1. Action 1: Enable the open sharing of knowledge and the re-use of research outputs, including through the development of the European Open Science Cloud (EOSC)

Purpose of the Action and expected outcomes

Action 1 of the ERA Policy Agenda aims to facilitate a system of open sharing, seamless access, and reliable re-use of research data. Scientific discovery and research impact are highly dependent on an open sharing of scientific data and research outputs. However, there are obstacles to Open Science practices and digital research, as a significant part of scientific data: 1) is not shared openly, (2) never makes it to a trusted and sustainable repository, and (3) is poorly annotated or not formatted in a standardised way allowing for machine-readability.[1]

In view of enhancing Open Science (OS) in Europe, the ambition of the EOSC action is to provide an environment that allows researchers, innovators, companies and citizens to publish, find and re-use each other's data and tools (i.e., methods, protocols, software, and publications) for research, innovation and educational purposes.[2] In line with this ambition, the ERA Policy Agenda 2022-2024 envisions three main outcomes:[3]

- Deploying OS principles and identifying OS best practices;

- Deploying the core components and services of EOSC and integrating existing data infrastructures in Europe, working towards the interoperability of research data;

- Establishing a monitoring mechanism to collect data and benchmark investments, policies, digital research outputs, OS skills, and infrastructure capacities related to the EOSC.

Implementation of the Action

The implementation of the EOSC is based on long-term collaboration between the European Commission and stakeholders in the European research landscape, which was initiated in 2015. Between 2018 and 2020, the Commission invested EUR 250 million through Horizon 2020 to prototype components of the EOSC. Since June 2021 this initiative received further support at the EU level with the Portuguese Presidency of the Council and the European Commission recognising the implementation of the European Open Science Cloud (EOSC) as a major step towards realising a 'web of FAIR[4] data and services' in the ERA. In June 2023, the role of R&I in contributing to addressing societal challenges was reinforced by the Lund Declaration of the Swedish Presidency, on the reuse of high-quality research data.

From 2021 onwards, EOSC is transitioning into a stakeholder-driven approach, co-developed with the entire EOSC community.[5] The implementation of the action is based on a formally established **Co-programmed European Partnership on EOSC** under the Horizon Europe Framework Programme. The EOSC Partnership is governed through a tripartite collaboration of the European Commission, the EOSC Association (representing the European research community), and the EOSC Steering Board (representing EU Member States and Associated Countries).[6]

It is being implemented according to a **Strategic Research and Innovation Agenda** (SRIA) which was co-developed with the EOSC community. The SRIA sets three core objectives for EOSC: 1) Ensure that OS practices become the 'new normal', 2) Enable the definition of standards, and the development of tools and services, to

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[1] ERA Portal Austria, Introduction, available at: https://era.gv.at/era/era-policy-agenda/open-knowledge-sharingeosc.
[2] European Commission (2021), European Research Area Policy Agenda – Overview of actions for the period 2022-2024, p.4-5.
[3] Council of the European Union (2021), Future governance of the European Research Area (ERA), available at: https://data.consilium.europa.eu/doc/document/ST-14308-2021-INIT/en/pdf.
[4] Findable, Accessible, Interoperable and Reusable.
[5] European Commission (2021), European Research Area Policy Agenda – Overview of actions for the period 2022-2024.
[6] 'Tripartite Collaboration' on the EOSC website, available at: https://eosc.eu/tripartite-collaboration.

allow researchers to find, access, reuse, and combine results, and 3) Establish a sustainable and federated infrastructure enabling open sharing of scientific results.[7]

Details of progress achieved towards the expected outcomes of this action are described below.

Deploying OS principles and identifying OS best practices.

- Member States and Associated Countries have developed new **national strategies for Open Science policy** for the mainstreaming of Open Science practices and FAIR principles across national research funding programmes. Most countries have also developed action plans for the creation of national platforms and data services to enable the connection of national/regional research infrastructures to the EOSC platform. A recent example is the National Open Science Strategy 2023-2027 of Spain,[8] with the strategic objective of guaranteeing interoperable and robust digital infrastructures for Open Science in order to facilitate the integration of Spain's national Open Science policy into the international ecosystem, including EOSC.[9]

- Over 25 **national tripartite events** (involving the European Commission, Member States or Associated Countries, and the EOSC Association) and two annual **EOSC Symposiums** have taken place since 2022, bringing together stakeholders from governments, research performing organisations, and research communities across Europe to reflect on the key achievements and strategic challenges of EOSC implementation, as well as to identify priorities for the years ahead.[10]

- An **'EOSC Catalogue of Best Practices'** was published in 2023, with illustrative examples from committed countries on EOSC and Open Science practices targeting publications, data, software, infrastructure, etc.[11]

Deploying the core components and services of EOSC and integrating existing data infrastructures in Europe.

