

# How Science Diplomacy Can Reshape Global Research Publishing

## A Theory of Change

SOPHIE GULLIVER · ANASTASSIA DEMESHKO · JON HARLE · TOM DRAKE

### Abstract

In today's digitally interconnected world, the swift exchange of knowledge and research should be commonplace and should drive substantial advancements in health, well-being, and prosperity globally. Yet our current research publishing system is holding us back, deliberately restricting access to research to generate profit and impeding collaboration and innovation, particularly for researchers in lower-income countries. While organisations like UNESCO and cOAlition S have made some progress towards Open Access research, reforms have been slow and, in certain ways, counterproductive. These reforms have too often substituted one set of barriers for another or focused too narrowly on individual or institutional changes, neglecting the broader political and policy environment. Strategic, high-level political and diplomatic engagement is critical, yet underutilised, in uniting behind a vision and driving substantial research publishing reform.

In this paper, we propose a vision for a reformed research publishing system that is accessible, high quality, and useable, with targeted reforms in the three domains of financing, infrastructure, and governance. We outline a theory of change in order to use science diplomacy to elevate research publishing reform to the international agenda and drive more effective global leadership and governance of this important global digital system. We note that the G20, as a broad and globally representative international forum, is well-positioned to spearhead research publishing reform efforts. We provide a case study to illustrate how the theory of change could be applied to the G20 to achieve national open access policy reform through science diplomacy, thereby reducing barriers to research access and creating a more inclusive and effective global research publishing system.

# How Science Diplomacy Can Reshape Global Research Publishing: A Theory of Change

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# Contents

Introduction.....	1
<b>A vision for reform: What a research publishing system that meets the needs of all nations would look like.....</b>	<b>2</b>
Existing principles for research publishing reform.....	2
A vision for a reformed publishing system.....	4
Characteristics of a reformed research publishing system.....	4
1. Accessibility: All researchers should be able to publish, and all readers should be able to read research.....	4
2. Quality: All readers should be able to assess the quality of research.....	6
3. Usability: Research should be published in an array of formats and be able to be reused by others with minimal restrictions.....	7
Domains of change to achieve a better research system.....	8
1. Financing: Generating transitional and recurrent resourcing for a reformed publishing system.....	8
2. Infrastructure: Creating or strengthening affordable, reliable infrastructure that enables effective research dissemination for all.....	12
3. Governance: Shaping an enabling economic and regulatory environment through organisational and national policies and practices.....	15
<b>Facilitating research publishing reform through science diplomacy.....</b>	<b>17</b>
A theory of change using science diplomacy for research publishing reform.....	18
Explanation of the theory of change.....	21
Build networks, capacity, and momentum.....	21
Gather evidence and reframe debates.....	22
Put research publishing reform on the international agenda.....	22
Spur political interest and impetus.....	23
Promote international harmonisation.....	24

Open Access policies and the G20: A case study using the theory of change.....	28
Conclusion.....	35
References.....	36
Annex 1.....	43

## Figures

1. Core characteristics of an improved research publishing system and domains of change for reform .....	4
2. Theory of change using science diplomacy for research publishing reform .....	20
3. Science diplomacy ecosystem relevant to research publishing.....	27

## Tables

1. Strength of common themes across seven sets of alternative principles for research publishing reform .....	3
2. Science diplomacy levers for change.....	19
3. Open access policy positions for G20 members.....	30
A1. Comparing open access guidelines and principles.....	43

## Boxes

1. Current financing models .....	10
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## Introduction

We live in an era of digital hyperconnectivity, free from the constraints of print and paper, in which knowledge can be shared with the click of a button and can spur meaningful improvements in health, well-being and prosperity across the globe. Yet despite advancements in digital technology, including the recent rapid rise of generative intelligence (AI) that should make the sharing of such knowledge more rapid, equitable, affordable, and effective, the research publishing system intentionally restricts access to the results of research efforts, preventing participation for millions of researchers, particularly those in emerging economies, for the sake of profit.

As a previous policy paper from some of the authors of this paper highlighted, the research publishing sector is controlled by a publishing oligopoly and hindered by market inefficiencies. In 2022, the top five publishers collectively earned \$7.7 billion, with profit margins reaching as high as 38 percent. Despite this, only 31 percent of their articles were available as Open Access (free of paywalls), and just 25 percent of their journals were fully Open Access.<sup>1</sup>

The failure of digital research publishing matters. These issues are not a niche concern for the academically minded. Research and innovation underpin almost every imaginable form of social and economic advancement, from effective primary healthcare to macroeconomic development to climate adaptation. Failing systems for sharing new knowledge are an under-recognised drag on progress and resilience, a drag that will become only more acute as generative AI grows in capability, with its potential transformational impacts on research generation, translation, and innovation. Fixing our ailing research publishing system is essential and could pay dividends into the trillions of dollars.<sup>2</sup>

A range of views exist about how to reform research publishing, so that it is more open, accessible, and equitable. While there is a broad commitment from various actors like UNESCO, cOAlition S, and numerous research institutions and funders to open access, there is no clear consensus on the desired end state of openness, nor how it should be achieved. Some actors seek cautious, incremental change and are concerned with protecting existing business models, with allowing time for evolution to safeguard research integrity, or with ensuring that the publishing system—given its importance to careers and revenues as much as to science—is not significantly disturbed. Other actors are comfortable with disruption if it enables a more radical shift in models of publishing that enable improved publishing speed and innovation while retaining research quality. The result is a debate that has become rapidly polarised.

While the movement towards research publishing reform has achieved some progress by reducing paywalls, these gains have been modest and sluggish, and appear to be losing momentum in the post-pandemic era.<sup>3</sup> More importantly, these changes have largely been achieved by erecting new but equally inequitable pay-to-publish barriers that prevent many researchers from effectively sharing their work.<sup>4</sup> Moreover, efforts to date have largely been targeted at academic or funding institutions rather than focused on higher-level political engagement at the national and international levels.

A more transformative and inclusive vision for change is possible, but the challenges are principally political, rather than technical or economic. What has been underutilised so far, is a targeted science diplomacy effort that can kick-start fresh action to reform our global systems for publishing research and sharing knowledge at the international level. Building on our last paper outlining opportunities for G20 action on research publishing reform,<sup>5</sup> this paper establishes a vision for research publishing reform, details a theory of change for how science diplomacy can realise such reform, and illustrates how this theory of change could be applied through a case study on the G20.

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## **A vision for reform: What a research publishing system that meets the needs of all nations would look like**

Significant research publishing reform requires a vision with which nations and other research actors can align themselves and towards which they can work. However, developing a vision for alternative research systems is challenging, given the current system's deep entwinement with the scientific enterprise and the ways in which research is funded, assessed, and communicated. Much work has been completed in recent years to articulate a series of alternative visions for research publishing reform, but these ideas have sometimes conflated system functions and system capabilities, and can be confusing and unwieldy. We seek to consolidate these visions with a science diplomacy audience in mind, outlining three high-level characteristics for a reformed research system, as well as three domains where change must be made to achieve these characteristics. Importantly, we recognise that any future system must be pluralistic: it must satisfy different needs and accommodate the varying resources available to different countries, and should centre researchers and citizens from emerging economies, who are currently most excluded and disadvantaged by the research publishing system.

### **Existing principles for research publishing reform**

Building on the founding principles of open access, several initiatives have articulated their own visions and principles for a reformed scientific publishing system, often in the context of a wider shift towards open science.<sup>6</sup> These include the International Science Council's "Key Principles for Scientific Publishing,"<sup>7</sup> "Towards Responsible Publishing" by cOAlition S,<sup>8</sup> Johan Rooryck's "Principles of Diamond Open Access Publishing: A Draft Proposal,"<sup>9</sup> UNESCO's "Recommendation on Open Science,"<sup>10</sup> the FAIR principles for open data,<sup>11</sup> the Principles of Open Scholarly Infrastructure,<sup>12</sup> and the Helsinki Initiative on Multilingualism in Scholarly Publishing.<sup>13</sup> These seven sets of principles articulate a broad vision for research publishing systems, while also demonstrating convergence around seven core concerns: accessibility, quality assurance and review processes, data and privacy, resilience and sustainability, inclusivity, structure of the system, and governance and ownership of the system. Table 1 below illustrates how well each set of principles covers these domains. The shading indicates the relative strength of the feature, with darker indicating a stronger focus (for further details, please see Annex 1).

