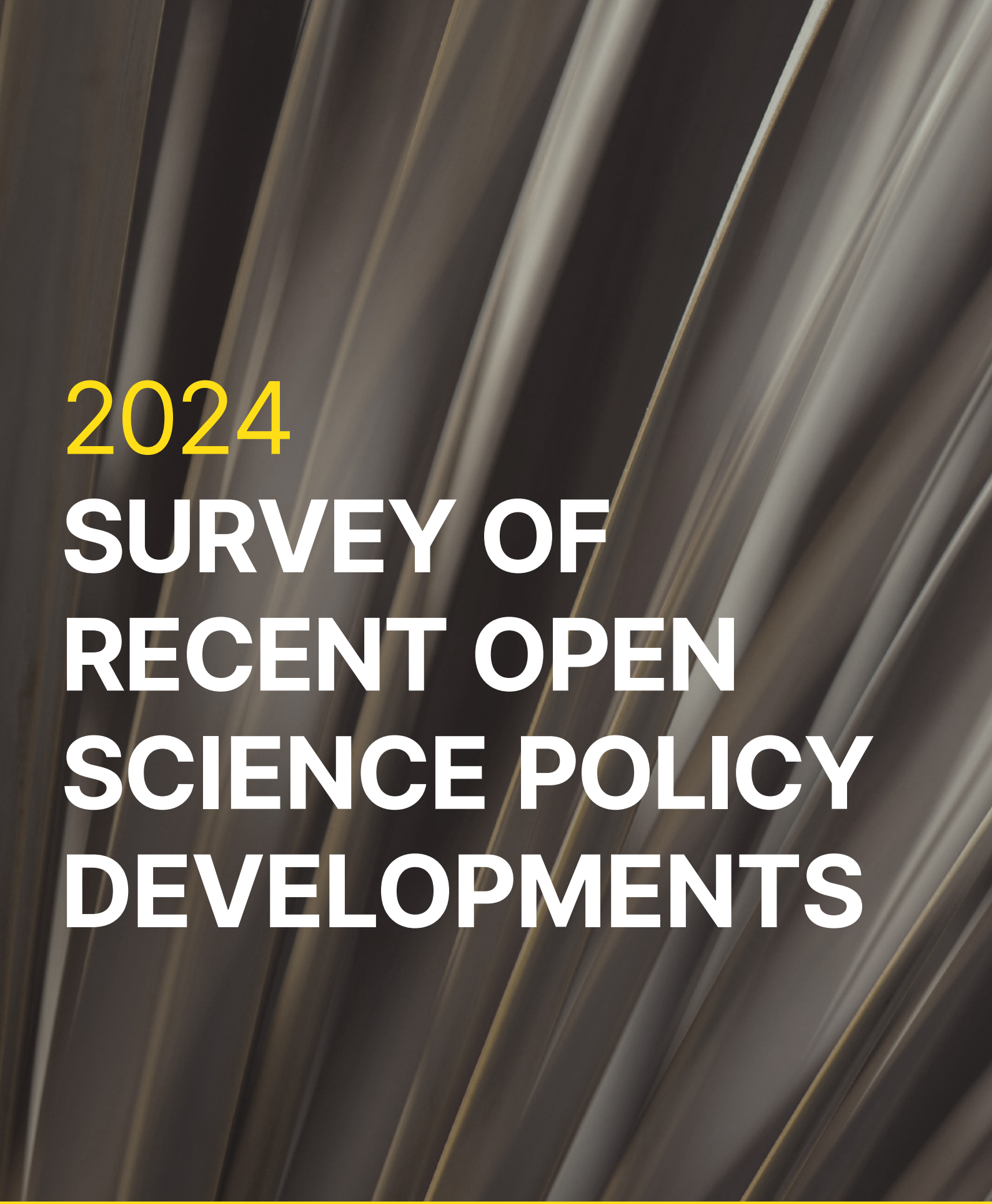

# 2024 SURVEY OF RECENT OPEN SCIENCE POLICY DEVELOPMENTS

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# Introduction

The 2021 adoption of the UNESCO Recommendation on Open Science marks a meaningful milestone in the global movement to make "the scientific process more transparent, inclusive and democratic" (UNESCO Open Science Advisory Committee, 2021). While we recognize that there are motivators for this shift beyond policies aimed at promoting open science, this feels like an important moment to review recent open science and adjacent policy developments across Africa, Europe, Latin America, and the United States, and to reflect on the implications for open digital research infrastructure.

Looking across these regions, we could not help but notice the diversity of the levers that are used to advance open science and the scales at which they operate. Europe, Africa, and Latin America have strong regional and continental initiatives and/or networks in development or in place, and we also see some trans-continental cooperation between Latin America, Europe, and Africa. In Europe, EU-level legislation and other continental efforts incentivize, guide, and support the development of national policies and strategies, which are also informed by the action of bottom-up, local initiatives and efforts. By contrast, we are not aware of significant, multilateral open science initiatives across North America; accordingly, our focus here is on the United States, where the US federal government and private philanthropies are important drivers of open science practice at the national level.

We also observe that the scope and core priorities across this landscape differ. In the US, while equity in participation is a component of the recent government-wide mandate to promote public access to research, it is secondary to providing access to research outputs. Public access to research outputs is also a long-standing priority and driver of policy in Latin America. On the African continent, access to basic infrastructure that supports research and collaboration is a priority, likely due to a history of inadequate investment. Meanwhile, the European Union (EU) has an ambitious open science policy that focuses on providing early access to research using digital and collaborative technology, but this is also embedded within a landscape of legislative initiatives regulating information technology, with potentially profound implications for the entire digital ecosystem.

This report builds upon the section "Regional policy developments and their implications for open infrastructure" originally published in "The 2024 State of Open Infrastructure Report" (Steinhart et al., 2024). It incorporates text from that report, and contains significant new material.

# Open science policy development in Africa

## Introduction

Within the African context, financial support for open science, and by extension open infrastructure, at the national government level has been sparse. In 2007, the African Union set a target for all African countries to spend a minimum of 1% of their GDP on Research and Development (R&D) by 2010 (Iizuka et al., 2015). To date, no African country surpasses that 1% threshold; Kenya and South Africa are closest to meeting this threshold at 0.8% each (Midega et al., 2021).

Despite the challenges faced by the research community, there is growing interest in open science on the continent. Internet connectivity, a key component of open science infrastructure, is still suboptimal but has improved substantially on a number of fronts. Between 2010 and 2021, Internet penetration rate across the region grew from 9.6% to 33% (International Telecommunication Union, n.d.). The formation of research and education networks (RENs) on the continent in the past three decades has helped increase researchers' and research institutions' Internet access, thus enabling the adoption of open science practices. We are also seeing greater recognition of science as a key driver of socio-economic progress through continent-level instruments such as Agenda 2063 (African Union Commission, 2015), Science, Technology and Innovation Strategy for Africa (STISA; African Union Commission, 2014), the Continental Education Strategy for Africa (CESA) (African Union Commission, 2016), and the African Union-European Union (AU-EU) Innovation Agenda (European Commission, 2023a). All this has motivated and supported open science policy development at the regional, national, and institutional levels.

## National and regional research and education networks

In the early 2000s, Internet connectivity in many parts of Africa was prohibitively expensive and limited by inadequate infrastructure. To address the cost of connectivity, National Research and Education Networks (NRENs) were organized across Africa to share resources and bulk purchase bandwidth from telecom operators. The increased access and availability of connectivity, along with digital tools and services such as Eduroam, reduced one of the most significant barriers to supporting open science. The Tertiary Education and Research Network of South Africa (TENET) and the Kenya Education Network Trust (KENET) were the pioneers, forming the first networks in 1998 and 1999, respectively. Since then, Africa has formed three Regional Research and Education Networks (RRENs), composed of national research and education networks (NRENs). Currently, 38 NRENs have been established, with funding from the European Union Directorate General for International Partnerships, the World Bank, and national governments. This funding allowed for continued investment in connectivity, infrastructure, and capacity building and ultimately played a vital part in promoting open science and internet connectivity in Africa (Foley, 2016).

One of the key functions of RENs is to foster collaboration and resource sharing among academic and research institutions. This collaborative approach has been instrumental in promoting open science in Africa, as it encourages the sharing of knowledge and research findings, thereby enhancing scientific participation and accelerating research output and discovery.

To support the sustainability, adaptability, and procurement of connectivity infrastructure for the NREN community, the European Union-funded AfricaConnect Project was initiated. This project, now in its third iteration with prospects for a fourth, continued to develop a high-capacity Internet network for research and education across Africa. With collective support from African RRENs, the project has been successful in connecting over five million end-users across 1,900 African institutions (Banda, 2020). It has also facilitated collaboration with other RRENs around the world, such as RedClara in Latin America, and GÉANT in Europe.

The three RRENs currently serving Africa are:[1]

- **UbuntuNet Alliance**, the pioneering RREN in Africa, has witnessed remarkable growth since its establishment in November 2005. From its initial five founding members, it has now expanded to 22 member NRENs, serving the Eastern and Southern Africa region. This growth is a testament to the increasing importance and impact of RRENs in Africa.
- **The West and Central African Research and Education Network (WACREN)** was established in August 2010, but efforts to establish it date back to 2006 (Oaiya, 2016). Its membership consists of over 15 NRENs in West and Central Africa.
- **The Arab States Research and Education Network (ASREN)** was formally launched in December 2010. Although it embraces countries outside Africa, it is considered one of the African RRENs per the AfricaConnect project.

RRENs and NRENs have evolved from solely providing connectivity to supporting high-performance computing, cloud storage, and federated identity management services. They are well-positioned to support and advance open science policy and infrastructure. However, the lack of NRENs in some countries poses significant challenges. These countries struggle to provide connectivity for their universities and research institutions to high-speed networks, hindering their participation in global research collaboration. The African Union's Digital Education Strategy, with its recommendations to launch and sustain 54 NRENs across the continent by 2027, aims to address this issue (African Union Commission, 2022).

## Regional collaborations advancing open science

The work of NRENs and RRENs in advancing open science development and adoption in Africa is augmented by regional efforts — we summarize some of the key regional efforts below.

Launched in 2016 by WACREN, **Library Support for Embedded NREN Services and E-infrastructure (LIBSENSE)**[2] aims to bring together the RENs and academic library communities to advance open access and open science in Africa. LIBSENSE has been holding regional policy development workshops in collaboration with regional research networks and university associations to implement the UNESCO Recommendation at the campus level. Another key supporting activity has been providing open science policy templates to make it easier for institutions to develop and implement open science policies. One such example of this is in Sierra Leone, where LIBSENSE helped form an NREN Sierra Leone Research and Education Network (SL-REN) and now is also working with stakeholders there to develop a national open science policy (LIBSENSE, 2023).

WACREN, Electronic Information for Libraries (EIFL)[3] and African Journals Online (AJOL) in 2023 also launched the partnership "Collaboration for sustainable open access publishing in Africa". This partnership is aimed at strengthening the quality and sustainability of Diamond Open Access publishing services across Africa, while maintaining their diversity. One of the project's key deliverables is to strengthen national and pan-African collaborations on Diamond Open Access and getting governments to commit to funding research by embedding diamond OA support in open science policies (EIFL, 2023a).

**The Science Granting Councils Initiative (SGCI)**[4] in sub-Saharan Africa is a multi-funder, capacity-building initiative that has been operating since 2015 and is aimed at strengthening the capacity of the region's Science Granting Councils (SGCs). Its objective is to support the development of research and evidence-based policies that will contribute to economic and social development. Operational in 17 African countries, SGCI centers open science as a key pillar for development (African Technology Policy Studies Network & Scinnovent Centre, n.d.).

