GRECO

PRACTICAL GUIDE ON OPEN SCIENCE

for researchers

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2020

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Summary

For two years, the project GRECO has conducted a survey to analyse the opinions, concerns and experiences of researchers in the field of engineering and photovoltaic (PV) energy about Open Science (OS). We gathered 106 responses, analysed them and came up with 39 Frequently Asked Questions about Open Science. The experience of researchers from the PV field is useful for other fields too. This **Practical Guide for Researchers** in general therefore tries to solve the most prevalent doubts, concerns and fears. It starts with a checklist for OS that researchers may consider in various phases of their investigation.

Then, the reader will find a Q&A section, organised into nine categories: 1) where to start, 2) Open Data, 3) Open Access, 4) open to society, 5) other open practices, 6) property, 7) resources, 8) politics and 9) metrics and incentives. There are 3 to 5 questions for each category, and the responses come from subject matter experts and other researchers who have tried and applied OS in its different forms. The end of this guide features two additional sections: one with the benefits expressed by the researchers in our survey and another about the gender perspective. Following OS values, this guide went through an open peer review process and is openly available.

Glossary / Abbreviations

APC – Article Processing Charge
CS – Citizen Science
DCAT – Data Catalogue Vocabulary
EC – European Commission
FAIR – Findable, Accessible, Interoperable and Reusable
JIF – Journal Impact Factor
NASEM – National Academies of Science, Engineering and Medicine
OA – Open Access
OD – Open Data
OS – Open Science
R&D – Research & Development
RRI – Responsible Research and Innovation

The Universal declaration of Human Rights states:

“Everyone has the right to freely participate in the cultural life of the community, to enjoy the arts and to share in scientific advancements and its benefits.”

Lea Shaver

The Right to Science and Culture (2009)

First things first: an introduction

Open Science is gaining momentum. More and more, funding agencies and research organisations demand concrete actions for researchers to implement in their daily work and their projects. Although not many people would doubt the benefits and opportunities of this new way of doing science, researchers face many concerns, doubts and a lack of knowledge to cope with the demands [1]. The EU-funded project GRECO is a pilot that tries to apply Open Science (in all its levels) to photovoltaic research. In this adventure, the project has gathered useful insights on how to tackle the demands, solve the questions and ease the concerns (or not) of researchers.

This guide is a way to share this practice-based knowledge and to encourage critical thinking. More broadly, it aims to foster Open Science practices all around the world.

Although this guide targets mainly researchers, we want to stress that moving towards Open Science requires action at several levels: It cannot rest entirely on the researchers' shoulders. There needs to be incentives to fully implement all forms of OS. The institutions, the funding agencies and the decision makers should promote and design different evaluation and reward systems.

> **"Science is like a parachute.**
> **If it doesn't open, it doesn't work"**
>
> Eva Méndez, Chair of the European Open Science Policy Platform

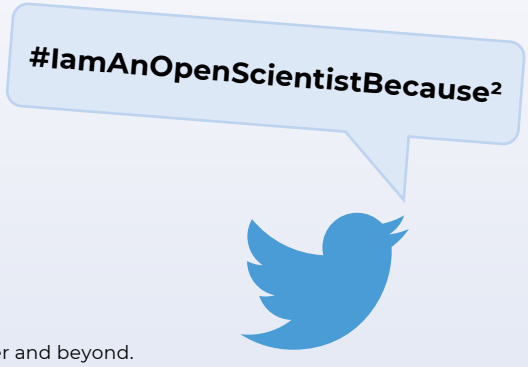
This guide has four sections:

1 CHECKLIST FOR OPEN SCIENCE
A list of concrete statements to consider and implement

2 FREQUENTLY ASKED QUESTIONS (FAQs)
Frequent questions by researchers and the corresponding answers from subject matter experts and other investigators who have applied OS one way or another

3 BENEFITS
Benefits for OS as expressed by the researchers in our survey

4 GENDER AND OPEN SCIENCE
The gender perspective on OS practices, by Giuliana Rubbia, vice president of the Italian Association Women and Science and member of the GRECO Social Advisory Board



1 Allen C & Mehler DMA (2019) Open science challenges, benefits and tips in early career and beyond. PLOS Biology 17(12): e3000587

2 Twitter - By **Pixel perfect © Flaticon** | **CC-BY-4.0**

Table of Contents

Download this checklist, share it with collegues and have it next to your desk[3].

CHECKLIST

This checklist quickly goes through the different aspects of Open Science (OS) and gives you hints on how to implement it

WHERE TO START

- ☐ Read and watch videos about Open Science (OS) → **OECD-iLibrary** and → **YouTube**
- ☐ Check the → **rainbow** of OS practices
- ☐ Find → **examples of OS projects** made in your field to get inspiration
- ☐ Take part in short courses → **Here** and → **Here**

OPEN DATA

- ☐ Make your data clear and comprehensible, following the FAIR principles and provide clear metadata
- ☐ Use open notebooks whenever possible
- ☐ Open your data early enough: before even having the full results, you can use collaborative platforms such as GitHub for developing code to process your data
- ☐ Upload your data to an open repository (specific to your field or generalist)

Remember: make your data as open as possible and as closed as necessary!

OPEN ACCESS

- ☐ Contact the librarians at your institution or from a public organization for support
- ☐ Find out the publishing conditions from your funder
- ☐ Check the → **Directory of Open Access Journals** and → **SHERPA/RoMEO** databases to identify the best publishing alternatives and the archiving policies
- ☐ Discuss the best route to openness: either Green (is there an embargo period?) or Gold (is there an extra payment, also called APC?)

OPEN TO SOCIETY

- ☐ Get in touch with the communication department of your institution, or with national or regional councils for scientific culture
- ☐ Map the stakeholders involved in your project and plan communication actions for them so they can contribute and improve your work
- ☐ If possible, find a way of involving society in your research process: defining research questions, collecting data, helping with the analysis and more!

PROPERTY

- ☐ Specify the licence of your scientific products When possible, use a Creative Commons Licence so other authors can reuse and share your work
- ☐ Check for property rights of other products you may use in your work (images, data, graphs, etc.) and be sure to use them properly and to attribute them

RESOURCES

- ☐ Make Open Science a new habit in your work!
- ☐ Find support in the administrative departments of your institution, your region or your country There are lots!

POLITICS

- ☐ Get involved in the decision-making of your institution and support frameworks that create an environment conducive to Open Science
- ☐ Discover which funding programmes incorporate and assess Open Science practices positively

METRICS & INCENTIVES

- ☐ Follow the new proposals for career assessment, as in the Open Science Policy Platform and → **Altmetrics**
- ☐ Be open to the new publishing trends and reconsider how you determine what research impact is!

