

NATIONAL STRATEGY FOR OPEN SCIENCE (ENCA)

2023 – 2027



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INTRODUCTION

Open science involves an evolution in the way scientific knowledge is produced, funded, communicated, and assessed. It represents a significant shift paradigm in research activities, dissemination of results, and measuring research performance that affects life sciences, physics, engineering, mathematics, social sciences, and humanities.

The concept of open science refers to open access to research outputs (publications, data, protocols, code, methodologies, software, etc.), the use of digital platforms based on open-source code, and the opening up of the entire scientific process, as much and as soon as possible, including practices such as open peer review, open educational resources, promotion of citizen science, and the development of new ways of research performance assessment, as summarized in Figure 1.

The six dimensions of open science are:

- **Open access to research outputs:** All publicly funded research available to society, to increase its visibility and dissemination, and to improve knowledge transfer.
- **Open data, protocols, and methodology:** New sources of information available to the research community, enabling reproducibility of analyses, improving understanding and scope of results, and contributing to speeding up discoveries through the reuse of data.
- **Open-source platforms:** Improved management and access to scientific information content databases ensuring the sustainability of digital infrastructures on which public R&D systems are based.
- **Open peer review:** Provide greater scientific rigor to reviews and to ensure transparency and accountability of all involved parties.
- **Citizen science:** Promote the participation of society in all phases of research activity, bringing scientific results closer to the public, and involving society in research design, data collection, and knowledge generation.
- **New ways of research performance assessment:** Provide incentives and recognition mechanisms for scientific merit that encourage open science practices among researchers.



Open science contributes to increasing transparency and encourages participation, cooperation, accountability, the ability to reuse research work, impact, and reproducibility of results. Likewise, it promotes the accessibility and sustainability of R&D systems and encourages the diversification of profiles in research groups and the incorporation of non-academic actors throughout the research process cycle, from project design to evaluation.

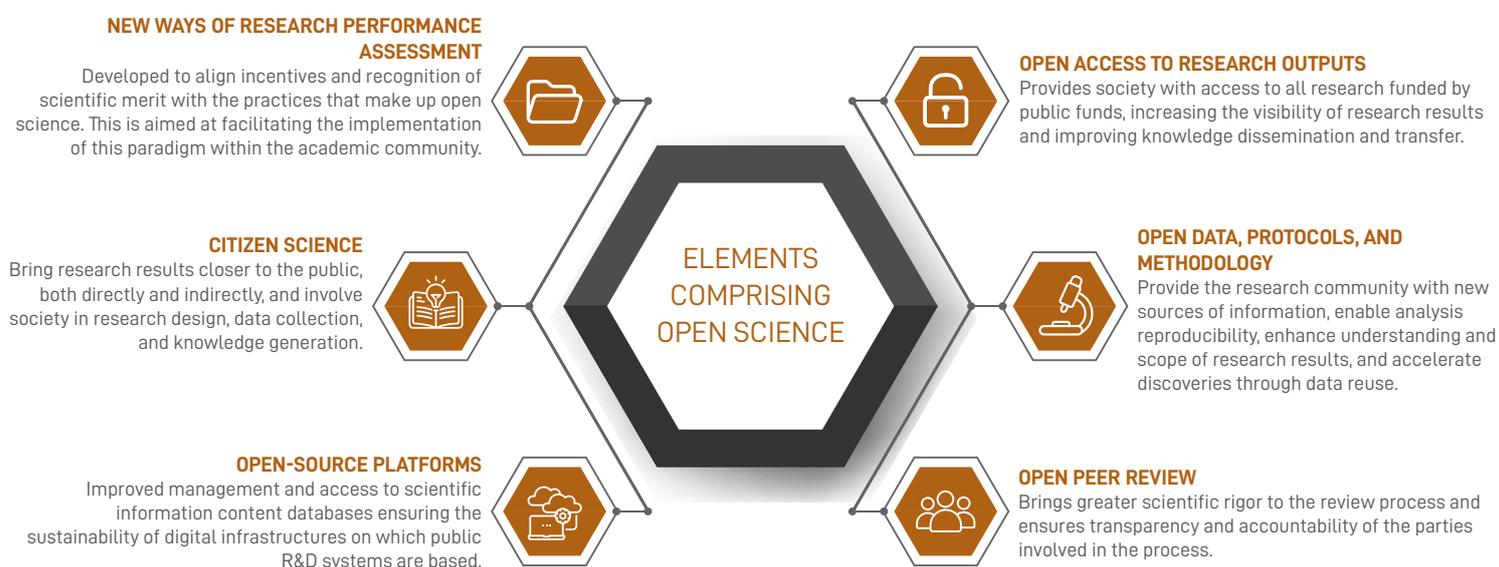


Figure 1: Elements comprising open science.

Source: Adapted from Gallagher, R.V., Falster, D.S., Maitner, B.S. et al. Open Science principles for accelerating trait-based science across the Tree of Life. *Nat Ecol Evol* 4, 294–303 (2020). <https://doi.org/10.1038/s41559-020-1109-6>

CONTEXT



The set of actions encompassed within open science is having a significant impact on scientific policy in Europe and globally. In the **European Union** context, the development of the new framework for the **European Research Area and Innovation**¹ (ERA) is based on the idea of a common area for research, innovation, and technology in Europe for a free circulation of knowledge. The collective construction of a stronger research area is based on prioritizing investments and reforms, ensuring the quality of science and universal access to it, as well as its valorization and communication to society, the economy, and industry, where open and transparent science plays a fundamental role².

In this European context, open science is being promoted through various actions. On the one hand, the European Union's **Horizon Europe** research and innovation framework program for the period 2021-2027 includes open science in various work programs, it identifies open science practices as excellent science, and introduces specific obligations regarding open access to scientific literature and research data management for its beneficiaries.

On the other hand, the **European Open Science Cloud (EOSC)** is being constructed, aiming to create a federation of existing research data infrastructures in Europe and to establish a network of data and related services for science, so they are interoperable, reusable, accessible, and open.