**TABLE 1. Strength of common themes across seven sets of alternative principles for research publishing reform**

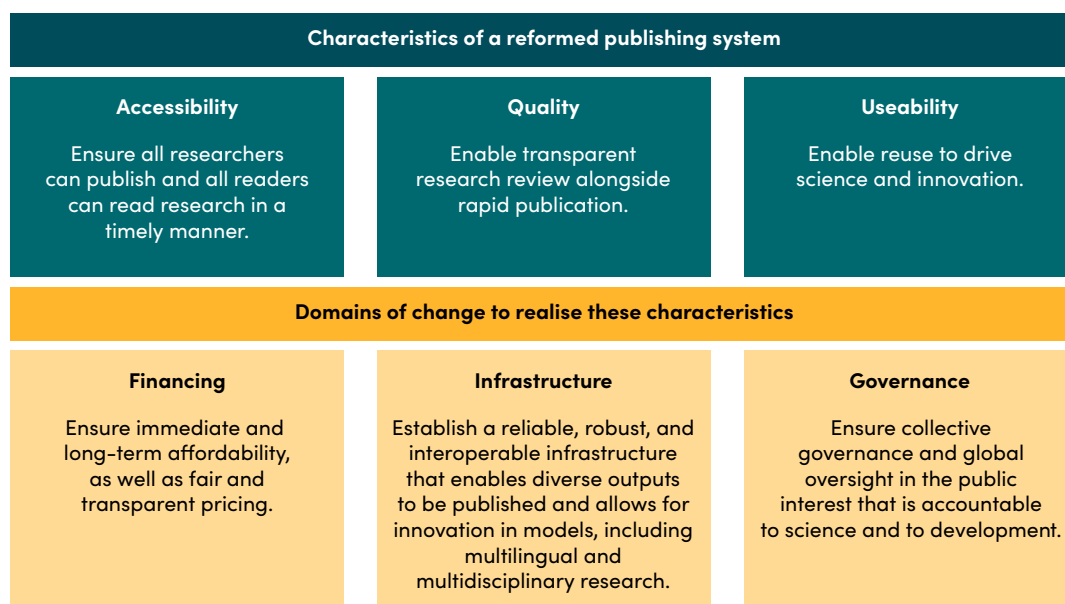
Principles	Focus	Summary	Accessibility to Readers/ Authors	Quality Assurance Processes	Data and Privacy	Resilience and Sustainability	Inclusivity	System Structure	Governance and Ownership
<b>International Science Council: 8 principles</b>	Open science	Eight principles to promote ideas, evidence, and data to be disseminated widely and be openly available for sceptical scrutiny, revision, and use through efficient and accessible publication systems	Minimal focus	Moderate focus	Moderate focus	Moderate focus	Minimal focus	Absent	Moderate focus
<b>UNESCO</b>	Open science	Set of four core values and six principles endorsed by member states	Minimal focus	Minimal focus	Absent	Moderate focus	Moderate focus	Absent	Moderate focus
<b>cOAlition S: 5 principles</b>	Open science	Five principles to support a community-based scholarly communication system fit for open science in the 21st century	Minimal focus	Minimal focus	Absent	Absent	Absent	Absent	Moderate focus
<b>Rooryck: 10 principles</b>	Research publishing	Ten principles to support the Action Plan for Diamond Open Access	Minimal focus	Minimal focus	Minimal focus	Absent	Minimal focus	Strong focus	Minimal focus
<b>FAIR principles for data</b>	Open data	Four FAIR principles emphasising the important capacity of computational systems to find, access, interoperate, and reuse data with no or minimal human intervention	Absent	Absent	Minimal focus	Absent	Absent	Absent	Absent
<b>The Principles of Open Scholarly Infrastructure (POSI)</b>	Research publishing	POSI principles setting out how scholarly infrastructure organisations and initiatives that support the research community can be run and sustained	Moderate focus	Absent	Moderate focus	Strong focus	Absent	Absent	Strong focus
<b>Helsinki Initiative on Multilingualism in Scholarly Communication</b>	Research publishing	Recommendations to support scholarly communication in national languages	Moderate focus	Absent	Absent	Absent	Strong focus	Absent	Absent

Absent
  Minimal focus
  Moderate focus
  Strong focus

## A vision for a reformed publishing system

The principles outlined above combine both functions and capabilities that research publishing requires, as well as levers of change that can help achieve the necessary reforms. However, all of the above frameworks are either (1) overly detailed for a science diplomacy audience, or (2) not focused specifically on research publishing reform. Building on these previous efforts, we identify three core characteristics for a reformed research publishing system and three domains in which change is required to achieve these reforms (see Figure 1). The motivating force behind this vision is to foster a research publishing system which is not only more effective in its core function of disseminating new knowledge, but also more equitable in terms of who gets to participate.

**FIGURE 1. Core characteristics of an improved research publishing system and domains of change for reform**



## Characteristics of a reformed research publishing system

### **1. Accessibility: All researchers should be able to publish, and all readers should be able to read research**

Accessibility has long been the focus of efforts to reform research publishing, and timeliness is an integral factor to the concept of access. Information made available after it is most useful is an unacceptable compromise for publicly funded research. Secondly, there is increasing recognition that the concept of access must include researcher's ability to publish, not only the reader's ability to read.



This means that the platform must:

- make new research available to readers as quickly as possible;
- do this without charging readers directly;
- be affordable to researchers to publish, ideally with no direct fees that could act as barriers to entry;
- ensure that published research is easily discoverable (i.e., it is indexed to major research repositories);
- be robust and reliable so that their data and outputs are safe in perpetuity; and
- support multilingual publishing.

Further, to satisfy the “accessibility” specification, all possible readers, whether professionals, policymakers, or citizens, as well as the communities they serve, must have immediate access to published research, at no cost to themselves and irrespective of their countries’ abilities to pay.

### *Why this is important*

At present, access to effective, reliable, and credible open access platforms is very uneven.<sup>14</sup> Researchers in wealthy institutions typically have much better access to such platforms—which are often commercially provided—with the costs of publishing met by their institutions or funders, or sometimes paid directly from a research grant.

To publish on the same platforms, researchers in low- and middle-income countries (LMICs) and less-wealthy institutions, who often lack institutional and funder support, must either pay to publish on their preferred publishing platform, ask for a discretionary waiver, or use a platform with lower production quality, reach, or reliability, or a weaker reputation. Notable exceptions exist in the Diamond research publishing system,<sup>15</sup> and particularly in Latin America. When publishing costs cannot be met, these researchers publish on closed access platforms, thereby denying many of their peers and potential readers access to their work.

Most readers outside of academic institutions have very limited access to research. Although around 48 percent of new publications are now published open access,<sup>16</sup> large archives of historical and valuable research remain behind paywalls. Many readers are asked to pay a per paper charge to read research and must do so before they can judge the value of the paper. Even when LMIC readers have access, platforms are often not optimised for low bandwidth and unreliable server connections, meaning the costs of broadband and data access can render access expensive and unreliable.

With notable exceptions (e.g., disciplines with long-standing preprint cultures, like high energy physics), most research is still first made publicly available through academic journals. Slow publication speed means researchers and their readers must wait considerable periods for their work

to be publicly available. This delay acts as a significant brake on scientific progress. The implications of slow publication are particularly significant for researchers in LMICs, who often report struggles to get their research accepted for publication.<sup>17</sup> Additionally, national and regionally published journals in LMICs are often managed by volunteers, which can introduce additional delays or make publishing processes more susceptible to disruption.

The dominance of English in research publishing also introduces additional obstacles and expenses for many researchers and readers, rendering significant research less visible and less read. New translation capabilities, including those enabled by natural language processing, should increasingly allow platforms to operate in many languages beyond the six official UN languages.

## ***2. Quality: All readers should be able to assess the quality of research***

To foster high-quality research, authors must have access to high-quality, affordable, and efficient publishing options. Such publishing platforms would enable them to make their work promptly accessible to peers for review, without jeopardising their personal career prospects due to limited publishing platform choices.

Therefore, research publishing systems must:

- facilitate scientific review and quality assessment (though the review process does not necessarily need to be linked with a decision to publish),
- make the results of any quality assessment clearly visible to readers, and
- consider making the process of quality assessment visible to readers.

### *Why this is important*

Preprint or prereview publishing options have grown in recent years, and there are promising new platforms emerging, including those created for researchers in LMICs (such as Open Research Africa, or the AfricArXiv platform). However, these platforms are not available to researchers in all disciplines, or where preprint solutions do exist, are not as desirable, given disciplinary cultures or institutional and national policies that discourage preprint publication.

Research is most often blind peer reviewed. Authors will receive anonymous review(s) to enable them to revise their articles for resubmission, but readers rarely see these reviews. However, such reviews can be important to help readers judge research quality. There is some experimentation in providing access to reviews among preprint servers and a small fraction of journals (1–5 percent), but such a practice is far from common.<sup>18</sup> Finding a balance between swift publication and basic checks on scientific rigor and method is important. Enabling readers to read reviews and signposting when reviews are limited can help maintain this balance.

The value of research is often implicitly judged by the journal in which it is published. “Impact factors” based on citations are commonly used by journals to report the relative value of articles, and researchers, in turn, are judged by the journals in which they have published. Initiatives such as the Declaration on Research Assessment are helping change this system, but progress is relatively slow, and the prestige economy remains strong.

### ***3. Usability: Research should be published in an array of formats and be able to be reused by others with minimal restrictions***

While digital publishing tools have enabled a diversification of formats, journal articles still make up the bulk of formally recognised and accepted research output. A more flexible future research publishing system would enable research outputs of different types and formats to be published, including supporting data, to promote more widespread use.

This means the research publishing system must:

- consider new alternative publishing formats to move beyond static PDFs that mimic paper-based publication;
  - This includes richer, “marked up” text, version controls that allow a document to evolve publicly, embedded code that enables readers to adjust parameters and display data in different ways, collaborative editing, and integrated review. Such flexibility could still be standardised in structure to ensure that research is still navigable and readable by end users and machine reading, as well as potentially for the future training of AI.
- ensure high-quality metadata to enable interoperability across platforms and allow linked outputs to be produced at different stages of the research process;
- enable the translation of scientific outputs into forms that can be used by other actors (in concrete practice, for professionals, communities, citizens, etc.); and
- provide licensing options that enable researchers to retain ownership of their work, but allow others to use and reuse it within specified terms of use, including via machine-based text, as well as for data mining and generative AI training data.<sup>19</sup>

#### *Why this is important*

The act of publishing research reflects an explicit intention to make that research widely available for others to read and use, so it is important that they are not obstructed from doing so. Research that is sensitive for commercial or security reasons is already restricted and not made publicly available. The Creative Commons license allows researchers to assert their copyrights but to grant reuse rights to others. However, many large publishers require authors to sign their rights over to the publisher at the point of publication, meaning that it is the publisher who determines reuse, not the researcher. There is growing recognition of the importance of rights retention in research funder policy, but many researchers remain unaware of this issue. Public funders should certainly not accept the transfer of rights in the final stage of publication.

Research published open access is increasingly published with a machine-readable Creative Commons license that allows reuse, sometimes restricted to noncommercial uses, and allows this information to be automatically processed and data to be automatically extracted. Such Open Access is the default for many large research funders, with restrictions permitted by exception, but smaller LMIC-based publishers may publish work that is grey open access—that is, free to read but without any explicit reuse license.

Enabling reuse through open licensing arrangements provides further benefits to academic and nonacademic users, which can enhance the practical value of research findings while ensuring authors are credited for their work. It enables research outputs to be translated into other languages to increase readership, enables research findings to be adopted by innovators and entrepreneurs to develop new solutions for society and business, and enables research to be adapted into new written or audio-visual formats to increase value for nonacademic users. In doing so, enabling reuse could also help foster wider trust in and appreciation for research, in turn making the case for public support for and investment in science.