**The African Open Science Platform (AOSP)**,[5] an initiative of the National Research Foundation (NRF) of South Africa, is a direct outcome of the NRF Open Access Statement that took effect in March 2015 (National Research Foundation, 2015). Its mission is to put African scientists at the cutting edge of contemporary, data-intensive science. AOSP is developing an integrated approach including federated hardware, communications and software infrastructure, policy and practice development to support open science in the digital era, and a network of excellence in open science that supports scientists and others in accessing and using modern data resources to maximize scientific, social and economic benefit (CODATA et al., n.d.). Five regional nodes have been formed across Africa, each aimed at supporting and

[1] Regional Research & Education Networks serving Africa as part of the Africa Connect program: https://africaconnect3.net/network/

[2] https://libsense.ren.africa/en/

[3] https://www.eifl.net/

[4] https://sgciafrica.org/

[5] https://aosp.org.za/

promoting efforts aligned with the implementation of open science programmes at a regional level, strengthening knowledge networks and infrastructure access, and enhancing cooperation between regions.

International organizations such as Electronic Information for Libraries (EIFL) are also engaging by supporting initiatives aimed at catalyzing adoption of open science. Their strategies include capacity building, funding, and policy formulation. EIFL has been instrumental in the development of the draft open science policy in Botswana (EIFL, 2023b) as well as the development of open science policies at the institutional level across Africa.

Other initiatives, such as the Southern African Development Community (SADC)'s Regional Indicative Strategic Development Plan (Southern African Development Community (SADC) Secretariat, 2020) and the East African Community (EAC)'s East African Science and Technology Commission (EASTECO)[6] are working to advance open science in different regions in Africa.

## Policy development at the national level

Along with the development of RRENs and NRENs and the emergence of regional initiatives and collaborations, African nations are developing national level policies in support of open science. We summarize some of these developments in Table 1.

**TABLE 1.**
Selected country-level open science policies in Africa

| Country | Year | Policy |
|---|---|---|
| **Ethiopia** | 2019 | A national open access policy was adopted by the Ministry of Science and Higher Education of Ethiopia (MOSHE) in 2019 (Beyene et al., 2022). It mandates open access to all published articles, theses, dissertations, and data resulting from publicly funded research and encourages open science best practices, including data management plans (DMPs) and FAIR data practices.<br><br>One result of the policy has been the creation of the National Academic Library of Ethiopia,[7] a free-to-use, centralized repository of Ethiopian research. |
| **South Africa** | 2022 | South Africa has a first draft of an open science policy, discussed in a stakeholder consultation meeting in February 2022 (Merwe, 2022). It mandates open access for publicly funded research, including data acquired or generated with public funds. The policy proposes the establishment of a "national 4 forum" to promote best practices in open science as well as incentives for researchers to publish in open access journals.<br><br>The South African Department of Science and Innovation (DSI) in 2022 announced that it is considering creating the South Africa Open Science Cloud (SAOSC), modeled on the European Open Science Cloud (Cavalli, 2022). |
| **Multiple countries** | 2022 | Work to develop national open science roadmaps has been initiated in several other countries across Africa, including Côte d'Ivoire, Ethiopia, Ghana, Lesotho, Mozambique, Nigeria, Somalia, Tanzania and Uganda (Oaiya, 2022). |

[6] https://easteco.org/

[7] http://ndl.ethernet.edu.et/

## Policy development at the regional and international levels

There are a number of instruments that have been developed at the continental and regional levels that contribute to the adoption of open science practices in Africa. Agenda 2063 (African Union Commission, 2015) is Africa's blueprint and master plan for transforming Africa into a global powerhouse. The plan, developed by the African Union, emphasizes science, technology, and innovation (STI) as integral to Africa's prosperity and security.

Agenda 2063 puts in place the building blocks to establish and implement open science on the continent. STI figures prominently in Aspirations 1 ("A prosperous Africa based on inclusive growth and sustainable development") and 2 ("An integrated continent, politically united, based on the ideals of Pan-Africanism and the vision of Africa's Renaissance"), with world-class information and communications technology seen as crucial for Africa's transformation. One of the core areas of Agenda 2063 is the development of a pan-African e-network, terrestrial and submarine infrastructure to enhance Internet connectivity. Expansion and modernization of post-graduate education facilities are also flagged as critical needs.

Science, Technology and Innovation Strategy for Africa (STISA) lays out four mutually reinforcing pillars: building and/or upgrading research infrastructures, enhancing professional and technical competencies, promoting entrepreneurship and innovation, and providing an enabling environment for STI development (Hamdy, n.d.). STISA explicitly outlines the important role that NRENs play in coordinating collaboration among stakeholders across the continent to further innovation and research.

The African Union Declaration on Internet Governance (Degezelle, 2022), ratified in 2017 in Algeria by information and communications technology (ICT) ministers from across Africa, advocates for an open, transparent, and inclusive strategy of Internet governance based on the principles of openness, including freedom of expression, respect for privacy, universal access, and technical interoperability.

Finally, the UNESCO Recommendation has provided a significant boost to efforts to advance open science on the continent (UNESCO Open Science Advisory Committee, 2021). By defining open science and the stakeholders that are critical to its successful implementation, and by addressing key issues such as multilingualism in science, the Recommendation has demystified open science in Africa and surfaced considerations to factor in when making policy.

## Opportunities and challenges

While we are seeing continuing progress towards open science and open infrastructure adoption on the continent, challenges remain. The levels of open science and infrastructure awareness, adoption, and development are uneven across the continent. Some nations, for example, South Africa and Kenya, have a history of engagement with open science, while other regions are still in the early stages. Some nations lack NREN support, and others lack open access publishing and repository infrastructures. This uneven rate of progress on the continent may impede policy harmonization that could support interoperable infrastructures across jurisdictions; such interoperability is one of the goals that the African Open Science Platform (AOSP) aims to achieve once it is fully operationalized.

Funding also presents a significant challenge. Given many competing priorities, including development goals, most African countries do not adequately invest in science. According to *The Race Against Time for Smarter Development* report (UNESCO, 2021), countries such as Lesotho and Madagascar invest 0% of their GDP in R&D, and the R&D expenditure for 24 additional African countries is unknown. This means that researchers and scholars often personally volunteer and/or fundraise locally for their research, and this lack of support is a significant barrier to advancing science on the continent.

That said, with an increased interest in open science and the development and maturation of supporting infrastructure (such as, but not limited to, enhanced internet connectivity), we do see growing opportunities for African communities to play active roles in and lead global collaborations to further open science in Africa and worldwide.

We are seeing concerted efforts to develop robust policy strategies to promote research in the continent. In the African Union's Agenda 2063, there is an explicit reference to science, technology, and innovation as being key to Africa's transition to a knowledge based economy. In 2023, we saw the formation of a partnership between the African Research Universities Alliance (ARUA) and The Guild of European Research-Intensive Universities. This partnership is aimed at creating 17 research clusters to perform joint research on social challenges, and participating organizations cited Agenda 2063 as being central to the aspirations of their collaboration (The Guild, 2023). We are also seeing a raft of policies dedicated to open science and open access (as referenced in Table 1 above) in many African countries, which can only strengthen the science and research ecosystem going forward.

The COVID-19 pandemic demonstrated the need for pan-African collaboration to address shared challenges. In the aftermath of the pandemic, the African Union formed five Regional Collaborating Centers across the continent to facilitate the sharing of research and health innovations (AfricaCDC, 2022). In East Africa, we have an inter-governmental initiative led by the Inter University Council of East Africa (IUCEA) to promote research collaboration as well as research training which has formed several centers of excellence (each focused on a specialization in STEM, agriculture, and health) in different East African countries with the aim of facilitating enhanced research (IUCEA, n.d.).

## Conclusion

While the development of open science policies in Africa is in relatively early stages of development, there has been steady progress. Initiatives led by NRENs, RRENs, and research organizations are helping drive an inclusive open science agenda forward. However, in order to see continued progress, there is a critical need for increased research funding, investment in infrastructure to support the African research community, and harmonization of open science policies across the continent.

# Open science policy developments in Europe

In Europe, funding provided by national governments and the European Commission (through research and innovation programmes such as Horizon Europe)[8] represent major sources of research and development funding (Eurostat, 2022a; Eurostat, 2022b). The European Commission has been at the forefront of promoting open access, scholarship, and science for the past two decades. One of its earliest initiatives was the Open Access Pilot in the Seventh Framework Programme (FP7; European Commission, 2007), which served as the European Union's (EU's) key research and development funding programme from 2007 to 2013. This was followed by the establishment of the Open Science Policy Platform, a high-level advisory group set up in 2016 by the European Commission's Directorate-General for Research and Innovation, to advise the European Commission on developing its Open Science Policy (os4os team, 2020). Today, open science is a policy priority for the European Commission. The EU's open science policy details eight areas of ambition, including the European Open Science Cloud (EOSC, more below), open data, metrics development, scholarly communication, and research integrity (European Commission, 2019). The policy's development and implementation are supported by the European Commission's research and innovation funding programmes and synergize with the EU's support for international bodies and platforms such as Plan S, the Research Data Alliance (RDA), and the ISC's Committee on Data of the International Science Council (CODATA), to name a few (European Commission, 2019).

Open science is also increasingly discussed and prioritized at the national level, with many European countries (including those within and outside the EU) developing and updating national open science strategies, roadmaps, action plans, and policies. At the national level, policy development is driven and influenced by diverse players, including institutions, libraries, researchers, research infrastructures, and government ministries.

In this section, we review selected, recent national instruments related to open science and infrastructure, focusing on how they discussed and prioritized open digital research infrastructure. We also highlight key recent EU-level coordination efforts and policy developments that have influenced or are likely to influence national strategies and instruments.

## Method and scope

Recognizing the number and range of open science and infrastructure-related legislations, policies, roadmaps, and declarations at European, national, organizational, and institutional levels, we chose to limit the scope of this preliminary analysis to the following:

- Selected national open science and open access policies; where these are not present for a country, we included the most similar instruments, which can include policies of national research funder(s), and working roadmaps and declarations at a national level;
- Selected national research infrastructure roadmaps, as listed on the European Strategy Forum on Research Infrastructures (ESFRI) national roadmaps catalogue;[9] and
- Selected national research, development, and innovation (RDI) programmes and roadmaps, national research and higher education (R&HE) roadmaps, and similar instruments at a national level.

We reviewed a total of 56 instruments from 33 European countries (not all are discussed in this report). In each of the above cases, we reviewed the most recent versions of the documents. Instruments from individual institutions, libraries, and funders are out of scope for this analysis.

[8] https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

[9] https://www.esfri.eu/national-roadmaps

We also want to highlight and point readers to sources of information that aggregate these national policies and initiatives, which we have found helpful during our research. These sources point to country-level developments in different aspects of open science and provide a timeline of, and additional context to, policy development. These are useful sources of information in helping users understand progress to date and ongoing developments in each country.

- OpenAIRE's Open Science Overview in Europe[10] is jointly created and maintained by OpenAIRE's National Open Access Desks. It gathers information on open science policy, infrastructure, and training, and is updated periodically.
- The EOSC Observatory[11] collects up-to-date information on Open Science Policies across EU Member States and Associated Countries.
- The Council of National Open Science Coordination's (CoNOSC) Open Science Policies page:[12] CoNOSC is a network of national Open Science coordinators in the UN-European region. Its policy page details national open science policy statuses and trajectories in CoNOSC member countries.
- National Initiatives for Open Science in Europe[13] (NI4OS Europe) is a Horizon Europe funded project with the aim to support the development and inclusion of national Open Science Cloud Initiatives in 15 Member States and Associated Countries in the EOSC governance, focusing particularly on South-Eastern European countries.
- Electronic Information for Libraries (EIFL) is a not-for-profit organization that works with libraries in developing and transitioning economy countries in Africa, Asia Pacific, Europe, and Latin America.[14] Its website provides information on EIFL's work and national library consortium information in a number of European countries, as well as interviews and news stories.[15]
- The ESFRI national roadmaps catalogue[16] provides links to national roadmaps, the year in which each was published/last updated, and the status of the roadmap.