- The deployment of the EOSC is supported by relevant EU funding, under Horizon 2020 (2014-2020) and Horizon Europe (2021-2027). During 2023-2024, EUR 130 million are invested into contributing to the objectives of the EOSC Partnership. This is part of co-investment (with in-kind and financial contributions) by the EU and non-EU partners of at least EUR 1 billion foreseen for the period 2021-2027.

- For example, the ongoing **EOSC-FUTURE project** (April 2021 – September 2023) aims to connect major stakeholders in the EOSC ecosystem, develop scientific use cases in collaboration with the thematic communities, consolidate an EOSC Portal cataloguing, and provide access to several EOSC resources. Other calls, such as the 'Managed Services for the European Open Science Cloud platform'[12] and six new calls for proposals under **INFRAEOSC** support accessing quality FAIR services, consolidating the sustainability of the EOSC ecosystem, developing innovative services for EOSC Exchange.[13]

- Successful thematic demonstrations of EOSC use cases have also been deployed since 2020. The **BY-COVID project**[14] (funded under Horizon Europe) aims to make COVID-19 data accessible to scientists in laboratories but also to medical staff in hospitals or government officials. Other key contributions are the **Blue-Cloud** initiative (Blue Cloud project under Horizon 2020 and Blue Cloud 2026 project under Horizon Europe) and the **AquaINFRA** project, which aim to connect FAIR scientific

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[7] Strategic Research and Innovation Agenda (SRIA) of the EOSC, available at: https://eosc.eu/sites/default/files/SRIA%201.1%20final.pdf.

[8] Estrategia Nacional de Ciencia Abierta (ENCA), available at: https://www.ciencia.gob.es/InfoGeneralPortal/documento/c30b29d7-abac-4b31-9156-809927b5ee49.

[9] 'Ireland launches National Action Plan for Open Research 2022-2030' on EOSC website, available at: https://eosc.eu/news/ireland-launches-national-action-plan-open-research-2022-2030.

[10] EOSC Symposium 2023 website, available at: https://symposium23.eoscfuture.eu/programme.

[11] EOSC Future (2023), EOSC Catalogue of Best Practices, available at: https://zenodo.org/record/7574165.

[12] Managed Services for the European Open Science Cloud (EOSC) Platform, available at: https://etendering.ted.europa.eu/cft/cft-display.html?cftId=12087.

[13] 'Funding & tender opportunities' on the Single Electronic Data Interchange Area (SEDIA) website of the European Commission.

[14] Project website, available at: https://by-covid.org.

data on the marine and coastal environment, biodiversity, and the water cycle. These projects act as EOSC blueprints in their domains.

- Finally, the EOSC Tripartite Governance has initiated a strategic discussion on the **governance and sustainability options for EOSC after 2027**, including the possible evolution of the current EOSC European co-programmed partnership after Horizon Europe.[15]

Establishing a monitoring mechanism to collect data and benchmark investments, policies, digital research outputs, OS skills, and infrastructure capacities related to the EOSC.

- At the end of 2022, the EOSC Steering Board expert group published an 'Opinion **Paper on Monitoring Open Science'** which made recommendations in line with short-term objectives related to monitoring progress towards Open Science policies, and practices in Europe. The recommendations include the implementation of several target indicators by 2024, for example policy on Open Access to publications, and policy on data management.[16]

- This is facilitated by the **EOSC Observatory**,[17] a policy intelligence tool co-developed by the Commission, Member States, and Associated Countries. The tool, launched in November 2022, is a one-stop-shop providing policymakers with intelligence on Open Science implementation across Europe. This policy intelligence tool collects and visualises data on the implementation of EOSC policies, initiatives, and financial mechanisms in more than 30 contributing countries. Data and related analytical reports support the ERA Monitoring Mechanism, where appropriate.

In addition, the 'Analysis of the Survey on National Contributions to EOSC 2021' was considered for the subsequent paragraphs looking at the level of financial contribution, and the types of policies implemented on the national level. The survey was conducted among representatives of EU Member States and Associated Countries at the EOSC Steering Board, and aimed to collect data on measures, policies, and practices toward Open Science.[18]

According to the EOSC 2021 survey, 62% of the committed countries have one or more policies in place promoting Open Science, with many policies being put in place in 2021.[19] Based on information provided by the 2023 OECD STIP Survey, Figure 1 shows with respect to the **estimated budget expenditure range** for relevant policies that more than half of the monitored policies fall under lower budget ranges. Most policies are funded within a budget of EUR 1 million and 5 million (50 policies). The OECD STIP survey data includes initiatives that specifically target implementation of this ERA action, as well as those which have broader scope, but are also related to this ERA action.