The dominance of the journal article as the primary research output is anachronistic and limits the ways in which researchers can communicate their findings, arguments, and data to peers and readers. Currently, some fields expect that data is published alongside an article or written output, and some funders require this. In computer science, it is also common to publish code. There is a range of repositories and other services that provide mechanisms for publishing different outputs, but the journal article is still dominant and regarded as the most important of research outputs (with the exception of monographs in some humanities disciplines).

## **Domains of change to achieve a better research system**

To achieve a research publishing system that is accessible, high-quality, and useable, extensive change will be needed in three domains that underpin the global research system: financing, infrastructure, and governance. There is no one way to achieve the desired change in each of these domains. Rather, we envision a future research publishing system that is likely a negotiated hybrid model—that embraces a mix of for-profit and nonprofit infrastructure, financing, and actors, as well as various elements of governance (i.e., centralisation and decentralisation) to deliver a future model that is better for all.

### ***1. Financing: Generating transitional and recurrent resourcing for a reformed publishing system***

Financing is important to meet the accessibility characteristics set out above, since the costs of access represent one of the greatest barriers to researchers and readers. Appropriate financing is also important because the current system is sustained in large part by volunteer labour in the

form of unpaid peer review conducted for journals managed and owned by commercial publishers, or by the volunteer work required to run journals and platforms managed by the research community (such as the large Diamond Open Access ecosystem). Ideally, financing models should be operated on a sufficient or “fair profit” basis (i.e., a mix of public, nonprofit services and for-profit, commercial labour, with commercial services contracted at fair rates, and with investments in nonprofit solutions where it is more cost-effective to do so) and managed for the public good rather than for private benefit.

### *Requirements:*

- Financing and operating models need both to make publishing affordable in the immediate term and to be designed so that future costs are likely to remain affordable and sustainable in the long term. Those costs need to be moved away from individuals and to be managed and paid for by research institutions and funders, whether directly or indirectly.
- The costs of any future publishing system should be based on fair and transparent pricing, according to which costs are calibrated to the economic reality of different regions and countries. This mode of pricing requires differential costs based on ability to pay, rather than flat global costs. Flat costs make it relatively more expensive, and thus more difficult, for researchers and research institutions in LMICs to publish compared with those in wealthier regions.

### *Current financing models*

Research publishing, while often provided by commercial providers, is largely publicly funded, with additional funding from philanthropic research funders. There are a number of financing models currently operating within the research publishing system. The dominant models are (1) fee-based models (including subscriptions), (2) membership financing models, and (3) contract- and grant-based models (see Box 1). Fees-based models currently dominate and often support for-profit publishing models, but high per-article charges, levied as flat fees irrespective of a researcher’s location or ability to pay, make them highly inequitable.

Nonprofit-oriented publishing models, including preprints and repositories and Diamond journals and platforms, often rely on financing models outside of fee-based models. Diamond journals and platforms account for 9 percent of total global publishing, and are typically publicly and philanthropically funded or are funded by providing in-kind resources (e.g., office space, hosting services) and volunteer time.<sup>20</sup> They typically operate on collective arrangements or membership models, based on commitments by groups of institutions to share platform and publishing costs. The most successful tend to receive core public funding from national research funding agencies. Global recognition of this model is growing,<sup>21</sup> but more work is needed to understand its costs at scale.<sup>22</sup>

## BOX 1. Current financing models

### *Fee-based financing models*

- **Subscriptions:** Readers or libraries pay journal subscription fees to access content. Subscriptions have faced significant backlash in recent years, given the increasing inability of readers and organisations to pay the rising charges.
- **Article processing charges:** Alternatively, authors pay article processing charges (APCs) to cover publication costs, ensuring that the content is freely available to everyone. While offering maximum accessibility and visibility for research findings, it poses financial barriers for authors, especially those with limited resources.
- **Fully OA agreement:** This solution is in limited use but has been piloted by Public Library of Science (PLOS). When articles in a given journal are already free to read, it seeks to raise funding from a collective of institutions to make it free for researchers from those institutions to publish as well. Institutions pay a tiered fee, based on their publishing histories. Researchers from institutions who are not members pay the standard fee.
- **Read and publish:** Institutions negotiate a fixed price for full reader access for their institutions, as well as provisions for their research to be published in a certain number of papers in the same period with no additional author charge.
- **Subscribe to open:** Institutions effectively flip their “to read” subscriptions to “to publish” subscriptions: their subscription payments thus become fees to allow their researchers to publish at no cost. It is designed to encourage libraries to maintain subscriptions, thus preserving publisher revenue.

### *Membership financing models*

- **Membership-based open access:** No charges are made to authors or readers, and funding is secured under a nonprofit model by repurposing the traditional subscription model. It has been successfully applied in several disciplines, including high-energy physics (the Sponsoring Consortium for Open Access Publishing in Particle Physics is funded by a group of national research bodies and by CERN, the European Organization for Nuclear Research). Funding received from the supporting members makes the journals free to read for all readers and free to publish for all authors.
- **Community-led and scholar-led initiatives:** These initiatives are typically run by groups of researchers spread across many institutions and countries, and by institutionally hosted initiatives (many of which are based in university libraries). They therefore have a range of backers— in financial terms, as well as in legal and other organisational terms.

### *Grant- and contract-based financing models*

- **Contracts for publishing services:** In several cases, public or private funders have established publishing platforms under contract with commercial firms. Prominent examples are Gates Open Research and Open Research Europe, which provide publishing services to the funders' respective grantees and run under contract by F1000/Taylor and Francis.
- **Grants for publishing infrastructure:** Public or private philanthropic funders provide support through grant funding. They may be based on longer-term, multiyear agreements, or may be funding arrangements targeted to enable investment in the development of new services or functions. Examples include the tools provided by the US nonprofit Center for Open Science, OurResearch, funding from the State of São Paulo Research Foundation in Brazil for its Scientific Electronic Library Online (SciELO), and China's Journal Excellence Action Plan.

### *Opportunities for change*

Financing will necessarily require exploring multiple models and platforms that can be sustained by a mix of different types of funding. There are a series of ways in which government, philanthropies, and research institutions could help drive the necessary shifts in financing.

### *Make long-term commitments*

- Make long-term commitments to shouldering the cost of developing shared, public, and nonprofit (Diamond) publishing platforms at the national, regional, and global levels, and to encouraging platforms to explore new funding models. Many successful platforms and services already exist. Investments in these platforms would enable them to serve more researchers, provide better functionality, and develop additional services to meet new and emerging needs.
- Explore multilateral and pooled financing between groups of donors. Such agreements would take time to negotiate but would make supported platforms more stable and efficient.

### *Invest in LMICs*

- Invest specifically in platforms developed by LMIC-based organisations to ensure that services are directly meeting the needs of currently underserved research communities.

### *Shift existing funding*

- Shift existing financing commitments away from providing APCs and towards investments in open platforms. This could include support for preprint platforms and repositories like VeriXiv, supported by the Bill & Melinda Gates Foundation, or arXiv, hosted by Cornell University, or for Diamond platforms.

### *Protect the future*

- Ensure that investments include protections against later stage commercial buyouts of successful nonprofit and public platforms.

### *Ensure fair pricing*

- Require that the costs of platform development and service provision are transparent to encourage fair pricing.

## ***2. Infrastructure: Creating or strengthening affordable, reliable infrastructure that enables effective research dissemination for all***

An accessible, diverse, and equitable publishing system requires robust, high-quality digital and human infrastructure that can handle the volume of outputs that researchers produce and that provides a reliable service to researchers and readers wherever they are based. While much of the current system is commercially oriented, the research publishing sector is notable for having given rise to an array of open-source infrastructures, which has placed sophisticated digital publishing tools in the hands of many researchers and institutions. The human dimension is important, too. While digital tools are ubiquitous, and open applications require no purchase or repeat subscription costs, they are complex to install, maintain, and manage. Skilled experts are needed to build, maintain, and develop the new digital tools and platforms that an evolving system requires, and to ensure that they fit the varied needs and operating environments of users.

### *Requirements:*

- The research publishing system provides a reliable, robust, and interoperable infrastructure that allows platforms in different regions of the world to collaborate and share data and information.
- A variety of research outputs can be published, including data, prereview and post-review papers, manuscripts, software, digital or visual artefacts, theses, and conference papers.
- Innovation in publishing models and approaches can occur, including models from emerging economies.
- A flexible infrastructure can emerge—one that satisfies the diverse needs of researchers and users in different countries who are working in different languages and disciplines, that does not impose a one-size-fits-all approach, and that is adaptable as those needs shift and evolve.



## Currently available infrastructure

Digital infrastructure for research publishing includes a series of components that together provide a complex, federated, and connected set of services to researchers, research publishers, and research readers. It needs to be resilient and technically superior, but also affordable to support a global system.

- **Journal publishing and content management systems** provide a range of functions. They allow researchers to submit work; editors to manage submissions, commission and receive peer reviews, and prepare manuscripts for publication; and they publish and host final outputs. These may be based on proprietary platforms (such as Editorial Manager) or on open infrastructure (such as Open Journal Systems).
- **Digital repositories** provide both storage and access to archival services for research outputs of all types. They may be institutional or subject-based. Proprietary platforms include Mendeley Data (Elsevier), while open systems include Zenodo (CERN). New “overlay journal” forms have emerged, in which content is hosted in different repositories or preprint services but accessed through a single journal.
- **Archival and preservation services** in addition to publishing and repository platforms ensure the long-term preservation of content and serve as a backup in case of system failure.
- **Protocols and standards** enable interoperability and metadata services, which ensure that the publishing system is consistent and that different platforms are able to be discovered and interoperated through the exchange of standardised metadata. Such protocols include services like Crossref (digital object identifiers), ORCID (digital identifiers for researchers), and the newly established Africa PID Alliance (persistent identifiers).
- **Discovery platforms** enable research to be discovered wherever it is published. These include public access search facilities like Google Scholar and commercial, fee-based services like Web of Science and Scopus. Open access discovery services include the Directory of Open Access Journals, the repository aggregator CORE, or OpenAlex.
- **Authentication and access** enable users to be identified and authenticated based on individual user accounts or IP address. While these are typically deployed when content is paywalled, they also have a role in identifying individual users in open systems to ensure that their research is properly linked to their other outputs and records.
- **Analytic tools** enable the usage of research outputs to be tracked and measured, and allow the reach and impact of research to be understood.