With this analysis, we aim to add value by focusing on open digital research infrastructure. In reviewing open science and access instruments, we look at whether and how infrastructure is discussed and prioritized, especially in forward-looking objectives and actions (as opposed to discussion on the context and existing initiatives). In reviewing research infrastructure and RDI/R&HE roadmaps, we investigate the contexts in which open science and open access are discussed and incorporated.

## Key findings

### Regional diversity in open policies

In our review of national open science and open access instruments, we find a wide variety of approaches involving different parties and stakeholders. These approaches include:

- *National policies* approved by ministerial bodies and/or the parliament, e.g. the National Policy of the Republic of Cyprus for Open Access to Scientific Information (2016) was approved by the Council of Ministers in 2016,
- *National strategies* and *action plans* put forward jointly by government ministries and other national bodies, e.g. Denmark's National Strategy for data management based on FAIR principles, prepared by the Danish e-Infrastructure Cooperation on assignment from the Danish Agency for Science and Higher Education (Andersen et al., 2021), and
- *Declarations* proposed by local research communities, e.g. the Declaration of the National Open Science Cloud in North Macedonia is open to all stakeholders to sign and endorse (National Open Science Cloud Initiative, n.d.).

Some instruments are created by means of a top-down approach, announced by a government ministry and then further developed by working groups composed of local experts from research institutions, infrastructures, and libraries, and/or refined through open consultation. Others are bottom-up efforts, where local experts convene and publish a proposal, which is then adopted by institutions and implemented (e.g. Proposal for a National Open Science Plan in Greece: Athanasiou et al., 2021).

[10] https://www.openaire.eu/os-eu-countries

[11] https://eoscobservatory.eosc-portal.eu/home

[12] https://conosc.org/os-policies/

[13] https://ni4os.eu/15-national-osc-initiatives/

[14] https://www.eifl.net/page/about

[15] https://www.eifl.net/where-we-work

[16] https://www.esfri.eu/national-roadmaps

The heterogeneity of approaches and stakeholders may reflect the different cultures of governance and prioritization of open science and access in governmental agendas in different European countries. While national instruments can be helpful in guiding and influencing local organizations and institutions in creating their own plans and policies, a national policy endorsed or approved by ministerial bodies is not necessarily better implemented than a bottom-up plan.

In our review of national research infrastructure roadmaps, we also note a diversity in approaches and extents of the integration of open science and access principles and priorities. For example, the French national strategy on research infrastructures assesses the amount of data in each research infrastructure and has a dedicated section assessing the development and adoption of open science policies and practices in each domain of research infrastructure (Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation, 2021b). Other research infrastructure roadmaps focus more on data infrastructure, e-infrastructure (e.g. high performance computing), or open access to infrastructure.[17] There are also roadmaps that do not mention open science, data, or access at all.

### Infrastructure increasingly prioritized in national open science strategies

Across Europe, the need to establish, develop, and maintain infrastructure to enable open access and science practices is increasingly recognized in national strategies. Below, we highlight a few ways that we see this materializing, including around open access infrastructure, research data infrastructure, and funding for infrastructure.

### Open access infrastructure

Recognizing the importance of infrastructure in facilitating open access to publications and other research outputs, some national instruments call for institutions to develop the necessary open access infrastructures together with local stakeholders and in accordance with international standards and guidelines. For example:

> "This policy strongly encourages Maltese institutions (RPOs and RFOs), which currently lack an institutional repository but engage in research activities or are aiming at reinvigorating their research system, to develop their institutional repository. To ensure best use of limited resources and to prevent duplication of work, this policy strongly encourages entities embarking on this task to seek advice from and collaborate with local stakeholders having relevant knowledge and experience on the subject matter" (in National Open Access Policy Malta, 2021).

> "In order to ensure mutual compatibility of scientific publication repositories, scientific institutions should create their publication repositories on the DSpace platform, in accordance with OpenAire guidelines and use the OAI-PMH protocol for integration with the National Scientific Performance Information System (NZDIS) and the European Open Science Cloud (EOSC)" (from Latvia's Open Science Strategy 2021-2027: Blums, 2021).

In countries where there is existing national open access infrastructure, we see national plans calling for the strengthening of the infrastructure. For example:

> "Continue developing the HAL national open archive, which includes: Simplify the process of making submissions to HAL for researchers publishing on other open access platforms across the world (CorHAL project); implement HAL's shared governance and long-term financing model as voted by the Open Science Steering Committee; develop the integrated service for self-archiving, automatic collection of publications and coordination with research data…" (from the Second French Plan for Open Science: Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation, 2021a).

> "Building on existing national institutional repositories, while preserving their sovereignty, the Signatories support the development of a user-friendly national repository search platform that is developed, maintained and operated by the institutions, with the costs covered by the state budget" (from Hungary Position Paper on Open Science: NKFIH, 2021).

Some strategies specifically call for the development of and investment in open access infrastructure beyond repositories. For example, Ireland's National Action Plan for Open Research outlines activities to "address the lack of preservation policies and infrastructure to support sustainable access to scholarly publications," which include "a feasibility study and pilot to establish a publicly owned, centralized national platform for Diamond OA publication of journals and books" and "supporting the open infrastructure for scholarly communication that underpins bibliodiversity in the international context by funding and establishing connections to initiatives such as the Global Sustainability Coalition for Open Science Services (SCOSS), infrastructures for Diamond OA, and endorsing the Action Plan for Diamond OA" (National Open Research Forum, 2022).

[17] "Open access to infrastructure" is distinct from "open access infrastructure", which is infrastructure designed to provide open access to literature and other research output.

Additionally, a number of national open access and open science instruments mention supporting further inclusion of open access journals and/or monographs published in the country in the Directory of Open Access Journals (DOAJ) and/or Directory of Open Access Books (DOAB), highlighting the increasing adoption of and dependence on open infrastructure such as DOAJ and DOAB (e.g. Romania's White Paper on the Transition to Open Science (2023-2030): Irimia et al., 2022; Slovakia's National Strategy for Open Science 2021-2028: Slovak Centre of Scientific and Technical Information, 2021; and Ukraine's National Open Science Plan, 2022).

### Research data infrastructure

Similarly, we observe growing emphasis on the development and maturation of infrastructure to enable Findable, Accessible, Interoperable, and Reusable (FAIR) data practices (Wilkinson et al., 2016) in both national open science strategies and research infrastructure roadmaps.

The strategies emphasize different key principles and priorities when it comes to the further development of research data infrastructure. These include technological sovereignty (e.g. Germany Research Data Action Plan: Bundesministerium für Bildung und Forschung, 2021), cost effectiveness and accessibility (e.g. Icelandic Roadmap for Research Infrastructures 2021: Magnússon & Smári, 2021), the use of international standards (e.g. "Strongly recommend widespread certification of data infrastructures using international standards, such as the Core Trust Seal" in Ireland's National Action Plan for Open Research: National Open Research Forum, 2022), security (e.g. "national infrastructure [...] facilitates access to and secure processing of research data" in the Norwegian Research Council Policy for Open Science, 2020: The Research Council of Norway, 2020), and long-term sustainability (e.g. The Swiss National Strategy Open Research Data Version 1.0 Action Plan, swissuniversities, 2021).

Many strategies also recognize the importance of synergistic efforts, e.g., in policy development and capacity building, in ensuring the effective adoption and use of infrastructure to advance FAIR data practices. For example, in the Swiss National Strategy Open Research Data Version 1.0 Action Plan (swissuniversities, 2021):

> "The second aspect of Action Area B (titled 'Development, promotion, and maintenance of financially sustainable basic infrastructures and services for all researchers') concerns defining and establishing ORD (open research data) support structures. One key feature is promoting the role of data stewards at Swiss higher education and research institutions, including the development and definition of effective models to anchor and connect these stewards."[18]

Some strategies explicitly call for increasing coordination between different types of national infrastructure or the development of a cohesive national open science infrastructure. For example, in the Second French Open Science Plan (Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation, 2021a):

> "As part of its strategy for data, algorithms and source codes, the Ministry of Higher Education and Research proposes to bring together the bearers of these infrastructures in a network of players around the challenge of collectively building the French ecosystem of open science infrastructures. Within this framework, these actors are to develop and implement a national policy of permanent and open identifiers to guarantee a reliable link between research contributors, their productions, their research centres and their institutions."

[18] The inclusion of the professionalization of research data roles in European national strategies complements and synergizes with many national, regional, and international efforts in this area, e.g. the work by the RDA Professionalizing Data Stewardship Interest Group, the FAIRSFAIR and Skills4EOSC projects, and many local and national communities of data stewards and managers.

### Other types of open infrastructure

Some strategies also discuss the need to develop and/or adopt other types of open infrastructure nationally. These include: integrating persistent identifier services, such as ORCID, DOI, and ROR, with publications and data, and encouraging their use by researchers and others (e.g. the Italian National Plan for Open Science, Ministero del'Università e della Ricerca, 2021; Proposal for a National Open Science Plan in Greece, Athanasiou et al., 2021); developing research software infrastructure (e.g. the Second French Open Science Plan; the Open Science 2030 in the Netherlands: NPOS2030 Ambition Document and Rolling Agenda, NPOS, 2022); and the development of open access/science indicators and monitoring systems (e.g. Denmark's National Strategy for Open Access, Ministry of Higher Education and Science Denmark, 2018; the Second French Open Science Plan, Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation, 2021a).

### Specific funding instruments for open infrastructure

Many of the reviewed roadmaps and instruments discuss the financial sustainability and cost effectiveness of the development and maintenance of open research infrastructure. It is worth noting that some outline funding programmes specifically to support the development of infrastructure. One example is Germany's Guidelines and Supplementary Instructions Infrastructures for Scholarly Publishing, which proposes a "funding programme 'Infrastructures for Scholarly Publishing', which aims to support the transition to open access through the establishment and development of suitable information and the (further) development of structural conditions'" (Deutsche Forschungsgemeinschaft, 2021). Another example is the Open Science NL Work programme 2024-2025, which specifies a EUR€17.5M instrument to "support the development of digital infrastructures that enable open science practices" (Open Science NL, 2023).

### Strong ties with European-level development

The relationship between European-level developments and national policies and roadmaps is intricate. European-level legislation sets standards and frameworks that member states must adhere to, requiring member states to harmonize their national laws with EU directives. EU programmes and funding mechanisms often support national initiatives that align with EU priorities, and in many cases, we see national policies and roadmaps shaped to leverage these resources effectively. Ultimately, the successful implementation of international declarations and legislation relies on national policies and roadmaps, and conversely, national policies and roadmaps can influence international agendas.

One example that demonstrates this intricate relationship is the development of EOSC.[19] EOSC's ambition is to provide European researchers, innovators, companies and citizens with a federated and open multi-disciplinary environment where they can publish, find and reuse data, tools and services for research, innovation and educational purposes (European Commission, 2022). The implementation of EOSC started in 2015, with the European Commission investing in prototyping components through calls for projects under Horizon 2020. Under Horizon Europe (the European Commission's research and innovation funding programme between 2021 and 2027), EOSC is run as a co-programmed European partnership, supporting the EU's Policy of Open Science and the European Data Strategy (European Commission, 2023b).

