THE CENTER FOR
OPEN DATA ENTERPRISE

Briefing Paper on Open Data for Sharing and Applying Research Data

This paper is one in a series of four Briefing Papers on key issues in the use of open government data. The U.S. federal government, like many governments around the world, releases "open data" that can help the public find better value in education, fair housing, and safer medicines, and has a wide range of other social and economic benefits. Open data also helps government agencies themselves operate more efficiently, share information, and engage the citizens they serve. Under the U.S. government's Open Data Policy,[1] all federal agencies "must adopt a presumption in favor of openness to the extent permitted by law and subject to privacy, confidentiality, security, or other valid restrictions." While this paper focuses on policies and examples from the U.S., it is meant to be useful to open data providers and users in other countries as well.

Introduction

Data generation and analysis is at the core of the scientific discovery process, and information technology has enabled scientists to generate and share research data in increasingly novel and powerful ways. These new capabilities have fueled a strong and growing movement for open science policies that increase access to the results of scientific research, including scientific research data. Governments, corporations, universities, and scientists are beginning to see the benefits of opening access to scientific data. Data sharing enables researchers to test each other's findings and build on results that are meaningful and replicable. National and international frameworks for opening scientific data have been developed over the last two decades,[2] and new policy initiatives are building on that work. Open science "has a lot of interlocking parts," as one writer puts it, ranging from access to published papers to making software open source.[3]

[1] Sylvia M. Burwell, Steven VanRoekel, Todd Park, Dominic J. Mancini, "M-13-13, Open Data Policy - Managing Information As an Asset", Executive Office of the President, Office of Management and Budget, May 9, 2013, https://www.whitehouse.gov/sites/default/files/omb/memoranda/2013/m-13-13.pdf (accessed April 20, 2016).
[2] See Contreras, "Bermuda's Legacy" and Jaylane J. Arias, Genevieve Pham-Kanter, Eric G. Campbell, "The growth and gaps of genetic data sharing policies in the United States", Journal of Law and the Biosciences, Volume 2, Issue 1, 56-58, first published online December 20, 2014, http://jlb.oxfordjournals.org/content/2/1/56 (accessed April 15, 2016).
[3] Rose Eveleth, "Free Access to Science Research Doesn't Benefit Everyone", The Atlantic, December 22, 2014, http://www.theatlantic.com/technology/archive/2014/12/free-access-to-science-research-doesnt-benefit-everyone/383875 (accessed April 14, 2016)

But access to scientific data is central to such efforts. Broadly, open science refers to "an approach to research based on greater access to public research data, enabled by ICT tools and platforms, and broader collaboration in science, including the participation of non-scientists, and finally, the use of alternative copyright tools for diffusing research results." Advocates for open science argue that it will "improve conditions for conducting research by reducing duplication of efforts and by minimising the time spent searching for information and accessing it," allowing scientists to better focus their energies.[4] There is also an element of fairness to consider: When scientific research is supported by public funds, as much research is, it's fair to argue that the public has a right to the data that's produced and to expect that the data will be used to the maximum extent possible to produce benefits to society.

Open sharing of research data has a wide range of benefits in areas as varied as energy, health and biotechnology. It can lay the groundwork for broad research, freeing up valuable time and energy for further discovery. Thanks to data shared from the Human Genome Project, for example, "the genetic basis for thousands of common hereditary diseases is now known, and widely-available genetic tests exist for many common diseases and other physical traits."[5] In addition, studies have shown that opening access to data and research can lead to more, and more diverse, follow-on research.[6]

Sharing and preserving scientific data can also facilitate discovery and reduce the time and financial cost of research. A recent study of Small and Medium Sized Enterprises (SME's) showed that without speedy access to up-to-date scientific research results, it takes such firms on average 2.2 years longer to develop or introduce new products." There is a growing recognition that "data and source code [are] first class research objects to be shared, scrutinized and reused."[7]

This paper presents an overview of the issue and possible solutions for government data stewards and other stakeholders interested in the application of open government data.[8] While it focuses on policies and examples from the U.S., it is meant to be useful to open data providers and users in other countries as well.