3 "Checklist - by tezar tantular" © → **The Noun Project | CC-BY-4.0**

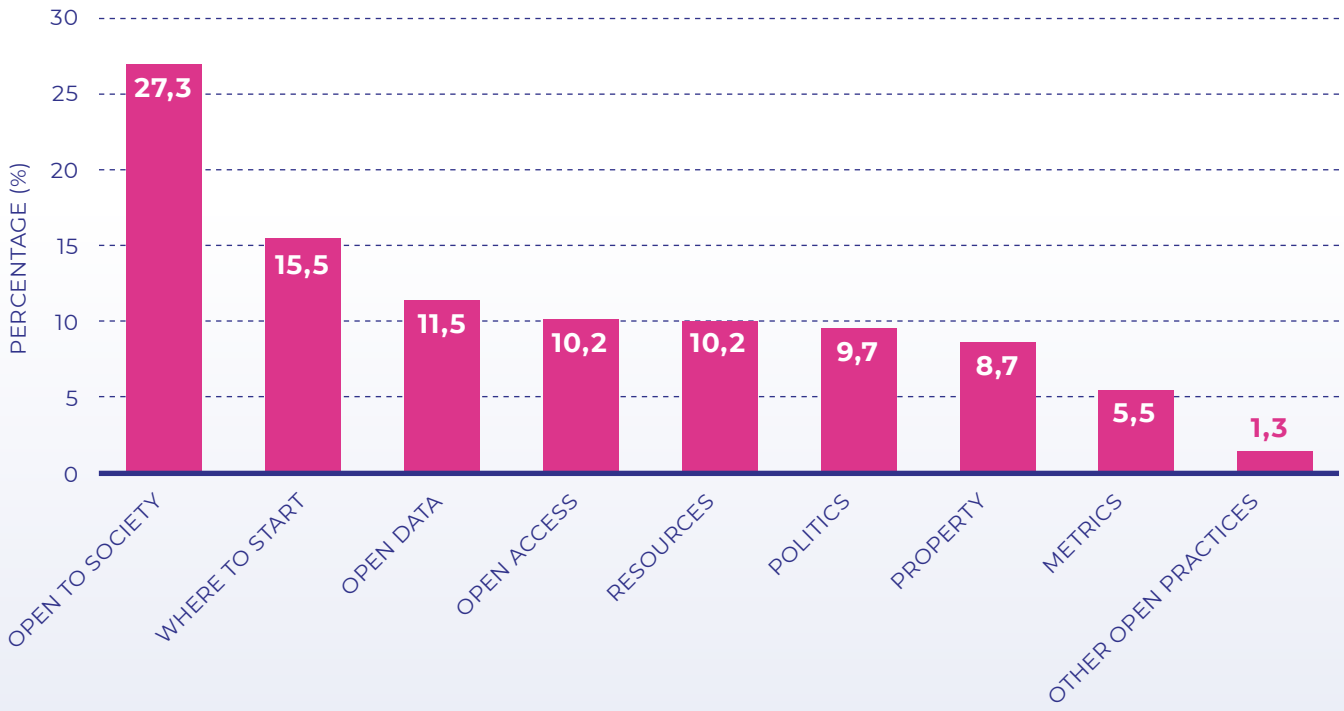
FAQs

This guide features **39 questions frequently asked (FAQs) by researchers** in regard to Open Science (OS). For two years, the project GRECO surveyed researchers from various countries, mainly in the field of engineering and photovoltaic (PV) energy. This is outstanding as this area of knowledge is hardly represented in the OS movement yet. It includes issues that are highly relevant to other fields. Our survey was based on the methodology "Six Thinking Hats", by the psychologist Edward de Bono. We collected 106 responses in which researchers shared their thoughts, concerns, perceptions, etc., in relation to OS. The data from the surveys was analysed using the qualitative analysis software, Atlas.ti.

Nine categories were defined to structure the answers. The graph below represents the number of comments researchers made in relation to each category. Almost 65% of all responses lie in four categories: Open to Society, Where to start?, Open Data and Open Access. And as the graph clearly shows, most comments relate to the category "Open to society".

To understand this result, it is important to highlight the context in which these surveys were taken: they mostly coincided with a course on Responsible Research and Innovation. As part of this course, there is a strong focus on public engagement. Therefore, most of the researchers taking the survey where aware that "opening to the world" is also part of OS.

Percentage distribution of the researchers' responses in the nine categories of the guide, according to our qualitative analysis.



Moreover, although other categories of Open Science are quite familiar to researchers, as they clearly relate to typical tasks (collecting data, referencing, publishing, etc.), the category "Open to Society" faces a lot of criticism and concern. Many researchers think that public engagement and science communication is not part of their job. In another study, Llorente et al., (2019) show that some researchers consider that the task of communicating science outside academia lies in the hands of specialised communication staff and journalists.

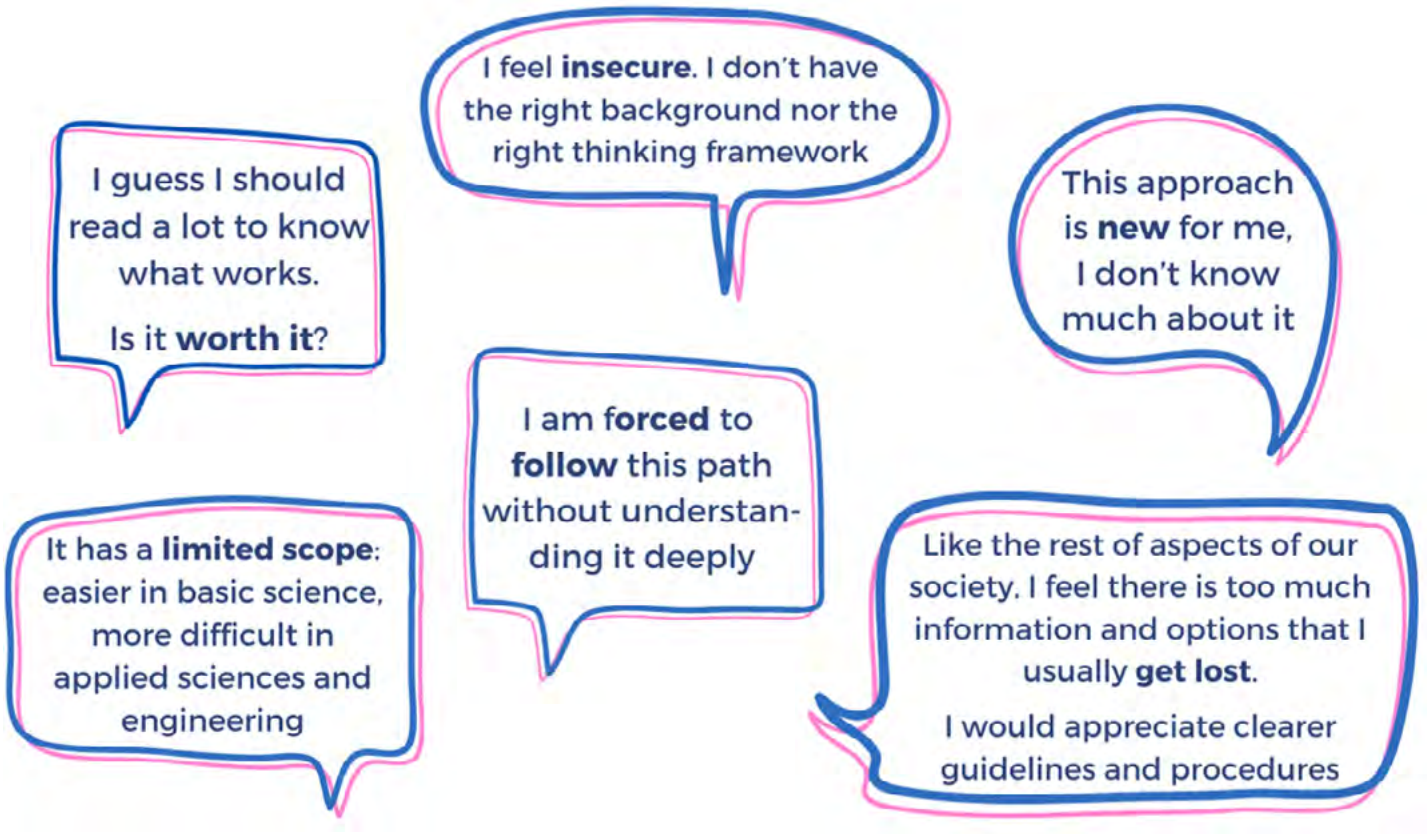
This translates into survey responses that were more concrete, but also less reflective and less drawn to researchers' daily practice. For instance: "If the end user is part of the decision making, there is a high possibility of acceptance". Although positive, this statement does not imply action or engagement by the researcher. Other comments express concerns like "I might feel controlled" or are very critical, "Do I really want citizens to intervene?"

Therefore, we highlight the need **to encourage science communication skills** and purpose in early career researchers. As one of the respondents stressed: "I feel excited to apply a novel methodology that could engage society and be a good example for other researchers."

The six thinking hats

The six thinking hats is a tool to structure thinking from different perspectives. We used it to gather information from researchers in relation to Open Science.
(Illustration: © ESCI)

4 Llorente C, Revuelta G, Carrió M, Porta M (2019) Scientists' opinions and attitudes towards citizens' understanding of science and their role in public engagement activities. PLoS ONE 14(11): e0224262. https://doi.org/10.1371/journal.pone.0224262



WHERE TO START?

01 Where can I find more information about Open Science?

02 Are there different levels to implement Open Science?

03 Where can I find examples of projects that have applied Open Science? Are there any specifically of my field?

04 Are there networks to discuss Open Science?

05 Does the definition of Open Science include Public Participation?

Responses by:
Luisa Barbosa and Elisa Albiñana

01

Where can I find more information about Open Science?

There are different places where you can get informed and stay up to date about Open Science.

→ **HERE** you can find news and events from the **European Commission.** For example, two recently published reports show how putting the FAIR data model into practice could save much expense, making several recommendations to implement it.

The → **EU Open Science Policy Platform** is the group that advises the European Commission about how to develop a policy for OS. Recently, they've published their → **Final Report** about their work during the last four years. There, they analyse the path taken after the publication of the OSPP-recommendations to confront the eight Challenges on Open Science. In the report, the OSSP also includes Practical Commitments for implementation made by different stakeholders and establishes the next move: to create a Shared Research Knowledge System by 2030, which would foster OS and all the practices that contribute to sharing and reusing reliable knowledge. You can follow on → **Twitter!**

The Organisation for Economic Co-operation and Development (OECD) published a report In 2015 called → **"Making Open Science a Reality"** where they reviewed the progress of many countries in applying Open Access and Open Data to publicly funded research. Also, the book "Open Science by Design: Realising a Vision for 21st Century Research" by the US National Academies of Sciences, Engineering, and Medicine, contains a → **chapter with OS design strategies** and the US legal framework.