Many of the national open science and research infrastructure instruments we reviewed call specifically for local research institutions and organizations to participate actively in the development of EOSC, strengthen the connection between and integration of national infrastructure with EOSC infrastructure, and start national initiatives in alignment with EOSC priorities.

[19] https://open-science-cloud.ec.europa.eu/

Another noteworthy continent-wide coordination effort in the research infrastructure space is the European Strategy Forum on Research Infrastructures (ESFRI). ESFRI is a strategic instrument to develop the scientific integration of Europe and to strengthen its international outreach (ESFRI, n.d.). The European Commission and ESFRI encourage Member States and Associated Countries to develop national roadmaps for research infrastructures. Since 2006, ESFRI has also established a European Roadmap for research infrastructures for the next 10-20 years. The Roadmap is continuously updated (the last update was in 2021) and provides strategic guidance for Member States and Associated countries in their research infrastructure investment. In the 2021 Roadmap, "data, computing and digital research infrastructures" is identified as a thematic area of research infrastructure, and the contribution of ESFRI research infrastructures to EOSC is highlighted (European Strategy Forum on Research Infrastructures, 2021). In addition, in the monitoring process for ESFRI Landmarks (which are selected reference research infrastructures in Europe), the general criteria for landmark and research infrastructure assessment include "optimizing data use" as one of the objectives and "number of publicly available data sets used externally" as a key performance indicator (Working Group on Monitoring of Research Infrastructures Performance, 2019).

## Conclusion

A rich, interconnected landscape of national and continent-level instruments around open science and infrastructure is developing in Europe. The heterogeneity within that landscape, from the policy development adoption approaches to the areas of focus within the instruments, reflects the regional diversity in cultures of governance and national agendas within the continent. Nevertheless, we observe the increasing prioritization of the development and maintenance of infrastructure to enable open access and science practices in many national instruments, including the establishment of specific national funding programmes for open infrastructure. These developments are supported by and supporting the development of continental-level initiatives, such as EOSC and ESFRI.

We also find it important to pay attention to and discuss open digital research infrastructure in the context of the broader technology and digital infrastructure space. The development of much recent European-level legislation, motivated by the increase in power and prevalence of big tech companies and their platforms, the desire to safeguard digital sovereignty, and the growth of the open movement and digital public good conversations internationally and in Europe, may have implications for open research infrastructure development and related strategy. These include the European Data Strategy (the Open Data Directive, Data Governance Act, and the European Data Act), the Digital Services Act package (Digital Services Act and the Digital Market Act), the EU AI Act, and the EU Cyber Resilience Act. We provide an overview of these legislative initiatives and an analysis of their (potential) impact on digital research infrastructure in Europe in the "Regional policy developments and their implications for open infrastructure" chapter in our 2024 State of Open Infrastructure report (Steinhart et al., 2024).

# Open science policy landscape in Latin America

## History and evolution

The open science movement has been well established in Latin America for nearly 30 years. Due to the widely held view that knowledge is a public good, scientific publishing has largely been in the hands of the academic and research institutions rather than commercial publishers (Hagemann, 2023).

The prioritization of openness in science dates back to 1998 with the formation of the **Scientific Electronic Library Online** (SciELO).[20] SciELO's chief objective is to increase the quality and dissemination of open access scientific output by improving and extending the means of evaluation and publication of scholarly contributions. A decentralized network of OA journals across 16 countries, SciELO was developed based upon Brazil's collection of journals (McKenna, 2023). In addition to SciELO, there are a number of organizations that are actively contributing to the adoption of open science and providing the infrastructure that underpins it, which we describe below.

**RedCLARA**[21] is the RREN of the Latin American region. Formed in 2004, RedCLARA provides regional interconnection and connection to the world through its links with other RRENs. In 2012, RedCLARA formed the Federated Network of Institutional Repositories of Scientific Publications (LA Referencia).

**LA Referencia**[22] is a Latin American network of open access repositories,based on technical and organizational agreements between public science and technology agencies of member countries. It supports national open access strategies by providing a platform for sharing and raising the visibility of scientific output of academic and research institutions. Drawing from multiple national nodes, scientific articles and doctoral and master's theses from more than 100 universities and research institutions from participating countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Ecuador, El Salvador, Spain, Mexico, Panama, Peru, and Uruguay) are made openly available.

**Redalyc**,[23] the Red de Revistas Científicas de América Latina y el Caribe, España y Portugal, was founded in 2003 with the aim of giving visibility to and improving the editorial quality of Social Sciences and Humanities journals in the Latin American region. Redalyc is an open infrastructure for open access scientific journals without article processing charges (Diamond Open Access) that includes an electronic publishing and editing platform, an indexing system for titles of proven scientific and editorial quality, and a metadata standardization service.

**Latindex**,[24] the Regional Online Information System for Scientific Journals in Latin America, the Caribbean, Spain and Portugal, was established in 1997 as the product of the cooperation of a network of institutions that coordinates, gathers and disseminates information on scientific serials produced in Ibero-America. It offers two information services: The Directory, available since 1997, is an exhaustive list that registers academic journals published in the countries of the Latin American and Caribbean. Latindex's second service is their Catalogue 2.0, available since 2018, which consists of electronic journals that meet the 38 established editorial quality criteria of Latindex.

**CLACSO**,[25] the Latin American Council of Social Sciences, is an international non-governmental institution, established in 1967. Currently, it brings together over 800 research and postgraduate centers in the field of social sciences and humanities in 51 countries in Latin America and other continents. In 1998, CLACSO established a virtual library with the objective of providing open Web access to the full text of books, periodical articles, working documents and conference papers published by its network members.

**AmeliCA**[26] is an open distribution infrastructure for scholarly publishing and open science. Established in 2019, AmeliCA is a cooperatively sustained, non-profit initiative with a mission to preserve and make openly accessible scholarly works.

[20] https://www.scielo.org/

[21] https://www.redclara.net/index.php/

[22] https://www.lareferencia.info/

[23] https://www.redalyc.org/

[24] https://latindex.org/

[25] https://www.clacso.org/en/open-access-to-knowledge/

[26] http://amelica.org/index.php/en/home/

## Policy development at the national level

There are several initiatives aimed at developing and implementing policies to advance open science at the national level in Latin America, which we summarize in Table 2.

**TABLE 2.**
National-level open science policies in Latin America since 2018. Adapted from Appel et al. (2018) and Heredia (2022).

| Country | Year | Policy |
|---|---|---|
| **Brazil** | 2022 | The fifth Open Governance National Action Plan of Brazil (2021-2023)(Office of the Comptroller General et al., 2021) commits to building a research assessment model to promote open science as an alternative to the models currently applied in Brazil. |
| **Argentina** | 2021 | The Argentinean Ministry of Science, Technology and Innovation (MINCyT) created the Advisory Committee on Open Science and Citizen Science, which produced the *Diagnosis and Roadmap for an Open Science Policy in Argentina* (MINCYT Argentina, 2022). This builds on a 2013 law (Sistema Nacional de Ciencia, Tecnología e Innovación, 2013) that requires that the outcomes of publicly funded research be made freely available in open access institutional repositories. |
| **Chile** | 2022 | In Chile, the initiative Datos Científicos (Scientific Data) has been established by the National Research and Development Agency (ANID, formerly National Commission of Scientific and Technological Research (CONICYT)), requiring that all data derived from research funded by ANID must be deposited in open repositories in appropriate formats (Zaballos, 2018). |
| | 2021 | ANID granted 12 universities funding through the Innovation in Higher Education (InES) fund (MINCIENCIA, n.d.) for a period of two years to strengthen their institutional capacities in open science, one of the most important dimensions of the fund being the implementation of technological infrastructure that complies with international interoperability standards. |
| **Uruguay** | 2019 | Uruguay does not have a national science policy. However, the National Agency for Research and Innovation (ANII), the government body that coordinates the evaluation of research activity, established its open access regulation (Agencia Nacional de Investigación e Innovación. (n.d.)), which mandates that grant recipients must deposit scientific publications in an institutional repository. |

## Policy development at the regional and international levels

Within the Latin American context, scientific knowledge has long been viewed as a public good rather than a commodity (Harris et al., 2021). This is evidenced by the fact that Diamond Open Access is well established across the region, and the relatively high investment by governments in research and scholarship (Mounier & Rooryck, 2023). Becerril-García and Aguado-López (2019) characterize the impact of these views on the ecosystem as follows:

> *The Latin American region, as a result, owns an ecosystem characterized by the fact that "publishing" is conceived as acts of "making public", of "sharing", rather than the activity of a profit-driven publishing industry (...) Latin American academic journals are led, owned and financed by academic institutions. It is uncommon to outsource editorial processes.*

A series of international policies within Latin America underpins the development of open access and consequently open science within the region. The Santo Domingo Declaration Science for the 21st Century: A New Vision and Framework for Action in 1999 (Anonymous, 1999) serves as the foundation for the advancement of open access and open science across the continent. The declaration was the outcome of a conference organized by UNESCO and the World Federation of Scientific Workers (WFSW) held in Santo Domingo, Dominican Republic, and outlined a new vision and framework for scientific endeavours in the 21st century. It lays the groundwork for the coordination of STI actions in the region and introduces a narrative consistent with what would later become open access and open science policies (European Commission, Directorate-General for Research and Innovation & Kouis, 2023). The declaration emphasized the importance of science and technology in the region's development, and called for increased collaboration, investment, and integration of scientific efforts. The key elements of the Santo Domingo Declaration include the promotion of open science, increased funding for research and development, and the establishment of networks to facilitate knowledge exchange. The Declaration seeks to enhance the visibility of Latin American scientific research on the global stage and to encourage the free flow of scientific information.

Subsequently, additional open access and open science policies have been developed, and we summarize these below.

**The Salvador Declaration on Open Access: The Developing World Perspective:** Developed and signed in 2005 by the Network of Latin American and Caribbean Social Science Virtual Libraries of CLACSO's Network of Member Centres in Salvador de Bahia, Brazil, this document contains a clear definition of open access and a defense of its benefits and urges governments to make it a priority in STI policies. The Declaration is often cited as influencing the design of subsequent open access policies in the region (European Commission, 2023c). It highlighted scientific communication as a crucial and inherent part of the activities of research and development and also made the case for unrestricted access to scientific information.

**The CLACSO General Assembly Declaration on Open Access to Knowledge Managed as a Common Good:** Signed in 2015 in Medellín, Colombia, the declaration names the problem of commercial publishers' shift from subscription-based access to open access supported by article processing charges (APCs) and calls for the development of public and interoperable repositories and infrastructure as part of a solution to address it (CLACSO, 2015). Its importance lies in the fact that it defined a non-commercial open access model for scientific communication.

**The Mexico Declaration in Defence of the Latin American Open Access Ecosystem:** Published by Latindex, Redalyc, CLACSO, and the Brazilian Institute of Science and Technology Information (IBICT) in 2017, the declaration articulates the need to defend a non-commercial open access model in the region and strongly underscores the public commitment of all the institutions involved to achieving it (Latindex et al. 2017).

**The Panama Declaration on Open Science:** Announced publicly in 2018 by members of universities and civil society organizations gathered in Panama City, one of the key aims of the Panama Declaration was "to move towards collaborative models of knowledge creation, management, communication, preservation and recognise that open science required going beyond open access, by repositioning society's leadership role to produce and benefit from science, technology and innovation" (Becerril-García & Aguado-López 2019). The Declaration emphasizes the development of national and regional open science policies and infrastructures and ethical considerations in open science (including responsible data-sharing practices), and advocates for strengthened regional collaboration and South–South partnerships.