Furthermore, the **Council Conclusions on Research Assessment and Implementation of Open Science**³, adopted on June 10, 2022, provide a straightforward detailed defense of the need to modify the research assessment system, and advocate for

¹ Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions. A new ERA for Research and Innovation (2020) <https://eur-lex.europa.eu/legal-content/ES/TXT/HTML/?uri=CELEX:52020DC0628&from=EN>

² Section 2.4 of Communication SWD (2020) 214 final.

³ Conclusions of the Council on Research Evaluation and Implementation of Open Science <https://www.consilium.europa.eu/media/56958/st10126-en22.pdf>

strengthening the non-commercial model of publication and communication of research results. Additionally, initiatives are being implemented to improve research assessment, including the recognition of open science practices by researchers and institutions⁴.

The **Organization for Economic Cooperation and Development (OECD)** has been working since 2004 to make open science a reality⁵ by providing recommendations and incentivizing public policies that eliminate obstacles for a free circulation of data and knowledge and accelerate scientific research process⁶. Its recommendations to enhance data sharing and access⁷ and its recommendations for the use of publicly funded research data⁸ are particularly noteworthy, as they are aimed at improving open science.

Lastly, in November 2021 the **United Nations Educational, Scientific and Cultural Organization (UNESCO)** developed and approved the **Recommendation on Open Science**⁹. In this text, open science is presented as an inclusive construct

that combines various movements and practices to make scientific knowledge openly available, accessible, and reusable by all citizens. Likewise, UNESCO emphasizes increased scientific collaboration and information exchange for the benefit of science and society, as well as the opening of the processes of creating, evaluating, and communicating scientific knowledge to the public beyond the traditional scientific community.

Many countries in our environment have implemented open science strategies. Countries such as the Netherlands¹⁰, Finland¹¹, France¹², Ireland¹³, Switzerland¹⁴, Portugal¹⁵, Latvia¹⁶, and Italy¹⁷ have formally established policies, work programs, and teams, and allocated budgets to carry them out. Norway¹⁸, Sweden¹⁹, and Denmark²⁰, on the other hand, have strong open access policies that include additional measures in favor of open science. Furthermore, several European countries, such as Germany, are investing in the creation of national research data infrastructures and networks for reproducibility

⁴ Process towards an agreement on reforming research assessment https://ec.europa.eu/info/news/process-towards-agreement-reforming-research-assessment-2022-jan-18_en

⁵ OECD. Making Open Science a Reality (2015): <https://doi.org/10.1787/5jrs2f963zs1-en>

⁶ OECD. Open Science: <https://www.oecd.org/sti/inno/open-science.htm>

⁷ Recommendation of the Council on Enhancing Access to and Sharing of Data (2021) <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0463>

⁸ Recommendation of the Council concerning Access to Research Data from Public Funding <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0347>

⁹ Recommendation on Open Science (UNESCO, 2021) https://unesdoc.unesco.org/ark:/48223/pf0000379949_spa

¹⁰ Netherlands. National Programme Open Science: <https://www.openscience.nl/en>

¹¹ Finland. Declaration for Open Science and Research 2020-2025: <https://avointiede.fi/en/policies/declaration-open-science-and-research-2020-2025>

¹² France. The National Plan for Open Science: <https://www.ouvrirlascience.fr/the-national-plan-for-open-science>

¹³ Ireland. National Framework on the Transition to an Open Research Environment: <https://www.gov.ie/en/publication/508e31-national-framework-on-the-transition-to-an-open-research-environment/>

¹⁴ Switzerland. Open Science 2021-2024: <https://www.swissuniversities.ch/en/topics/digitalisation/open-science-2021-2024>

¹⁵ Portugal. Política Nacional de Ciência Aberta: <https://www.ciencia-aberta.pt/pnca>

¹⁶ Latvian Open Science Strategy 2021-2027 <https://www.izm.gov.lv/en/article/latvian-open-science-strategy-2021-2027-now-english>

¹⁷ Piano Nazionale per la Scienza Aperta https://www.mur.gov.it/sites/default/files/2022-06/Piano_Nazionale_per_la_Scienza_Aperta.pdf

¹⁸ Norway. Open Access: <https://www.openaccess.no/english>

¹⁹ Swedish Research Council (Open Access): <https://www.vr.se/english/mandates/open-science.html>

²⁰ Denmark's National Strategy for Open Access: <https://ufm.dk/en/research-and-innovation/cooperation-between-research-and-innovation/open-access/Publications/denmarks-national-strategy-for-open-access>

to ensure the quality of their research and the reuse of data²¹. Across the board, **Plan S**²² has led European funding agencies from various countries to firmly position themselves in support of open access, driving an urgent transition to open science.

The Ministry of Science and Innovation and the Ministry of Universities acknowledge that open science and open knowledge increase transparency and foster participation, cooperation, accountability, the reusability of research work, and reproducibility of its results. They acknowledge that it also improves the quality and reliability of research through principles such as inclusion, equity, impartiality, research integrity, and participation.

The **Spanish Science, Technology, and Innovation Strategy (EECTI) 2021-2027** makes a commitment to open science in its objective 4 “Knowledge generation and scientific leadership,” as well as in action axis 14 “Science and innovation in society.” Similarly, the **State Scientific, Technical, and Innovation Research Plan (PEICTI) 2021-2023** includes different initiatives within the State Subprogram for Institutional Strengthening aimed at implementing open and inclusive science models.

In the legal area, the Law 17/2022, of September 5²³, amending Law 14/2011, of June 1, on Science, Technology, and Innovation, emphasize

es the value of science as a common good and advocates for open access to publicly funded research outputs. Article 37, “Open Science,” promotes the development of open infrastructures and platforms, requires the open access through archive of publications, data, codes, and methods in repositories, and encourages the open participation of civil society in scientific processes.

Besides, Organic Law 2/2023 of March 22 on the University System (LOSU)²⁴ includes Article 12, “Promotion of Open Science and Citizen Science”, which strengthens the mandate of open access of all research outputs in the university open institutional repository.