Infrastructure is closely connected to financing (and also to governance; see below). Funders can either invest in the publication of individual research outputs or clusters of outputs (e.g., through covering fees), or they can invest in the infrastructure that enables wider communities of researchers to publish. There are essentially three forms of infrastructure in use: proprietary

systems, operated under license; hybrid systems, which are sustained by a combination of commercial and public or community funding; and open, nonprofit infrastructure.

The bulk of research publishing relies on infrastructure that falls into the first category: these publishing platforms are built and maintained by commercial entities, and are proprietary, owned and used by a publishing firm, or developed by one firm and made available to others under license. Discovery services and authentication systems, for example, are often licensed to and used by several publishers.

Services such as CrossRef,<sup>23</sup> the digital object identification service, or ORCID,<sup>24</sup> the persistent identifier system for researchers (as opposed to research outputs), fall into the second category: they are developed, funded, and maintained as community models by a nonprofit governed and funded by a mix of commercial and noncommercial entities. In the third category is a growing range of nonprofit, openly licensed infrastructures. Open Journal Systems is a long-standing example.<sup>25</sup> Others include the family of services developed by AmeliCA/Redalyc in Latin America,<sup>26</sup> which are built and managed under the sponsorship of universities and other public agencies, or the more recent additions of the Zenodo repository,<sup>27</sup> the open bibliographic service OpenAlex,<sup>28</sup> or the PubPub platform developed by Knowledge Futures.<sup>29</sup>

Increasing sophistication in digital tools, including the business models that enable such tools to be built by nonprofit entities, and investment by philanthropic and public funders offer new opportunities for high-quality, nonproprietary open infrastructure.

### *Opportunities for change*

There are several opportunities to shift the provision of research publishing infrastructure, building on existing strengths and successes:

#### *Invest in existing platforms*

- Invest in successful or promising platforms to provide core services and technologies for publication, archiving, discovery, and analytics, and support their ability to provide new services and functionality. Such platforms would include both stand-alone platforms and foundational or shared technologies that provide functionalities across multiple platforms. Much can be learned from Latin America, which has pioneered the creation of publicly funded infrastructure over several decades, with institutionally led platforms like SciELO.<sup>30</sup> Important platforms have also emerged from other regions, such as African Journals Online. Such nonprofit infrastructure has recently begun to gain greater traction and policy interest, including from nations with significant research budgets and thus power to invest.<sup>31</sup>

### *Support innovation*

- Support the piloting and development of new services and publishing models to encourage new solutions, such as the open research tools developed by Redalyc,<sup>32</sup> OurResearch,<sup>33</sup> the Center for Open Science, and Invest in Open Infrastructure,<sup>34</sup> which supports funders in investing in innovation for open science.

### *Pursue diversity*

- Deliberately invest in an array of diverse platforms and services, especially those based in LMIC organisations like African Journals Online, to bring strength, resilience, and adaptability to the research publishing system.

### *Enabling coordination*

- Support the additional costs that enable platforms and services to organise collectively, to collaborate in the development of services, and to enable the sharing of data and information to enhance interoperability. Such collaboration will, in turn, have benefits for governance.

## ***3. Governance: Shaping an enabling economic and regulatory environment through organisational and national policies and practices***

A major issue for reform is how the publishing system is led and governed. Governance structures should ideally reflect a globally distributed community of researchers and research users. This is particularly important because the operation of the current system is controlled in large part by a combination of European and American government policy, commercial firms, and philanthropic investment. As a result, decisions and investments often do not reflect the needs of researchers and users in Africa, Asia, and Latin America. Ideally, research publishing should be a distributed ecosystem: simultaneously well connected, yet organised at several levels and anchored regionally to enhance coordination between a dispersed community.

### *Requirements:*

- Financing and operating models should ensure that critical infrastructure for science is collectively governed in public interests, and not controlled by for-profit enterprises, individual public agencies, or countries.
- Research systems, policies, and practices should be harmonised as much as possible for consistency and maximal leverage, while allowing for national and regional variation and innovation.
- There should be collective oversight of research publishing systems by researchers and research institutions from across the world and with balanced regional representation, so that the research publishing system is both accountable to science and to development.

## *Existing governance models*

The research publishing system is governed through a series of policies and frameworks that set guidelines and standards on research publication surrounding authorship, ethics, integrity, conflicts of interest, research publication, and peer review norms. These standards are established through a combination of professional membership associations, research funders, industry bodies, nonprofits, national governments, regional bodies, and international organisations. Additionally, various sector bodies organise and represent stakeholders concerning specific issues.

Individual journals or publishers often voluntarily adopt standards to align with common practices and to signal their credibility and reputability. Research funders and cross-funder initiatives act as a further element of governance through the policies they set for the publications resulting from their funding. While membership bodies have made greater efforts to diversify, it is notable that all are based in North American or Europe, with members predominantly from these continents. LMIC participation and representation in existing governance mechanisms is notably absent.

## *Opportunities for change*

Governments and philanthropic funders could promote new forms of governance in research publishing.

## *Make a multilateral commitment towards policy alignment*

- Set a new tone and expectations for the future of research publishing through collective statements and national and collective commitments to encourage the development of new strategies, models, and policies. Such a statement could encourage more entities and states to adopt and harmonise existing open access or open science policies.

## *Explore collaborative governance networks and systems*

- Such a step could involve exploring a multistakeholder governance network that would ensure balanced global representation from various research publishing sectors, constituencies, or regions through a central board advised by committees. For instance, public research funders could have seats allocated by bodies like the Global Research Council. The central council, supported by a small secretariat, would elect a rotating chair and officers.

A community governance model is another option that would prioritise researchers and users by separating funding decisions from operational control. This model, exemplified by the Global Fund to Fight AIDS, Tuberculosis and Malaria, emphasises community-driven system direction, including various constituencies such as countries, NGOs, and the private sector.

### *Support science bodies in LMICs*

- Invest directly in open access initiatives and platforms, and invest indirectly in the LMIC research funding system, such as the Science Granting Councils Initiative has done in 16 African countries,<sup>35</sup> to strengthen national funding and regulatory bodies and to ensure that they can act on behalf of their countries and their interests.

### *Shift research assessment*

- Explore new forms of research assessment, commit to end the use of publication platforms as a proxy for quality and impact, and free up the research publishing system to focus on the core mission of timely, accessible, and quality research publication. Support initiatives such as the Coalition for Advancing Research Assessment, which addresses the responsible use of quantitative metrics and the appropriate use of qualitative measures;<sup>36</sup> the Agreement on Reforming Research Assessment<sup>37</sup> project, which is establishing a global observatory on responsible assessment; the Latin American Forum on Research Assessment (FOLEC-CLACSO);<sup>38</sup> and development-focused frameworks like the International Development Research Centre's Research Quality Plus.

### *Enable convening and coordination*

- Support such a dispersed but connected research publishing system in coordinating and convening, in order to ensure genuine and equitable participation, as well as building and sharing skills and knowledge. Examples include the work of the International Science Council and its Centre for Science Futures, the work of regional bodies such as the Latin American Council of Social Sciences (CLACSO), or the Science for Africa Foundation.

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## **Facilitating research publishing reform through science diplomacy**

There is no single solution to research publishing reform. A plural, diverse research publishing system is required to meet the various needs of researchers, research users, disciplines, and languages, and to satisfy the different financing levels available in different countries. Creating this reformed system will be complex and will require sustained, high-level global cooperation, negotiation, and leadership to manage the inevitable politics. Such challenges make research publishing reform a promising site for the practice of science diplomacy. Science diplomacy is the intersection of science policy and international policy and diplomatic relations, often considered along three key dimensions:<sup>39</sup>

- **Science in diplomacy:** Scientific advice informs foreign policy objectives.
- **Diplomacy for science:** Diplomacy facilitates international science cooperation.
- **Science for diplomacy:** Scientific cooperation is used to improve international relations between countries.

In the context of research publishing reform, science diplomacy primarily focuses on the second dimension: using foreign policy to facilitate cooperation dedicated to open research practices. Given the international nature of science diplomacy, the primary actors involved are envisioned to be nation-states, supported by international and multilateral organisations and forums and a robust ecosystem of civil society organisations.

While there are clear synergies between science diplomacy and research publishing reform, the link between these two concepts has been “barely acknowledged,” according to Mayer (2020),<sup>40</sup> with science diplomacy rarely referenced in research publishing reform discussions. There have been ad hoc science diplomacy initiatives. For example, UNESCO published a consolidated roadmap and made recommendations for member states on Open Science. The G7 forum put open science on the agenda in 2017, where it remains to this day. The Organisation for Economic Co-operation and Development (OECD) published Science, Technology and Industry Working Papers, while the 2023 G20, led by India, produced several supportive communiqués. Initiatives like Plan S have also triggered some international conversation. Yet the full potential of science diplomacy to generate country-level momentum towards change and to provide unambiguous leadership on what that change should look like is lacking.

## **A theory of change using science diplomacy for research publishing reform**

A theory of change is a comprehensive description of how and why a desired change is expected to happen in a particular context. It is a tool used for planning, participation, and evaluation to promote social change. Theory of change defines the long-term change that is envisioned from the current status quo and outlines the causal pathways through which this change is expected to be achieved. This process involves mapping potential interventions and change mechanisms as well as the assumptions underlying them.

Given the complex and contested nature of the concept of science diplomacy, there is no one theory of change explaining how science diplomacy operates.<sup>41</sup> Rather, theories of how science diplomacy operates can be constructed drawing on existing social, political, and international relations and power theories. When science diplomacy is framed along the dimension of “diplomacy for science” to promote international cooperation on research publishing reform, theories of transnational advocacy and policymaking become useful for understanding how and what types of policy impact can be achieved. Drawing on the work of Jones and Villar (2008),<sup>42</sup> Keck and Sikkink (1998),<sup>43</sup> Carin and Shorr (2013),<sup>44</sup> Kingdon (1995),<sup>45</sup> and Jones and Baumgartner (2005),<sup>46</sup> the Table 2 below outlines different ways diplomacy for science can influence policy, politics, and actions at the national and international levels.