The Panama Declaration set the tone for greater international collaboration to further open science (CILA, 2018). In 2021, LA Referencia and RedCLARA signed a memorandum of understanding with the three African RRENs with the aim of advancing open science policies, services, and infrastructure that reflect the unique needs and conditions of each continent within a framework of international cooperation (AfricaConnect3, 2021). Other examples of international collaborations are the Building the Europe Link to Latin America and the Caribbean (BELLA) I and II[27] programmes that seek to enhance Internet connectivity between Europe and Latin America via submarine and terrestrial cables, and the development of LA Referencia's metadata validation service based on the OpenAIRE standard, which makes repositories in Latin American and the Caribbean (LAC) interoperable with European repositories. The EU-LAC Foundation,[28] an international intergovernmental body established in 2010 by LAC and EU states, has as its mandate to promote dialogue and collaboration on issues such as higher education, science, technology, and innovation.

## Opportunities and challenges

While we have seen great strides in the development and use of open infrastructure across Latin America, there is room to further catalyze the adoption of open science. The recent COVID-19 pandemic, while posing a significant challenge that affected funding for R&D in some Latin American countries (Quintans-Júnior et al., 2020), also presented opportunities for making the case for open science. Latin American scientists demonstrated that even with limited funding, they could contribute to solving unprecedented challenges. For example, in Peru, researchers at the Centre for Research and Innovation of UPC University rapidly developed a low-cost COVID-19 virus detection test kit using BEARmix, an open source RT-PCR protocol (Marcinkevicius & Pavlovich, 2022). In the same vein, a team of biomedical engineers from the University of Antioquia in Colombia developed a low-cost lung ventilator using open source schematics from MIT adapted to the local context (Orth, 2020).

Efforts to develop and harmonize policies at both the regional and national levels are helping to promote the uptake of open science in Latin America. At the national level, since 2010, several Latin American countries have implemented national open access policies (Table 2) that have helped to drive adoption of open science policies at the institutional level. The UNESCO Recommendation on Open Science has also played a critical role in this arena. For example, Current Research Information Systems (CRIS) are included among the kinds of shared research infrastructures the UNESCO Recommendation describes as having the potential to support open science. CRISs are in widespread use across Latin America, and play an important role in the reporting and assessment of research performance. Managed in keeping with the principles of open science, they can make visible the scholarly scientific contributions of Latin American researchers. Brazil and Peru have been pioneers in developing CRIS systems in Latin America and now other countries like Argentina, Chile, Costa Rica, Colombia, and Ecuador are following suit (Vázquez Tapia, 2022). A recent document, published by FOLEC in 2021, proposes and promotes the discussion about the creation of a Latin American CRIS (Heredia, 2022).

Finally, in 2022, IBICT (Brazil) launched Civis, an open-source platform to support citizen science. It focuses on promoting non-scientist contributions and engagement in knowledge, data, and information analysis and production that are relevant to science and issues of social, environmental, and territorial importance (IBICT, n.d.). This is significant because the UNESCO Recommendation identifies citizen science infrastructure as one area deserving of investment.

In spite of opportunities to promote the use and adoption of open infrastructure at scale, some barriers remain. One significant challenge is the hegemony of the English language in science. Despite the fact that Spanish and Portuguese are the primary languages in Latin America, many journals only accept English language content, locking out sources of knowledge in other languages. The UNESCO Recommendations specifically call out the issue of language as a barrier for the adoption of open science globally:

> *...open science respects the diversity of cultures and knowledge systems around the world as foundations for sustainable development, fostering open dialogue with indigenous peoples and local communities and respect for diverse knowledge holders for contemporary problem solving and emergent strategies towards transformative change* (UNESCO Open Science Advisory Committee, 2021).

[27] https://www.bella-programme.eu/index.php/en/

[28] https://eulacfoundation.org/en

Ramírez Castañeda (2020) suggests that the imposition of English not only impoverishes science but also substantially affects the publishing possibilities of researchers from non-English speaking countries. At the same time, they are continually subjected to requests for reviews from journals claiming they need to have their texts proofread by speakers proficient in the language of publication.

Article Processing Charges (APCs) present another barrier to the widespread adoption of open science practices. This is an especially controversial practice in Latin America and is at odds with the long and widely held view that knowledge is a public good. Professional incentives that drive researchers to publish in high impact factor, APC-based journals, threaten the vibrant publishing ecosystem in the region. This focus on rewarding publication in prestige journals renders invisible important contributions to research and education (Alperin, 2022). Further ramifications of this focus on publishing in high impact journals include underfunding of community-owned infrastructures because funds are instead directed towards APCs.

The COVID-19 pandemic drove a significant redistribution of resources to ensure robust and effective responses to the health crisis. In Brazil, the pandemic caused a decline in science funding that has continued even after the widespread containment of the pandemic (SciELO, 2020). Even under ordinary conditions, in Latin America most countries spend less than 1% of GDP on science and technology; only Brazil spends more than 1% of GDP on research and development (UNESCO, 2021). Issues of funding were further exacerbated by the COVID-19 pandemic, straining the budgets of most countries in Latin America.

One of the most important impediments to advancing open science in Latin America is political and economic instability, which has led to substantial changes in government support and funding for research and scholarship. Despite a history of government support for open science, research, and scholarship, this support has been tested of late due to the COVID-19 pandemic and changes in the political climate, as we see some right-wing administrations actively defund the sciences. In Mexico, President Obrador has cut science funding by over 50% (Wade, 2019) and has continually mocked scientists. In Argentina, President Millei has expressed his intent to dissolve the ministry of science altogether (Trager, 2023). At the same time, we also see pro-science governments that are committed to increasing funding for open science. One such example is provided by the Chilean government, which has empowered its national R&D agency (ANID)[29] to support open science in the country.

We note the tension between the global movement to promote open science, and a substantial history of leadership in open access and infrastructure in Latin America on the one hand, and a shifting political climate and varied commitment of support for open science on the other. The next few years will be key in determining the trajectory of open science and supporting infrastructure in Latin America.

[29] https://anid.cl/

# Open Science Policy Developments in the United States

The primary sources of research funding in the United States are government agencies and private philanthropic foundations. There has been significant activity in both of these sectors, particularly in the past year or two on the federal side, to advance public access to the results of research and open science more generally. In 2023, the US Office of Science Technology and Policy (OSTP) launched the Year of Open Science, with the overall objective of advancing national open science policies. The OSTP and the National Science and Technology Council (NSTC) set the stage by defining open science as the "principle and practice of making research products and processes available to all, while respecting diverse cultures, maintaining security and privacy, and fostering collaborations, reproducibility, and equity" (Office of Science and Technology Policy, 2023).

Over the course of the year, federal agencies drafted or updated their public access plans in response to new directives from the OSTP (discussed in the next section), launched public access policies that were already in development (e.g. the National Institutes of Health's (NIH) data management and sharing policy), implemented new open science infrastructures and programmes (e.g. the Department of Energy's (DOE) unified access point for persistent identifier (PID) services, National Aeronautics and Space Administration's (NASA) five-year Transform to Open Science (TOPS) mission), announced new funding opportunities (NEH's Digital Humanities Advancement Grants and the National Science Foundation's (NSF) Geosciences Open Science Ecosystem), and more (Office of Science and Technology Policy, 2024).

## Recent US federal government public access policy developments

Much of the significant and recent policy development around open science and supporting infrastructure in the United States relates to evolving US federal government mandates that the results of government-funded research be made widely and publicly available. The 2022 directive (Office of Science and Technology Policy (2022), known informally as the "Nelson memo") issued by the Office of Science Technology and Policy (OSTP) is the most recent but not the first such mandate; the National Institutes of Health (NIH) issued its first public access policy in 2005 (National Institutes of Health, 2005), the National Science Foundation began requiring data management plans (including data sharing) in grant proposals in 2011 (National Science Foundation, 2011), and the OSTP issued its first multi-agency public access directive to federal agencies in 2013 (the "Holdren memo", Office of Science and Technology Policy, 2013). The Nelson memo extends the Holdren memo in several important ways:

- Eliminating embargoes on the release of research outputs,
- Extending the policy to cover all federal research funders, not only those with more than US$100M in extramural research (as was the case with the Holdren memo),
- Requiring agencies to (eventually) extend their data sharing requirements to all research data, not only those that directly support peer-reviewed publications,
- Promoting the assignment of PIDs to research outputs and including PIDs for authors and organizations in metadata, and
- Addressing concerns related to equity both in participation[30] in the research process and in access to its results.

Agencies with more than US$100M in annual research expenditures were given 180 days from the data of the memo (25 August 2022) to update their public access policies, and agencies with US$100M or less in research expenditures were given 360 days to develop new (or extend existing) policies. These new or updated policies are to be submitted to the OSTP and Office of Management and Budget (OMB) for review, with finalized policies published by 31 December 2024, and taking effect not more than one year after publication. These policies are tracked on the US government website *Public Access Plans & Guidance* (CENDI, n.d.). As of early March 2024, all agencies should have submitted drafts to OSTP and OMB, but policy availability for the agencies listed on the *Public Access Plans & Guidance* website is incomplete.

[30] Agencies are not tasked with addressing the issue of equitable participation in research immediately; rather the National Science and Technology Council Subcommittee on Open Science is charged with overall coordination among agencies and with considering "measures to reduce inequities in publishing of, and access to, federally funded research and data, especially among individuals from underserved backgrounds and those who are early in their careers" (OSTP 2022).

A look at several of the available draft and final policies shows that they are strikingly similar in general terms, although this comes as no great surprise as they were all crafted in response to the Nelson memo. Some of the common elements include deposit of articles (or at the very least, article metadata with link out to an open access copy hosted elsewhere) to agency-designated repositories or catalogs, a focus on repositories as the preferred means of distributing research data, and selection of data repositories that meet the criteria set forth in the National Science and Technology Council's (NSTC, 2022) "Desirable Characteristics of Data Repositories for Federally Funded Research" (when the choice of repository is left to the researcher), allowing some exemptions to sharing (for example in the cases of legal or ethical concerns, proprietary, controlled or classified data, or trade secrets), and allowing "reasonable" costs of compliance to be included in grant proposal budgets.[31]

A few differences across agency policies stand out:

- The National Institute of Standards and Technology (National Institute of Standards and Technology (NIST), 2023) allows an embargo of up to 12 months for publications under limited circumstances (namely that a co-author has transferred copyright to the publisher),
- Some agencies are adopting a shift in terminology from "Data Management Plan" to "Data Management and Sharing Plan," to more strongly emphasize data sharing requirements,
- Agencies (Agency for Healthcare Research and Quality (AHRQ), USDA, NASA, NIST, and the United States Geological Survey (USGS)) have well developed data sharing infrastructure that will meet the needs of many of their funded researchers, while others steer researchers to external repositories (Agency for Healthcare Research and Quality, 2023; U.S. Department of Agriculture, 2023; U.S. Department of the Interior, 2023; National Aeronautics and Space Administration (NASA), 2023; National Institute of Standards and Technology (NIST), 2023),
- The NIH and NSF are leading in the area of attempting to ensure equitable access to participate in the research process, even though doing so is not (yet) explicitly required. The policies of both agencies acknowledge the potential for a shift towards article processing charges (APCs) as a means of paying for open access to inequitably impact researchers with inadequate funding and/or small awards, and suggest initial strategies for at least beginning to adjust policy and practice to mitigate that possibility (National Institutes of Health (NIH), 2023); National Science Foundation, 2023), and
- Most agencies expect to monitor and manage compliance via existing award reporting mechanisms, although some have more mature systems in place than others. Some agencies explicitly mention the possibility of adjusting or withholding funding for non-compliance (Agency for Healthcare Research and Quality, 2023; U.S. Department of Energy (2023); National Institutes of Health (NIH), 2023; National Aeronautics and Space Administration (NASA), 2023; U.S. Census Bureau (2024); U.S. Department of the Interior, 2023).