Federal Frameworks for Open Scientific Data

Institutions that fund research have the ability to set ground rules that encourage greater access to scientific data. Many are now doing so, beginning with major funding agencies in the federal government. The National Institutes of Health (NIH) has been moving towards open access for scientific

[4] "Commission Recommendation of 17.7.2012 on access to and preservation of scientific information", European Commission, July 7, 2012, http://ec.europa.eu/research/science-society/document_library/pdf_06/recommendation-access-and-preservation-scientific-information_en.pdf (accessed April 14, 2016), 3.

[5] Jorge L. Contreras, "Bermuda's Legacy: Policy, Patents and the Design of the Genome Commons", Minnesota Journal of Law, Science & Technology, Vol. 12, p. 61, 2011; Washington University in St. Louis Legal Studies Research Paper No. 10-09-02, August 28, 2010, http://ssrn.com/abstract=1667659 (accessed April 14, 2016), 72.

[6] See, for example: Fiona Murray, Julian Kolev, Philippe Aghion, Scott Stern, Mathias Dewatripont, "Of Mice and Academics: Examining the effects of openness on innovation", National Bureau of Economic Research, 2009, http://www.nber.org/papers/w14819.pdf (accessed May 17, 2016).

[7] Tim Smith, "On the Road to Open Science", CERN, last updated November 25, 2015, http://home.cern/cern-people/opinion/2014/11/road-open-science (accessed April 14, 2016).

[8] This paper was originally prepared as background for an Open Data for Sharing and Applying Research Data Roundtable, co-hosted by the White House Office of Science and Technology Policy and the Center for Open Data Enterprise on May 25, 2016.

data since 2003, when the agency began requiring all grant applications requesting more than $500,000 in any given year to include a data-sharing plan. In 2014 the NIH instituted a Genomic Data Sharing Policy that establishes expectations for the preservation and sharing of genomic data generated through NIH-funded research.[9] The guidelines have been said to incorporate "the most significant protections and guidelines to date."[10] The National Science Foundation has been requiring data management plans since 2011.[11]

Open science has had a significant place in the Obama Administration's broader open government agenda. The Administration's core open science policies were set out in a 2013 memo issued by John Holdren, director of the Office of Science and Technology Policy, on "Increasing Access to the Results of Federally Funded Scientific Research" (The Holdren Memo).[12]

The Holdren Memo set open science objectives for all Federal agencies that spend more than $100 million per year on research and development. The memo instructs these agencies to "develop a plan to support increased public access to the results of research funded by the Federal Government."[13, 14] It also directs agencies to review options and needs for data repositories in areas of research they support and to require "extramural researchers receiving Federal grants and contracts for scientific research and intramural researchers [to] develop data management plans."[15] This requirement does not spell out specific data management practices, but leaves it to investigators to specify appropriate data management processes and options for long-term data preservation and access.

Federal policies governing scientific data-sharing cover data generated through different funding mechanisms, including:

- **Scientific data generated within government.** Agencies that produce large scientific datasets internally are already releasing data as a result of the Administration's Open Data Policy.[16] For example, the National Oceanic and Atmospheric Administration has more than 70,000 datasets indexed online.[17] While these agencies and offices are releasing more data every day, they still face significant challenges, such as privacy, quality, infrastructure, and security concerns.
- **Data generated from individual grants or contracts.** Government institutions, particularly the NIH and the National Science Foundation (NSF), fund considerable amounts of research via