The ENCA 2023-2027 is based on all previous commitments related to open science adopted by different agents in the system, including those contained in Law 17/2022, in LOSU, in the EECTI 2021-2027, and in the PEICTI 2021-2023.

The ENCA also relies on the declaration of the Ministry of Science and Innovation regarding open science and knowledge²⁵, and on specific actions by funding agencies such as the State Research Agency (AEI)²⁶ and the Carlos III Health Institute (ISCIII)²⁷, as well as education, institutions, teaching, research, and knowledge transfer assessment agencies such as the National Agency for Quality Assessment and Accreditation (ANECA)²⁸. It also relies on the commitment

²¹ National Research Data Infrastructure (NFDI): https://www.dfg.de/en/research_funding/index.html

²² Plan S and cOAlitionS: <https://www.coalition-s.org>

²³ Law 17/2022 on Science, Technology, and Innovation <https://www.boe.es/eli/es/l/2022/09/05/17/con>

²⁴ Organic Law 2/2023 on the university system <https://www.boe.es/eli/es/lo/2023/03/22/2/con>

²⁵ Appearance of the Minister of Science and Innovation before the Committee on Science, Innovation, and Universities of the Congress of Deputies (February 20, 2020) https://www.congreso.es/public_oficiales/L14/CONG/DS/CO/DSCD-14-CO-38.PDF

²⁶ The State Research Agency adheres to the San Francisco Declaration on Research Assessment https://www.congreso.es/public_oficiales/L14/CONG/DS/CO/DSCD-14-CO-38.PDF

²⁷ The Carlos III Health Institute (ISCIII) has undertaken actions directly related to open science as a funding body for the Strategic Action on Health, such as incorporating non-scientific individuals in the evaluation process of the independent clinical research projects call or requiring research personnel benefiting from knowledge generation funding calls since 2021 to develop a data management plan.

²⁸ ANECA's position in the Open Science Commission COS-Gob <https://www.aneca.es/-/postura-de-aneca-en-la-comision-open-science-cos-gob>



of research agents, particularly universities and Public Research Organizations (OPIs).

Furthermore, the recent deployment of the Strategic Project for Economic Recovery and Transformation (PERTE) “New Language Economy,” which includes actions aimed at strengthening science in Spanish and promoting investments in artificial intelligence with a focus on multilingualism²⁹, and reflects the Spanish government’s commitment to measures that seek to eliminate barriers to accessing science for society.

This commitment is also evident in other measures such as the implementation of the Open Government Plan with the creation of the Data Office³⁰ to promote the sharing and use of data in all productive sectors; the transposition of EU Directive 2019/1024 on open data and the reuse of public sector information; and the National Statistical Plan 2021-2024, which includes an increase in the exploitation of administrative data and the establishment of a common data architecture from different administrative sources.

²⁹ See also on multilingualism: Conclusions of the Council on Research Evaluation and Implementation of Open Science <https://www.consilium.europa.eu/media/56958/st10126-en22.pdf>

³⁰ The Data Office is attached to the State Secretariat for Digitalization and Artificial Intelligence (SEDIA) <https://portal.mineco.gob.es/es-es/digitalizacionIA/oficina-del-dato/Paginas/oficina-del-dato-se-digitalizacion-ia.aspx>

MISSION

The Spanish National Open Science Strategy (ENCA, the Strategy) 2023-2027 has the mission of strengthening the quality, transparency, and reproducibility of scientific activity in Spain, improving dissemination among the scientific community and knowledge transfer to society, and designing how Spain responds to the challenges faced by the Spanish scientific community in this new global paradigm.

VISION

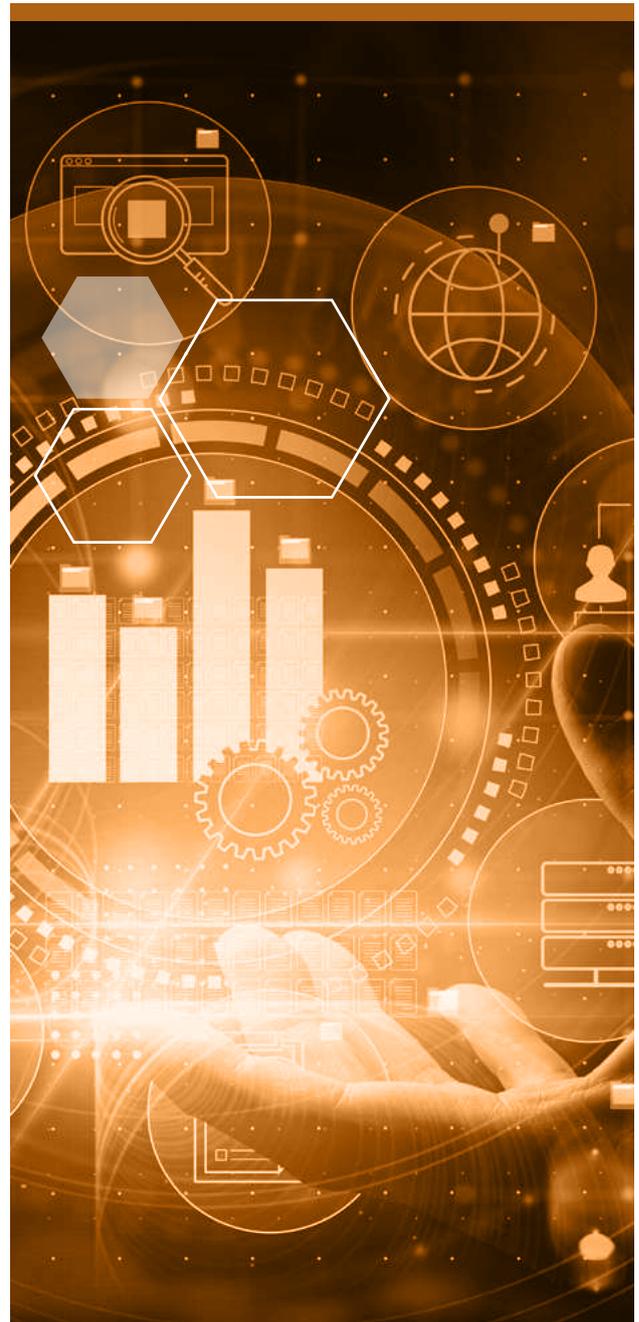
Through the ENCA, the aim is to ensure that by 2027 the funding, execution, communication, and assessment processes of scientific research in Spain incorporate the principles of open science.

