member. It accepts the legal persons as members, has to be set up in accordance with the relevant Belgian law and has a legal capacity to contract.

Organisational structure

The AISBL/IVZW is made up of two organs, the general management body also called “general assembly”, and the administrative body, which administers the association and takes care of its day-to-day activities. The statutes determine the form, composition and mode of operation of the administrative body. The Governance Structure usually is described with: Council, Board of the Council, Scientific Steering Committee, Access Committee, Board of Directors, Members, Hosting Members or other, relevant terms.

Scope of operations

The AISBL/IVZW must be located in Belgium, however the members can live elsewhere with only a delegate/proxy being based in Belgium. The minimal number of members is two and there's no maximal limit. The status of members must be regulated in the statutes. AISBL/IVZW are also recognised outside of Belgium, which makes it easier for them to get services in other European countries and to transfer to another European country. AISBL/IVZW is appropriate where the main objective is to have a community run organisation that has as members legal persons from more than one jurisdiction. Members have limited liability and do not tie their own assets to the fate of the association. They must however still act in good faith, and could still be sued for example for knowingly using their position in the association to make it perform illegal acts.

Funding

The AISBL/IVZW don't require any initial capital to be created. Typically, the AISBL/IVZW are funded via the membership fees, however they can generate their own budget through limited commercial operations (sell goodies, etc) as long as it serves the non-profit purpose and does not generate benefit for its members. Allowing commercial activities must be indicated in the statutes. Engaging in commercial activities also makes the association subject to VAT and taxes. Even without any capital contribution or commercial operations, the association must comply with a number of accounting obligations.

Benefits and risks

As an international legal person, the organisation is flexible, doesn't require any initial capital, has a clear legal regime across Member States and is community owned. Additionally, it has tax benefits, limited liability for members, and the ability to operate internationally. The AISBL/IVZW can raise funds and engage in activities that are in line with their nonprofit missions. The risk of AISBL/IVZW is no required commitment from the Member States.

Private & Public Interest Foundations

Governance

A foundation is a legal entity, established for a specific purpose, such as charitable, cultural, or scientific pursuits. The foundation, as opposed to an association, requires funding members who are willing to invest money to pursue its goal.

Foundations that are recognised as having a public benefit purpose by the Belgian government are exempt from many taxes, including corporate income tax, gift and inheritance tax, and registration duties. This can be a significant advantage for organisations that are dependent on donations from supporters.

The private foundations must be established through a notarial deed or a private agreement. None of these legal entities requires a certain minimum capital(https://justice.belgium.be/fr/themes_et_dossiers/societes_associations_et_fondations/associations/aisbl/personnalite_juridique_et_depot).

Considered Structures

If a foundation shares the same non-profit goal, it differs from an ASBL/VZW by simply having no partners or members. The tax on the donations or inheritances may greatly vary depending on various

conditions. Hence, it requires an extremely careful tax planning to attain the desired goal of tax optimisation via the choice of the least taxed route.

Organisational structure

The governance of a foundation in Belgium is overseen by a board of directors, which is responsible for making decisions, setting the overall strategy and direction of the organisation. The board is also responsible for ensuring that the foundation operates in accordance with all laws and regulations.

In addition to the board of directors, a foundation in Belgium also has a supervisory board, which is responsible for overseeing the activities of the board of directors. The supervisory board is composed of at least three members, who are also appointed by the founders of the foundation or by the existing board members.

Scope of operations

The mission and objectives of a foundation define its scope of operations. The foundation is usually established to support a specific cause or promote a particular agenda. It may engage in activities such as funding research, providing grants to organisations or individuals, organizing events, advocating for policy change, or creating awareness about social issues. The foundation may also invest in programs or initiatives that align with its mission and values. Ultimately, the scope of operations of a foundation is defined by its mission and the impact it seeks to make in society.

Funding

Public and private foundations get their funds from the donors and other sources. The way of fundraising diverse foundations between private and public. A public foundation relies on a large number of people, while a private foundation is generally funded by a single, large endowment of funds. This endowment is used to generate profits through investments. A public charity solicits donations from donors, grants and the community. The endowment structure of foundations allows for a steady source of funding through investments. Foundations are not required to pay out the full amount of their endowment each year, but they must spend at least 5% on charitable activities. This means that foundations are more likely to be able to fund large-scale projects, while public charities must rely on smaller donations from a larger number of people.

Benefits and risks

Private Foundations have greater control over their assets than public charities, and they are not required to pay out a certain percentage of their income. In addition, they can receive grants from other charitable organisations, but public charities cannot. They can use any money that is left over at the end of the year as they see fit.

As much as it can be beneficial, they are also required to pay a small excise tax each year on the amount of their net investment assets. They are also subject to an additional 2% tax on investment income, which is imposed on the net investment income that exceeds the foundation's minimum payout requirement.

Public charities, on the other hand, don't need to pay any taxes on their investment earnings because they are not required to distribute any of their earnings. This tax difference is the reason why foundations tend to have more money available for grants than public charities. In fact, if a foundation's investment income is less than its minimum payout, it will be subject to a 100% tax on its net investment income.

The difference between the two types of charities impacts how they are regulated.

References

The above information was collected and validated through the following sources:

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Legal form and Governance Models 'Open Access Infrastructure for Research in Europe towards 2020. Deliverable Code: D1.2 – Goals and strategy of legal entity; D1.4 - Governance model for OpenAIRE legal entity'. Version (0.1 - Draft)

Service from hub.brussels '1819', the Brussels agency for business support website

<https://1819.brussels/en/information-library/start-business-formalities/non-profit-association-npo>

Thomson Reuters 'Practical Law' Tool website https://content.next.westlaw.com/8-633-0854?_lrTS=20230107005955784&transitionType=Default&contextData=%28sc.Default%29

4.6.2. Own run initiative within existing structure of EuroGeoSurveys

History

EuroGeoSurveys (EGS) presents the experiences and achievements of more than 50 years of supporting Geoscience across Europe and highlights the path towards a Geological Service for Europe. In 1970, Geological Survey Directors developed the concept of a partnership to promote geoscience in Europe which evolved to an informal network of 21 Western European Geological Surveys (WEGS). The organisation was increasing collaboration between members and developing of thematic working groups and in 1992 it became the official Forum of European Geological Surveys (FOREGS). With the encouragement from the European Commission (EC), in 1995, the GS from the 15 EU Member States and Norway formed EGS as a non-profit, international association. The GS progressed to become key contributors to EU co-funded geoscience research and development projects and policies while constantly growing with Members from Europe. When in 2011, European Parliament called on the EC to assess the need for an EU GS, the EGS members declared their commitment to establish a common European Geological Knowledge Base and a Geological Service for Europe in 2014. In 2016, EGS launches the European Geological Data Infrastructure (EGDI) that evolved over the years and is still functional in 2023.