Many of these policies are still in draft stage, with additional policies to be released, but the overall trend is towards increasing and more immediate access to the results of federally funded research. Substantial questions remain regarding allowable and reasonable costs, as well as how potential changes in how the costs of publishing are paid might impact researchers and research funders.

## Private funder policies

Some private funders in the US have also developed public access, open access, or open science policies. As an illustration of the growing interest in the topic, the Open Research Funders Group (ORFG) launched in 2016 with the aim of promoting open sharing of the results of research and has grown from an initial cohort of eight to 26 participating funders (Open Research Funders Group, 2016). Without an overarching mandate analogous to the Nelson memo to drive policy development towards a shared baseline or within any particular timeframe, the policies of private funders are more varied in emphasis, scope, and implementation[32] and seem to emerge from a general sense that providing public access to the research they fund is simply the right thing to do (Williams, 2015; Openness by Default, 2017).

[31] What is meant by "reasonable" is not clearly specified, and a current area of research for IOI.

[32] Because we do not discuss the details of individual policies one by one, but rather make comparisons across them, we list the funders and policies reviewed at the end of this report.

Some common provisions (or lack thereof) of private funder policies include:

- Private funder policies on allowable embargoes are more varied than US federal funders. Aligning Science Across Parkinson's (Aligning Science Across Parkinson's (ASAP), 2021), the Bill & Melinda Gates Foundation (2015), Howard Hughes Medical Institute (Howard Hughes Medical Institute (HHMI), 2020, 2023), and Robert Wood Johnson Foundation (Robert Wood Johnson Foundation (RWJF), 2019, 2020) require immediate public access to research outputs; other policies either do not specify any limits on embargoes or allow up to twelve months,
- Posting publications to preprint services is widely encouraged (American Heart Association (AHA), n.d. a,b; Bill & Melinda Gates Foundation, 2015; Chan Zuckerberg Initiative (CZI), 2021; Howard Hughes Medical Institute (HHMI), 2020, 2023) or required (Aligning Science Across Parkinson's (ASAP), 2021),
- Most allow expenses associated with public access in grant budgets; two funders specify they will pay APCs directly (Aligning Science Across Parkinson's (ASAP), 2021; Bill & Melinda Gates Foundation, 2015),[33]
- Most policies address publications and data at a minimum. A few go further and apply to software and materials produced in the course of research, and
- Accessibility for machine processing or assistive technology is rarely (if ever) mentioned.

Overall, private funders have much more latitude to determine policy than their federal counterparts. Their policies are sometimes less specific, certainly more varied, and are proceeding on independent timelines.

## Implications for open infrastructure

The federal policy developments in particular have wide-ranging implications for researchers, their institutions, and the research infrastructure that they rely on. We share here a few thoughts on what this might mean for open infrastructures that support research and scholarship.

Increased use of some infrastructures is the most obvious consequence of these expanded mandates. We speculate in a recent report (Steinhart and Skinner, 2024) that research data repositories whose sources of revenue do not scale up with an increase in deposits may eventually be faced with sustainability challenges. We might expect the same possibility for other fee-free infrastructures such as preprint services, repositories and open access publishers that do not charge fees. Disciplines that are underserved by current available infrastructures will make those gaps more evident, possibly surfacing interesting opportunities to expand existing infrastructure in new directions, or develop entirely new services. Alternatively, particularly for disciplines that receive less funding overall, some researchers may be faced with mandates that can't be met using existing infrastructure.

Institutions and funders alike will seek ways to monitor and manage compliance. Some funders are already better equipped than others to manage this.

The Nelson memo also directs federal agencies to ensure the results of the research they fund are accessible for machine access and for individuals using assistive technologies. In the case of funders who support their own infrastructure (for example, NIH's PubMed Central), it is clear where the responsibility lies for making good on this requirement. When researchers rely on independent infrastructure, this mandate potentially breaks down, and it is not at all clear who is responsible for ensuring compliance and where in the research process adapting materials to maximize accessibility should occur. arXiv launched an experimental project to provide an accessible HTML version of TeX/LaTeX submissions (Frankston 2023), a significant step forward in making a piece of critical scholarly infrastructure more accessible, but we can be certain that the cost of achieving this milestone was not insignificant.

Finally, institutions and funders alike will seek ways to monitor and manage compliance. Again, some funders are already better equipped than others to manage this. NIH is one such example, providing institutions with access to their Public Access Compliance Monitor (PACM) system which can be used to track a manuscript's progress through the process of publication in PubMed Central. Research Information Management and Current Research Information Systems (RIMs and CRISs, respectively) may also aid institutions in tracking outputs and their status. Aggregate sources of information include the COKI Open Access Dashboard,[34] OA.works OA.report,[35] CHORUS[36] and others. Whether open or proprietary solutions will prevail and whether they will meet the needs of research stakeholders remains to be seen.

[33] The Gates Foundation recently announced they will no longer pay APCs, effective 1 January 2025 (Bill & Melinda Gates Foundation, 2024).

[34] https://openknowledge.community/dashboards/coki-open-access-dashboard/

[35] https://oa.report/

[36] https://www.chorusaccess.org/

# References


AfricaCDC. (2022, January 22). Regional Collaborating Centres: Oversight, Core Functions, and Priorities. https://africacdc.org/download/regional-collaborating-centres-oversight-core-functions-and-priorities/

AfricaConnect3. (2021). Africa and Latin America agree to closer collaboration around open science. AfricaConnect3 | Welcome to the AfricaConnect3 Website. https://africaconnect3.net/africa-and-latin-america-agree-to-closer-collaboration-around-open-science/

African Technology Policy Studies Network, & Scinnovent Centre. (n.d.). Science Granting Councils Initiative in Sub-Saharan Africa (SGCI). https://atpsnet.org/wp-content/uploads/2019/06/FINAL-Concept-Note-and-TOR-for-the-Open-Science-Masterclass-Paper.pdf

African Union Commission. (2014). Science, Technology and Innovation Strategy for Africa 2024. https://au.int/sites/default/files/newsevents/workingdocuments/33178-wd-stisa-english_-_final.pdf

African Union Commission. (2015). Agenda 2063: The Africa We Want. African Union. https://au.int/sites/default/files/documents/36204-doc-agenda2063_popular_version_en.pdf

African Union Commission. (2016). Continental Education Strategy for Africa (CESA 16-25). https://www.google.com/url?q=https://au.int/sites/default/files/documents/29958-doc-cesa_-_english-v9.pdf&sa=D&source=docs&ust=1717604741221035&usg=AOvVaw3e1KQBo4VRq22D9svx1BvC

African Union Commission. (2022). Digital Education Strategy. African Union. https://au.int/en/documents/20221125/digital-education-strategyand-implementation-plan

Agencia Nacional de Investigación e Innovación. (n.d.). Reglamento de Acceso Abierto. https://www.anii.org.uy/upcms/files/listado-documentos/documentos/anii-reglamento-de-acceso-abierto.pdf

Agency for Healthcare Research and Quality. (2023). AHRQ Public Access to Federally Funded Research. https://www.ahrq.gov/funding/policies/publicaccess/index.html

Aligning Science Across Parkinson's (ASAP). (2021). Aligning Science Across Parkinson's (ASAP) Open Access Policy. Aligning Science Across Parkinson's. https://parkinsonsroadmap.org/open-access-policy/

Alperin, J. P. (2022). Why I think ending article-processing charges will save open access. Nature, 610(7931), 233–233. https://doi.org/10.1038/d41586-022-03201-w

American Heart Association (AHA). (n.d. a). American Heart Association (AHA)—Open Science Policy Statements for AHA Funded Research. https://professional.heart.org/en/research-programs/awardee-policies/open-science-policy-statements-for-aha-funded-research

American Heart Association (AHA)—Open Science—Frequently Asked Questions. (n.d. b). https://professional.heart.org/en/research-programs/awardee-policies/open-science-frequently-asked-questions

Andersen, B., Arndt, A., Belsø, R., Brandt Nielsen, T., Buchvald Vind, T., Christensen-Dalsgaard, B., de Lichtenberg, U. N., Degn-Pedersen, S., Egebjerg, J., Hall-Andersen, M., Hansen, L., Horst, M., Fink, A. S., Markus, S., Midtgaard, T., Pedersen, B., Ploug, N., Renner Hansen, J., Skøtt, O., … Wilkowsk, B. (2021). National strategy for data management based on the FAIR principles (p. 32 pages) [PDF]. https://doi.org/10.48715/EA59-TP35

Anonymous. (1999). The Santo Domingo Declaration. Second ACP Summit, Santo Domingo, Dominican Republic. https://www.oacps.org/wp-content/uploads/2022/05/The-Santo-Domingo-Declaration.pdf

Appel, A., Lujano, I., & Albagli, S. (2018). Open Science Practices Adopted by Latin American & Caribbean Open Access Journals. ELectronic PUBlishing, Connecting the Knowledge Commons: From Projects to Sustainable Infrastructure(Long Papers). https://doi.org/10.4000/proceedings.elpub.2018.29

Athanasiou, S., Amiridis, V., Gavriilidou, M., Gerasopoulos, E., Dimopoulos, A., Kaklamani, G., Karagiannis, F., Klampanos, I., Kondyli, D., Koumantaros, K., Konstantopoulos, P., Lenaki, K., Lykiardopoulos, A., Manola, N., Mitropoulou, D., Benardou, A., Boukos, N., Nousias, A., Ntaountaki, M., … Psomopoulos, F. (2021). National Plan for Open Science. Zenodo. https://doi.org/10.5281/zenodo.4656150

Banda, T. (2020, August 19). Research and Education Networks in Africa. https://www.asren.net/sites/default/files/public/research_and_education_networks_in_africa_tiwonge_banda.pdf

Becerril-García, A., & Aguado-López, E. (2019). The End of a Centralized Open Access Project and the Beginning of a Community-Based Sustainable Infrastructure for Latin America: Redalyc.org after Fifteen Years. In L. Chan & P. Mounier (Eds.), Connecting the Knowledge Commons—From Projects to Sustainable Infrastructure: The 22nd International Conference on Electronic Publishing – Revised Selected Papers (pp. 41–55). OpenEdition Press. https://doi.org/10.4000/books.oep.9003

Beyene, M., Tekle, S. M., & Alemneh, D. G. (2022). Open Access Initiatives in Ethiopia's Higher Learning Institutions. In Handbook of Research on the Global View of Open Access and Scholarly Communications (pp. 23-43). IGI Global.