In other words, these processes should be more open and transparent and based on criteria of scientific and social impact; communicable and evaluable research outputs should be expanded beyond academic publications; public, decentralized, and non-commercial infrastructures for communication, access, and preservation of research results should be strengthened; and opportunities for societal participation in research activities should be open at all stages, including citizen science as well as free and open access to all outcomes funded with public funds.

The ENCA aims to promote a significant cultural change in the Spanish Science, Technology, and Innovation System (SECTI). To achieve this, the ENCA encourages a profound debate with external stakeholders (mainly large publishers and scientific information service providers) and urges all actors to find a global alternative to the established academic communication system,

closely linked to researchers' and institutions' assessment processes.

The ENCA will provide support for the preparation of the upcoming State Plan for Science, Technology, and Innovation 2024-2027 to be aligned with national, European, and international policies on open science.



METHODOLOGY FOR THE DESIGN OF THE STRATEGY

The Ministry of Science and Innovation, through its General Secretariat for Research, established the Commission for Open Science (COS) in late 2018 and was coordinated by the Spanish Foundation for Science and Technology (FECYT). The main objective of COS has been to define, through a participatory process, the principles and objectives of the National Strategy for Open Science.

COS was structured into two groups: COS-Gob, comprised of high-level R&I policy decision makers, and COS-Tec, composed of technical expertise to contribute to the R&I decision-making processes. Each group included representatives from key national-level funding and research assessment institutions, such as the Ministry of

Science and Innovation, the Ministry of Universities, the Ministry of Economic Affairs and Digital Transformation, the State Research Agency (AEI), and the National Agency for Quality Assessment and Accreditation (ANECA). Additionally, research performing organizations representing the research community and involved in project funding and personnel hiring, including the Spanish National Research Council (CSIC), Carlos III Health Institute (ISCIII), the Severo Ochoa Centers and María de Maeztu Units of Excellence Alliance (SOMMA), and the Conference of Spanish University Rectors (CRUE), were also represented.

The collaborative work of these groups and institutions ensured the proper coordination and design of an open science policy, considering the perspectives of decision-makers, technical experts, and major research entities.

The drafting of this document has incorporated contributions received through consultations with experts and stakeholders in the SECTI, along with interaction with other ministries.



SITUATION ANALYSIS

In the development of this Strategy, strengths, potential threats, or weaknesses, as well as opportunities have been considered, and the SWOT analysis has showed:

STRENGTHS	WEAKNESSES
<ul style="list-style-type: none"> • Political commitment with cultural and institutional change towards open science. • Supportive legislative framework for open science: Article 37 of the Law on Science, Technology and Innovation, and Article 12 of the Organic Law of the University System. • Support of open science and knowledge by funding, assessment, and accreditation agents within the national system of science, technology, and innovation. • Existing network of institutional repositories and national, European, and Ibero-American aggregation services. • Existence of institutional open science policies in a growing number of research performing organizations. 	<ul style="list-style-type: none"> • Lack of awareness of open science practices within the scientific community (both researchers and institutions) and concerns about the workload and implications for research assessments. • Absence of an assessment system that promotes open science practices. • Uncertainty about how research quality will be effectively ensured in the new context of open science. • Limited budget allocated specifically to developing a concrete open science policy. • Insufficient number of professionals specialized in data processing, analysis, and management. • Lack of coordination among key stakeholders within the SECTI regarding open science.
OPPORTUNITIES	THREATS
<ul style="list-style-type: none"> • International and unstoppable movement towards a more transparent and open science driven by UNESCO and the OECD. • Actions in favor of open science being carried out by the European Union and its Member States: European Policy Agenda for ERA, the establishment of the EOCS, Horizon Europe program, and the creation of the Coalition for Advancing Research Assessment (CoARA). • Development of actions in favor of non-commercial academic publishing models in the European context: Open Research Europe. • Signing of reading and publishing license agreements (“transformative agreements”) between CRUE and CSIC and some commercial academic publishers. 	<ul style="list-style-type: none"> • Oligopoly of large publishers and distributors of scientific production. • Increase in publication costs due to the lack of national coverage of transformative agreements with commercial publishers. • Opportunistic behavior of certain commercial publishers.

STRATEGIC OBJECTIVES

The Strategy recognizes the concept of open science and knowledge as a comprehensive paradigm, without disregarding any of its dimensions, although the specific measures are limited to the detailed strategic objectives below.



Ensure the existence of sufficiently robust and well-articulated interoperable digital infrastructures capable of absorbing the impact of implementing a national open science policy and facilitating its integration into the international ecosystem, including, where applicable, the European Open Science Cloud (EOSC).



Promote the proper management of research data generated by the national R&I system through the FAIR principles (Findable, Accessible, Interoperable, Reusable).



Implement open and free access by default to publications and scientific results directly or indirectly funded with public funds, for the entire population.



Establish new research assessment mechanisms and a system of incentives and recognition aimed at promoting open science practices, as well as providing training to all personnel (researchers, managers, funders, evaluators) to align their professional performance with the principles of open science.

STRATEGIC AXES

The Strategy will be implemented through specific measures that ensure the effective involvement, awareness, training, and capacity building of the individuals who will be key in this cultural change: researchers, support staff, management, and citizens. These measures should be properly coordinated among funding, execution, and assessment agents of research activities, and supported by the current legal framework and the action of the Spanish government.

The strategic axes on which the ENCA is structured are as follows:

A

Digital infrastructures for open science.

B

Management of research data following FAIR principles.

C

Open access to scientific publications.