EGDI provides access to Pan-European and national geological datasets and services from the GS Organisations of Europe. It is central to EGS' key strategy to establish a Geological Service for Europe and underpins EC strategies in areas where geological data and information are vital.

Governance

EGS is governed by the General Assembly of the Members and by the Executive Committee. EGS is a non-profit organisation located in Belgium, governed by the Belgian law of a non-profit nature. It connects currently 37 national and regional Geological Surveys from Europe. It's based on the agreement between those surveys, who, through their membership fees, support the activity of the Secretariat.

Currently, the EGDI Consortium (the core team of experts from GEUS, GeoZS, BRGM, BGS, CGS, and CSIC-IGME who manage the operations and basic maintenance of EGDI) has the EGS General Assembly and the ExCom who approve the work of the platform and provide strategic guidance. EGDI is still in the process of establishing the governance, with a possible case presented on the Figure 8. In this case, the role of EGS General Assembly and ExCom does not change, however, GSEU has a strong influence and high requirements on the EGDI operations through the funding that project brings.

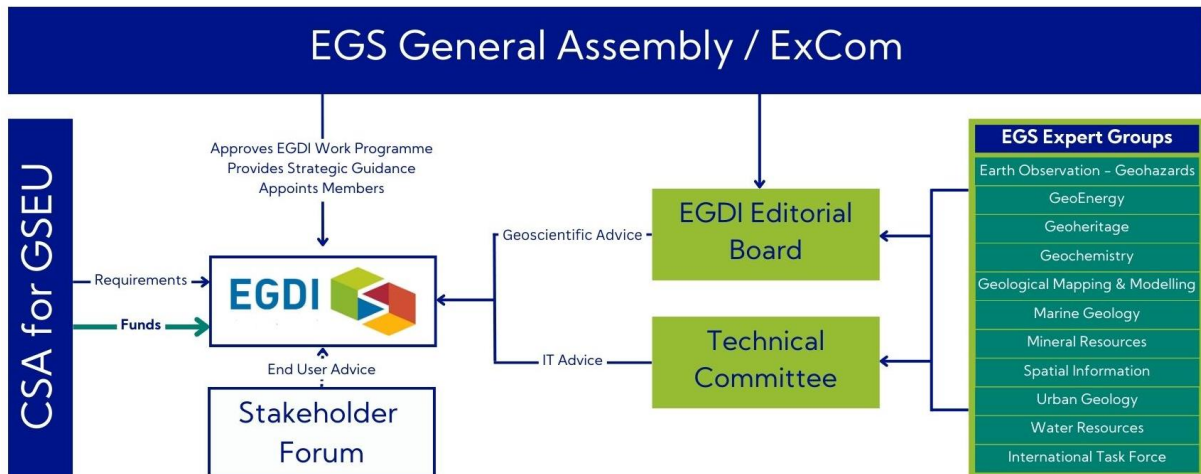


Figure 8. The proposed organisational structure of EGDI

Organisational structure

EGS is built from an Executive Committee (ExCom) that consist of six Members (President, Vice-President, Treasurer and three additional Members), Board of Directors and the Secretariat with Secretary General. The Executive Committee (ExCom) manages the EGS' affairs and the General Assembly as a supreme governing body, has the power of overseeing the ExCom, and direct the actions of the organisation. The EGS Secretariat is the operational body of EGS.

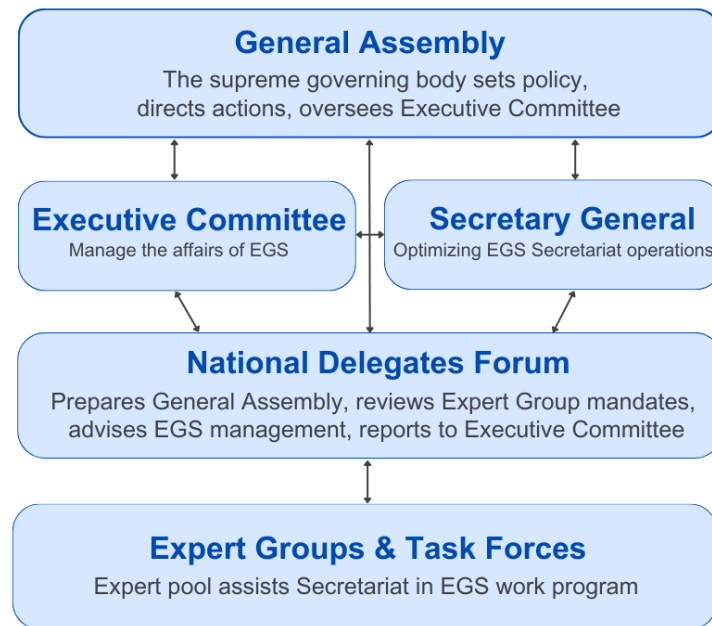


Figure 9. The organisational structure of EGS

The EGDI current organisational structure, from 2021, has the EGDI Consortium with EGS General Assembly and ExCom approving the work of the platform and providing strategic guidance. The Spatial Information Expert Group delivers information and makes sure the platform is operational.

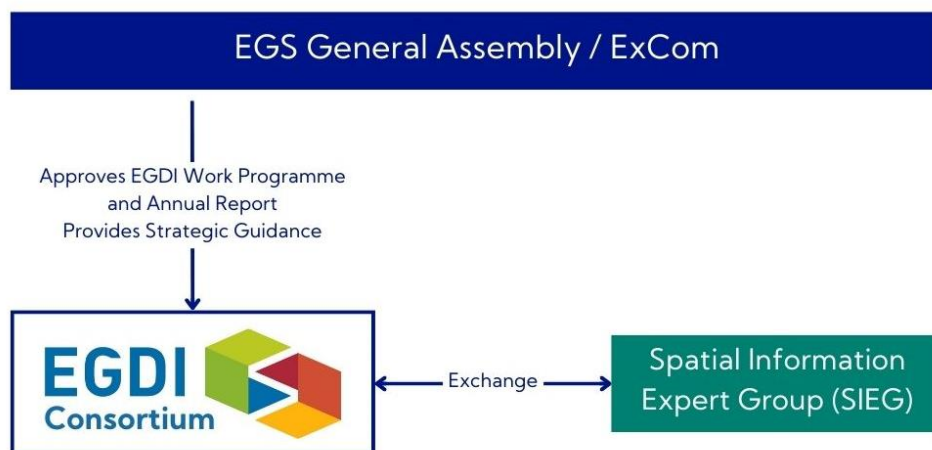


Figure 10. The current organisational structure of EGDI

The EGS' Expert Groups would provide the data and knowledge to the EGDI editorial board and technical committee, who would provide the geoscientific and IT advice to the EGDI operations. The EGS General Assembly and the ExCom would still have the same role as currently. They would also have an impact on the created EGDI editorial board. Both, the EGDI editorial board and the EGDI operations would respond to the EGS Assembly and the ExCom. Currently, the budget for EGDI support comes from the GSEU project, which brings also certain requirements. The Stakeholder Forum is thought of as a separate body, that provides only the end user advice.