The → **European Open Science Cloud** is a digital platform by the EC that federates existing data infrastructures for the storage, management, analysis and reuse of data. Together with → **OpenAire,** they provide technical infrastructure to harvest research outputs. → **Here** you can find lots of info about Open Data management.

Finally, → **here** you'll find a toolkit for Public Engagement, and many other tools to learn about and implement Responsible Research and Innovation (RRI).

02

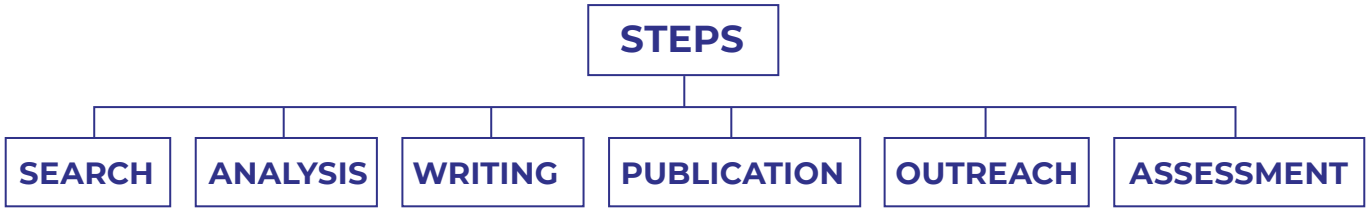
Are there different levels for implementing OS?

Of course! You can approach Open Science by lots of different routes and start by implementing one or more actions. There is no need (and possibly no resources) to do it all at once.

The 101 Innovations project came up with what's called the → **"Rainbow of OS Practices"** [5], where they present the different levels for OS, describing examples and the corresponding tools for each one. Rainbow refers to the combinations of the practices that, all together, make Open Science.

The six different levels match the steps that compose a research process. You can apply OS in all of them:

5 Kramer, Bianca, & Bosman, Jeroen. (2018, January). Rainbow of open science practices. Zenodo. **http://doi.org/10.5281/zenodo.1147025**



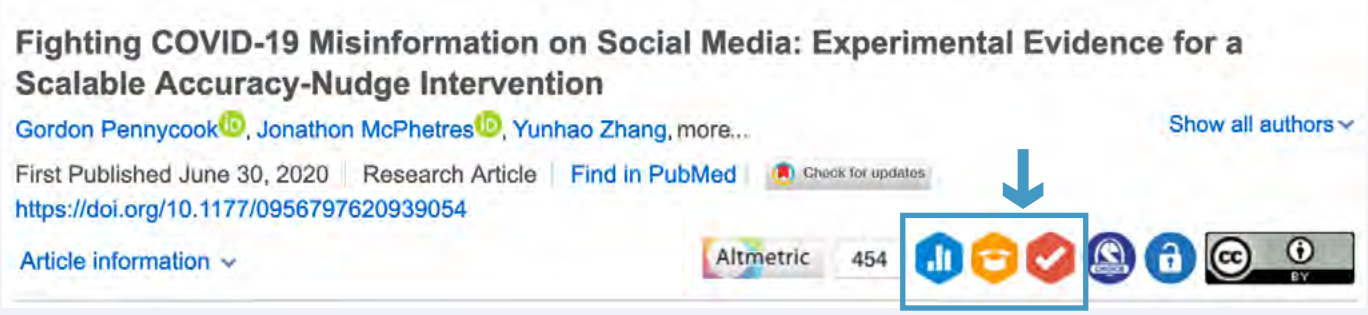
As an example, you can start your bibliography search by using shared reference libraries, such as Zotero. After that, you can open your research data with Dryad and open metadata, like the Extensible Markup Language (XML) with Overleaf. When creating images, presentations or posters, you can use an open licence, like CC – BY; when publishing, use Open Access journals and repositories. You can also disseminate your results with the public via social media or talks.

Note: In this rainbow, the level of outreach is represented as "communicating through social media". However, the interaction with society can be much wider. A whole area of Open Science is called Citizen Science, which aims to involve society in the research process (see more in the chapter "Open to Society" p.27).

03

Where can I find examples of projects that have applied Open Science? Are there any specifically from my field?

There are platforms like the **→ Center for Open Science (COS)** whose goal is to help researchers and projects to implement Open Science correctly. COS has a free and open platform called **→ Open Science Framework,** a management tool that helps you collaborate with other projects and integrate different tools, so you can keep track of every file created in your project and its open/closed state. COS has established a partnership with 68 journals[6] to use **→ OS badges,** icons to indicate that the content of a paper is available and certify its accessibility in a persistent location.



Example of science badges used in a publication of SAGE journals. The blue arrow and rectangle indicate the badges.

6 Current numbers in July 2020

You may search for OS badges in journals of interest to you in order to identify projects or institutions in your field that have implemented OS. Moreover, COS curates in Zotero a **→ library of papers** with OS badges, which is freely available.

On the other hand, the website **→ openscience.eu** was very recently launched as a platform to discover projects, initiatives and groups that implement Open Science. This website was created by **→ OpenScience4OpenSocieties,** a non-profit organisation formed by scientists, research managers and media experts whose goal is to facilitate OS.

04

Are there networks to discuss Open Science?

→ FOSTER is an e-learning platform about Open Science practices. Many training resources are available on it. On some courses, you can debate with other colleagues, or contact the organisers if you have a concrete question. FOSTER provides an **→ OS toolkit,** containing ten online courses; and an **→ OS training handbook.** The Centre for Open Science also provides **→ training services.**

They offer workshops with virtual conferences and document sharing tools, so you can learn and ask about implementing OS.

Finally, OpenAire is a European Open Access network that offers **→ training** and solves key questions to find journals and suitable repositories. You can find their **→ calendar of events** and get in touch to **→ solve questions.**

05

Does the definition of Open Science include public participation?

Yes, Open Science includes public participation. If you want to fully implement OS, you have to engage with people outside academia, even though sometimes it's considered as beyond the scope of the research profession (see FAQs, p.10). In fact, the European Directorate for Research and Innovation presented in 2016 the institutional vision of "Open Innovation, Open Science, Open to the World" [7] stressing that Open Science involves engaging with non-institutional participants, in other words: the general public.

The strand of OS that relates to the public is called Citizen Science. Its aim is to actively involve citizens and the different sectors of society (industry, government) in research, therefore co-creating science. This provides a great number of benefits, for example, helping science be more trustworthy, or making science useful and more directed to societal needs.

Funding frameworks are also changing to encourage scientists to engage in Citizen Science. The European Union (EU) research programme, Horizon Europe, one of the largest sources of

7 European Commission (2016). Open Innovation, Open Science, Open to the World. A Vision for Europe. Directorate General for Research and Innovation. doi: 10.2777/061652.

research funding on the planet, now promotes a more general conception of OS[8], which goes far beyond Open Access and Data: It means *"sharing knowledge and data as early as possible in the research process [and engaging] in open collaboration with all relevant knowledge actors"*[9].