D

Incentives, recognition, and training.

AXIS A**Digital infrastructures for open science**

Digital infrastructures for open science are the platforms and services for generating, depositing, storing, and long-term preservation of research outputs (scientific articles, research data, methodologies, code, protocols, software, etc.). Some of these infrastructures include data spaces defined in the European Data Strategy³¹, institutional, regional, and thematic repositories for open access to scientific publications and research data³², institutional research management systems, and publishing platforms provided by public institutions responsible for editing, reproducing, and disseminating scientific journals, books, and other publications.

All initiatives proposed in this Strategy will be supported by platforms and technological resources developed with open-source software, enabling the achievement of European digital sovereignty, and facilitating the use of specific licenses for content distribution and reuse.

Expected outcome: Availability of interoperable and fully operational digital infrastructures with sufficient capacity to implement national, European, and international policies on open science, including integration into the international ecosystem and, where appropriate, the European Open Science Cloud (EOSC).

³¹ European Data Strategy: https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age/european-data-strategy_es

³² For these purposes, repositories are understood as infrastructures located in universities, organizations, and research centers, typically managed by libraries, that include a set of services provided by universities or research centers to their community to collect, manage, disseminate, and preserve their digital scientific output through an organized open access, and interoperable collection.

AXIS B

Management of research data following FAIR principles

Research data refers to any material that has been generated, collected, observed, or recorded during the lifecycle of a research project and serves as evidence of the research process. It is recognized by the scientific community and is used to validate research results and ensure their reproducibility. Access to data and other relevant digital objects for research, such as software, is essential for the reproducibility of scientific findings³³. It facilitates interdisciplinary collaboration, stimulates economic growth through better opportunities for innovation, enables data reuse in social innovation, improves resource efficiency, enhances transparency, accountability, and the performance of public investment, fosters scientific research, ensures public support for research funding, and strengthens public trust in research (OECD 2021)³⁴.

Unlike scientific publications, research data is a research output that does not always have a standardized dissemination circuit, assessment system, citation method, academic credit, and standardized reuse. Therefore, this Strategy addresses the need to provide research data with the attributes that comprise the FAIR principles (Findable, Accessible, Interoperable, Reusable)³⁵, necessary to ensure their transparency and reproducibility.

Findable: Research data should be easily locatable by both humans and machines. **Accessible:** Data and metadata should be retrievable using their identifier, utilizing an open and standardized communication protocol. **Interoperable:** Data should be able to be used and combined with other data or tools. **Reusable:** Data should be able to be reused, and to enable this, they should be published under clear and accessible reuse licenses.

Expected outcome: Implementation of a research data management methodology by the FAIR principles generated by SECTI, ensuring their findability, accessibility, interoperability, and reusability.

33 Research data can be experimental, observational, operational, third-party, public sector, monitoring, raw, processed, or reused. For each discipline or scientific domain, there is an interpretation of what research data is, its nature, and how it is collected. Examples include, among others, experimental results, measurements, fieldwork observations, survey results, recordings of physical samples, documentation, code, instrument configurations, statistics, and images.

34 OECD/LEGAL/0347. Recommendation of the Council concerning Access to Research Data from Public Funding. Adopted in 2006 and revised in 2021: <https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0347>

35 Wilkinson, M., et al. (2016). The FAIR Guiding Principles for scientific data management and Stewardship. *Sci Data* 3, 160018: <https://www.nature.com/articles/sdata201618>

AXIS C**Open access to scientific publications**

Open access entails providing free online access to scientific literature under licenses that allow its use and exploitation by researchers, administrations, businesses, and the public, without economic, legal, or technological barriers. Open access increases and enhances the transparency of the scientific process and, consequently, access to knowledge, facilitating the direct and indirect dissemination of science to the public and empowering society to address the challenges of the 21st century.

Spain has a policy of open access to scientific publications outlined in Law 14/2011, of June 1, on Science, Technology, and Innovation, which has been amended by Law 17/2022, of September 5. Article 37 establishes that researchers must deposit the scientific articles produced as a result of publicly funded projects in institutional or thematic open-access repositories. Until now, assessments of compliance with the 2011 law have shown only symbolic compliance³⁶. These assessments have identified the main causes of this low level of compliance as a lack of coordination among key decision-makers and legal safeguards that prioritized agreements with scientific publishers over the obligation to deposit in open access. Both causes have been addressed in the amendment to the law, which came into effect on September 6, 2022, so that researchers in the public sector or whose research activities are predominantly funded by public funds and who choose to disseminate their research outputs in scientific publications must deposit a copy of the final accepted version for publication and the associated data in institutional or thematic open access repositories simultaneously with the publication date.

Expected outcome: Fulfillment of the mandate for immediate open access by default in scientific publications, eliminating access barriers for the entire population.

³⁶ <https://www.recolecta.fecyt.es/documentacion/informe-de-la-comision-de-seguimiento-sobre-el-grado-de-cumplimiento-del-articulo-37>

AXIS D**Incentives, recognition, and training**

Incentives are an essential element within the ENCA. The implementation of the open science paradigm requires a cultural shift, both from institutions dedicated to funding, executing, and evaluating scientific activity, and from researchers associated with the science, technology, and innovation system. Regarding institutions, they need to integrate a new set of values into their daily operations, which should translate into the development of norms and procedures and the implementation of specific actions that promote the cultural change of individuals involved in research. Incentives for change serve to guide, align, and reward practices, breaking long-established inertia **in on** how research is conducted and measured that does not reflect the standards and objectives of open science, and should be aligned with the research assessment reform advocated by the European Council in its Conclusions on research assessment and the implementation of open science policies.

Expected outcome: Establishing a new assessment system for research activities within the national science, technology, and innovation system that aligns with the principles of open science and provides the necessary training for its implementation.

MEASURES OF ACTION BY AXIS

AXIS A

Digital infrastructures for open science

Each of the action axes defined in the ENCA 2023-2027 will be translated into specific action measures, establishing how they will be carried out and the expected timeframe for their implementation (short, medium, or long term³⁷).