Scope of operations/activities (including main long-term deliverables and overarching mission)

EGS activities are of a not-for-profit scientific and have international character. They promote the contribution of geosciences to EU affairs and action programmes; provide a permanent network between the Geological Surveys of Europe and a common, but not unique, gateway to each of the Members and their national networks; jointly address European issues of common interest in the field of geoscience; publish, or see its Members publishing, technical advice for the EU Institutions.

EGS pursues activities that lie in the public interest or in the interest of public administration that benefits from the combined and coordinated expertise of its members and in the direct interest of the EU and/or of the European Free Trade Association. EGS acts either in response to specific requests from the EU, or through its own initiative in formulating proposals for actions of interest to the EU, which may be either inside the EU or beyond its borders. In furtherance of these objectives, EGS can engage in any lawful activity that can reasonably be expected of an association and undertake such activities as it considers appropriate to the achievement of its aims and objectives (including, but not limited to, conferences, training courses, seminars, workshops, focus groups, study tours, staff exchanges, studies, surveys, publishing, software tools, and lobbying). The Members, at their discretion, commit to providing resources in expertise, equipment and data, for which they don't obtain any financial advantage.

EGS doesn't perform activities that would undesirably overlap with the activities of the Members.

Funding

The operational costs of EGS are covered by the membership fees, with additional income from projects. The fees are paid on an annual basis and revised every three years. The EGS Secretariat also generates a minor amount of additional income from the rent of its meeting room in its headquarters in Brussels.

The initial scoping study carried out prior to establishing EGDI was co-funded by the EU through the FP7 research programme (EGDI-Scope, Grant Agreement no. 312845, 2012-2014). Following that, EGS self-financed the development of the EGDI platform with its members until its launch in 2016, and the ensuing maintenance costs, although further development was very limited due to budget constraints. Integration and harmonisation of new and existing datasets to EGDI has been supported through various projects since its launch, most notably from the GeoERA ERA-NET programme (Grant Agreement no. 731166, 2017-2022), co-funded by the EU. Currently, EGDI is being further developed with funding from the GSEU Project.

Benefits and limitations

The benefit of EGS as an organisation is that it allows to stay independent from another supra-organisation. The organisation is free to join any project, become a member of an association, upon approval by the General Assembly. However, it also means that the only sustained funding source is coming from membership fees, which in itself can vary depending on the size of membership and decision of the members on the fee structure. Additional non-commercial funding sources can vary drastically from year to year, for example project funds, and cannot always be relied upon.

References

EGS Statutes, 2019

<https://eurogeosurveys.org/>

4.7. European Digital Infrastructure Consortium (EDIC)

A European Digital Infrastructure Consortium (EDIC) is a new legal entity created by the European Commission (2022) under Decision (EU) 2022/2481 establishing the Digital Decade policy programme 2030. The Decision establishes a framework for multi-country digital projects envisaged to contribute to delivering digital targets at EU level by 2030. The main goals of the Digital Decade policy programme are summarised as:

- a digitally skilled population and highly skilled digital professionals
- **secure and sustainable digital infrastructures**
- digital transformation of businesses
- digitalisation of public services.

Specific to data infrastructures, the policy programme specifies:

- “providing secure and accessible digital and data infrastructures capable of efficiently storing, transmitting and processing vast volumes of data,”
- “reducing the geographical digital divide and granting access to digital technologies and data on open, accessible and fair terms,” and
- “developing a comprehensive and sustainable ecosystem of interoperable digital infrastructures.”



Figure 11. Reporting and roadmaps related to the Digital Decade policy programme 2030
 (source: https://digital-strategy.ec.europa.eu/en/policies/europes-digital-decade#tab_2)

By October 9, 2023, each Member State will submit to the Commission a National Roadmap outlining measures to contribute to EU level objectives and digital targets. The first Report on the Digital Decade

will be published by January 9, 2024, and is expected already in Q4 2023. The report will identify significant gaps and shortages and recommend policies, measures or actions to be taken by Member States. Within 5 months of publication of the report and every second year thereafter, the Member States will submit revised national roadmaps.

One of the tools for achieving the objectives and digital targets of the Digital Decade will be multi-country projects.

Multi-country projects shall aim to achieve one or more of several specific goals listed here:

- a. improving the cooperation between the Union and the Member States and among the Member States in achieving the general objectives
- b. reinforcing the Union's technological excellence, leadership, innovation and industrial competitiveness in critical technologies, complementary technology combinations, and digital products, infrastructure and services that are essential for economic recovery and growth and for the security and safety of individuals
- c. addressing strategic vulnerabilities and dependencies of the Union along the digital supply chains in order to enhance their resilience
- d. increasing the availability, and promoting the best use, of safe digital solutions in areas of public interest and the private sector while observing the principles of technological neutrality
- e. contributing to an inclusive and sustainable digital transformation of the economy and society that benefits all citizens and businesses, in particular SMEs, across the Union
- f. promoting digital skills for citizens through education, training and life-long learning, with a focus on fostering gender-balanced participation in education and career opportunities.

Multi-country projects must involve at least 3 Member States. Third countries may participate in multi-country projects if those countries are associated to a directly managed Union programme which supports the digital transformation of the Union, and if its participation is necessary to facilitate the achievement of the general objectives and digital targets with regard to the Union and the Member States.

Multi-country projects may be implemented by recourse to any of the following mechanisms:

- a. joint undertakings
- b. European Research Infrastructure Consortia
- c. the Union's agencies
- d. independently by the Member States concerned
- e. to promote the execution of important projects of common European interest under Article 107(3), point (b), TFEU
- f. European digital infrastructure consortia (EDIC)
- g. other appropriate implementation mechanisms.

Thus, multi-country projects may be implemented by Member States by means of an EDIC. Member States may be represented by one or more public entities, including regions or private entities with a public service mission, as a member of an EDIC. EDICs will have legal personality from the date of entry into force of the relevant Commission decision (see Article 14(3) of European Commission, 2022). EDICs will have a statutory seat located on the territory of a Member State that is a member providing

a financial or non-financial contribution and will have the legal capacity accorded to legal entities under the law of the Member State in which they are located. They may acquire, own and dispose of movable, immovable and intellectual property, conclude contracts and be a party to legal proceedings.

To establish an EDIC, Member States must submit a written application to the European Commission containing:

- a. a request to the Commission to set up the EDIC;
- b. the proposed Statutes of the EDIC
- c. a technical description of the multi-country project to be implemented by the EDIC
- d. a declaration by the host Member State whether it recognises the EDIC as an international body.

The Commission will decide whether to accept or reject the application. If rejected, it is possible for Member States to instead form a multi-country project consortium by way of an agreement (see above).