[9] "NIH Genomic Data Sharing Policy", National Institutes of Health, August 27, 2014, http://grants.nih.gov/grants/guide/notice-files/NOT-OD-14-124.html (accessed May 17, 2016).
[10] Arias, Pham-Kanter, and Campbell, 56.
[11] "Grant Proposal Guide". Chapter II.C.2.j. *National Science Foundation Data Management Plan Requirements.* 26 Dec 2014. http://www.nsf.gov/bfa/dias/policy/dmp.jsp (accessed May 23, 2016).
[12] John Holdren, "Memorandum for the Heads of Executive Departments and Agencies: Increasing Access to the Results of Federally Funded Scientific Research", The Executive Office of the President Office of Science and Technology Policy, February 22, 2013, http://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf (accessed April 15, 2016).
[13] Holdren, 2.
[14] Ibid, 4-5. The most recent list of Department and Agency Public Access Plans can be found at https://www.whitehouse.gov/sites/default/files/microsites/ostp/public_access_-_report_to_congress_-_jan2016.pdf (accessed April 25, 2016).
[15] Holdren, 5.
[16] M-13-13.
[17] Data.noaa.gov, "Data Catalog", National Oceanic and Atmospheric Administration https://data.noaa.gov/dataset (accessed April 25, 2016).

grants and contracts with research institutions. Generally, work performed under contract is considered a government project that is conducted by an outside organization, while grant-funded research is considered the grantee's project being conducted with financial support from government. Grantees typically retain the rights to their data even if the government has a license to use it. Numerous government science funding agencies have successfully encouraged their grantees to share their research data, but many challenges such as culture and intellectual property remain.

- **Data from cooperative agreements with external research institutions.** Unlike typical federal contracts and grants, cooperative agreements include the understanding that the government will continue to be involved while the relevant project is carried out.[18] Federal research agencies have published guidance and conditions on their use of cooperative agreements.[19] These agreements put additional restrictions on participants, including the need to have data collections approved by the Office of Information and Regulatory Affairs – which is also true of data collections conducted by government scientists [20] - and allow government stakeholders to closely monitor progress and ensure that procedures are being followed.

Challenges in Sharing Research Data

Agencies face a number of challenges in implementing data-sharing policies. They need to work with various stakeholders to ensure there are robust infrastructures to preserve and provide access to data, develop approaches for determining which data are most valuable for preservation and reuse, agree on metadata and data standards to foster discovery and effective reuse, address issues of intellectual property and other legitimate proprietary interests, and establish incentives that promote data sharing among organizations and researchers that may be hesitant to change.

Platforms and Infrastructure

Releasing any sort of data requires not only good publishing platforms, but also a coordinated infrastructure to house the data and make data repositories and libraries interoperable. These infrastructures can be costly to build and maintain, both in terms of money and time, and require continued investment to grow.[21] Government and the private sector will have to work together to provide the necessary infrastructure to preserve research data while making it discoverable and accessible.

Standards and Interoperability

[18] Office of Justice Programs, "Comparing Grants and Cooperative Agreements", National Institute of Justice, June 12, 2014, http://www.nij.gov/funding/Pages/grant-and-cooperative-agreement-comparison.aspx (accessed April 25, 2016).
[19] Cooperative Agreement Conditions. *National Sunlight Foundation.* http://www.nsf.gov/awards/managing/co-op_conditions.jsp. Grants and Cooperative Agreements. *NASA.* https://prod.nais.nasa.gov/pub/pub_library/granta.html. Grant/Cooperative Agreement Forms. *U.S. Department of Energy.* http://science.energy.gov/grants/policy-and-guidance/agreement-forms
[20] Office of Justice Programs.
[21] European Commission, "Communication from the Commission to the European Parliament…", 6.

Scientific data both within specific disciplines and across disciplines is very heterogeneous. If data collections are created without data-sharing in mind, they may be useful only to the small group of scientists who generated them. Extracting the maximum benefit from shared scientific data requires a level of standardization and interoperability that does not yet exist and will be difficult to achieve. [22]

In addition to the core data itself, the metadata that describes it may also need to be standardized and improved. Ensuring quality metadata will be particularly important to make data easy to discover and use effectively.[23] It can be important to know how data was collected and have information about the study protocol to understand the data and determine whether and how they can be reused.