A1. Identification of digital infrastructures, both national and international, necessary for the implementation of the ENCA.

HOW: Existing national digital infrastructures (large, medium, and small) not included in the ICTS map, as well as international infrastructures (e.g., *OpenAIRE*, *ESFRI Roadmap*³⁸) in which Spain participates or should participate, will be mapped to determine the investments in digital infrastructures required for the successful implementation of the ENCA.

TIMEFRAME: Short term.

A2. Generation and maintenance of new digital infrastructures for storage and preservation of research outputs necessary for the implementation of the ENCA.

HOW: Digital infrastructures for storage, cataloging, access, and preservation of research data and data produced by public administrations that can be used for research will be created to provide full coverage to the SECTI.

TIMEFRAME: Long term.

A3. Financing of digital infrastructures for open science.

HOW: Public funding calls included in the PEICTI 2024-2027, and institutional financing plans will be strengthened, and new funding lines will be created to ensure the creation, maintenance, and development of open science digital infrastructures and the necessary personnel for their proper functioning.

TIMEFRAME: Medium-term.

A4. Interoperability of all open science digital infrastructures to guarantee their sustainability and facilitate the integration of data and services into the European Open Science Cloud (EOSC).

³⁷ Short-term is considered as 12 months, medium-term as 24 months, and long-term as 36 months and beyond.

³⁸ European Strategy Forum on Research (ESFRI) <http://www.esfri.eu>

HOW: An Interoperability Plan for open science digital infrastructures will be developed in coordination with the guidelines of EOSC and OpenAIRE, the repository certification services of RECOLECTA, the Normalized Curriculum Vitae (CVN), and the journal evaluation services of FECYT.

TIMEFRAME: Medium-term.

AXIS B

Management of research data following FAIR principles

B1. Creation, recognition, and promotion of professional profiles to support research data management within the SECTI as support figures for research teams, adding specific and necessary expertise and alleviating the workload of research teams.

HOW: Funding will be provided, within research support personnel calls, for the creation of professional profiles to support the FAIR management of research data, such as data stewards and research data analysts, among others.

TIMEFRAME: Short term.

B2. Improvement of the communication of scientific results, overcoming the current limitations of the scientific results communication system, and including adequate assessment of other research outputs such as data and other digital objects of the scientific process, as well as the adoption of new forms of scientific communication based on them.

HOW: Scientific publications should be linked to their underlying research data. The development of a Data Management Plan (DMP) will be mandatory as an integral part of research projects funded by public funds, including the evaluation of this plan within project monitoring activities, whenever the research discipline involves the existence of data. This DMP will have a standard that facilitates its assessment and monitoring, according to an appropriate procedure and protocol.

TIMEFRAME: Medium-term.

B3. Strengthen the implementation of the legal framework and mechanisms that facilitate open access to research data.

HOW: Interministerial coordination and coordination between the General State Administration and the Autonomous Communities will be reinforced to ensure that the application and monitoring of national regulations on open data and reuse of public

sector information are aligned with the objectives of the ENCA and allow access to public research data and data generated by public administrations for research purposes.

TIMEFRAME: Short to medium term.

AXIS C

Open access to scientific publications

C1. Compliance with the legal mandate for open access to facilitate the deposit of all scientific publications.

HOW: It will be ensured that public sector research personnel, or researchers whose research activities are predominantly funded by public funds and who choose to disseminate their research results in scientific publications, deposit a copy of the final accepted version for publication and associated data in institutional or thematic open access repositories simultaneously with the publication date. Depositing all works, including those by research personnel, in open access repositories will be considered a best practice for merit assessment, promotion, etc., within research institutions (universities, public research organizations, and research centers). Compliance will be considered as an assessment criterion in public calls.

TIMEFRAME: Short to medium term.

C2. Evaluation of the national open access policy to assess the effectiveness of measures and strengthen incentives if necessary.

HOW: The degree of compliance with the national policy of open access, as stated in the Law on Science, Technology, and Innovation, will be periodically measured. Additionally, the publication in open access will be included among the regular indicators monitored by the SECTI, in coordination with the monitoring bodies of the EECTI 2021-2027 and the PEICTI for the periods 2021-2023 and 2024-2027, as well as the SICTI.

TIMEFRAME: Short to medium term.

C3. Negotiation of agreements for transforming the scientific communication model to ensure equal conditions for research personnel across the SECTI regarding access to scientific content, options for open-access publishing, and depositing their publications in open-access repositories.

HOW: Negotiations will be conducted with relevant parties to reach national agreements with major commercial scientific publishers, allowing research personnel from across the SECTI to self-archive and provide immediate open access to their publications in duly accredited repositories without additional costs.

TIMEFRAME: Long term.

C4. Diversification of mechanisms for publishing research results, supporting a non-commercial model of research outcome communication through complementary or alternative dissemination tools to commercial scientific journals, such as research outcome publication platforms, institutional publishing services, and open access repositories. Compliance with the peer review process will be ensured, and mechanisms to guarantee publication quality will be strengthened.

HOW: Ensuring that publishing research outcomes funded by public funds in open access publication platforms (e.g., Open Research Europe, ORE³⁹) and in reputable journals not indexed in commercial bibliographic databases are adequately considered in the curricular assessment exercises carried out by the AEI, ISCIII, and ANECA, considering the value of the contribution rather than the publication journal itself.

TIMEFRAME: Medium-term.

C5. Strengthening the implementation of the legal framework and mechanisms that facilitate open access to scientific publications.

HOW: Interministerial coordination will be reinforced to ensure the application and monitoring of national regulations regarding open access to scientific publications, without prejudice to the application of intellectual property rights regulations.

TIMEFRAME: Short to medium term.

³⁹ Open Research Europe <https://open-research-europe.ec.europa.eu>

AXIS D
Incentives, recognition, and training

D1. Strengthening scientific knowledge about open science.

HOW: The analysis of different dimensions of open science and the necessary tools for its implementation will be included as a research subject in public calls included in the PEICTI 2024-2027 and institutional funding plans.