Governance

An EDIC must have at least the following two bodies:

- a. **an assembly of members** made up of the Member States, other eligible entities, and the Commission, the assembly being the body having full decision-making powers, including the adoption of the budget
- b. **a director**, appointed by the assembly of members, as the executive body and legal representative of the EDIC.

The Commission will participate in the assembly, without having voting rights. However, where a centrally managed Union programme contributes financially to a multi-country project, the Commission will have a veto right against decisions related only to actions financed under centrally-managed Union programmes.

Organisational structure

Membership of an EDIC must include at least 3 Member States. Only Member States providing a financial or non-financial contribution are eligible to become members and have voting rights. Other Member State may become members at any time, based on terms to be specified in the Statutes. Member States providing a financial or non-financial contribution may also join as Observers with no voting rights. Membership may be open to entities other than Member States, which may include third countries as, international organisations of European interest, and public or private entities, as specified in the EDIC Statutes. Where entities other than Member States are members, Member States shall hold jointly the majority of the voting rights, regardless of the contributions from entities other than Member States.

Scope of operations

Non-exhaustive areas of activity in which multi-country projects addressing the objectives of the Digital Decade policy programme could be established include:

- a. **European common data infrastructure and services**
- b. endowing the Union with the next generation of low-power trusted processors
- c. developing the pan-European deployment of 5G corridors

- d. acquiring supercomputers and quantum computers, connected with the European high-performance computing (EuroHPC)
- e. developing and deploying an ultra-secure quantum and space-based communication infrastructures
- f. deploying a network of security operations centres
- g. connected public administration**
- h. European blockchain services infrastructure
- i. European digital innovation hubs (EDIHs)
- j. high-tech partnerships for digital skills through the 'Pact for Skills' initiative
- k. skills and training in cybersecurity
- l. other projects which meet all the requirements set out in Article 11 and which become necessary to the achievement of the general objectives of the Digital Decade Policy Programme 2030 over time due to emerging social, economic or environmental developments.**

Funding

According to decision (EU) 2022/2481 establishing the Digital Decade policy programme, all Union programmes and investment schemes may, if allowed by the acts establishing them, contribute to a multi-country project. Other entities, whether public or private, may contribute to multi-country projects, where appropriate.

Benefits and risks

An EDIC appears quite suited and relevant to a GSE given that the EGDI – data infrastructure and knowledge hub – are central to the operation of a GSE and given that EDICs are specifically designed to support secure and sustainable digital infrastructures. Benefits include a close link to, and mandate from the Commission, and an apparently simple path to establishment and consequent access to EU programs and investment schemes.

Table 2: Options analysis overview – opportunities and risks

Proposed GSE structure	Opportunities	Risks
Intergovernmental organisation	<p>Permanent structure secured under international law</p> <p>Member State support via binding agreement</p> <p>Flexible financing options, while usually primarily via memberships fees</p> <p>Potential for influential policy role</p> <p>Allows possibilities for drawing on very wide expert networks</p> <p>Can be centralised or decentralised (multiple nodes, for example)</p> <p>Can encompass research, infrastructure, and advisory roles</p> <p>Strong potential for complementing and strengthening related national services/organisations</p> <p>No direct link to the European Commission</p>	<p>Typically very long lead-in time to establishing IGOs</p> <p>Can generate conflicts between national and IGO policy</p> <p>Establishment requires definition of a strong multi-state need/vision that cannot be achieved alone</p> <p>Financing via sources beyond membership fees requires organisational strategic considerations</p> <p>No direct link to the European Commission</p>
EC-established initiative of joint cooperation (e.g., EMODnet)	<p>Long-term initiative established by European Commission</p> <p>Allows possibilities for drawing on very wide expert networks</p> <p>Can be cross-thematic</p> <p>Strong basis in research, but also provision of advisory, infrastructure, and services</p> <p>Managed under a single European Commission DG</p>	<p>Funding via calls for tender</p> <p>Specific services are funded and must be defined carefully to avoid overlaps with other providers</p> <p>Performance contracts cannot exceed 2 years</p> <p>Joint funding from several DGs is possible, which can introduce complexities</p> <p>Managed under a single European Commission DG</p>

Proposed GSE structure	Opportunities	Risks
Decentralised European Agency	<ul style="list-style-type: none"> Permanent structure secured under EU law Secure EU financing Part of the EU institutional system Reduces workload of EU institutions Cost reduction for EU institutions Governance allows neutrality in relation to national interests Allows possibilities for drawing on very wide expert networks Priorities closely linked to EU policy and strategy Not linked to a single European Commission DG 	<ul style="list-style-type: none"> EU budget subject to annual negotiation and impacted by macro-economic influences Priorities closely linked to EU policy and strategy (also a challenge e.g., in the case of EEA that saw a quadrupling of its budget over 4 years as a result of the Green Deal and Russia's invasion of Ukraine) Already a very large network of EU agencies to navigate within
European Partnership	<ul style="list-style-type: none"> Broad consortiums possible, including industry, academia, research organisations, public bodies, civil society organisations Strong research and innovation focus Funding sources can be pooled No new legal entity required in the case of co-fund or co-programmed partnerships Long-term funding (ca 10 years) 	<ul style="list-style-type: none"> Largely restricted to research and innovation rather than services, coordination and support Competitive funding calls rather than dedicated funding, as would be preferred in the case of a data infrastructure and knowledge hub Requirement for Member State or industry funding commitments with only 30-60% EU co-funding Funding insecure beyond each programming period

Proposed GSE structure	Opportunities	Risks
European Research Infrastructure Consortium	<p>A legal capacity recognised in all EU countries and associated/third countries</p> <p>A faster process than creating an international organisation</p> <p>A great flexibility is allowed concerning the rules of functioning</p> <p>Exemptions from VAT and excise duty</p> <p>Strong research and innovation focus</p>	<p>Restricted to research and innovation rather than services, coordination and policy support</p> <p>Requirement for Member State or industry funding commitments</p> <p>Possible political constraints because the members are national entities</p> <p>Risk of heavier administrative burden for the creation and the functioning of the structure</p> <p>Any amendments of the statutes should be submitted to the European Commission for approval</p>
EGS independent initiative	<p>Strong basis in research, but also provision of advisory, infrastructure, and services</p> <p>Independent agenda</p>	<p>Limited funding via membership fees and insecure/periodic funding from project sources</p> <p>Limited direct links to the EU institutions</p> <p>Organisation must be based in Belgium operating under Belgian law</p>

Proposed GSE structure	Opportunities	Risks
<p>European Digital Infrastructure Consortium (EDIC)</p>	<p>A legal capacity recognised in all EU countries</p> <p>Legal recognition by the EC, including Commission representation on the governance</p> <p>Priorities closely linked to EU and national policy and strategy (linked to Digital Decade policy programme and national roadmaps)</p> <p>Flexible funding options (EC, EU, Member State, private) with potential for significant funding</p> <p>Can be centred around a European common data infrastructure and services (EGDI), which is envisaged as central to the GSE</p>	<p>Structure is linked to the Digital Decade policy programme for 2030. The roadmap for relevant policy beyond 2030 is not yet defined.</p>