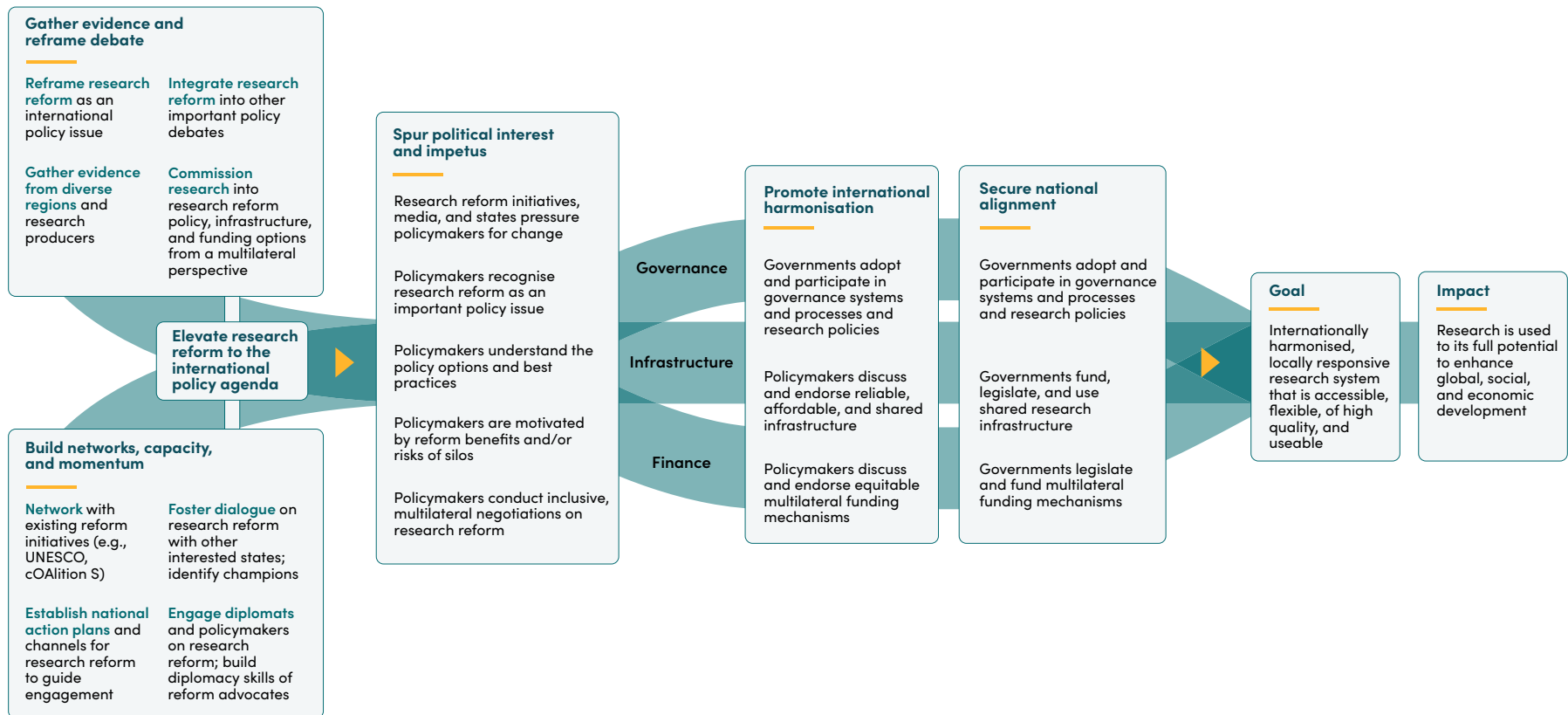
**TABLE 2. Science diplomacy levers for change**

<b>Impact Dimension</b>	<b>Description</b>
<b>Frame debates and get issues onto the political agenda</b>	Issues must win decision makers’ attention in order to be addressed. <sup>47</sup> Drawing attention to new issues or reframing existing issues can affect how stakeholders perceive an issue’s importance and urgency and can spur action. Issues can gain prominence on the agenda through changes in the political cycle (e.g., elections), the media, or public attention. Often short “windows of opportunity” open when conditions are particularly favourable for increased attention and action on an issue. <sup>48</sup> However, if political conditions change, issues can also be deprioritised.
<b>Build knowledge</b>	Creating a strong knowledge foundation is important for informed policy creation. Knowledge building and information generation and dissemination, including by commissioning studies from new or different perspectives as well as collecting case studies of change, can help to frame debates and inform the policymaking process. <sup>49</sup>
<b>Influence discursive positions</b>	Changes in language and rhetoric can help promote recognition or renewed focus on issues or provide a new framing that makes an issue more palatable for change. Such framing can encourage states or organisations to commit to declarations, codes of conduct, or potential future actions.
<b>Secure procedural change</b>	Changing the process by which decisions and/or policies are made and who is involved in making them by, for example, opening new spaces for policy dialogue, can propel renewed action.
<b>Change policy content</b>	Influencing the content of policies of states and of regional and international organisations can be impactful. However, for these policies to have impact, they need to be endorsed, adopted, and legislated. Policy change does not necessarily equate to tangible change.

A second key foundation for a science diplomacy theory of change is international relations theory, which explains why states engage in scientific cooperation and who holds power in these interactions. From a realist perspective, states pursue scientific cooperation to advance their own interests, viewing it as a strategic asset to enhance power, security, and international standing. In contrast, a liberalist perspective focuses on the mutual benefits of collaboration facilitated by international institutions. Typically, science diplomacy operates through “soft” power, which exerts influence via attraction and persuasion instead of coercion. This approach prioritises “power with” other states rather than “power over” them, and emphasises collaborative efforts and shared problem solving capacities. Additionally, soft power encompasses the ability to set the agenda and determine which topics are prioritised or sidelined in scientific discourse and cooperation.<sup>50</sup>

Drawing on these theoretical foundations, we constructed a theory of change to illustrate how science diplomacy can be deployed to achieve the end goal of an internationally harmonised, yet locally responsive Open Access research publishing system that is accessible, equitable, and sustainable and that will benefit humanity worldwide.

**FIGURE 2. Theory of change using science diplomacy for research publishing reform**





This theory of change states that by gathering evidence and reframing research publishing reform as a global issue, alongside building supportive networks and momentum, policymakers can elevate research publishing reform to the international agenda. This increased attention will foster further international debate, diversify evidence for the benefits and possibilities of research publishing reform, and increase the salience and urgency of the issue, prompting policymakers to engage in dialogue and negotiate for internationally harmonised research publishing policies, governance systems, infrastructure, and financing models. Such harmonisation, once endorsed, will encourage states to implement meaningful national reforms in line with these international policies, culminating in a globally coherent, yet locally adaptable research system that maximises the potential of research to benefit the entire world.

While this simplified theory of change is linear, change in highly dynamic international policy environments is often nonlinear and unpredictable. Phases can be skipped, or progress can be cyclical with backsliding. This theory of change is intended as a general framework of science diplomacy to promote research publishing reform but will likely look different in different contexts and should evolve as the context evolves.

## Explanation of the theory of change

### *Build networks, capacity, and momentum*

Putting and keeping research publishing reform on the international agenda requires catalytic momentum and cooperation. States, research funders and producers, and civil society can best influence the international agenda when they have strong, supportive research reform networks and technical capacities. States, regional groups, and coalitions should build or leverage existing national, regional, and international networks to share research publishing reform experiences and proposals and to build coalitions with a common vision for change. It is particularly important to ensure that these coalitions are diverse so that they can benefit from the knowledge of up-and-coming research producers from emerging economies who can share unique perspectives, approaches, and experiences while collaborating together. Identifying and convening research reform champions from interested national governments, organisations, or initiatives is also foundational to network building. These champions can become strong spokespeople and can form the core of advisory and expert committees.

States, research funders and producers, and civil society should also enhance their own knowledge and technical capacities in research reform and diplomacy. An important starting point could be developing or refining their own organisational or national plans for open science or open access, as these platforms can provide a strong foundation for engagement in research publishing reform debates and science diplomacy.<sup>28</sup> In tandem, research reform advocates in government and civil society should be trained in diplomatic skills and know-how to prepare them to effectively engage in multinational, multistakeholder negotiations.<sup>51</sup> As states involve themselves more in these issues and interact with other global actors, this preparation will also strengthen their capabilities.

While some initial coalition-building and convening can help get research publishing reform onto the international agenda, this step also leads to forward momentum—once research publishing reform is on the international agenda, opportunities for further research and cooperation will likely increase.

### ***Gather evidence and reframe debates***

Gathering evidence and reframing research publishing reform debates can further elevate this issue onto the international agenda and can bring significant opportunities for further research and convening stakeholders. Framing research publishing reform as an international—rather than national, academic, or institutional—issue creates impetus for international action, especially if research reform is closely connected with other important global issues, like climate change, health security, or open science. It is critical to produce evidence to outline the costs and demonstrate the societal benefits of research publishing reform and to describe the possibilities and trade-offs of different research systems at a global scale. It is especially important to include solutions from emerging research producers—for example, collaborative investments in public platforms, like the cooperation between Brazil and South Africa on SciELO, or the development of highly diversified and domain-specific infrastructures, as seen in India and China. Beyond presenting evidence on the benefits and limitations of research publishing reform, international forums can provide policymakers with opportunities to engage with stakeholders from research institutions, civil society, and industries. Such interactions are crucial for negotiating priorities and strategies for transitioning to reformed research systems.

It is important to recognise that states do not have equal capacities to gather evidence, participate in regional and international forums, and reframe debates. Historic power asymmetries at the international level mean that developed economies often have an outsized influence compared with emerging economies. As has been seen with climate change negotiations at the international level,<sup>52</sup> it may be necessary to bolster the capacities of certain states so that they can better participate.