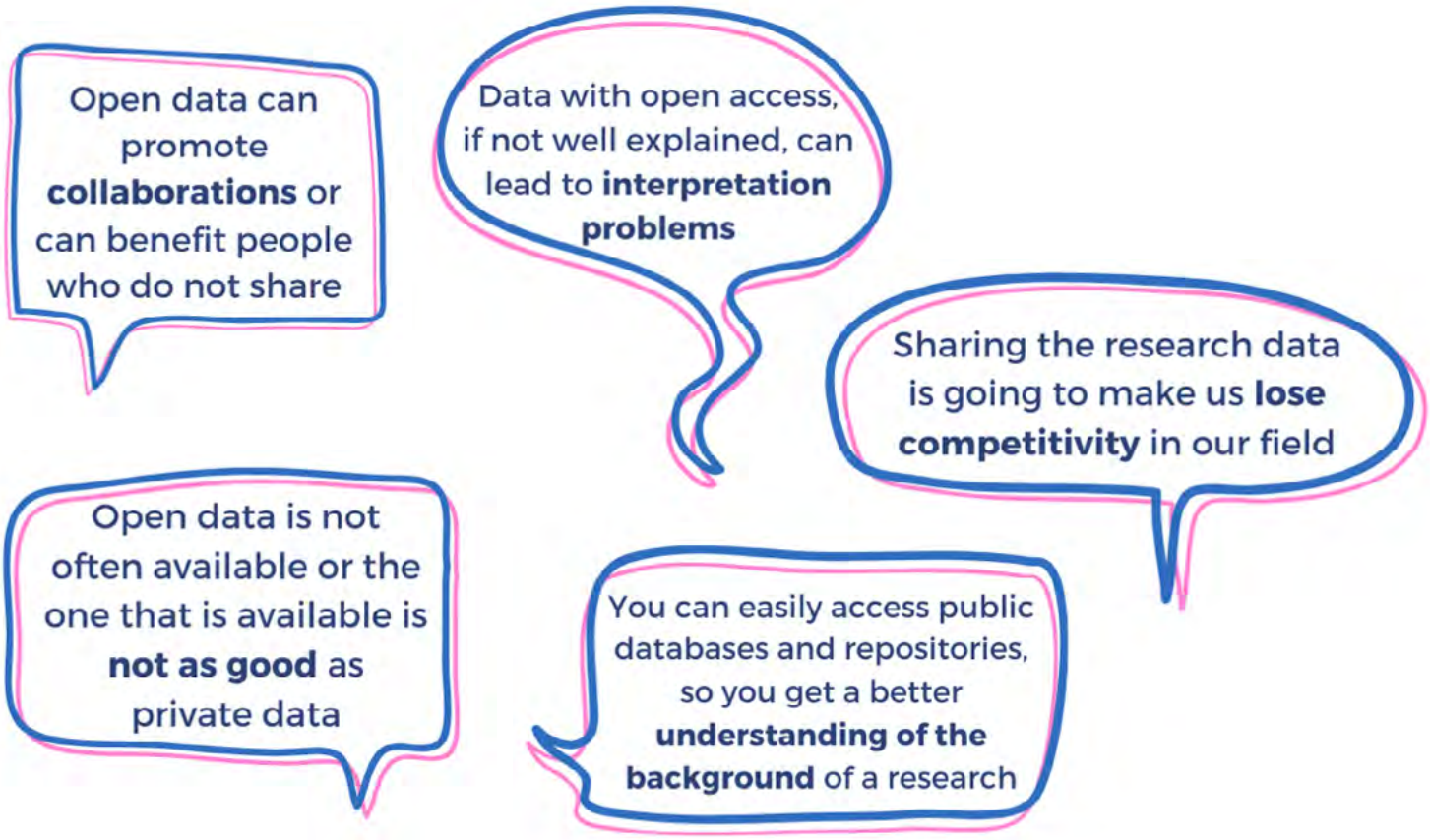
In this → **report** you can read the eight ambitions of OS as defined by the EU, which includes education and Citizen Science. So, indeed, Open Science is also about communicating and sharing your research with the public and involving them in the process.

As an example, → **OpenAIRE** ran a project that involved schools (targeting a network of 10,000 schools in Europe) to connect students with scientific data from ongoing EU-publicly funded projects. Their aim was to find out how to engage at the local and national levels to support a culture of openness around data.

If you want to know more about public participation in science, check the chapter "Open to Society".

8 Burgelman, J.C., Pascu, C., Szkuta, K., Von Schomberg, R., Karalopoulos, A., Repanas, K. and Schouppe, M., 2019. Open science, Open Data and open scholarship: European policies to make science fit for the 21st century. Frontiers in Big Data, 2, p.43.

9 Von Schomberg, R. (2019). "Why responsible innovation?" in *International Handbook on Responsible Innovation A Global Resource,* eds R. Von Schomberg and J. Hankins (Cheltenham: Edward Elgar Publishing), 12–32.



OPEN DATA

Responses by:
Oscar Corcho, Sabine Haas, Pilar Rico-Castro and Ludwig Hülk

06

How to ensure the data shared is well interpreted and useful?

The data that is opened needs to be sufficiently well described so it is easily interpreted and hence more useful for potential data re-users. If you want someone else to use the data, it should always be well documented – whether it is open or closed.

Metadata can help as it provides additional information. It should include aspects that go from the description and units of the parameters, to sources and copyright information. There are many existing metadata standards and schemes in different formats. Some offer a broad framework for general purposes while others provide a distinct set for specific domains. For the former, examples are the **→ Data Catalog Vocabulary (DCAT), → Dublin Core,** and **→ Frictionless Data Package.** Metadata is usually categorized in three types: descriptive meta-data, structural metadata, and administrative metadata. It contains information such as title, author, descriptions, resolutions, information on format and structure, license and much more. A good example of a domain specific adaptation of metadata is the community development of the **→ Open Energy Metadata** for energy and climate related data sets.

This information ensures findability, accessibility, interoperability and the reuse of your data (FAIR principles). It's useful to create an ontology (a set of concepts and categories in a subject area that shows their properties and the relations between them) to find a common way of expressing things which then helps to ensure the correct understanding of metadata and data.

07

Is there still privacy for confidential data?

Yes, of course! **→ OpenAIRE** has developed a data anonymisation tool called Amnesia. It allows identifying information to be removed from data. Amnesia not only removes direct identifiers like names, Social Security Numbers, etc. but it also transforms secondary identifiers like birth dates and postcodes so that individuals cannot be recognised in the data. Here you can find a **→ guide** on how to deal with sensitive data according to OS principles.

08

Isn't "closed" data of better quality than open?

Not necessarily. Quality isn't so much about whether data is open or closed, but rather about the processes of data acquisition, curation and preservation. These are independent of the final decision on how to make data available (or not). Actually, there are different standards and quality criteria for Open Data (OD) that the community of OD researchers have established. For instance, there is a list of legal, practical, technical and social requirements for a dataset to be of high quality (therefore, usable).

In the **→ European Data Portal** you can find Open Data Certificates developed by the Open Data Institute. The certificates work as a self-assessment questionnaire for publishers, and in some cases users, to assess the usability of a dataset according to the requirements.

09

When shall I open my data?

In Open Science, the general principle needs to be that data should be as open as possible, and as closed as necessary. If possible, you should make your data open since it is acquired and you shouldn't wait until the results of your experiments are published.

Of course, embargo periods may be applicable for some specific types of data sources.

10

How can I put the FAIR principles into practice? Is it difficult?

The → FAIR principles are: **F**indable, **A**ccessible, **I**nteroperable and **R**eusable! FAIR is not difficult. It is important to follow simple guidelines for the description and publication of your data or services, which may be adapted to your specific area of research: with specific repositories for sharing your data sources, with specific metadata items to be used, with specific ontology repositories to find ontologies, etc. (see also question 6).

11

How will archiving data benefit me as a researcher?

First of all, having a good archival and preservation strategy will ensure you will never lose that data for which spent so much time to capture and curate. Besides, you will normally obtain a Digital Object Identifier as a result of the archival process (so you will be able to refer to and cite your dataset).

Working across 5 European countries, the → **Knowledge Exchange** studied current and future incentives for sharing research data from the researchers' point of view. In 2014, they published the report, → **„Incentives and motivations for sharing research data, a researcher's perspective".** The report stresses that data sharing actually keeps your research safe and secure, increases your research efficiency and improves its integrity, makes your outputs more visible and encourages collaboration. Check out this → **summary** (see section "Benefits").

10 **https://www.europeandataportal.eu/elearning/en/#/id/co-01**
Icon "Study – By Laymik" © → **The Noun Project** | **CC-BY-4.0**

OPEN ACCESS

Responses by:
Pilar Rico, Teresa Malo de Molina, Ana B. Cristóbal, Eva Méndez, Clara Armengou and Ilaria Fava

12

Are there different levels of open publications? Can I choose which one to use?

There are two main and non-mutually exclusive routes to Open Access:

'Green' Open Access (also called self-archiving):

- ✓ The authors archive (self-archiving or by a third person) in an open repository the final version of the article, the final manuscript peer reviewed or a pre-print which is not yet peer reviewed. The version deposited depends on the funder or the publisher.
- ✓ It can be deposited before, during or after the publication. Usually it is archived after an embargo period set by the publishers who review and publish the article in journals.
- ✓ Usually the commercial publisher's version is immediately available upon payment, during the embargo period, through subscriptions or fees for view / downloads.
- ✓ Both versions have the same content (peer reviewed) but may have a different format.
- ✓ This model is promoted by most of the Open Access community formed by researchers and librarians.
- ✓ The problem is that it usually doesn't imply an important impact in the scientific evaluation system, or to the researcher's career.

'Gold' Open Access (also known as Open Access publishing):

- ✓ The publication is immediately made available in Open Access by the scientific publisher. Research articles are accessible permanently from the time they are published.
- ✓ The publication costs are covered by the authors or by their institution; the authors may or may not retain the copyright of their work, depending on the publishers' agreements. These costs are called article processing charge, or APC.
- ✓ In some pay-walled journals, called **Hybrid Journals,** subscriptions and publications offer Open Access to certain articles. This has been adopted by some important scientific publishers by imposing the APC payment.
- ✓ So, in the Gold route, articles can be published either in a fully OA journal (where all the content is accessible) or a hybrid journal (accessible by subscription, but with certain articles open).