4.8. Summary of Options Analysis

Seven options have been outlined as potential candidates for the organisational structure of a GSE: Intergovernmental organisation; EC-established initiative of joint cooperation, decentralised European agency, European partnership (co-funded, co-programmed, or institutionalised), European Research Infrastructure Consortium, EGS independent initiative, and European Digital Infrastructure Consortium. The most financially and politically secure long-term structures include intergovernmental organisations, EU agencies, and institutionalised EU Partnerships, however all – particularly intergovernmental organisations and EU agencies – require relatively long lead in periods (typically decades) and are bureaucratically heavy during this establishment phase. In contrast, the simplest structures, such as the existing structure of not-for-profit organisation EuroGeoSurveys, are also the least secure in terms of member commitment and funding, funding that is also limited largely by membership fees and dependency on sporadic project funding. Thus, some of the middle-ground options (in terms of organisational and funding security) seem more viable. These include an EC-established initiative of joint cooperation (such as EMODnet), a European Partnership (co-funded or co-programmed), an ERIC, or an EDIC. However, ERICS and Partnerships primarily fund research, whereas an EC-established initiative of joint cooperation or an EDIC may have more potential to provide secure funding for the needed coordination and support actions delivered through the data infrastructure and knowledge hub that is an essential core component of a GSE.

5. Actions and roadmap for achieving a GSE

Before deciding on the preferred organisational model for a GSE, it is not possible to finalise appropriate actions. However, there are useful actions and planning that can be initiated, and that are necessary, on the path to any of the possible models. Therefore, we outline an interim roadmap to support the transition towards a sustainable GSE, in line with the revised EGS strategy, and including actions already underway.

As a framework for the roadmap, the following key points must be considered:

- There is broad consensus, based on stakeholder discussions with representatives of the EU institutions, research community, and industry, that there is a **strong need for sound, up-to-date geoscientific, pan-European harmonised data to support multiple policy areas** that require knowledge of the subsurface.
- There is also broad consensus, from the same stakeholder discussions, that **to gain support, application of this data and knowledge base to policy must be clearly demonstrated** via case studies, i.e., the direct, and immediate policy applicability of EGDI must be demonstrated.
- Many EU policy areas were once (scientifically) considered in relative isolation, such as raw materials, carbon capture, renewable energy, water resource management, the agricultural sector, defence, marine planning, environmental management, urban development. There is increasing policy recognition that these **policy areas intersect in the subsurface and will increasingly face issues of prioritisation of subsurface use**. In parallel, 3D and 4D geomodelling of the subsurface is reaching new levels of sophistication and international expert collaboration, also in parallel with rapidly advancing AI and other machine learning technologies that are increasingly capable of the complex predictive modelling of distinct subsurface datasets. These developments highlight the opportunity, and the need in building a case for a sustainable GSE, to build EGDI into a holistic knowledge base to serve multiple Green Deal ambitions and implementation of supporting legislation.
- Again, there is broad consensus, based on stakeholder discussions, that recognition from the EC and from the research community, who are already aware of and use EGDI, is useful in gaining support for a future sustainable GSE, but there is an **urgent need for strong Member State support**, particularly in raising awareness and further action in the Council. Thus, active engagement from EGS members in national-level lobbying is required.
- For a GSE to be viable, there **must be clear benefits for both national and EU level key stakeholders**, specifically national governments and the EU.
- There is a multitude of diverse European data infrastructures and data spaces that are relevant to the Green Deal. **EGDI, as the foundation of a GSE, must find its place in this community of data spaces.**

Table 3. Interim draft roadmap 2023–2027

Objectives	Actions	Participating entities	Timescale
Build EGS strategic focus on achieving a sustainable GSE	Implement a revised EGS strategy focused on achieving a legal basis of a sustainable GSE	EGS strategy working group , EGS Secretariat, EGS members, EGS Expert Groups	2022–2023*
	Designate responsible EGS ExCom members for implementation of the strategy's 4 pillars – Support Decision Making (Earth Science for Policy), Data and Information Infrastructure, Applied Research, and the cross-cutting Communication pillar	EGS ExCom , EGS members	Q4 2023
	Develop a strategic implementation plan including policy-relevant refocusing of EGS Expert Groups activities	EGS strategy working group , EGS ExCom, EGS members	Q1 2024
	Designate responsible EGS experts for the strategy's 4 thematic goals – Resourcing Europe, Energy Transition and Decarbonisation, Enhancing safety, security and wellbeing for EU citizens, The Subsurface in Europe's Digital Twin	EGS ExCom , EGS members, EGS Expert Groups	Q1 2024
	Revise the EGS SRIA in line with EU policy needs and EGS strategy	WP9 , GSEU partners, EGS members, EGS Expert Groups	2024
Determine stakeholder GSE needs	Stakeholder interviews and Deliverables 8.7 & 8.8 – Stakeholder mapping – needs and expectations	WP8, WP9, EGS Project Manager, EGS Secretariat <i>DGs:</i> CLIMA, CNECT, ECHO, ENER, ENV, GROW, INTPA, JRC, MARE, REGIO, RTD, TRADE <i>Agencies:</i> EEA, EIT <i>Partnerships:</i> Agriculture of Data, Water4All, Clean Hydrogen, Clean Energy Transition, Sustainable Blue Economy, EOSC, EIT Raw Materials	2023-2024* Deliverable 8.7* & 8.8
	Use this interim report as a basis for engagement with key GSEU stakeholders (specifically EC) to carry out a detailed stakeholder needs analysis for GSE		2023–2027*: Regular, ongoing stakeholder engagement regarding the most suitable model for a GSE

Objectives	Actions	Participating entities	Timescale
		<i>Projects:</i> Futuram, GREAT (Green Deal Data Space), EIT	
	Advisory board representation on key related projects	EGS Secretary General , Futuram, GREAT (Green Deal Data Space)	<u>2023–2025</u>
Establish required geoscientific knowledge base	Build required pan-European datasets , standards, and metadata Apply for relevant projects under anticipated calls in the proposed EU Partnership on Raw Materials for the Green and Digital Transition (2025–2027) to feed EGDI with up-to-date CRM data relevant to implementation of the CRM Act and as a research component of the future GSE	WPs 2–7 , GSEU partners, extended geoscientific research network (as relevant)	2022–2027* (staged, with implementation as data products become available)
Demonstrate policy application of EGDI and the policy need for integrated 3/4D geomodelling capacity (via EGDI) to support implementation of diverse Green Deal legislation	Through a knowledge brokering program linking GSEU experts and EGDI data products with policy makers via a series of in-person engagements, identify key policy questions that must be answered. From this, develop science-based policy tools that can be applied using EGDI to usefully serve policy on an ongoing basis. Link this activity with the detailed needs analysis.	WP9 , GSEU experts (WPs 2–7), EGS Secretariat, DGs GROW, ENV, ENER, CLIMA, MARE, EEA	2024: develop key case studies that can be incorporated into a position paper (see below) 2025–2027: develop additional policy relevant case studies
	Continue to identify and respond to opportunities for scientific advice via EU public consultations	EGS Secretariat , EGS Expert Groups, GSEU WP leads and partners	<u>2022: Critical Raw Materials Act</u> <u>2023*: Net Zero Industry Act</u> , Soil Health Law*, Industrial Carbon Management Plan*
	Build EGS coordinated actions within bilateral EU strategic partnerships on Raw Materials (e.g., Ukraine, African countries, Greenland)	EGS Secretariat , EGS Expert Groups, EGS members, EGS ExCom, GSEU project manager, DG GROW, ERMA, OAGS and African Geological Surveys	<u>2022: Ukraine</u> 2023: Greenland* 2024–2025: Africa