### ***Put research publishing reform on the international agenda***

To date, research publishing reform seldom features on diplomatic agendas, and the use of science diplomacy for orchestrating and coordinating research publishing reform initiatives remains marginal.<sup>53</sup> Windows of opportunity for getting research publishing reform on the international policy agenda include planned events like the G20 and G7 summits, UN meetings and conferences including those run by UNESCO, as well as regional meetings or open science forums. Side meetings and smaller committees or working groups can sometimes prove more accessible entry points. Windows of opportunity could also emerge from discussions about technological advancements like AI and/or significant policy shifts in research publishing reform from an influential state or regional or institutional actors.

When considering setting an agenda, it is crucial to critically examine the power dynamics at play—which states or regions possess the influence to introduce or dismiss items from the international

agenda? Which states have the capacity to respond and engage? Are issues placed on the agenda as a symbolic gesture only, or are they a meaningful priority? It is important to interrogate these assumptions of power to ensure that engagement is as equitable as possible.

### *Spur political interest and impetus*

Once research publishing reform is on the international agenda, it creates more visibility for the issue and heightens external pressure, which can motivate policymakers to take action. Civil society groups, research funders and producers, and reform initiatives like Plan S can use this visibility to further advocate for change, both publicly and privately, to policymakers. Conversely, large publishers and those with vested interests in maintaining the current system may exert counterpressure, which can potentially delay action. This opposition should be anticipated.

At this stage, it is important to consider the multifaceted motivations for states to act on research publishing reform. Gluckman et al. propose three reasons why states practice science diplomacy: to directly advance their own national needs, to address cross-border interests, and to meet global needs and challenges.<sup>54</sup> States motivated by self-interest may, for example, want to pursue research publishing reform to bolster their own research and innovation ecosystems,<sup>55</sup> or to ensure they align with international standards rather than adopt divergent strategies.<sup>56</sup> Beyond their own borders, states may see the mutual benefits that a collaboratively built research publishing system offers them and states in their regions or spheres of influence, and see research publishing reform as a means to strengthening research ties and cooperation and to influencing research agendas. States may also see research publishing reform as imperative to tackling the global challenges of our time to enhance planetary flourishing. Appealing to these different motivations will be important to nudge policymakers into action.

Conversely, several deterrents may hold states back from embracing research publishing reform. Policymakers may be sceptical of the benefits of an open access system, given the lack of reliable evidence. Some may consider research publishing reform risky without indication of reciprocity from other states, especially in an era marked by resource scarcity and intense global competition.<sup>57</sup> Research is competitive and sits at the intersection of local and global knowledge economies. Factors such as global rankings of higher education institutions, the commercialisation of scientific results through patents and technology, and researcher mobility all contribute to a more competitive research publishing stance. Some states may withdraw from processes if they are seen to be favouring historically dominant research producers at the expense of emerging research producers.

Once research publishing reform is on the agenda and states are interested and motivated to act, there must be sufficient opportunities for states to engage in exploratory dialogues and negotiations based on trust, reciprocity, and respect with other actors within the wider research ecosystem. This foundation of trust will support the development of future international recommendations for research publishing reform.

## *Promote international harmonisation*

When political interest and momentum lead to dialogues and negotiations, these preconditions pave the way to forming and endorsing international-level agreements such as consensus statements or harmonised policies for research publishing reform. These policies should include consideration of governance systems, infrastructure, and funding mechanisms, and will likely involve multilevel negotiations and agreements on different research publishing standards, protocols, governance systems, cost-sharing arrangements, ownership issues, and access. Achieving internationally harmonised policy positions will require careful balance and recognition of the diverse economic, political, and cultural contexts of different countries, while also valuing the benefits of system change or of harmonisation and consistency. Ultimately, this will not be a one-size-fits-all solution but rather a flexible framework that upholds the principles of open research while accommodating unique national and regional circumstances.

International cooperation and harmonisation depend on a climate of reciprocity and cordiality between states. However, shifts in international relations could instead see states acting in their own self-interest and eschewing cooperation.<sup>58</sup> Forming a universally inclusive research system risks creating asymmetries by attempting to integrate disparate research publishing reform agendas and capacities across states, as well as by ignoring differences between developed and emerging knowledge economies, including governance mechanisms, markets, and cultural and language contexts. There is also the assumption that all stakeholders will benefit equally from a reformed research system. Yet it may be that some countries will benefit more than others from these changes, and these trade-offs should be acknowledged. It is also important to consider that the corporate publishing sector may significantly influence research publishing reform frameworks according to their commercial interests.

## *Secure national alignment*

Once an internationally harmonised framework on research publishing reform has been agreed upon, the final step requires states to translate these international commitments into their national policies and frameworks and to implement them. This step involves making domestic legislative changes and allocating budgets to support a reformed research system, as well as participating in ongoing international dialogues, governance, and monitoring processes. It is crucial to involve local actors in this process, including research institutes, academic institutions, learned societies, and civil society organisations. Their involvement ensures that the implementation of international commitments reflects the specific needs and capabilities of each country. Engaging these stakeholders not only aids in the effective adoption of reformed research publishing policies but also strengthens the support for reform within the national context by fostering a collaborative effort towards a more accessible and open system of scholarly communication.

While national alignment is important to sustainable change in research systems, the complex interplay between the international, national, and local levels of the research publishing ecosystem must be acknowledged. Policy changes cannot occur in a vacuum. They must be pursued in

tandem with other important changes in the system in order to see meaningful change. Such changes include influencing researcher behaviours, academic incentives, publisher imperatives, and institutional prerogatives that interact with this theory of change.

### *Contextualising a science diplomacy theory of change*

This macrolevel theory of change provides an overall outline of how science diplomacy can support research publishing reform. However, this theory of change requires adaptation to a specific context and stakeholders for effective implementation. At a recent workshop with global open access experts, we discussed and mapped the research publishing reform landscape through the lens of science diplomacy entry points. We uncovered a complex network involving numerous forums, stakeholders, and initiatives at the global, regional, and national levels. Figure 3 maps out these relationships between different actors, depicting the direction and strength of relationships through the direction and thickness of the arrows.

### *Science diplomacy forums*

International entry points for science diplomacy include intergovernmental forums like the G20, G7, the Asia-Pacific Economic Cooperation, and BRICS, where leading economies discuss scientific collaboration, including issues related to research publishing reform. Regional bodies like the EU and the African Union play critical roles in shaping research publishing policies and practices within their respective regions. They often develop frameworks and guidelines to promote open access and facilitate collaboration among member states. The United Nations General Assembly (UNGA) Science Summit provides another crucial forum for discussing science diplomacy and its role in addressing global challenges, including those related to research dissemination and accessibility. UN agencies like UNESCO also promote open science and support initiatives that advocate for transparent and equitable research publishing practices, as well as host an annual open science conference.

### *States*

A range of influential international actors are crucial for supporting, influencing, and advocating for science diplomacy through the above forums. States are particularly important for unlocking science diplomacy, as they sit at the nexus of a state-based international system and a vibrant domestic sphere. Some states have been historically dominant research producers, including the United States, European nations, the UK, Japan, and Canada. Other nations are emerging as influential producers, including the meteoric rise of China as a dominant research producer, as well as increases in output from India, Brazil, Indonesia, South Korea, South Africa, and Türkiye.<sup>59</sup> Both historically dominant and emerging research producers are important champions for research publishing reform through their policies, funding priorities, and participation in international forums. States are also often the main audience for engagement and advocacy efforts from subnational actors, and play a crucial role in shaping research funders, institutions, and civil society policies and practices.

## *Research ecosystem*

Within the research ecosystem, research funders—including philanthropic funders like the Wellcome Trust and the Bill & Melinda Gates Foundation, as well as multilateral development banks—play an influential role in science diplomacy. Given their large budgets, the open access policies and requirements of these funders strongly influence the research publishing ecosystem, as well as state policies and international conversations. These funders can be early adopters and model new approaches to open access thinking and practice that can influence policymakers at the national and international levels.<sup>60</sup>

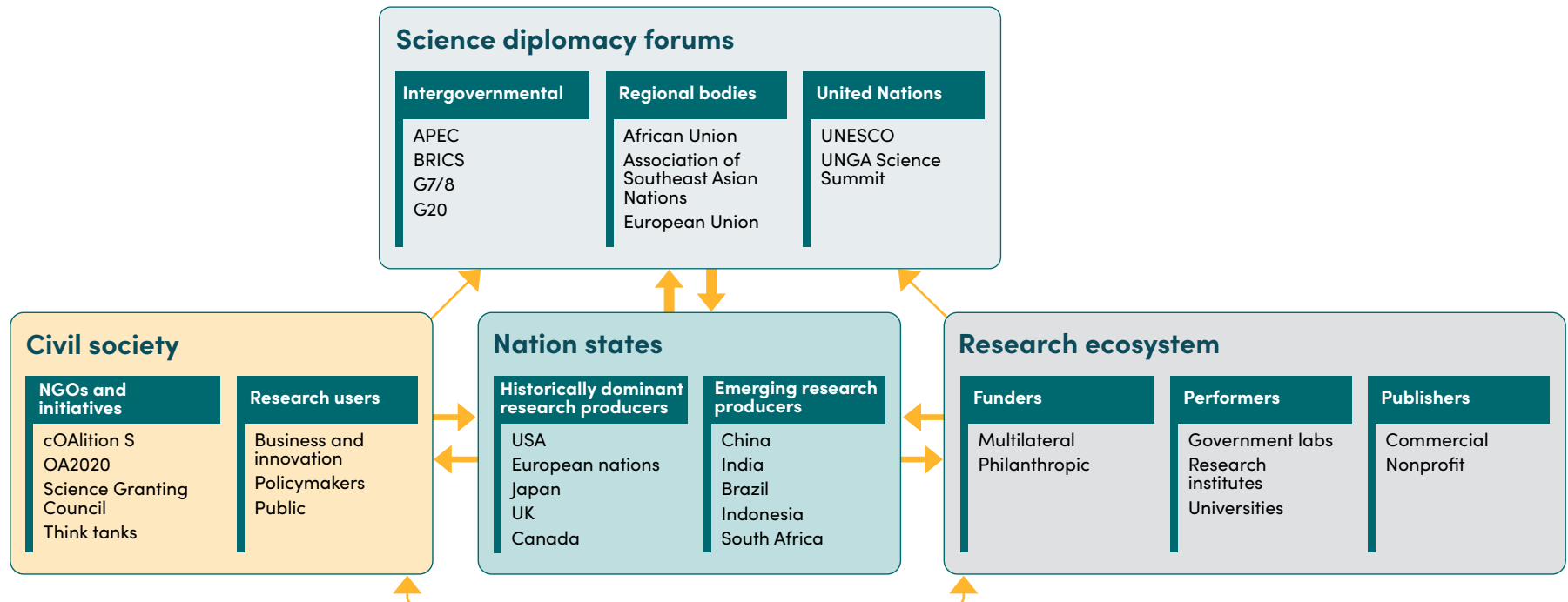
Additionally, initiatives such as the Science Granting Councils Initiative and the Global Research Council facilitate coordination among research funders and institutions worldwide, fostering collaboration and advancing open access principles. National and subnational research institutions, libraries, learned societies, and universities, especially those that are larger and historically influential, also play essential roles in advocating for open access, supporting researchers in adopting transparent publishing practices, and promoting collaboration on a global scale. Research publishers, especially commercial publishers and their professional associations, have the resources to influence research funders and producers,<sup>61</sup> state policies,<sup>62</sup> and international conversations on research publishing reform.<sup>63</sup>