However, when the research has been financed by a R&D funding agency, the OA mandate will be properly set in the funding conditions. For example, the Horizon 2020 Framework Programme establishes that all beneficiaries must deposit a machine-readable electronic copy of the publication in a repository and ensure Open Access to the deposited publication. Therefore, they have to follow the green route and archive an OA version of their published work in an institutional or thematic repository – no matter if it had been published in an open-access journal or in a subscription access journal. [11]

11 Comisión Europea (2017) H2020 Programme Guidelines to the Rules on Open Access to Scientific Publications and Open Access to Research Data in Horizon 2020.
http://ec.europa.eu/research/participants/data/ref/h2020/grants_manual/hi/oa_pilot/h2020-hi-oa-pilot-guide_en.pdf

13

What is an embargo period? Is it the same for publishers and funders?

The embargo period is the time that authors are requested to cede their copyrights in favour of the publisher. It runs from the formal publication of the article until its Open Access publication (meanwhile authors can't put it in an OA repository). Publishers have the exclusivity of reproduction, distribution, communications and transformation of the article. By this they want to protect subscriptions or purchases, and it can run from 6 months to a couple of years. Each publisher or journal has its own policy on this.

The concept is the same for publishers and funders. However, embargo periods imposed by publishers on authors may be longer than embargo periods allowed by funders. With the hybrid model of OA, authors pay the corresponding APCs to the journals to make OA possible for some of the articles. By this, the author complies with both the funders and publishers. However, publishing in hybrid journals tends to be very costly for researchers. Financial considerations make it advisable to consult, with the administrator of the repository, the different options for offering Open Access to a paper within the embargo period allowed by funders before opting for a hybrid journal.

The different institutions or funding research agencies that demand Open Access publications of the research performed with public funds, allow short embargo periods. In Horizon 2020, the embargo period is 6 months, but it can be extended to one year in the case of social science and humanities. Other national laws establish a maximum of 1 year for an embargo period.

14

Where can I find out about journals' Open Access policies?

Open Access policies can vary from one publisher to another, but also within the same publisher in different journals. To find out about a journal's or publisher's OA policy and related issues, you can consult the national databases and also the international one: → **Sherpa Romeo.** If you have any questions or comments, you can contact them via an → **online form** or email, → **help@jisc.ac.uk.** In some countries you will also find national databases.

Sherpa Romeo uses a set of properties to classify publishers' policies, some of them listed below:

OA Fee Requires the payment of a fee (in addition to any normal publication fees that may be required) to make the article Open Access.

Embargo Does not allow availability of the document until the embargo period has ended.

Publisher Deposit The repositories in which the journal publisher will automatically deposit the article version.

Location The websites on which the pathway allows the article version to be available. This includes self-archiving and publisher-deposit locations, including the website of the journal.

Depending on the publisher and the journal, these properties combine in a pathway towards Open Access. For instance, some journals allow you to publish the preprint version (which is not peer reviewed) with open status somewhere else, others allow publishing the post print version openly (which is already peer reviewed but not in the journal layout) and others allow the open publication of the publisher's PDF version to be made available somewhere else.

The Directory of Open Access Journals, **→ DOAJ,** is a widespread source of information about OA journals, and **→ "Think. Check. Submit"** is a useful tool if you need guidance on how to identify the best journal for your needs.

These databases help you judge which journals are in line with your funder's or institution's requirements and your academic goals. They also help you to easily identify a fully OA journal from a hybrid.

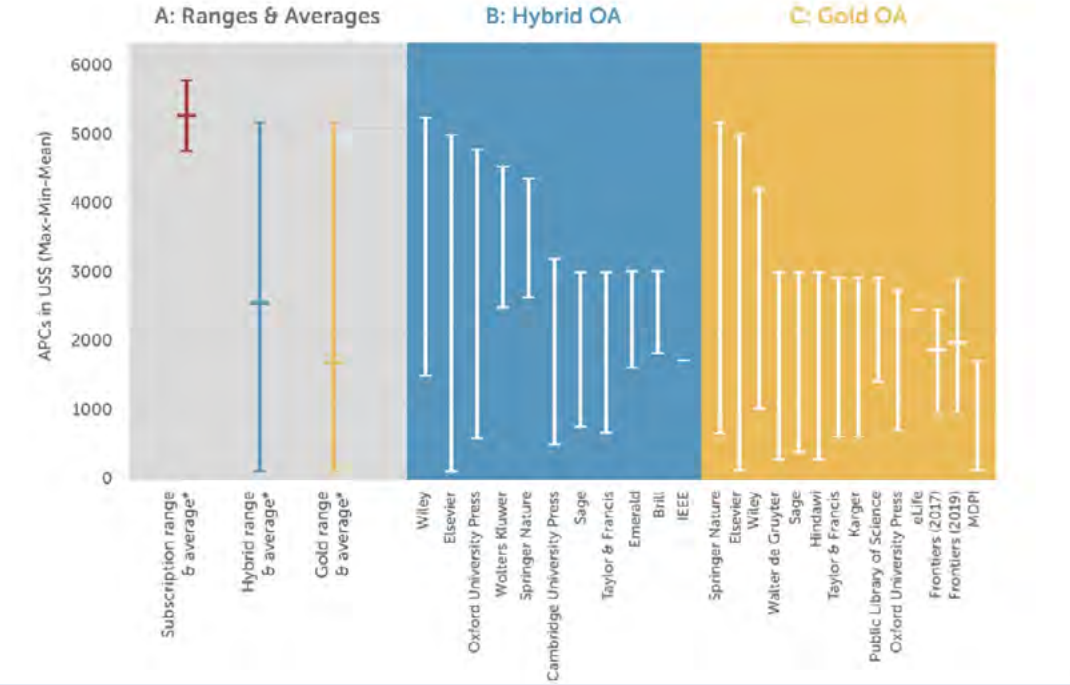
15

How much does Open Access cost and where can I get funds to publish in Open Access?

Open Access is free for the researcher if you use the Green Open Access (self-archiving), as you publish your articles in repositories (see question 18). However, institutional repositories do have a cost for the institution.

Researchers usually need to publish in pay-walled journals that are recognised within their scientific field. The route called Gold Open Access means these journals publish openly. It doesn't necessarily imply that you'll have to pay for opening your paper, but journals may apply an **Article Processing Charge (APC)** depending on the publisher's policy.

Nowadays, the publishing pathway of some renowned scientific journals requires the payment of an APC (by the researcher or the funding agency), which normally varies from **$1,000 to $1,200** (but can vary from under $100 to over $5000). This depends mostly on the impact factor of the journal (IFJ), the knowledge discipline and the number of pages of the article.



APCs charged by some publishers in 2016.
Source: https://blog.frontiersin.org/2017/12/08/frontiers-apcs-structure-and-rationale-2/

The APC is additional to the subscription payment. In order to avoid this extra charge, institutions and funding agencies are trying to negotiate the payment model with the publishers, because they pay both for reading and for publishing. This model is called → **Read & Publish.** Some transition agreements are being negotiated in order to encourage important scientific publishers to use this model. It will hopefully be implemented in the coming years.

Most funding agencies consider APCs as eligible direct costs. Generally, if the funder requires you to open publications or data, the charges will be included in your project financing. The problem is when your financing is low, meaning it may cover all the costs. Sometimes, institutions cover the fees of one OA article per year, under certain conditions. With the → **OpenAPC initiative,** you can check the information on fees paid for Open Access publishing. The dataset is built voluntarily by universities and other higher education institutions, funders or national consortia and it is published on GitHub under an Open Database licence.

Example from the energy field

"In the area of energy and physics, Green OA tends to be allowed freely without an embargo period. The only consideration is that several publishers' policies only accept Green OA without an embargo period when using repositories like arXiv or REPEC (they are thematic, so your manuscript may be rejected). Another problem may arise if your funder sets a maximum embargo period and a specific repository. This embargo period may not correspond to the one your publisher established; or the repository may not follow the requests from the publisher. For that reason, you'll have to follow the gold route, where you'll probably have to pay the extra charges (APCs)."

Ana Belén Cristóbal

We highly recommend taking a look at the quick guide → **"Managing your Open Access costs"** that takes less than 5 minutes to read.

16

Does Open Access also imply peer review? Does Open Access mean more critique of my publications?

Of course, OA implies peer review! Publications are not of a lower quality since they go through the same peer review process as other publications. Open Access does not mean more critique of any publication, but researchers get great benefits from it. Authors gain visibility for their research output and thus the dissemination and usage of their results increases. Open Access leads to more impact, international collaboration and opportunities for new funding sources. It also allows researchers to save time in seeking articles they cannot access through their libraries.

12 Ross-Hellauer T. (2017) "What is open peer review? A systematic review" [version 2; referees: 4 approved]. F1000Research 2017, 6:588 https://doi.org/10.12688/f1000research.11369.2

17

Is there any way to comply with funders' requirements and journal policies while not paying to open my paper?