Objectives	Actions	Participating entities	Timescale
	Embed coordinated EGS-NGSO advisory services into the CRM Regulation	EGS Secretariat , EGS Expert Groups, EGS ExCom, GSEU project manager, DG GROW	2023–2024*
	Continue to contribute to EU expert advisory boards (e.g., GEO HLWG, WGGW, RMSG, Soil EG) and seek similar opportunities.	EGS Expert Group representatives , GSEU partners, EGS Secretariat, EGS Secretary General	<u>2022–2027*</u>
	Engage with DG CLIMA regarding a coordinated EGS representation regarding the NZI Act on relevant legally mandated stakeholder groups	EGS Secretariat , EGS Expert Group Chairs, GSEU project manager, GSEU WP leads	Q3 2023*
	In coordination with DG GROW, develop the MIN4EU database for use as the open CRM database (primary and secondary, i.e., waste dumps) required under the CRM Act, including by first showcasing initial GSEU products that directly serve these policy needs .	WP2 , WP7, GSEU partners, DG GROW, Futuram	2023–2024*
	In coordination with DG CLIMA, develop an atlas of subsurface storage targeted at contributing to implementation of the NZI Act .	WP3 , WP7, GSEU partners, DG CLIMA	2023–2024*
	Develop visualisation and policy applications of EGDI 3/4D data models for Europe	WP7 , GSEU partners, relevant DGs: CLIMA, CNECT, ENER, ENV, GROW,	2023–2027*: with implementation as data products become available
	Using EGDI as the foundation and the Dutch key register for the subsurface as a case study, explore the case for and the policy needs for and interest in future cross-thematic geomodelling via EGDI as the basis for pan-European subsurface spatial planning to reduce risk and cost in implementation of EU legislation, while sustainably managing competing subsurface use.	EGS Secretariat , EGS Expert Groups, EGS ExCom, GSEU WP7 & 9, EEA, DGs CLIMA, CNECT, DEFIS, ECHO, ENER, ENV, GROW, JRC, MARE, REGIO, RTD, TRADE	2023–2024*
Gain national-level support for a GSE	Gain EGS member support for, and carry out, EGS/GSEU events linked to the EU Presidency , highlighting application of GSEU/ EGDI/ GSE to the Presidency agendas. Develop and coordinate this network of national contacts to bring GSE to the Council agenda in the context of EU science-policy advisory (e.g., multi-Member State support for EGS position papers)	WP9, WP8, other WPs as relevant, EGS Secretariat , GSEU partners, relevant NGSOs (Hungary, Poland, Denmark, Cyprus, Ireland, Lithuania, Greece) and their relevant ministries, EU Council, EC	2024–2027*

Objectives	Actions	Participating entities	Timescale
	Explore possibility of developing a 3+ country consortium to establish EGDI as a multi-country project (European Digital Infrastructure Consortium)		
Establish EGDI as a high value dataset	Build formalised links between EGDI and the Green Deal Data Space	EGS Secretariat, WP7 , GSEU partners, GREAT project, GDDS, DG CNECT	2023–2024*
Develop geoscientific community support for GSE	Build a broad community of geoscientific and industry partners willing to partner in a future potential future sustainable GSE model	WP9 , GSEU partners, EGU, EFG, EAGE, EIT RM, ETP SMR, industry associations	2024–2025
Agree organisational structure for GSE	Use this interim report as a basis for further engagement with the GSEU consortium, conclude the 2-3 most suitable options for more detailed analysis in the next phase of task 9.3. Deliverable 9.9 “Technical Report on the feasibility and functional structure of the Geological Service for Europe v2_FINAL” (month 30)	WP9 , GSEU partners, EGS members, DGs as relevant, Member State governments as relevant	Q1 2025
Gain EU-level support for a GSE	Engage with relevant EU institutions, with national-level support, to advocate for the selected model for a GSE	WP9 , EGS Secretariat, GSEU partners, EGS members, EC (post ‘27 work programme)	Q1-Q2 2025
Agree implementation plan	Deliverable 9.10 “ GSE Implementation Plan ” (month 48)	WP9 , GSEU partners, EGS members, DGs as relevant, Member State governments as relevant	Q4 2026
Implement GSE		WP9 , GSEU partners, EGS members, DGs as relevant, Member State governments as relevant	2027 onward



Given that the GSEU project will end in September 2027, ideally the GSE would be in place and ready to begin full operation at that point, or by start 2028 latest. This would coincide with the onset of the successor to Horizon Europe. This requires that the framework for the GSE is decided prior to initiation of the strategic planning process for the successor to Horizon Europe, which is likely to start around mid-2025. This timing fits well with the planned final Deliverable 9.9 “Technical Report on the feasibility and functional structure of the Geological Service for Europe v2_FINAL” in February 2025.

Importantly, a core component of the GSE is the delivery of harmonised, up-to-date data, information, and expert knowledge through an EGDI. The EDIC structure is a potentially viable option to achieve this as a secure structure focussed on multi-country digital projects and providing access to EU and national funding. An EDIC is also a structure that could be initiated in the short to medium term, through establishment of a 3-state (minimum) multi-country project in the context of biannual readjustments of national roadmaps in response to the annual State of the Digital Decade report, the next of which is anticipated in late 2023 or early 2024. However, an important point is that data must remain up to date. A GSE requires ongoing data collection and research to maintain a strong knowledge base. It may be necessary to consider some combination of structure, e.g., an EDIC complemented by a co-fund partnership. If so, the roadmap to a GSE would need to be in place by early 2025 to anticipate the strategic planning process for the successor to Horizon Europe. Similarly, it may be prudent to maximise engagement of incipient GSE activities in existing relevant partnerships such as Water4All and the proposed EU partnership on Raw Materials for the Green and Digital Transition, a candidate for the 2025-2027 partnerships and the successor of the ERA-MIN co-fund action.