TIMEFRAME: Medium to long term.

D2. Consideration of open science practices for Public R&D Funding.

HOW: Grant calls for research projects will establish open science requirements for beneficiary institutions, and their proper compliance will be monitored. Additionally, in the assessment process of research projects seeking public funding, the incorporation of open science practices in the project's design and execution will be considered as a scoring criterion. The evaluation of open science practices will also be included in the assessment of scientific and curricular merits, both at the individual and institutional levels, for the granting of other public grants, including programs for human resources and institutional strengthening.

TIMEFRAME: Medium to long term.

D3. Adaptation of the assessment processes for teaching, research, and knowledge transfer to the parameters of open science.

HOW: The progressive reduction of the use of quantitative bibliometric indicators related to journal impact (JCR, Journal Citation Reports, and SJR SCImago Journal Rank) in the assessment of research merits will be implemented, gradually incorporating qualitative indicators. The use of merit-based criteria on the importance of scientific and technical contributions and their content will be promoted. Internationally recognized criteria that value the diversity of scientific and technical contributions beyond scientific publications, such as dissemination and scientific advisory, scientific management activities, training activities, and the impact of research results on society, will be utilized. A permanent discussion forum involving all stakeholders within the SECTI will be created to advance in a coordinated manner in the reflection and implementation of this change.

TIMEFRAME: Medium to long term.

D4. Establish mechanisms to promote the idea that open science is an excellent science.

HOW: The FECYT-ANECA Open Science Award will be created to recognize the work carried out by institutions in the production of scientific and technical works in all areas of knowledge that contribute to enhancing the visibility, prestige, and effectiveness of open science at the national level.

TIMEFRAME: Medium-term.

D5. Training for researchers and evaluators in research merit assessment committees, academic career committees for individuals and institutions, and panels for the allocation of publicly funded projects.

HOW: A program for awareness raising and continuous training will be designed to educate teaching and research staff as well as institutions about the opportunities and challenges of open science, with a particular focus on members of assessment committees of major assessment agencies. The accreditation of doctoral degrees will include the assessment of transversal skills related to open science. Training in open science will be provided in the form of micro-credentials.

TIMEFRAME: Medium-term.

GOVERNANCE, MONITORING PLAN, AND EVALUATION

The ENCA is established under the auspices of the Spanish Strategy of Science, Technology, and Innovation. In this regard, the monitoring and evaluation of the ENCA will be carried out by the Monitoring Committee of the EECTI, which was created by the Council of Ministers' Agreement on October 19, 2021, and was established on January 21, 2022⁴⁰.

The Committee includes representatives from the MCIN, MUNI, autonomous communities, labor unions, civil society, the business sector, and funding agencies. For the monitoring of the ENCA, the Monitoring Committee of the EECTI may establish a group of experts to collaborate in the monitoring and evaluation process.

A biennial monitoring process will be conducted for the performance and outcome indicators detailed in the following table, and a report with the main results will be elaborated. An interim evaluation will be carried out in 2025, followed by a final evaluation one and a half years after its completion. This evaluation will be externally conducted and will incorporate the impact indicators described in the following table, as well as other relevant indicators in the evaluation process. The Monitoring Committee of the EECTI will be responsible for defining the areas to be evaluated.

The monitoring indicators are as follows:

MEASURES	ACHIEVEMENT	RESULTS	IMPACT	SOURCE
A. Digital infrastructures for open science				
A.1. Identification of digital infrastructures to determine the necessary investment.	Having a map of digital infrastructure.	Planning scheme for the investments to be made.	Increase in the number of digital infrastructures in Spain.	FECYT
A.2. y A.3. Generation and maintenance of new digital infrastructures.	Number of created digital infrastructures.	Number of created infrastructures in full operation by 2027.	Increase in the volume of contained information.	FECYT
A.4. Interoperability of all digital infrastructures.	Development of the interoperability plan.	Number of interoperable infrastructures.	Increase in the coverage and robustness of digital infrastructures in Spain.	FECYT

⁴⁰ Spanish Science, Technology, and Innovation Strategy (EECTI) <https://www.ciencia.gob.es/InfoGeneralPortal/documento/e8183a4d-3164-4f30-ac5f-d75f1ad55059>

MEASURES	ACHIEVEMENT	RESULTS	IMPACT	SOURCE
B. Research data management following FAIR principles				
B1. Creation, recognition, and promotion of support professional profiles for research data management.	Amount granted for the promotion of these profiles.	Number of hired people.	Increase in the number of hired personnel in research centers.	AEI, ISCIII, FECYT
B2. Improvement of communication of scientific results.	Implementation of a monitoring procedure for the linkage of all publicly funded research results.	Number of institutions complying with current regulations.	Increase in the number of repositories linking all publicly funded research results.	FECYT
B3. Strengthen the implementation of the legal framework and mechanisms that facilitate open access to research data.	Establishment of coordination mechanisms among different administrative levels to address this issue.	Number of institutions complying with the current regulations.	Increase in the number of repositories that incorporate research data management.	MICIN, MUN, FECYT
C. Open access to scientific publications				
C1 y C2. Compliance with the open access mandate in scientific publications.	Degree of compliance with the legal mandate of depositing publications in open access.	Number of publications funded with public funds deposited in open-access repositories.	Increase in the visibility of open-access publications.	FECYT
C3. Negotiation of agreements for the transformation of the scientific communication model.	Number of institutions benefiting from these negotiations.	Number of agreements reached resulting in cost savings to the system.	Increase in the visibility of open-access publications.	FECYT
C4. Diversification of mechanisms for publishing research results.	Number of calls considering open platforms.	Number of open platforms meeting the publication and/or deposit requirements of the calls.	Number of publications on open platforms.	FECYT
C5. Strengthening the implementation of the legal framework and mechanisms facilitating open access to scientific publications.	Establishment of coordination mechanisms between different administrative levels to address this issue.	Number of institutions complying with current regulations.		FECYT
D. Incentives, recognition, and training				
D1. Strengthening scientific knowledge about open science.	Calls for open science.	Number of funded projects related to open science.	Number of academic publications on open science.	FECYT
D2. Consideration of open science practices for public funding of R&D.	Number of calls including open science requirements.	Number of open science research outcomes associated with publicly funded.	Increase in calls evaluating open science practices.	FECYT
D4. Generating mechanisms to promote the idea that open science is an excellent science.	Development of a training plan.	Number of institutions providing training in open science.	Number of participants in training sessions in assessment committees.	FECYT