Privacy and Confidentiality

Privacy and confidentiality can be concerns in releasing many kinds of research data, including data in the social sciences, transportation, education, and health. In medical projects in particular, such as the Precision Medicine Initiative, scientists are exploring ways to protect privacy while making the data more accessible for other researchers.[24] An earlier Open Data Roundtable and Briefing Paper explored privacy in the context of detailed open data more broadly.[25]

Intellectual Property

Different kinds of federal research funding include different approaches to intellectual property rights, which can affect data-sharing. In addition, in traditional scientific publishing, researchers may give up their IP rights, include rights to their data, as part of some agreements with publishers. Other kinds of publishing arrangements allow researchers to retain their copyright while granting licenses to publishers.[26]

Other Proprietary Interests

The traditional structure of scientific communications, which relies on publishing completed research reports in peer-reviewed journals, does little to encourage scientists to share their underlying data.[27] Researchers have a strong incentive to hold onto their data so that they can mine it to generate more publications, rather than allowing others to benefit from their work. Some may also be concerned that other researchers may re-examine the data and come up with different results. From a scientific perspective, however, sharing data in a way that allows it to be reexamined can make research results more reliable and reproducible.

---

[22] The High Level Expert Group on Scientific Data, "Riding the Wave: How Europe can gain from the rising tide of scientific data", European Union, October 2010, http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=707 (accessed April 18, 2016), 17.
[23] European Commission, "Commission Recommendation",6.
[24] Precision Medicine Initiative: Privacy and Trust Principles, The White House, November 9, 2015 https://www.whitehouse.gov/sites/default/files/microsites/finalpmiprivacyandtrustprinciples.pdf (accessed May 23, 2016).
[25] Center for Open Data Enterprise, Briefing Paper on Open Data: Protecting Privacy. http://www.opendataenterprise.org/reports/BriefingPaperonOpenDataandPrivacy.pdf
[26] European Commission, "Commission Recommendation", 5.
[27] Eveleth.

Potential Solutions

Scientific Communities

Some major scientific projects over the last several years have begun to put data-sharing principles into practice. Participants in these projects have considered challenges that include intellectual property concerns, lack of robust infrastructure, lack of data standards, and the rights of human subjects.[28] Several projects have now shown that collaboration and leadership can work through these issues and build better outcomes.

The Human Genome Project (HGP) was one of the largest initiatives to demonstrate that data-sharing is not only possible, but vital for the advancement of projects in some scientific communities.[29] The HGP and following efforts generated data that enabled scientists to avoid doing the time-consuming work needed to isolate and sequence the genes relevant to specific diseases.[30] Built on the principle that "the genome belongs to everybody,"[31] the HGP was one of the best examples of a scientific community coming together around a broad information commons to benefit its stakeholders, the private sector, and the public. By addressing enabling successful data-sharing, the HGP "generated $965 billion in economic output between 1988 and 2012, creating more than $293 billion in personal income through wages and benefits, and nearly 4 million jobs."[32]

The HGP showed how researchers in a community can come together to agree on the most valuable data, the appropriate repositories, the timelines for submitting and reusing data, and other issues. Scientists in other areas have undertaken similar efforts, such as the Group on Earth Observations (GEO) and the Sloan Digital Sky Survey (SDSS), which has "created the most detailed three-dimensional maps of the Universe ever made…" The success of the SDSS can be attributed to hundreds of scientists from dozens of institutions collaborating across the globe.[33]

Collaborative Platforms and Data Management

Many government-funded labs and research projects are developing platforms to make data-sharing easier. If built correctly, online infrastructures and data-sharing will allow new levels of collaboration. As a European Union report predicts, "Researchers with widely different backgrounds - from the humanities and social sciences to the physical, biological and engineering sciences – [will be able to] collaborate on the same set of data from different perspectives."[34]