Bill & Melinda Gates Foundation. (2015). Bill & Melinda Gates Foundation's Open Access Policy. Gates Open Access Policy. https://openaccess.gatesfoundation.org/open-access-policy/

Bill & Melinda Gates Foundation. (2024). 2025 Open Access Policy. Gates Open Access Policy. https://openaccess.gatesfoundation.org/open-access-policy/2025-open-access-policy/

Blums, A. M. (2021). Informatīvā ziņojuma projekts 'Latvijas atvērtās zinātnes stratēģija 2021.-2027. Gadam'. https://tapportals.mk.gov.lv/legal_acts/49c3f689-5eb9-40e0-9376-65b694c5a0e3#

Bundesministerium für Bildung und Forschung. (2021, January 27). Aktionsplan Forschungsdaten—BMBF. Bundesministerium für Bildung und Forschung - BMBF. https://www.bmbf.de/bmbf/de/forschung/digitale-wirtschaft-und-gesellschaft/aktionsplan-forschungsdaten/aktionsplan-forschungsdaten.html

Cavalli, V. (2022). South African Open Science Cloud – EGI's contribution to SA-EU Dialogue Policy Framework Report. EGI. https://www.egi.eu/article/south-african-open-science-cloud-egis-contribution-to-sa-eu-dialogue-policy-framework-report/

CENDI. (n.d.). Science.gov—Public Access Plans & Guidance. https://www.science.gov/Public-Access-Plans-Guidance.html

Chan Zuckerberg Initiative. (2021). Chan Zuckerberg Science Initiative Institutional Approval Form. https://www.chanzuckerberg.com/wp-content/uploads/2018/02/Institutional_Approval_Form.pdf

CILA. (2018). Declaración de Panamá sobre Ciencia Abierta. https://forocilac.org/en/declaracion-de-panama-sobre-ciencia-abierta/

CLACSO (Latin American Council of Social Sciences). (2015). CLACSO's Declaration on open access to knowledge managed as a commons by the scholarly community. https://www.clacso.org.ar/conferencia2015/documentos/asamblea/declaraciones/CLACSO-Declaration-on-open-access-to-knowledge-managed-as-a-commons-by-the-scholarly-community.pdf

CODATA, Academy of Sciences of South Africa, & National Research Foundation. (n.d.). *The Future of Science and Science of the Future: Vision and Strategy for the African Open Science Platform.* https://zenodo.org/record/2222418#.YTs_-o4zbb0

Degezelle, W. (2022). The Open Internet as cornerstone of digitalisation: The Global Gateway Partnership Opportunities between the European Union and Africa. Stantec. https://fpi.ec.europa.eu/system/files/2022-10/The%20Open%20Internet%20as%20cornerstone%20of%20digitalisation%20DIGITAL.pdf

Deutsche Forschungsgemeinschaft. (2021). Guidelines and Supplementary Instructions: Infrastructures for Scholarly Publishing. https://www.dfg.de/resource/blob/167536/8977405c3cbaf223822c31b7c42aade2/12-11-en-data.pdf

EIFL. (2023a). New Project to Strengthen Diamond OA in Africa. https://eifl.net/news/new-project-strengthen-diamond-oa-africa

EIFL. (2023b). Botswana: Making Strides Towards National Policy. https://www.eifl.net/blogs/botswana-making-strides-towards-national-policy

ESFRI. (n.d.). About | www.esfri.eu. Retrieved 6 May 2024, from https://www.esfri.eu/about

European Commission. (2007). Open Access Pilot in FP7. https://ec.europa.eu/research/participants/data/ref/fp7/90379/open-access-pilot_en.pdf

European Commission. (2019). Open Science—European Commission. Retrieved from https://web.archive.org/web/20240411165328/https://research-and-innovation.ec.europa.eu/document/download/77d34a83-7ed9-4041-9fb2-3be3094f2319_en?filename=ec_rtd_factsheet-open-science_2019.pdf

European Commission. (2022). European Open Science Cloud (EOSC). https://research-and-innovation.ec.europa.eu/strategy/strategy-2020-2024/our-digital-future/open-science/european-open-science-cloud-eosc_en

European Commission. (2023a, July 20). New EU-Africa Innovation Agenda to enhance cooperation in science, technology and innovation. https://research-and-innovation.ec.europa.eu/news/all-research-and-innovation-news/new-eu-africa-innovation-agenda-enhance-cooperation-science-technology-and-innovation-2023-07-20_en

European Commission. (2023b, December 14). European Open Science Cloud (EOSC) | Shaping Europe's digital future. https://digital-strategy.ec.europa.eu/en/policies/open-science-cloud

European Commission. (2023c). *Open Access Policies in Latin America, the Caribbean and the European Union: Progress Towards a Political Dialogue.* European Commission. https://www.enssib.fr/bibliotheque-numerique/documents/71351-open-access-policies-in-latin-america-the-caribbean-and-the-european-union-progress-towards-a-political-dialogue.pdf

European Commission, Directorate-General for Research and Innovation, & Kouis, D. (2023). *Analysis of the requirements for the Open Source infrastructure of the Open Research Europe Publishing Platform.* Publications Office of the European Union. https://doi.org/10.2777/13928

European Strategy Forum on Research Infrastructures. (2021). Roadmap 2021: Strategy report on research infrastructures. https://roadmap2021.esfri.eu/media/1295/esfri-roadmap-2021.pdf

Eurostat. (2022a, November 29). EU investment in R&D increased to €328 billion in 2021. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20221129-1

Eurostat. (2022b). Intramural R&D expenditure (GERD) by source of funds [dataset]. Eurostat; Organisation for Economic Cooperation and Development (OECD). https://doi.org/10.2908/TSC00031

Foley, M. (2016). The Role and Status of National Research and Education Networks(NRENs) in Africa. World Bank http://documents.worldbank.org/curated/en/233231488314835003/pdf/113114-NRENSinAfrica-SABER-ICTno05.pdf

Frankston, C. (2023). Accessibility update: arXiv now offers papers in HTML format – arXiv blog. Retrieved March 28, 2024, from https://blog.arxiv.org/2023/12/21/accessibility-update-arxiv-now-offers-papers-in-html-format/

Hagemann, M. (2023). Latin America Exemplifies What Can Be Accomplished When Community Is Prioritized Over Commercialization. International Open Access Week. https://www.openaccessweek.org/blog/2023/latin-america-exemplifies-what-can-be-accomplished-when-community-is-prioritized-over-commercialization

Hamdy, A. (n.d.). Report by ASRIC Secretariat on the implementation of STISA-2024. https://asric.africa/documents/Congress-Dec-2020/Report%20on%20the%20implementation%20of%20STISA-2024%20-%20ASRIC%20Secretariat.pdf

Harris, S., Becerril García, A., Hervé Mboa Nkoudou, T., & Dandawate, V. (2021). Global Trends in Open Access: Themes from Africa, Asia and Latin America. The Scholarly Kitchen. https://scholarlykitchen.sspnet.org/2021/05/13/global-trends-in-open-access-africa-asia-and-latin-america/

Heredia, A. (2022). A tradition of open, academy-owned, and non-profit research infrastructure in Latin America. Information Services & Use, 42(3–4), 447–452. https://doi.org/10.3233/ISU-220177

Howard Hughes Medical Institute (HHMI). (2020). Howard Hughes Medical Institute (HHMI) Open Access to Publications Policy. https://hhmicdn.blob.core.windows.net/policies/Open-Access-To-Publications-Policy

Howard Hughes Medical Institute (HHMI). (2023). Howard Hughes Medical Institute (HHMI) Sharing Published Materials/ Responsibilities of HHMI Authors. https://hhmicdn.blob.core.windows.net/policies/Sharing-Published-Materials-Responsibilities-of-HHMI-Authors

Iizuka, M., Mawoko, P., & Gault F. (2015). Innovation for Development In Southern & Eastern Africa:Challenges for Promoting ST&I Policy https://www.merit.unu.edu/wp-content/uploads/2015/02/252608902-Innovation-for-Development-in-Southern-Eastern-Africa-Challenges-for-Promoting-ST-I-Policy.pdf

International Telecommunication Union. (n.d.). *Measuring digital development Facts and figures 2021.* International Telecommunication Union. https://www.itu.int/en/ITU-D/Statistics/Documents/facts/FactsFigures2021.pdf

IBICT. (n.d.). *Science built through collaboration among everyone.* https://civis.ibict.br/en/

Irimia, A., Trif, I., Cucu, M., & Popa, A. (2022). Cartea Albă a Tranziției către Știința Deschisă (2023-2030). https://uploads-ssl.webflow.com/615f0ec368dc44a3d513e3ba/63a23b5a3853df2aac215bc1_Carte%20Alba%20OS_18.12.pdf

IUCEA. (n.d.). ACE II project overview. https://ace2.iucea.org/overview/

Latindex, Redalyc, CLACSO, & IBICT. (2017). Declaration of Mexico in support of the Latin American non-commercial Open Access Ecosystem. https://perma.cc/ULS5-GD8R

LIBSENSE. (2023). Sierra Leone takes steps to ingrain open science in national research fabric. https://libsense.ren.africa/en/sierra-leone-takes-steps-to-ingrain-open-science-in-national-research-fabric/

Magnússon, M. L., & Smári, Ó. (2021). Icelandic Roadmap for Research Infrastructures 2021. Ministry of Education , Science and Culture. https://www.rannis.is/media/innvidasjodur/Roadmap-to-Icelandic-infrastructure_August_2021.pdf

Marcinkevicius, E., & Pavlovich, M. (2022). Open access methods and protocols promote open science in a pandemic. *Star Protocols.* https://doi.org/10.1016/j.xpro.2022.101226

McKenna, J. (2023, December 21). *Open Access in Brazil.* https://blog.mdpi.com/2023/12/21/open-access-in-brazil/

Merwe, C. van der. (2022, February 17). South Africa's draft open science policy promises shake-up. Research Professional News. https://www.researchprofessionalnews.com/rr-news-africa-south-2022-2-south-africa-s-draft-open-science-policy-promises-shake-up/

Midega, J., Kyobutungi, C., Okiro, E., Okumu, F., Aniebo, I., & Erondu, N. (2021). African countries must muscle up their support and fill massive R&D gap. The Conversation. http://theconversation.com/african-countries-must-muscle-up-their-support-and-fill-massive-randd-gap-161024

MINCIENCIA. (n.d.). *Innovation in Higher Education Competition (INES)*. https://www.minciencia.gob.cl/ines/

MINCYT Argentina. (2022). *DIAGNOSIS AND ROADMAP FOR AN OPEN SCIENCE POLICY IN ARGENTINA*. MINCYT Argentina. https://www.argentina.gob.ar/sites/default/files/2023/01/cac_final_document_-_english_version.pdf

Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation. (2021a, July 6). Second French Plan for Open Science. Ouvrir La Science. https://www.ouvrirlascience.fr/wp-content/uploads/2021/10/Second_French_Plan-for-Open-Science_web.pdf

Ministère de l'Enseignement supérieur, de la Recherche et de l'Innovation. (2021b). French national strategy on research infrastructures, Edition 2021. https://www.enseignementsup-recherche.gouv.fr/sites/default/files/2023-02/french-national-strategy-on-research-infrastructures---2021-26489.pdf

Ministero del'Università e della Ricerca. (2021). National Research Program 2021-27: National Plan for Open Science. https://www.mur.gov.it/sites/default/files/2023-01/PNSA_2021-27_ENG.pdf

Ministry of Higher Education and Science Denmark. (2018). 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/national-strategy-for-open-access-english.pdf

Mounier, P., & Rooryck, J. (2023). Towards a federated global community of Diamond Open Access [Billet]. The Diamond Papers. https://thd.hypotheses.org/296

National Aeronautics and Space Administration. (2023). NASA's Public Access Plan. https://www.nasa.gov/wp-content/uploads/2021/12/nasa-ocs-public-access-plan-may-2023.pdf

National Institute of Standards and Technology. (2023). National Institute of Standards and Technology Plan for Providing Public Access to Results of Federally Funded Research. https://www.nist.gov/document/public-access-plan-public-comment-june-2023

National Institutes of Health. (2005). NOT-OD-05-022: Policy on Enhancing Public Access to Archived Publications Resulting from NIH-Funded Research. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-05-022.html

National Institutes of Health. (2023). NOT-OD-23-091: Request for Information on the NIH Plan to Enhance Public Access to the Results of NIH-Supported Research. https://grants.nih.gov/grants/guide/notice-files/NOT-OD-23-091.html

National Open Access Policy Malta. (2021). https://mcst.gov.mt/wp-content/uploads/2022/05/National-Open-Access-Policy-2021.pdf

National Open Research Forum. (2022). National Action Plan for Open Research. https://doi.org/10.7486/DRI.FF36JZ222

National Open Science Cloud Initiative. (n.d.). Declaration of the National open science cloud nosci.mk – nosci.mk. Retrieved 6 May 2024, from https://www.nosci.mk/?page_id=349

National Open Science Plan. (2022). https://mon.gov.ua/storage/app/media/nauka/2023/01/26/National-Open-Science-Plan-Ukraine.pdf

National Policy of the Republic of Cyprus for Open Access to Scientific Information (2016). https://opensciencecy.ucy.ac.cy/wp-content/uploads/2019/09/FINAL-EN-National-Policy-for-Open-Access-to-Scientific-Information.pdf

National Research Foundation. 2015. Statement on Open Access to Research Publications from the National Research Foundation (NRF)-Funded Research. https://chelsa.ac.za/wp-content/uploads/2018/12/NRF_open_access_-statement_19Jan2015_V6.pdf https://www.nsf.gov/pubs/policydocs/pappguide/nsf11001/gpg_2.jsp

National Science Foundation. (2011). NSF Grant Proposal Guide Chapter II - Proposal Preparation Instructions.