ANNEX 1. TABLE OF ENTITIES AND MEASURES

MEASURES FOR EACH OBJECTIVE	AEI	ANECA	CRUE	CSIC	ISCI	FECYT	MICIN	MUN	SEDIA	SOMMA	DIALNET
A. Digital infrastructures for open science											
A1. Identification of national and international collaborative digital infrastructures necessary for the implementation of ENCA.			X	X	X	X	X		X	X	
A2. Generation and maintenance of new digital infrastructures for storage and preservation of research outcomes necessary for the implementation of ENCA.			X	X	X		X	X	X	X	X
A3. Financing of digital infrastructures for open science.	X				X	X	X		X		
A4. Interoperability of all digital infrastructures.			X			X			X		
RESPONSIBLE FOR MONITORING						X	X ⁴¹				
B. Research data management following FAIR principles											
B1. Creation, recognition, and promotion of professional profiles supporting research data management.	X	X			X						
B2. Improvement of communication of scientific results	X	X		X	X	X			X		
B3. Strengthening the implementation of legal framework and mechanisms facilitating open access to research data.				X	X		X	X	X		
RESPONSIBLE FOR MONITORING			X			X				X	
C. Open access to scientific publications											
C1. Compliance with the legal mandate of open access to facilitate depositing all scientific publications.	X	X	X	X	X					X	
C2. Evaluation of the national open access policy						X	X	X			
C3. Negotiation of agreements for transforming the scientific communication model.	X		X	X	X	X		X		X	
C4. Diversification of publication mechanisms for research outcomes	X	X			X	X					
C5. Strengthening the implementation of legal framework and mechanisms facilitating open access to scientific publications.							X	X			
RESPONSIBLE FOR MONITORING						X	X				

⁴¹ The implementation of this measure would fall under the responsibility of MCIN through the DGPI, with the involvement of the three relevant sub-directorates, and with the collaboration of FECYT

MEASURES FOR EACH OBJECTIVE	AEI	ANECA	CRUE	CSIC	ISCI	FECYT	MICIN	MUN	SEDIA	SOMMA	DIALNET
D. Incentives, recognition, and training											
D1. Strengthening scientific knowledge about open science.	X				X	X					
D2. Consideration of open science practices for Public R&D Funding.	X	X			X						
D3. Adjustment of teaching, research, and transfer merit assessment processes to open science parameters.	X	X	X		X		X				
D4. Creating mechanisms to promote the idea that open science is excellent.		X				X					
D5. Training for researchers and evaluators.	X	X			X	X					
RESPONSIBLE FOR MONITORING		X				X		X			

*The entities and organizations that will participate in the implementation and monitoring of the ENCA are: State Research Agency (AEI); National Agency for Quality Assessment and Accreditation (ANECA); Conference of Spanish University Rectors CRUE); Spanish National Research Council (CSIC); Carlos III Health Institute (ISCI); Spanish Foundation for Science and Technology (FECYT); Ministry of Science and Innovation, General Secretariat of Research (MICIN); Ministry of Universities (MUN); State Secretariat for Digitization and Artificial Intelligence (SEDIA); Severo Ochoa and Maria de Maeztu Centers of Excellence Alliance (SOMMA).

**Other entities not included in this table may also contribute to the implementation of the ENCA.

ANNEX 2. OBJECTIVES, AXES, AND MEASURES

	Objective 1: Ensure the existence of interoperable digital infrastructures	Objective 2: Promote proper research data management	Objective 3: Implement open and free access as the default for scientific publications and research outcomes	Objective 4: Establish new research assessment mechanisms and a system of incentives and recognition to drive open science practices, as well as provide training for personnel to align with the principles of open science
MEASURES FOR EACH OBJECTIVE AXIS				
A. Digital infrastructures for open science				
A1. Identification of national and internationally participating digital infrastructures necessary for the implementation of ENCA.				
A2. Generation and maintenance of new digital infrastructures for storage and preservation of research outcomes required for ENCA implementation.				
A3. Financing of digital infrastructures for open science.				
A4. Interoperability of all digital infrastructures.				
B. Research data management following FAIR principles				
B1. Creation, recognition, and promotion of professional profiles to support research data management.				
B2. Improvement of communication of scientific results.				
B3. Strengthening the implementation of legal frameworks and mechanisms to facilitate open access to research data.				
C. Open access to scientific publications				
C1. Compliance with the legal mandate of open access to facilitate the deposit of all scientific publications.				
C2. Evaluation of the national open access policy.				
C3. Negotiation of agreements for the transformation of the scientific communication model.				
C4. Diversification of mechanisms for publishing research outcomes.				
C5. Strengthening the implementation of the legal framework and mechanisms that facilitate open access to scientific publications.				

	Objective 1: Ensure the existence of interoperable digital infrastructures	Objective 2: Promote proper research data management	Objective 3: Implement open and free access as the default for scientific publications and research outcomes	Objective 4: Establish new research assessment mechanisms and a system of incentives and recognition to drive open science practices, as well as provide training for personnel to align with the principles of open science
D. Incentives, recognition, and training				
D1. Strengthening scientific knowledge about open science.				
D2. Consideration of open science practices for Public R&D Funding.				
D3. Adaptation of assessment processes for teaching, research, and knowledge transfer to open science parameters.				
D4. Creating mechanisms to promote the idea that open science is excellent.				
D5. Creating mechanisms to promote the idea that open science is excellent.				



NATIONAL STRATEGY FOR OPEN SCIENCE (ENCA)

2023 – 2027