---

[28] See Contreras and Arias, Pham-Kanter, and Campbell
[29] Wikinomics, 164.
[30] Contreras, 78.
[31] Eliot Marshall, "Bermuda Rules: Community Spirit, With Teeth", Science, Vol. 291, Issue 5507, page 1192, http://science.sciencemag.org/content/291/5507/1192.full (accessed April 15, 2016).
[32] SPARC Impact Stories, "From Ideas to Industries: Humane Genome Project", SPARC, http://sparcopen.org/impact-story/human-genome-project (accessed April 15, 2016).
[33] SDSS, "collaboration overview", Sloan Digital Sky Survey, http://www.sdss.org/collaboration/ (accessed May 17, 2016).
[34] The High Level Expert Group on Scientific Data, "Riding the Wave: How Europe can gain from the rising tide of scientific data", European Union, October 2010, http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=707 (accessed April 18, 2016), 8.

Published by The Center for Open Data Enterprise, www.opendataenterprise.org (2016)

There are a growing number of data platforms tailored to specific disciplines. NIH supports more than 60 disciplinary data repositories, including GenBank, dbGaP, the Protein Data Bank, National Database for Autism Research. The NIH also runs a data science "commons" to encourage scientists to work online with the "digital objects of biomedical research". [35]The University of Michigan maintains the Interuniversity Consortium for Political and Social Research (ICPSR) for social sciences data. Other examples include the data platform at CERN and private-sector solutions like Dryad and figshare that can play a part in the broader mosaic of data-sharing infrastructure.[36] Broader solutions are also being investigated around the globe. In 2015 the European Union announced the launch of the European Open Science Cloud dedicated to hosting research data from across disciplines.[37] In the United States the Open Science Data Cloud is being built with similar goals.[38] The National Data Service represents another cross-disciplinary approach.[39]

In addition to publishing data on new platforms, researchers and data stewards are using "data lifecycle management" to maintain the quality of data through all its stages. The European Commission's guidelines note that "These stages should include acquisition, curation, metadata, provenance, persistent identifiers, authorisation, authentication and data integrity."[40] A number of federal agencies, including NOAA and USGS, have sophisticated approaches to data lifecycle management that include scientific data.[41] While effective, data lifecycle management requires commitment, financial resources, and attention to specific data standards, forms of documentations, formats for release, and more.

Flexible Timelines for Data Sharing and Access

While the HGP and similar initiatives are designed to share "broad utility" research data that will be of use to the entire scientific community, different rules may need to apply to different types of data. "Broad utility" data is often most useful when released immediately, while other data may benefit from a slower timeline for release in order to protect the rights and abilities of "data generators" to publish and patent discoveries from their initial research.[42] Participants at a 2009 Data Release Workshop held in Toronto, Canada argued that "funding agencies should require rapid pre-publication data release for" projects with "broad utility", but not necessarily for those that are "hypothesis-driven" and designed to support a specific research objective.[43]

The appropriate timing for data release may depend on the characteristics of the research field itself, such as how long it takes to do relevant research and how quickly the field evolves. Data-sharing agreements may need to allow researchers to fully leverage their data, or even patent their findings,

[35] The NIH Commons. *National Institute of Health.* 30 Dec 2015. https://datascience.nih.gov/commons (accessed May 23, 2016).
[36] Dryrad. *Dryrad.* 7 July 2016. http://datadryad.org and Figshare. *Figshare.* https://figshare.com
[37] "European Open Science Cloud", European Commission, 2015, https://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud (accessed April 15, 2016).
[38] Open Commons Consortium, Open Science Data Cloud. https://www.opensciencedatacloud.org (accessed May 23, 2016).
[39] The National Data Service, http://www.nationaldataservice.org, (accessed May 4, 2016).
[40] European Commission, "Commission Recommendation", 7.
[41] USGS Data Management, *USGS.* 7 June 2016. https://www2.usgs.gov/datamanagement/why-dm/lifecycleoverview.php and Environemental Data Management Committee, *NOAA.* https://nosc.noaa.gov/EDMC/nao_212-15.php
[42] Contreras, 110.
[43] Ibid, 109-110.

before releasing the data; most patent decisions are made before research results are published.[44] Policies and agreements can be written to provide flexible timelines for release of data when that will make greater data-sharing possible.