Yes! Many funders' OA requirements are based on Green Open Access, like Horizon 2020. The obligation to archive an OA version of the published work in an institutional or thematic repository is free of charge if authors do not give up their copyright in favour of the publisher for a longer period than the funders allow.[13]

You can find out whether a specific journal complies with a funder's OA policy, and what action needs to be taken, by using the Funders and Authors Compliance Tool, → **Sherpa Fact.**

It is important to double-check the policies on the publisher's website, particularly the Green OA requirements (mandatory disclaimers or CCL). Some repositories such as arXiv and most of the institutional repositories are curated by librarians who ensure you meet the journal policies. But there are others like ZENODO where there's no curation process, so you should make sure you're doing it right.

We highly recommend taking a look at the quick guide → **"Complying with Open Access policies"** that take less than 5 minutes to read.

18

What are repositories and how can they be used? Which one should I select?

The **repositories** are storage spaces with open files (data or publications). Repositories should maintain interoperability protocols where you can publish open documents next to their metadata, which must be sufficiently clear for identifying, locating and preserving the data. The metadata and the access protocols follow international standards. The most common access protocol is the → **OAI PMH,** which allows the interoperability of every repository that follows it, so that you can collect and exchange the metadata of the documents included in them.

The repositories can be **domain specific, generalist or institutional** (which collect the publications and data of one particular institution). To choose the right one for you, speak first to your institutional librarian, funder or colleagues. You may also search in → **FAIRsharing** and → **re3data.org** as these two databases provide a list of certified data repositories. Finally, you can check out this → **Nature article** with a list of repositories in several disciplines.

If there is no subject-specific repository in your field, you can consider the generalist repositories. Some of them are listed below:

→ **Dryad Digital Repository**
→ **Figshare**
→ **Mendeley Data**
→ **Open Science Framework**
→ **Zenodo**

We recommend selecting a repository that issues a persistent identifier, preferably a Digital Object Identifier (DOI), and that has a robust preservation plan to ensure the data is preserved permanently.

13 Rico-Castro, P. (2019): "¿Amigos o enemigos? Cómo la open science pone a las políticas de Open Access frente al espejo". ("Friends or foes? how open science places Open Access policies in front of the mirror"). RUIDERAe: Revista de Unidades de Información, N°. 15, 2019. **https://revista.uclm.es/index.php/ruiderae/article/view/2166**

In many countries, universities have an institutional repository whose metadata is incorporated in data aggregators. An aggregator collects the metadata of different repositories, so they all have a common access. In the European Union, the data aggregator is called OpenAIRE. which also offers guides for choosing a data repository. Another international aggregator is the Bielefeld Academic Search Engine (BASE).

19

Should I archive data and publication in the same repository?

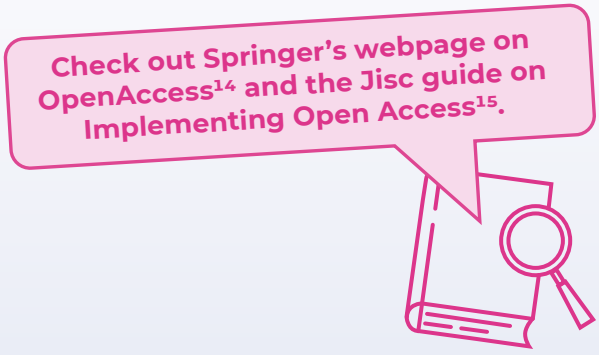
It depends on the policy of each repository. There are some repositories that accept data and publications. But these two types of information are distinct, and they need different formats and typologies. Many repositories therefore differentiate them.

As a researcher, you should consider the **→ FAIR Data Principles** when depositing data (Findable, Accessible, Interoperable and Reusable, see questions 6 and 10). There are some conditions in order to obtain this: data must have a unique identification assigned, present a detailed metadata, data and metadata must have an accessible licence that allows their use and reuse, etc.

Therefore, data should be archived, shared and curated at a disciplinary level, at the research facilities, or data repositories. This way, data can be more adequately deposited, described, shared and curated.

The liaison between data and publications is very much recommended and necessary. For that reason, a protocol **(→ Scholix)** has been established in the context of the Research Data Alliance (RDA).

We recommend you to take a look at this guide on managing research data.



14 https://www.springer.com/gp/authors-editors/authorandreviewertutorials/open-access/what-is-open-access/10286522
15 https://www.jisc.ac.uk/guides/implementing-open-access

OPEN TO SOCIETY

20 Who else should I engage outside academia and how?

21 Is society ready to join in on the high-level debates about new technical solutions and be included in the decision-making when they might not have the capability to foresee the benefit?

22 Is Citizen Science useful?

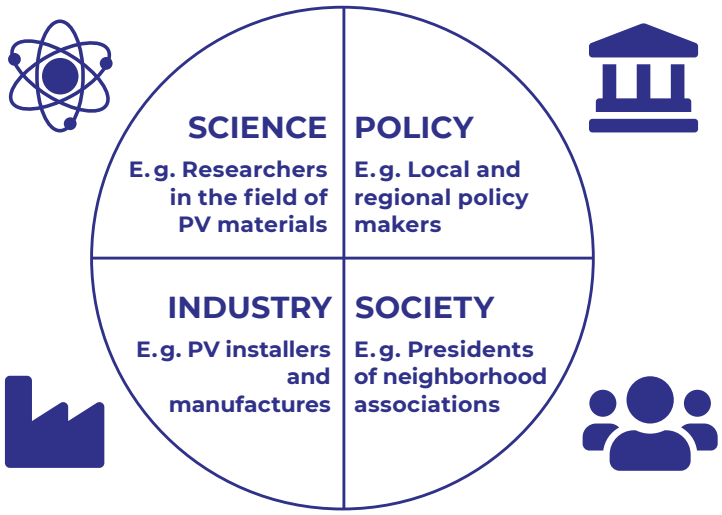
23 Which Citizen Science projects are good examples?

Responses by:
Luisa Barbosa, Gema Revuelta and Elisa Albiñana

20

Who else should I engage outside academia and how?

The stakeholders (People or organisations who have an interest in your research, affect or are affected by its outcomes) you decide to involve will depend strongly on the project and field of study. However, it is important to take into account that a more diverse scenario will provide innovative and thought-provoking ideas. To put it simply, you should consider representatives of the following sectors:



These two websites present different methods for opening your project and general helpful instructions:

→ ActionCatalogue

→ involve

There are different levels of engagement with society and several ways of doing it:

Active Citizen Participation in Research	**Citizen Science** Citizens get involved in some parts of the research process, such as analysis or design
Formal Engagement	**Citizens Panels** A random representative group of citizens consulted via surveys to assess public preferences and opinions on specific issues
Informal Public Engagement	**Mobilisation and Mutual Learning (MML)** Dialogue events that allow stakeholders to share their opinions, expectations and concerns on a certain topic
Virtual Dialogue	**Social Media** Networks allow users to comment and react to posts
One-way Communication	**Open Days** Citizens can visit research facilities and learn what scientist do
No Information	**Research is totally closed** to the public and there is no engagement

The Ladder of Public Engagement in Science

Modified by the Studies Centre on Science, Communication and Society – University Pompeu Fabra from Arnstein (1969) "A Ladder of Citizen Participation," JAIP, Vol. 35, No. 4, pp. 216-22

21

Is society ready to join high-level debates about new technical solutions and to be included in the decision-making when it might not have the capability to foresee the benefits?

Yes. The aim of engaging citizens in debates about science, technology and innovation is not to discuss the technical aspects of it, but the social, ethical, political and economic implications. Remember that society is made up of all kinds of people with a wide range of expertise. Some examples of scientific debates with citizens in the field of artificial intelligence, photovoltaics and neuro-enhancement are:

→ Danish Board of Technology
In EuropeSay on Artificial Intelligence, citizens were invited to participate in debates where they share their thoughts and concerns about the impact and future of AI. They just have to gather with their friends or family, connect to the internet and discuss the questions that show up on screen. The answers are then collected and analysed by politicians and researchers to define funding priorities and research projects.

→ GRECO project
The solar energy research and innovation project organised four workshops with different stakeholders – industries, policy-makers and consumers – in order to discuss their perception about energy consumption for irrigation and the major issues it faces. After this, researchers proposed three different solutions and let the irrigator community determine which solution would be most beneficial and relevant.

→ SuperMI (NERRI project)
SuperMI was a series of citizen debates about neuro-enhancement, which is about increasing cognitive abilities in healthy people such as improving memory or calculating faster. Experts were able to ask participants questions and receive the answers instantly, via an automatic and anonymous voting system. Thanks to these debates, experts and communicators could understand the views of attendees, the diversity of expectations and the barriers to the use of the technology used.

22

Is Citizen Science useful?

Researchers who use Citizen Science can a) conduct studies that would be impossible otherwise because of the amount of time or number of people needed [16] [17]; and b) develop projects with societal impact. Data quality is not an issue as long as the project is designed with robust data validation systems [18]. Citizen Science is also cost effective and can provide greater data at lower unit costs than conventional research techniques [19]. Exciting opportunities also exist in which it is possible to link remote sensing data with Citizen Science techniques.