## *Civil society*

Civil society initiatives, such as Coalition S and OA2020, and think tanks like the Open Society Foundations and the Center for Global Development (CGD) are driving forces in the movement towards research publishing reform, influencing the science diplomacy process, conversations, and outcomes. Coalition S, comprising a coalition of research funders, mandates open access to the results of publicly funded research. OA2020 aims to accelerate the transition to open access by transforming subscription-based journals to open access models. These initiatives collaborate with and aim to influence various stakeholders across the science diplomacy ecosystem to advance research publishing reform and promote the widespread dissemination of scientific knowledge. These strategies can include changing the practices of research funders, producers, and publishers, influencing the policies of states, and contributing to and catalysing international dialogue and debate.

As can be seen, there are many actors playing different yet complementary roles in the science diplomacy arena for research publishing reform. Effectively implementing a science diplomacy theory of change requires bringing together interested actors and developing a context analysis to understand the international policy environment, suitable entry points and windows of opportunity, as well as key enablers—individuals, organisations, or factors that support research publishing reform—and blockers that might impede progress. The following section shows how this can be achieved through a case study of the application of this theory of change to the G20.

**FIGURE 3. Science diplomacy ecosystem relevant to research publishing**



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## Open Access policies and the G20: A case study using the theory of change

The G20 is a promising opportunity to jump-start reforms in the research publishing system. G20 nations account for about 90 percent of global research spending, researcher population, publication output, and patent registration.<sup>64</sup> CGD has previously written a case study detailing how suitable the G20 is to take the lead on reforming the research publishing system.<sup>65</sup> The G20 can use science diplomacy as outlined in our theory of change as an avenue to operationalise research publishing reform at the international level.

Open access policies that can stipulate certain requirements for publishing to their funding recipients act as a key lever for achieving publishing reforms. Open access policies are a set of principles that require or recommend that researchers provide free, immediate, and full access to published research. These requirements can be enforced by research funders, institutions, or governments in order to encourage researchers to move towards open access publishing, and in effect, to increase access to research, so that everyone is able to learn from research findings. The specifics of such policies can be complex, and while there have been efforts towards standardisation,<sup>66</sup> there can be considerable variation between research funders.<sup>67</sup>

Central governments are often a main source of funding for research and innovation, and have the potential to influence system reform. Government-mandated research agencies may fund national projects through field-specific departments (e.g., US National Institutes of Health) or through nationwide, non-discipline specific entities or primary funders (e.g., UK Research and Innovation Institute). According to OECD data, the top three countries for gross expenditure on research and development financed by the government in 2021 (adjusted for purchasing power parity and standardised to 2015 prices) were the United States (US\$136.2 billion), the European Union (US\$122.9 billion), and China (US\$120.4 billion).<sup>68</sup> The conditions that these government institutions stipulate in their open access policies determine the direction of the research they fund, while also influencing the culture of the wider national research ecosystem.



In terms of system reform, open access policies are a type of market shaping tool and therefore become more effective when funders align, sending clear, strong signals to the market. If we consider this definition within the context of the vision for reform outlined in Section 2, it becomes clear that open access policies are primarily, though not exclusively, about improving *access*. The lack of consistency in open access policies between different states and funders means that more effective *governance* could achieve better results. A science diplomacy theory of change can help us better understand the actions that we can take to get open access policy onto the G20 agenda, build political impetus and interest in coordinating open access policy, and achieve better international open access policy harmonisation implemented at the national level.

### *Understanding G20 members' open access policies*

Table 3 summarises open access policies, where available, for all 19 G20 member states, plus the African and European Unions. For a policy to be included, the policy-holding organisation must be national (not subnational) and cross-sectional (i.e., not focusing on a specific topic such as health or environmental research). We focused on two key elements of the policy: access requirements and funding availability to support open access publishing. The review is intended to be descriptive and does not imply, for example, that funding for article processing charges should be made available.

**TABLE 3. Open access policy positions for G20 members**

Country	Policy*	Article Access				Open Access Funding		
		Immediate	6 Months	12 Months	Not Reported	Eligible Expense for Reimbursement	Conditional Support	Not Reported
<b>African Union</b> <sup>#</sup>	No formal national policy							
<b>Argentina</b>	Open Access institutional digital repositories – Federal Law 26.899/2013 <sup>69</sup>							
<b>Australia</b>	Australian Research Council Open Access Policy <sup>70</sup>							
<b>Brazil</b>	No formal national policy found							
<b>Canada</b>	Tri-Agency Open Access Policy on Publications <sup>71</sup>							
<b>China</b>	Law of the People’s Republic of China on Progress of Science and Technology <sup>72</sup>							
<b>European Union</b> <sup>#</sup>	Regulation (EU) 2021/695 of the European Parliament and of the Council establishing Horizon Europe <sup>73</sup>							
<b>France</b>	Second French Plan for Open Science <sup>74</sup>							
<b>Germany</b>	Open Access in Germany – Joint Guidelines of the Federal Government and the Länder <sup>75</sup>							
<b>India</b>	Science, Technology, and Innovation Policy <sup>76</sup>							
<b>Indonesia</b>	No formal national policy found							
<b>Italy</b>	Position statement on Open Access to research outputs <sup>77</sup>							
<b>Japan</b>	Japan Science and Technology Agency Policy on Open Access to Research Publications and Research Data Management <sup>78</sup>							
<b>Republic of Korea</b>	No formal national policy found							
<b>Mexico</b>	General guidelines for the national repository and institutional repositories <sup>79</sup>							
<b>Russia</b>	No formal national policy found							
<b>Kingdom of Saudi Arabia</b>	Open Access to government-funded research infrastructure in the Kingdom of Saudi Arabia – Policy document <sup>80</sup>							
<b>South Africa</b>	No formal national policy found							
<b>Türkiye</b> <sup>^</sup>	TUBITAK (Scientific and Technological Research Council of Türkiye) Open Science Policy <sup>81</sup>							
<b>United Kingdom</b>	UK Research Institute Open Access policy <sup>82</sup>							
<b>United States</b>	Memorandum for Ensuring Free, Immediate, and Equitable Access to Federally Funded Research <sup>83</sup>							
<b>Total (%)</b>		<b>6 (29%)</b>	<b>4 (19%)</b>	<b>5 (24%)</b>	<b>3 (14%)</b>	<b>4 (19%)</b>	<b>4 (19%)</b>	<b>7 (33%)</b>

Notes: \*The inclusion criteria were policies at the national level, not including state-level or sector-specific open access policy documents. #Although not countries, the African Union and European Union were included as they are a part of the G20 intergovernmental forum. ^In Türkiye, the time frame in which articles should be available varies by research field: articles are expected to be published as soon as they are accepted for publication, but if this is not possible, articles should be available no later than 6 months after publication for life sciences, technology, engineering, and mathematics and no later than 12 months after publication for the social sciences and humanities.

We found significant variation in Open Access policy positions between G20 members. National Open Access policies were found for 15 G20 members (71 percent). At times, information about Open Access was found under open science policies (i.e., Türkiye, India, and China). The type of mandating organisation also varied, as country policies were directed by national or supranational funders, federal governments, or national research institutions. Similarly, the type of document enforcing Open Access to research publications ranged from legal government documents to guidelines or position statements. Further, the extent of the detail of these documents was inconsistent. For example, the non-mandated guidelines for Germany and Italy were more informative than the policy documents for China and the Kingdom of Saudi Arabia. For this reason, it was not always possible to ascertain the member's position on research publication access and financing, even when a policy was present.

Policy positions on the timeliness of publication access were reported for 11 member states. Immediate article access was listed as a requirement for six nations (29 percent). More commonly, member states set expectations for research to be published within a set timeframe, often either six (4 nations, 19 percent) or twelve months (5 nations, 24 percent) (of note, Türkiye had varying expectations for different research fields under a single national-level policy and so was counted under several policy positions). Several of the entities reviewed, including Japan,<sup>84</sup> the European Union,<sup>85</sup> and Canada,<sup>86</sup> are in the process of revising their open access policies, which are expected to require immediate access, which indicates momentum towards no embargoes.

Policy positions for financing the cost of publishing research were also divided. Four nations (19 percent) took the stance that publication costs were an eligible expense for reimbursement by the institution. Alternatively, four member states (19 percent) would provide conditional support for the costs incurred by complying with the policy. The various stances on covering publication costs are as follows: publication costs are covered if researchers publish in completely open access journals; costs are refused for all hybrid journals or, in the UK's case, hybrids that are not in a transitional process; covered on a case-by-case basis with approval required from the funder/institution; or covered based on the availability of institutional budgets. For seven G20 members (33 percent), the position on covering publication costs was not reported in their policy documents.