Incentives for Researchers to Share Data

Funders can and do play a key role in changing the culture to embrace open data. For example, a stated goal of the European Commission's recommendation on access to and preservation of scientific information is an "academic career system [that] supports and rewards researchers who participate in a culture of sharing the results of their research."[45] Funders that are already working to change the culture they operate in, including the NIH, NSF, and the Gates Foundation, have been mentioned previously in this paper.

Major scientific publishers are also providing approaches that could highlight the value of data itself in a way that rewards researchers for publishing it. For example, the journal *Nature's Scientific Data* allows researchers to write up articles about their data sets that can be published and cited apart from any more traditional articles that report on results of the data analysis.

A related approach is to develop new citation systems for datasets themselves, so that researchers who publish their data online will benefit from having their data used and cited. The hope is that "Data citation standards and good practices can...form the basis for increased incentives, recognition, and rewards for scientific data activities that in many cases are currently lacking in all fields of research."[46] That goal will also require universities' tenure and promotion decisions, review procedures for government grants, and other institutional processes to take citations of datasets into account.

Flexible Approaches to Intellectual Property

Copyright laws in the United States do not clearly apply to data itself – just to the fixed forms in which data may be published. It will be helpful to have clearer rules on data ownership, terms of use, and the ability to use and reuse data. Better rules could encourage data sharing while protecting researchers. Flexible licensing systems like Creative Commons may provide a helpful model. Recently, CERN announced the creation of an open data portal that will facilitate access to data created by the Large Hadron Collider and that will use Creative Commons to manage intellectual property concerns.[47]

Under the right circumstances, even commercial businesses working with the government may have incentives to give up rights to data. In the Human Genome Project, "a number of pharmaceutical firms

---

[44] European Commission, "Communication from the Commission to the European Parliament…", 5.
[45] European Commission, "Commission Recommendation", 5.
[46] CODATA, "CODATA-ICSTI Data Citation Standards and Practices", International Council for Science: Committee on Data for Science and Technology, http://www.codata.org/task-groups/data-citation-standards-and-practices (accessed May 4, 2016).
[47] Cian O'Luanaigh, "CERN makes public first data of LHC experiments", CERN, last updated November 20, 2014, http://home.cern/about/updates/2014/11/cern-makes-public-first-data-lhc-experiments, (accessed April 15, 2016).

abandoned their proprietary human genome projects to back open collaborations."[48] These businesses were willing to give up this proprietary advantage largely out of concern that the growing rush to patent pieces of the DNA sequence would lead to higher costs and a slower pace of discovery for everyone.[49] Similarly, some analysts have noted that "public-private partnership models that pool the resources of Big Pharma, philanthropists, government, and nongovernmental organizations [that] currently offer the most hope for neglected diseases."[50] These partnerships can both help advance basic science and solve highly complex issues.

Another example is Intel's program of university partnerships. These partnerships share costs and risks while casting a wide net for ideas, inspiration, and discovery. They are built on rapid and regular sharing. "Rather than wrangle over who gets to control and exploit the fruits of joint research efforts, Intel and its academic partners sign on to Intel's open collaborative research agreement, which grants nonexclusive IP rights to all parties."[51]

Data and Metadata Standards

A number of scientific organizations are developing standards for data and metadata to improve interoperability. GEO is developing standards for earth observation data, for example, and there are efforts to identify "common data elements" for clinical trials. Some efforts at standardization have brought together governments and the private sector.[52] For example, the Research Data Alliance was launched as a collaborative effort by "the European Commission, the United States National Science Foundation and National Institute of Standards and Technology, and the Australian Government's Department of Innovation." It aims to "develop and adopt infrastructure that promotes data-sharing and data-driven research" around these challenges.[53]