Estimated financial contributions were most likely to come from relevant ministries (10 countries), and Research Funding Organisations (7 countries).[20] Many policies fall under the budget range of between 5 and 20 million (36 policies), and of less than EUR 1 million (37 policies). With respect to the **types of policy instruments**, the most common (Figure 15) are policies on collaborative infrastructures (e.g., academic libraries) and governance support, such as national strategic documents across all three budget categories. Policies providing direct financial support tend to provide between EUR 1-5 million in support. An example of an initiative with a budget of more than EUR 500 million is the Digital Europe Programme[21] at the EU level.

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[15] 'EOSC Building – Sharing Perspectives and Thoughts for the Future' presentation by Suzanne Dumouchel, Director, EOSC Association, June 2023, publicly available at: https://eosc.eu/sites/default/files/2023-06/20230613_EOSCbuilding-SuzanneDumouchel.pdf.

[16] European Commission (2022), Opinion paper on Monitoring Open Science, available at: https://op.europa.eu/en/publication-detail/-/publication/2bcde3e1-7f53-11ed-9887-01aa75ed71a1/language-en/format-PDF/source-280038927.

[17] EOSC Observatory, available at: https://eoscobservatory.eosc-portal.eu/home.

[18] Analysis of the survey results is based on the answers of 34 EOSC Steering Board members (25 Member countries, 8 Associated Countries, and 1 other country.

[19] EOSC Future (2021), Analysis of the Survey on National Contributions to EOSC 2021.

[20] Ibid.

[21] 'Digital Europe Programme', the EC website, available at: https://commission.europa.eu/funding-tenders/find-funding/eu-funding-programmes/digital-europe-programme_en.
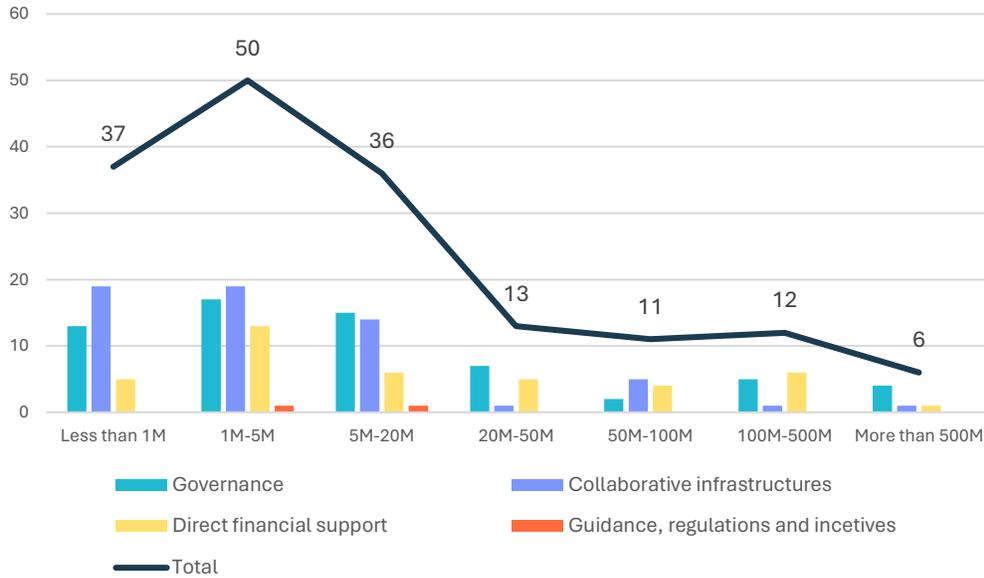
Figure 1: Action 1: Distribution of budget per policy instrument.

In terms of **policy themes**, the EOSC survey results showed that in 2020, 95% of existing policies in Member States and Associated Countries related to addressing open access to data, data management, and/or FAIR and policies addressing preservation and reuse of scientific information. However, the lowest percentage (48%) corresponded to policies addressing citizen science. Policies that were still in the planning phase at the time of the survey showed similar trends.[22]

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[22] EOSC Future (2021), Analysis of the Survey on National Contributions to EOSC 2021.