National Science Foundation. (2023). NSF Public Access Plan 2.0: Ensuring Open, Immediate and Equitable Access to National Science Foundation Funded Research. https://nsf-gov-resources.nsf.gov/2023-06/NSF23104.pdf

National Science and Technology Council (NSTC). (2022). Desirable Characteristics of Data Repositories for Federally Funded Research. The National Science and Technology Council. https://doi.org/10.5479/10088/113528

NKFIH. (2021, October 19). National Research, Development and Innovation Office | Position Paper on Open Science [Text]. Nemzeti Kutatási, Fejlesztési és Innovációs Hivatal, 2008. Minden jog fenntartva. https://nkfih.gov.hu/openscience/position-paper-on-open

NPOS. (2022). Open Science 2030 in the Netherlands: NPOS2030 Ambition Document and Rolling Agenda. Zenodo. https://doi.org/10.5281/zenodo.7433767

Oaiya, O. (2016, May 10). WACREN – History, Structure, Status. https://indico.wacren.net/event/41/contributions/292/attachments/174/204/Omo_Oaiya_Libraries_in_NREN_Workshop_Abuja0510.pdf

Oaiya, O. (2022). National open science policies in Africa. https://www.unesco.org/sites/default/files/medias/fichiers/2022/05/National_and_Institutional_OS_Policies.pdf

Office of Science and Technology Policy. (2013). Increasing Access to the Results of Federally Funded Scientific Research. https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf

Office of Science and Technology Policy. (2022). Ensuring Free, Immediate, and Equitable Access to Federally Funded Research. https://www.whitehouse.gov/wp-content/uploads/2022/08/08-2022-OSTP-Public-Access-Memo.pdf

Office of Science and Technology Policy. (2023). FACT SHEET: Biden-Harris Administration Announces New Actions to Advance Open and Equitable Research. https://www.whitehouse.gov/ostp/news-updates/2023/01/11/fact-sheet-biden-harris-administration-announces-new-actions-to-advance-open-and-equitable-research/

Office of Science and Technology Policy. (2024, January 31). FACT SHEET: Biden-Harris Administration Marks the Anniversary of OSTP's Year of Open Science. The White House. https://www.whitehouse.gov/ostp/news-updates/2024/01/31/fact-sheet-biden-harris-administration-marks-the-anniversary-of-ostps-year-of-open-science/

Office of the Comptroller General, Secretary of Transparency and Prevention of Corruption, & Transparency and Public Oversight Board. (2021). Fifth National Action Plan on Open Government. https://www.opengovpartnership.org/wp-content/uploads/2022/01/Brazil_Action-Plan_2021-2023_EN.pdf

Open Research Funders Group (ORFG). (2016). Prominent Funding Organizations Team Up to Launch Open Research Funders Group. Open Research Funders Group. https://www.orfg.org/news/2016/12/15/prominent-philanthropic-organizations-team-up-to-launch-open-research-funders-group

Open Science NL. (2023). Open Science NL - Work programme 2024-2025. Open Science NL. https://doi.org/10.5281/zenodo.10074873

Openness by Default. (2017). Inside Higher Ed. https://www.insidehighered.com/news/2017/01/16/gates-foundation-open-access-policy-goes-effect-joining-others

Orth, M. (2020, April 6). "We Need to Solve This": Colombia's Amazing Race to Build a $1,000 Ventilator. *Vanity Fair.* https://www.vanityfair.com/news/2020/04/colombias-amazing-race-to-build-a-1000-ventilator

os4os team. (2020, August 7). Open Science Policy Platform: Final report (2020). *openscience.eu.* https://openscience.eu/open-science-policy-platform-final-report/

Quintans-Júnior, L. J., Albuquerque, G. R., Oliveira, S. C., & Silva, R. R. (2020). Brazil's research budget: endless setbacks. *EXCLI journal, 19,* 1322–1324. https://doi.org/10.17179/excli2020-2887

Ramírez Castañeda, V. (2020). Disadvantages in preparing and publishing scientific papers caused by the dominance of the English language in science: The case of Colombian researchers in biological sciences. *PLOS ONE.* https://doi.org/10.1371/journal.pone.0238372

Robert Wood Johnson Foundation (RWJF). (2019). Robert Wood Johnson Foundation's (RWJF) Policy for Data Archiving. https://www.rwjf.org/en/about-rwjf/how-we-work/organizational-policies/policy-for-data-archiving.html

Robert Wood Johnson Foundation (RWJF). (2020). Robert Wood Johnson Foundation's (RWJF) Policy for Open Access. https://www.rwjf.org/en/about-rwjf/how-we-work/organizational-policies/policy-for-open-licensing.html

SciELO. (2020). Science funding crisis in Brazil and COVID-19: Deleterious impact on scientific output. SciELO. https://doi.org/10.1590/0001-3765202020200700

Sistema Nacional de Ciencia, Tecnología e Innovación, 26.899 (2013). https://www.boletinoficial.gob.ar/pdf/linkQR/bkE1ZXJVZjdsVXBycmZ0RFhoUThyQT09

Slovak Centre of Scientific and Technical Information. (2021). National Strategy for Open Science 2021-2028. https://otvorenaveda.cvtisr.sk/wp-content/uploads/2021/09/National-Strategy-for-Open-Science-2021-2028.pdf

Southern African Development Community (SADC) Secretariat. (2020). SADC Regional Indicative Strategic Development Plan (RISDP) 2020-2030.

Steinhart, G., & Skinner, K. (2024). The Cost and Price of Public Access to Research Data: A Synthesis. https://zenodo.org/doi/10.5281/zenodo.10729547

Steinhart, G., Collister, L., Huang, C.-K. (Karl), Lippincott, S., Neylon, C., Riordan, D., Sellanga, J., Skinner, K., Thaney, K., & Tsang, E. (2024). 2024 State of Open Infrastructure: Trends in characteristics, funding, governance, adoption, and policy. Invest in Open Infrastructure. https://doi.org/10.5281/zenodo.10934089

swissuniversities. (2021). Swiss National Strategy Open Research Data Version 1.0 Action Plan. https://www.swissuniversities.ch/fileadmin/swissuniversities/Dokumente/Hochschulpolitik/ORD/ActionPlanV1.0_December_2021_def.pdf

The Guild. (2023, March 7). Universities launch Africa-Europe Clusters of Research Excellence to pioneer new approach to equitable collaboration. https://www.the-guild.eu/news/2023/universities-launch-africa-europe-clusters-of-research-excellence.html

The Research Council of Norway. (2020). The Research Council Policy for Open Science. https://www.forskningsradet.no/siteassets/forskningspolitisk-radgivning/apen-forskning/nfr-policy-open-science-eng.pdf

Trager, R. (2023, November 21). *Argentina's new populist president has the country's scientists worried.* Chemistry World. https://www.chemistryworld.com/news/argentinas-new-populist-president-has-the-countrys-scientists-worried/4018484.article

UNESCO. (2021). *The race against time for smarter development.* UNESCO. https://unesdoc.unesco.org/ark:/48223/pf0000377433

UNESCO Open Science Advisory Committee. (2021). UNESCO Recommendation on Open Science. UNESCO. https://www.unesco.org/en/open-science/about

U.S. Census Bureau. (2024). U.S. Census Bureau Plan for Providing Public Access to Results of Federally Funded Research—Draft for public comment. https://www2.census.gov/foia/ds_policies/PublicAccessPlan_Census_DraftforPublicComment.pdf

U.S. Department of Agriculture. (2023). Implementation Plan to Increase Public Access to USDA-Funded Research Results. https://www.nal.usda.gov/sites/default/files/page-files/USDA_Public_Access_Implementation_Plan_8_10_2023_0.pdf

U.S. Department of Energy. (2023). U.S. Department of Energy Public Access Plan. https://doi.org/10.11578/2023DOEPUBLICACCESSPLAN

U.S. Department of the Interior. (2023). Public Access to Results of Federally Funded Research at the U.S. Geological Survey: Scholarly Publications and Digital Data (ver. 2.0). https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/s3fs-public/media/files/USGS-Updated%20PublicAccessPlan%20%28ver.2.0%2C%202023%29.pdf

Vázquez Tapia, R. (2022, May 14). *"Development and characterisation of CRIS systems in Latin America: Preliminary results of diagnostic survey."* https://dspacecris.eurocris.org/bitstream/11366/2010/4/VazquezTapia_slides_CRIS2022_Development-and-characterisation-of-CRIS-systems.pdf

Wade, L. (2019, July 23). *Mexico's new president shocks scientists with budget cuts and disparaging remarks.* www.Science.Org. https://www.science.org/content/article/mexico-s-new-president-shocks-scientists-budget-cuts-and-disparaging-remarks

Wilkinson, M. D., Dumontier, M., Aalbersberg, Ij. J., Appleton, G., Axton, M., Baak, A., Blomberg, N., Boiten, J.-W., da Silva Santos, L. B., Bourne, P. E., & others. (2016). The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data, 3(1), 1–9. https://doi.org/10.1038/sdata.2016.18

Williams, T. (2015). Why Big Foundations Ganging up for Open Access is Important. Inside Philanthropy. https://www.insidephilanthropy.com/home/2015/2/6/why-big-foundations-ganging-up-for-open-access-is-important.html

Working Group on Monitoring of Research Infrastructures Performance. (2019). Report of the ESFRI Working Group on Monitoring of Research Infrastructures Performance. https://www.esfri.eu/sites/default/files/ESFRI_WG_Monitoring_Report.pdf

Zaballos, A. (2018, October 5). *Open Access in Latin America & The Caribbean.* https://www.mysciencework.com/omniscience/open-access-latin-america-caribbean

Invest in Open Infrastructure

# About Invest in Open Infrastructure

Invest in Open Infrastructure (IOI) works to increase the investment in and adoption of open infrastructure to further equitable access to and participation in research. We do this by providing actionable, evidence-based tools and recommendations for decision makers, offering tailored strategic support to infrastructure services and funders, and catalysing investment in open infrastructure. For more information, please visit www.investinopen.org.

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