Six G20 members did not have a formal national Open Access policy. For these members, requirements at the state level or field-specific research institutions or funders were found, but these guidelines did not fit our criteria for national, cross-sectional policies. Moreover, several of these countries are championing Open Access research in other ways. For example, although we did not find a national Open Access policy for South Africa, there are significant initiatives which exemplify South African leadership on Open Access, such as the Africa Open Science Platform.<sup>87</sup> Similarly, while we did not identify an African Union Open Access policy (as in the EU), there are

other regional Open Access initiatives led by the Science for Africa Foundation.<sup>88</sup> The Republic of Korea has also recently joined Horizon Europe, which may spur change in setting their priorities for developing a national Open Access policy.<sup>89</sup>

Given the variability in G20 nations' approaches to open access policies in only the two components we studied here, the coordinated response required for system reform pose a challenge. The lack of alignment that the table illustrates is an opportunity for the G20 to take the lead in addressing the problem and encouraging policy harmonisation.

### *How could the G20 be used to improve Open Access policies?*

The G20 has already taken some action for setting research accessibility as a priority, with influential members taking steps towards the goal of free, immediate, and complete access to research.<sup>90</sup> Open Science specifically was supported in the G20 Leaders' Communiqué in the 2016 Hangzhou Summit<sup>91</sup> and the 2021 Rome Summit.<sup>92</sup> In the 2023 New Delhi Summit, the first Chief Science Advisers Roundtable (CSAR) took place, and its Outcome Document addressed synergising global efforts to expand access to research knowledge.<sup>93</sup>

*“(8) We acknowledge the need to enable immediate and universal access to appropriate publicly funded scholarly scientific knowledge to communities within and beyond G20 members [referenced e.g., UNESCO declaration on open science]. We recognise that international collaborative efforts on this policy matter can further strengthen national priorities and ambitions and foster innovation. We acknowledge the importance of working together to synergise and align our open and public access policies and programs based on best practices in cognizance with the respective national legislations and policies. Such open and public access policies should uphold respect for universal human rights, the protection of national security, and principles and rules related to academic freedom, research integrity, privacy, and protection of intellectual property rights.*

*(9) We recognize the importance of evolving approaches to providing immediate and free access to appropriate publicly funded research publications. We recommend establishing interoperability standards that would allow interlinking among various national as well as international repositories to expand access to publicly funded research outputs. We recommend that such policies should align with the Findability, Accessibility, Interoperability, and Reuse (FAIR) principles. Frameworks for research assessment and evaluation that take into consideration the holistic contribution of research outputs, including both their intrinsic merit as well as the broader impact, are desirable and deserve further development.”*

From this statement, it is clear that G20 scientific advisers recognise that providing immediate and free access to appropriate publicly funded research requires international collaborative efforts towards innovation, interoperability, and equity. However, despite this recognition, little has been done to harmonise Open Access policies, and beyond this roundtable, there have been few efforts to actively advance system reform.

The G20 can play a pivotal role in advancing research publishing reform via improved Open Access policy alignment, pursued through a science diplomacy theory of change. Alongside the G20, stakeholders such as civil society organisations, universities, think tanks, and others will need to:

### *Gather evidence and reframe debates*

- Generate or synthesise evidence on the benefits and challenges of Open Access policies, analysis of the current landscape of research publishing, and political economy analysis of reform.
- Develop strategies on how to work towards international Open Access policy cohesion, framing the need to reform Open Access policies as an international issue, rather than a problem limited to academics or national institutions.

### *Build networks, capacity, and momentum*

- Organise, through new or established networks and initiatives (e.g., UNESCO), to increase cohesion on national Open Access policies.
- Identify champions for leading research publishing reform, potentially from member states who worked to elevate the Open Access agenda in the past or who wish to show leadership in a new space.
- Create opportunities for these champions to build diplomacy skills, to engage diplomats, and to advocate for establishing national Open Access policies.
- Foster dialogue with member states about existing Open Access policies and leverage their commonalities to build momentum and establish networks; at the same time, encourage nations without national Open Access policies to participate in these networks to learn from each other's experiences.
- Take advantage of relevant entry points in the G20 ecosystem, for example the Think20 (T20), Science20 (S20), CSAR, and the Research and Innovation Working Group.

Within the G20 ecosystem, diplomats and other officials will need to:

### *Spur political interest and impetus*

- Identify and take advantage of windows of opportunity to place research publishing reform on agendas in relevant G20 meetings and workstreams.
- Hold side meetings to build coalitions of groups with similar views to agree on influencing strategies.
- Communicate the national and international benefits of research publishing reform from a global public goods perspective to further elevate the case for Open Access policy.

### *Promote international harmonisation*

- Through official meetings and workstreams, develop an evidence-informed consensus statement on principles for Open Access policies.
- Establish a working group to guide the formulation of Open Access policy harmonisation.
- Develop a clear communication strategy designed to engage diverse stakeholders and foster increased acceptance of scientific recommendations.
- Foster bilateral or multilateral agreements to cooperate on position statements for the different components of an Open Access policy, including infrastructure and finance.

### *Secure national alignment*

- Follow through on consensus agreements made in G20 forums by advancing national policy.
- Promote and support the translation of the harmonised framework for Open Access policies into national settings; gather international commitments to achieve this in reasonable time frames and monitor these commitments.
- Provide guidance and consider budget support for country-level and local efforts to implement Open Access reforms; consider including local actors such as research institutes, academic institutions, and civil society organisations.

The success of the above actions would enable greater alignment on national Open Access policies in G20 countries, providing clearer direction for science diplomacy engagement in research publishing reform. Crucially, these outcomes are likely to have wider spillover impacts on policies in other research institutions and in other countries, ultimately driving deeper, more effective reform of this important global system than has been seen in recent decades.

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## Conclusion

Research publishing reform is essential if we want to reap all the benefits of research, especially as technology advances and systems innovate. There is some momentum towards change, and further transformation is possible. Yet to achieve this change, we need to unite behind a vision for research publishing reform and reconceptualise it as a political issue that requires strategic political and diplomatic engagement. In this paper, we present a synthesised vision of research publishing reform with three key characteristics and three domains of change. A reformed system must be accessible, of high quality, and useable, with reforms focused on three key domains: financing, infrastructure, and governance.

To attain this vision, we look beyond theories of change that focus on institutional change or individual researchers' behaviours and instead propose a theory of change for science diplomacy, to understand how to best spur political interest in research publishing reform, to agree on internationally harmonised principles focused on financing, infrastructure, and governance, and to secure national alignment on further research publishing reforms. To apply this theory of change, we identify key entry points and actors in the research publishing landscape. We conclude by illustrating how the theory of change could be applied to the G20 in the context of national Open Access policies.

The G20 and other international forums, with their international influence and commitment to cooperation, can play leading roles in promoting research publishing reform, which have been neglected for too long. As the research publishing landscape evolves alongside rapidly advancing technology, it is imperative that we leverage science diplomacy to unite behind a vision for reform and accelerate progress towards a more equitable publishing system.

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## Annex 1

TABLE A1. Comparing open access guidelines and principles

	International Science Council: 8 Principles	UNESCO: 4 Core Values and 6 Sets of Principles	cOAlition S: 5 Principles	Rooryck: 10 Principles	FAIR Principles for Data	The Principles of Open Scholarly Infrastructure (POSI)	Helsinki Initiative on Multilingualism in Scholarly Communication
<b>Accessibility, participation, use</b>	Universal and prompt open access for authors and readers  Open licenses to permit reuse	Values: equity and fairness  Principles: collaboration, participation, and inclusion	All outputs arising from research immediately and openly shared  Authors responsible for disseminating their findings and choosing where and how to do this	No financial barriers to reading or publishing  Nationally covered, transparent, and accountable costs		No patents	Supports dissemination of research results for the full benefit of the society
<b>Quality and review</b>	Rigorous and timely peer review	Values: quality and integrity  Principles: transparency, scrutiny, critique, and reproducibility	Open quality control provided by the scientific community  All research outputs considered for research assessment	Transparent and consistent quality standards  Open data and peer review			
<b>Data and privacy</b>	Accessible data and metadata			Digital privacy of readers and authors safeguarded	Findable, accessible, interoperable, and reusable metadata	Open data (within constraints of privacy laws)  Available data (within constraints of privacy laws)	

TABLE A1. (Continued)

	International Science Council: 8 Principles	UNESCO: 4 Core Values and 6 Sets of Principles	cOAlition S: 5 Principles	Rooryck: 10 Principles	FAIR Principles for Data	The Principles of Open Scholarly Infrastructure (POSI)	Helsinki Initiative on Multilingualism in Scholarly Communication
<b>Resilience and sustainability</b>	A record of science open to future generations	Value: flexibility Principle: sustainability				Time-limited funds used only for time-limited activities  Goals: to generate surplus and to create financial reserves  Mission-consistent revenue generation  Revenue based on services, not data  Open source	
<b>Inclusivity</b>	Interoperability between disciplines, regions, and languages	Values: diversity and inclusiveness Principle: equality of opportunities		Publishing should support all dimensions of diversity, equity, and inclusion			Provide equal access to researched knowledge provided in a variety of languages  Protect national infrastructures for publishing locally relevant research  Promote language diversity in research assessment, evaluation, and funding systems



TABLE A1. (Continued)

	International Science Council: 8 Principles	UNESCO: 4 Core Values and 6 Sets of Principles	cOAlition S: 5 Principles	Rooryck: 10 Principles	FAIR Principles for Data	The Principles of Open Scholarly Infrastructure (POSI)	Helsinki Initiative on Multilingualism in Scholarly Communication
<b>Structure</b>				Diamond publishing based on a federated, global network of communities  Services can be provided by commercial actors under transparent costs			
<b>Governance and ownership</b>	Accountable to the scientific community	Principles: responsibility, respect, and accountability	Diverse, 'scholar-led' publishing system supported by its stakeholders	Publishing should be academic-led  All elements of published research owned by academic communities		Coverage across the scholarly enterprise  Stakeholder-governed  Non-discriminatory participation or membership  Transparent governance  Cannot lobby  Living will  Formal incentives to fulfil mission and wind-down	