6. Concluding remarks

This **interim report**, on the feasibility and functional structure of the Geological Service for Europe (GSE), establishes a foundation for further discussion of stakeholder views and needs for a sustainably funded GSE. The **key objectives** of a sustainably funded GSE have been here defined as:

1. **harmonised geoscientific/subsurface FAIR data**, information, and knowledge
2. a **pan-European expert network**
3. recognition of the GSE as the **geoscientific reference partner** for the European Commission
4. the provision of geoscience data and expertise to **inform and support sound policy**
5. a **proactive and responsive** science-policy service.

To achieve these key objectives, the GSE must deliver **permanent access to**:

1. A **harmonised data inventory and infrastructure, EGDI**, supporting knowledge of critical raw materials resources; geological maps and models; sustainable geoenery capacities; groundwater monitoring, assessment, and forecasting; offshore windfarm siting; coastal vulnerability; geomodelling and visualisation.
2. A **knowledge hub** with integrated decision support tools to make EGDI a cohesive and accessible knowledge resource for users, via a data hub, applications, collaboration tools, and educational facilities.
3. the **EU International Centre of Excellence on Sustainable Resource Management**, to establish and maintain partner networks and build capacity in and promote implementation of UNFC and UNRMS.

To achieve these key objectives, the GSE must also deliver **on-demand services including** policy relevant white papers, reports, and expert advisory services.

Of the **seven organisational models considered** in the context of a future GSE (Intergovernmental Organisation, Agency, Commission initiated Joint Cooperation, European Partnership, ERIC, EGS independent initiative, and EDIC), all have benefits and risks. Most secure in terms of funding, legal status, and security of the partnership/s is the IGO model. However, history demonstrates that IGOs have very long lead-in times for implementation. The same is true of decentralised EU Agencies, which also have a secure legal basis, but which also belong to the EU institutions, which would not be the case with an IGO model for the GSE. This means that agencies have very strong ties to EU policy, strategy, and budgets, which all have pros and cons. Three other models considered – joint cooperation, European Partnership, and ERIC – can all have significant budgets, but these are typically secured for shorter periods (often up to ten years) and tend to have a very strong research, rather than applied science-for-policy, focus. However, this is not always the case and some recent initiatives with these structures also have a strong policy-serving focus (e.g., the Water4All Partnership). An EGS independent initiative has the benefit of a very flexible, member-governed governance and operational structure but poor financial security, being dependent on limited membership fees and ad-hoc project income. The EDIC structure, with its focus on securing sustainable digital infrastructures, seems suited to formalising and gaining a mandate and funding for a core component of the GSE, its digital infrastructure and associated knowledge hub.

The **development of an interim roadmap** towards a future sustainable GSE takes into account **several key points** recognised from stakeholder discussions and from this initial options analysis, namely:

1. **harmonised, pan-European geoscience-based data is needed to support multiple policy areas**
2. to gain support, **application** of this knowledge base to policy **must be clearly demonstrated**;
3. there is a **strong need for national-level support** for a GSE
4. there **must be clear benefits of a GSE at national- and EU-level**
5. the GSE must comprise **a service that benefits all members** and which **cannot be delivered by any one member alone**, i.e., it must require collaboration
6. ideally, the fundamentals of the **GSE should be easy to articulate and visualise** for non-specialists.

The **next steps** will be to take this interim report to our stakeholders to carry out **more in-depth needs analyses**. We will facilitate **knowledge brokering** to identify and develop EGDI-based science-policy tools and advisory services, and we will then **showcase EGDI application** to these policy needs. Aside from continuing our efforts to build support for a sustainable GSE through our various active and planned science-policy engagements, we will specifically explore the case for, and policy needs for, and interest in cross-thematic geomodelling as the basis for **integrated pan-European subsurface spatial planning**, using the products and services we will develop through EGDI and GSEU. We will also seek **national-level advocacy** for this activity. In parallel, we will continue to build on the **strategic links** being made (via WP7 and WP9) with other projects and with the larger community of **European Data Spaces** relevant to the Green Deal. These activities, through the next phase of WP9.3, will lead towards the development of the agreed organisational structure for the GSE (Deliverable 9.9) and the implementation plan for the GSE (Deliverable 9.10).



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9. Appendix I – Abbreviations

Abbreviations	
AI	Artificial intelligence
AISBL/IVZW	International non-profit associations
ASBL/VZW	Non-profit associations
BGS	British Geological Survey
BoD	Board of Directors
BRGM	Bureau de Recherches Géologiques et Minières / Geological Survey of France
CCS	Carbon Capture and Storage
CE	Council of Europe
CERN	European Organization for Nuclear Research / Conseil Européen pour la Recherche Nucléaire
CGS	Czech Geological Survey
CIS	Common Implementation Strategy
CLIMA	Directorate-General for Climate Action
CNECT	Directorate-General for Communications Networks, Content and Technology
COM	Communication From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions
CORINE	Coordination of Information on the Environment
COST	European Cooperation in Science and Technology
CRM	Critical Raw Materials
CSA	Coordination and Support Action
CSIC-IGME	Consejo Superior De Investigaciones Científicas - Instituto Geológico y Minero de España / Spanish Geological Survey
DEFIS	Directorate-General for Defence Industry and Space
DestinE	Destination Earth
DGs	Directorates General

EAGE	European Association of Geoscientists & Engineers
EASME	Executive Agency for Small and Medium-sized Enterprises
EC	European Commission
ECHO	Directorate-General for European Civil Protection and Humanitarian Aid Operations
ECMWF	European Centre for Medium-Range Weather Forecasts
ECO	Executive Coordination Office
EDIC	European Digital Infrastructure Consortium
EDIHs	European digital innovation hubs
EEA	European Environment Agency
EEC	European Economic Community
EFG	European Federation of Geologists
EFTA	European Free Trade Association
EG	Expert Group
EGDI	European Geological Data Infrastructure
EGS	EuroGeoSurveys
EGU	European Geosciences Union
Eionet	European Environment Information and Observation Network
EIT	European Institute of Innovation and Technology,
EJP	European Joint Programme
EMNs	European Metrology Networks
EMODnet	European Marine Observation and Data Network
EMPIR	European Metrology Programme for Innovation and Research
EMRP	European Metrology Research Programme
ENER	Directorate-General for Energy
ENV	Directorate-General for Environment
EOSC	European Open Science Cloud
EP	European Parliament

EPOS	European Plate Observing System
ERA-NET	European Research Area - Networks
ERIC	European Research Infrastructure Consortium
ERMA	European Raw Materials Alliance
ESA	European Space Agency
ESFRI	European Strategy Forum on Research Infrastructures
ETP SMR	European Technology Platform on Sustainable Mineral Resources
EU	European Union
EUMETNET - ECOMET	European Multi service Meteorological Awareness
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EURAMET	European Association of National Metrology Institutes
Euratom	European Atomic Energy Community
EuroHPC	European high-performance computing
ExCom	Executive Committee
FAIR	Findable, Accessible, Interoperable, and Reusable
FOREGS	Forum of European Geological Surveys
Futuram	Future Availability of Secondary Raw Materials
GA	General Assembly
GDDS	Green Deal Data Space
GEO	Group on Earth Observations
GeoZS	Geološki zavod Slovenije angleško ime / Geological Survey of Slovenia
GEUS	Geological Survey of Denmark and Greenland
GREAT	Green Deal Data Space project
GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
GS	Geological Surveys
GSE	Geological Service for Europe
GSEU	Geological Service for Europe project