16 Erwin, T.L. & Johnson, P.J. The Coleopterists Bulletin **54**(3), 269-278 (2000).
17 Hochachka, W.M. et al. Trends in ecology & evolution **27**(2), 130-137 (2012).
18 Burgess, H.K. et al. Biological Conservation **208**, 113-120 (2017).
19 Theobald, E.J. et al. Biological Conservation **181,** 236-244 (2015).

Citizens can be involved in the research process in the following ways:

DEFINE RESEARCH QUESTIONS

E.g. → **CitieS-Health** is a project where groups of citizens co-design experiments (creating research questions) to explore pollution and health in their cities. They do so via workshops and surveys.

COLLECT DATA

E.g. → **Generation Solar** is the brainchild of the project GRECO, an app where citizens can collaborate to build a database of photovoltaic installations worldwide and create a network of users. The initiative helps develop more accurate models of future energy systems and promote clean energy.

ANALYSE THE DATA

E.g. → **Galaxy Zoo** is a project where volunteers can help to analyse an immense number of satellite images that computer programming has not been able to do. Participants just have to identify galaxies and sort them out by shape. The results have been used in peer-reviewed publications.

WRITE AND PUBLISH PAPERS

E.g. → **EteRNA** is a game where users solve puzzles to figure out the folding of RNA molecules or they propose their own puzzles. The best designs are tested in the lab and players are invited to co-write scientific papers. As most players are not experts, "their creativity isn't constrained by what they think a correct answer should look like", say EteRNA's creators.

23

Which Citizen Science projects are good examples?

A variety of online platforms now provide data on Citizen Science projects. They include:

EU-Citizen.Science
https://eu-citizen.science/

Zooniverse
https://www.zooniverse.org/

SciStarter
https://scistarter.org/

The most recent examples include:

Safecast – a good example of the power that society can bring to science. It was first created after the nuclear incident at the Fukushima Daiichi Power Plant in Japan where data on local radiation levels was not available. A group of expert volunteers started gathering and making available useful public data, while enabling people to easily monitor their own homes and environments. https://safecast.org/

COVID-19 Symptom Study App – the world's largest Citizen Science project studying the evolution of the pandemic with 4.5 million users. It has created a huge database that scientists can use to study the evolution of the pandemic and its early symptoms and to understand which groups in society are at greatest risk.
The project provides **daily feedback** to its citizen scientists on case numbers where they live and regular webinars on the progress of the studies including → **COVID-19 Vaccines** and → **vitamin supplements** for the disease. https://covid.joinzoe.com/

OTHER OPEN PRACTICES

24 What should I do to open my notebooks? What should I know about them?
25 What does Open Peer Review imply? How can I explore this route?
26 How can software, models, and procedures be openly shared and reviewed?

Responses by:
Antonio Martí, Sabine Haas, Elisa Albiñana and Luisa Babosa

24

What should I do to open my notebooks? What should I know about them?

1 Choose the **appropriate software.** We strongly recommend you gather information on the experience of fellow researchers with open notebooks beforehand, such as the **→ study by the Gordon Institute.** You probably won't be surprised to learn that choosing isn't. Our recommendation is **→ ELABFTW,** because:

- Although you will have to set your own server (it's well documented), you will own your data. This means if you are not happy with the performance of the software you are using, you can move your data. For us, this is a crucial feature you should look for in any software you use.
- It is open source. This means you have access to the code, and you know there will be no loophole for third parties spying on you.
- It is free. The price of commercial solutions may increase with time. Will you be able to afford the software licence of your choice in the future if things go bad? What if the price increases unreasonably and the service provider holds the data in their servers?
- It is multiplatform (Linux, Mac or Windows users).
- You control the access to the notebooks. Eventually, everybody can see them.
- In the worst-case scenario, it will allow you to get some practice on the use of open notebooks in order to make better choices later.

2 Be aware your team will need **training and time to adapt.** Save time and money for that.

3 Try to **understand all the features of the software.** You will likely find useful features you never thought about in the first place. Save time for that too.

4 Once you decide to make the move, **encourage everybody to use it.**

25

What does Open Peer Review imply? How can I explore this route?

Open Peer Review (OPR) was originally defined as a review process, made by peers who revealed their identity. It has now expanded to include other innovations, to the point that a study found 122 different meanings![20] [21], From our practical perspective, OPR implies two things:

- **Transparency,** as you know who the peer reviewers are, plus the referee reports are published under CC-BY licence. Besides, the decision letters after the review and author responses will be public too (for accepted papers only). Referee names will only be disclosed with their consent.
- **Openness,** as anyone can participate. This is called Open Community Peer Review.

Note that submissions assessed via community OPR also undergo the usual peer review process (by author-nominated and editor-selected reviewers).

20 Ross-Hellauer, T., 2017. What is open peer review? A systematic review. F1000Research, 6.
21 **https://plos.org/resource/open-peer-review/**

For instance, → **PubPeer** is a non-profit database whose goal is to improve the quality of research by enabling the interaction between researchers who can make comments on peer-reviewed publications. These comments can be seen as useful information, but its veracity must be checked by the readers themselves. Now they have created a version 2.0, where anonymous comments are allowed.

If you want to know more about Open Peer Review and how to start this practice, check out the course by → **FOSTER.**

26

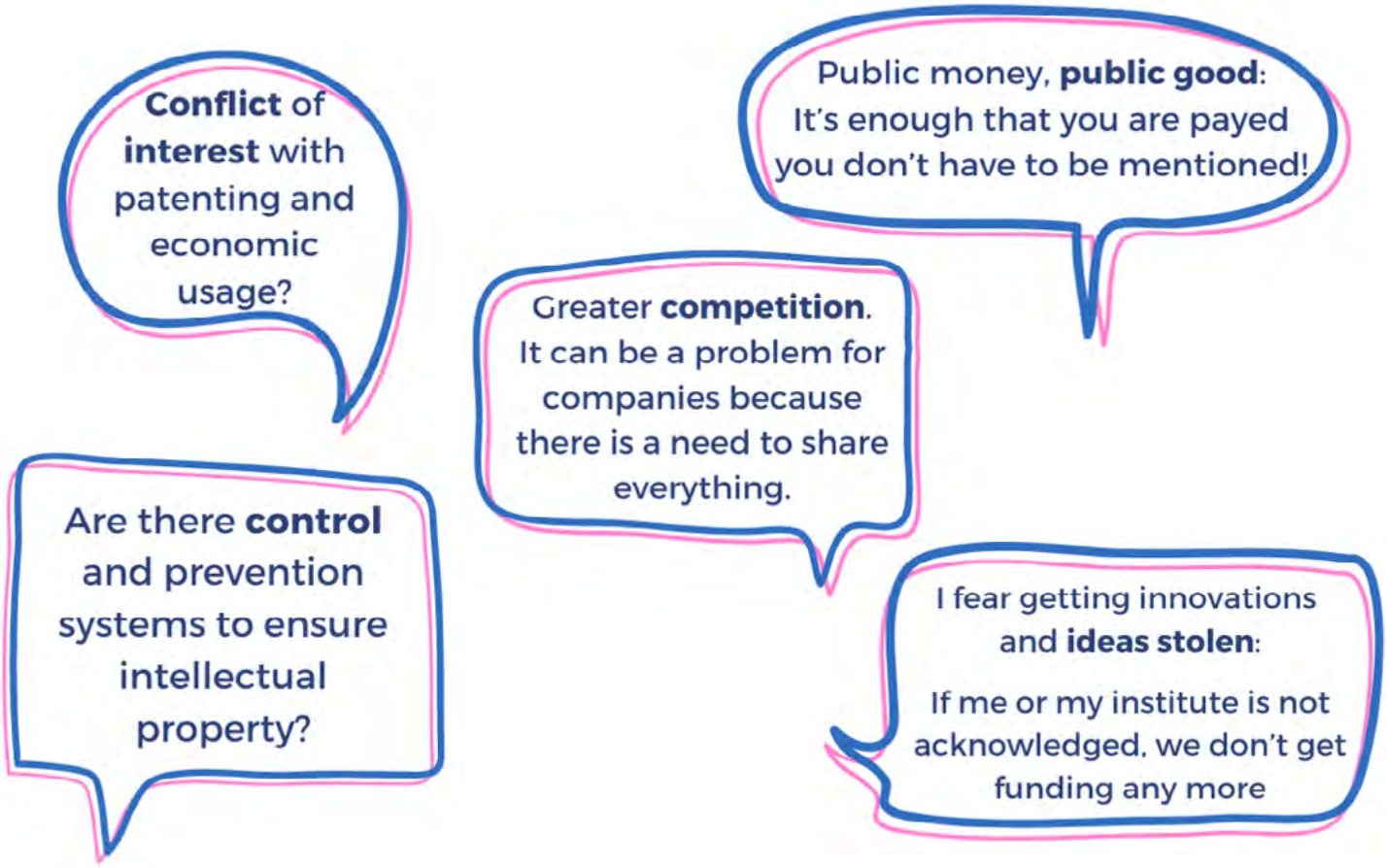
How can software, models and procedures be openly shared and reviewed?