International Collaboration

International collaboration presents a challenge, but also a great opportunity for scientific data sharing. Many governments and institutions around the world – including the U.S, Canada, and the European Union -- have begun to promote international data sharing efforts. For instance, the US, EU, and Japan all run versions of GenBank through the International Nucleotide Sequence Database Collaboration.[54] Other examples include a number of organizations focused on Earth science and astrophysics. As governments and global institutions look to work together they will have to tackle differing regulatory regimes, approaches to privacy, and other challenges.

[48] Wikinomics, 163.
[49] Contreras.
[50] Wikinomics, 172.
[51] Ibid, 174-178.
[52] Comet Initiative, *COMET Initiative.* https://www.nlm.nih.gov/cde/ and http://www.comet-initiative.org/
[53] "About RDA", Research Data Alliance, https://rd-alliance.org/about-rda, (accessed May 4, 2016).
[54] GenBank, "International Nucleotide Sequence Database Collaboration", NIH, http://www.ncbi.nlm.nih.gov/genbank/collab/ (accessed May 17, 2016).

International collaboration continues apace. As recently as May 2016, Science and Technology Ministers from G7 countries agreed to establish a working group to share good practice on open science (including data sharing) and to work toward better incentives for data sharing.[55]

Questions for Further Consideration

- As various efforts to create data standards for research data continue, what must be done to avoid building siloes around particular types of data?
- How can we develop incentives for scientists to promote data-sharing?
- What can funders do to change the culture to be more open?
- How do concerns about data security and privacy relate to opening scientific data?

Acknowledgments

The Center for Open Data Enterprise thanks Open Data Partner Microsoft and Open Data Supporter Booz Allen Hamilton for supporting the Center's work on the Open Data Roundtables and this Briefing Paper. The lead researcher and author for this paper is Matthew Rumsey, Research Fellow at the Center for Open Data Enterprise. The Center is an independent nonprofit 501(c)3 organization, based in Washington, DC, whose mission is to maximize the value of open data as a public resource.

Copyright Statement

Suggestions for Further Reading

John P. Holdren, Memorandum: Increasing Access to the Results of Federally Funded Scientific Research, February 22, 2013
https://www.whitehouse.gov/sites/default/files/microsites/ostp/ostp_public_access_memo_2013.pdf

The High Level Expert Group on Scientific Data, Riding the Wave: How Europe can gain from the rising tide of scientific data, European Union, October 2010
http://ec.europa.eu/information_society/newsroom/cf/document.cfm?action=display&doc_id=707

NASA Plan for Increasing Access to the Results of Scientific Research (Digital Scientific Data and Peer-Reviewed Publications), November 21, 2014
http://science.nasa.gov/media/medialibrary/2014/12/05/NASA_Plan_for_increasing_access_to_results_of_federally_funded_research.pdf

[55] Tsukuba Communique, *Cabinet Office*. http://www8.cao.go.jp/cstp/english/others/communique_en.html (accessed May 23, 2016)

Bill & Melinda Gates Open Access Policy
http://www.gatesfoundation.org/How-We-Work/General-Information/Open-Access-Policy

NIH Public Access Policy Details, NIH
https://publicaccess.nih.gov/policy.htm

Out of Cite Out of Mind: The Current State of Practice, Policy, and Technology for the Citation of Data
https://www.jstage.jst.go.jp/article/dsj/12/0/12_OSOM13-043/_article

Making Open Science a Reality: OECD Science, Technology and Industry Policy Papers
http://www.oecd-ilibrary.org/science-and-technology/making-open-science-a-reality_5jrs2f963zs1-en

Published by The Center for Open Data Enterprise, www.opendataenterprise.org (2016)