GSO	Geological Survey Organisations
HLWG	High Level Working Group
ICE-SRM	International Centre of Excellence on Sustainable Resource Management
ICS-C	Integrated Core Services - Central Hub
ICT	Information and communication technologies
IGOs	Intergovernmental Organizations
INGV	Istituto Nazionale di Geofisica e Vulcanologia
INSPIRE	Infrastructure for spatial information in Europe
Interpol	International Criminal Police Organisaion
INTPA	Directorate-General for International Partnerships
IP	Implementation Phase
IT	Information technology
JRC	Joint Resource Centre
KIC	Knowledge and Innovation Community
MARE	Directorate-General for Maritime Affairs and Fisheries
MFF	Multi-Financial Framework
ML	Machine Learning
NAFTA	North American Free Trade Agreement
NATO	North Atlantic Treaty Organisation
NGSOs	National Geological Survey Organisations
NPO	Non-Profit Organisations
NRIs	National Research Infrastructures
NZI	Net Zero Industry
OAGS	Organisation of African Geological Surveys
OECD	Organisation for Economic Co-operation and Development
OPEC	Organization of Petroleum Exporting Countries
P2P	Public to Public Partnerships
PP	Preparatory Phase

PPP	Public Private Partnerships
REGIO	Directorate-General for Regional and Urban Policy
REGULATE	Regulation of Groundwater in Telecoupled Social-Ecological Systems
RIs	Research Infrastructures
RM	Raw Materials
RMSG	Raw Materials Supply Group
RTD	Directorate-General for Research and Innovation
SDGs	Sustainable Development Goals
SG	Steering Group
SGECs	Sustainable Geo-Energy Capacities
SIA	Strategic Innovation Agenda
SIEG	Spatial Information Expert Group
SMEs	Small and medium-sized enterprises
SRIA	Strategic Research and Innovation Agenda
TCs	Technical Committees
TCS	Thematic Core Services
TFEU	Treaty on the Functioning of the European Union
TRADE	Directorate-General for Trade
UN	United Nations
UNECE	United Nations Economic Commission for Europe
UNFC	United Nations Framework Classification
UNRMS	United Nations Resource Management System
VAT	Value added tax
WEGS	Western European Geological Surveys
WFD	Water Framework Directive
WGGW	Working Group Groundwater
WP	Work Package
WTO	World Trade Organization

10. Appendix II – Consortium Partners

Consortium partners			
	Partner Name	Acronym	Country
1	EuroGeoSurveys	EGS	Belgium
2	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek	TNO	Netherlands
3	Sherbimi Gjeologjik Shqiptar	AGS	Albania
4	Vlaamse Gewest	VLO	Belgium
5	Bureau de Recherches Géologiques et Minières	BRGM	France
6	Ministry for Finance and Employment	MFE	Malta
7	Hrvatski Geološki Institut	HGI-CGS	Croatia
8	Institut Royal des Sciences Naturelles de Belgique	RBINS-GSB	Belgium
9	Państwowy Instytut Geologiczny – Państwowy Instytut Badawczy	PGI-NRI	Poland
10	Institut Cartogràfic i Geològic de Catalunya	ICGC	Spain
11	Česká Geologická Služba	CGS	Czechia
12	Department of Environment, Climate and Communications - Geological Survey Ireland	GSI	Ireland
13	Agencia Estatal Consejo Superior de Investigaciones Científicas	CSIC-IGME	Spain
14	Bundesanstalt für Geowissenschaften und Rohstoffe	BGR	Germany
15	Geološki zavod Slovenije	GeoZS	Slovenia
16	Federalni Zavod za Geologiju Sarajevo	FZZG	Bosnia and Herzegovina
17	Istituto Superiore per la Protezione e la Ricerca Ambientale	ISPRA	Italy
18	Regione Umbria	Regione Umbria	Italy
19	State Research and Development Enterprise State Information Geological Fund of Ukraine	GIU	Ukraine
20	Institute of Geological Sciences National Academy of Sciences of Ukraine	IGS	Ukraine
21	M.P. Semenenko Institute of Geochemistry, Mineralogy and Ore Formation of NAS of Ukraine	IGMOF	Ukraine
22	Ukrainian Association of Geologists	UAG	Ukraine
23	Geologian Tutkimuskeskus	GTK	Finland
24	Geological Survey of Serbia	GZS	Serbia
25	Ministry of Agriculture, Rural Development and Environment of Cyprus	GSD	Cyprus
26	Norges Geologiske Undersøkelse	NGU	Norway

27	Latvijas Vides, ģeoloģijas un meteoroloģijas centrs SIA	LVGMC	Latvia
28	Sveriges Geologiska Undersökning	SGU	Sweden
29	Geological Survey of Denmark and Greenland	GEUS	Denmark
30	Institutul Geologic al României	IGR	Romania
31	Szabályozott Tevékenységek Felügyeleti Hatósága	SZTFH	Hungary
32	Eidgenössisches Departement für Verteidigung, Bevölkerungsschutz und Sport	VBS (DDPS)	Switzerland
33	Ελληνική Αρχή Γεωλογικών και Μεταλλευτικών Ερευνών	HSGME	Greece
34	Laboratório Nacional de Energia e Geologia I.P.	LNEG	Portugal
35	Lietuvos Geologijos Tarnyba prie Aplinkos Ministerijos	LGT	Lithuania
36	Geosphere Austria - Bundesanstalt für Geologie, Geophysik, Klimatologie und Meteorologie	Geosphere Austria	Austria
37	Service Géologique de Luxembourg	SGL	Luxembourg
38	Eesti Geoloogiateenistus	EGT	Estonia
39	Štátny Geologický ústav Dionýza Štúra	SGUDS	Slovakia
40	Íslenskar Orkurannsóknir	ISOR	Iceland
41	Instituto Português do Mar e da Atmosfera	IPMA	Portugal
42	Jarðfeingi	Jarðfeingi	Faroe Islands
43	Regierungspräsidium Freiburg	LGRB	Germany
44	Geologischer Dienst Nordrhein-Westfalen	GD NRW	Germany
45	Landesamt für Geologie und Bergwesen Sachsen-Anhalt	LfU	Germany
46	Vlaamse Milieumaatschappij	VMM	Belgium
47	Norwegian Petroleum Directorate	NPD	Norway
48	United Kingdom Research and Innovation - British Geological Survey	UKRI-BGS	UK