The common way to do that is by developing a source code on the software developing platform → **GitHub.** By providing this source code with an open licence, you can make it available for everyone, free of charge and allow them to use it according to the terms of the licence.

The GitHub workflow[22] enables discussions, code reviews and easy collaboration. The software is developed transparently with discussions being archived (in so-called "issues") and changes in the code being documented in the code history.

By developing your code on GitHub, users and other developers can comment and suggest changes. Usually, changes made to the code must be accepted and, therefore, reviewed by one or more members of the development team. Apart from developing code on GitHub, open source code can be handed in to → **JOSS,** the Journal of Open Source Software, where an open peer-review process takes place similarly to the peer review made on papers.

22 See an example of how to contribute to the oemof application developed in GRECO: **https://github.com/greco-project/pvcompare/blob/dev/CONTRIBUTING.md**



PROPERTY

27 How is my Intellectual Property protected to prevent others from stealing or benefiting from my research if I make it open?

28 What do I have to know to use open material from other authors and to license my scientific work ?

29 Is the competitiveness between companies going to decrease because of the need to publish in Open Access? If so, how can this be handled?

Responses by:
Ludwig Hülk, Teresa Malo de Molina and Naël Gardin

27

How is my intellectual property protected from others stealing or benefiting from my research if I make it open?

In most national legislations, every created intellectual or creative "work" is protected by default (e.g. § 2 UrhG in Germany)[23]. This copyright does not cover ideas and information themselves, only the form in which they are expressed[24]. When researchers publish their findings in (peer-reviewed) articles, the findings and conclusions are certainly accessible for readers. On the other hand, the underlying data, methods (models, processing scripts) and results (plots, graphics) are still protected. Publishing and applying suitable open licences to these materials grant the rights (also called freedoms) to hold a copy, and reuse and republish these materials when following the defined obligations (e.g. attribution of the authors).

Good scientific practice follows the idea that research always has to be reproducible and should be available and verifiable to everybody, not just to the audience of a certain scientific journal. Open Science provides the right tools and methods for this. In contrast, when research is done using public funds, it has been already paid for by the public. Not publishing the created works would be considered stealing from the public and society (e.g. "Public Money, Public Code"[25]).

Besides these ethical considerations, the benefits of publishing all materials under open licences increase the scientific credibility and legitimacy, and improve co-operation and collaborative development. Current barriers identified include the need for knowledge and experience of the legal implications, additional effort, and the personal and institutional restriction in a performance-based science system.

28

What do I have to know to use open material from other authors and to license my scientific work?

If you want to use material from other authors, you should first know the licence they have adopted so you can use their work properly. The licence indicates the openness of the material and what you are allowed to do under which conditions. A suitable open license is an indisputable precondition for Open Science. There are different kinds of material (e.g. software, data, artwork) and there is a suitable license for any given type. For instance, the Creative Commons Licences are open under some conditions:

- **Attribution (BY),** the author requests that their authorship always be recognised.
- **Equal Sharing (SA),** the author requests that any derived works (other data, images, etc., that be based on theirs) must be licensed under the same conditions as the original.

A proper attribution consists of the **Title, Author** or copyright holder, **Source and License.** When using licensed material, you must follow the given license obligations, otherwise you will lose the granted rights. Only the public domain license (also no rights reserved or CC0) has no obligations and material licensed under it can be used without any restrictions.

The Wikipedia entry → **"Best practices for attribution"** give examples for correct image attribution. Also, there is an "Attribution Generator" called → **Lizenzhinweisgenerator,** useful to create the attribution string. Keep in mind that other conditions may apply to Open-Source Software and Open Data.

23 http://www.gesetze-im-internet.de/urhg/__2.html
24 https://en.wikipedia.org/wiki/Intellectual_property#Copyright
25 https://publiccode.eu/

Now, if you are the one wanting to assign a license to your scientific work, the process goes like this: First, you have to identify what kind of material (software, data, artwork) is to be licensed and under what conditions. Then, you must document this (using e.g. metadata) to allow others to use the material after all. This is probably the most important part of granting an open license. Therefore, it is important to specify explicitly the license version (like CC-BY-4.0) and the correct title of the licensed work.

A more complicated task can be the identification of the rightful copyright holder. Even if a researcher or a group of researchers are the authors, copyright depends on country legislations and sometimes on personal contracts. In research institutes and in other general employment relationships, the copyright holder is the employer and must therefore be attributed. In universities, researchers often have more freedoms and can choose between university, faculty, research group, or personal copyright.

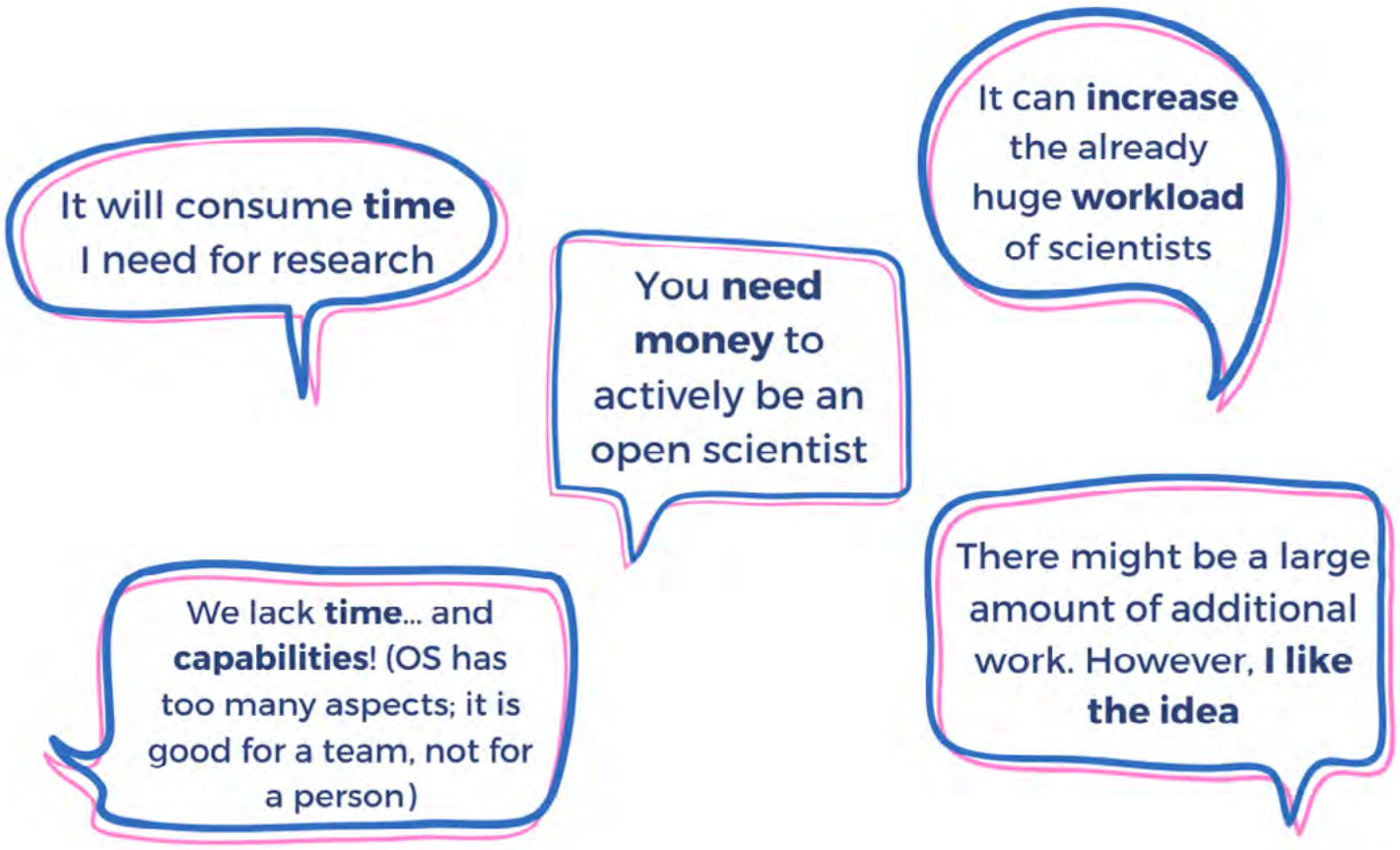
For a responsible license choice, you can get familiar with popular open licenses and consult detailed resources for **→ Open Source licenses, → Open Data licenses,** or **→ Creative Commons.**

29

Will companies be less able to compete with one another due to the need to publish in Open Access?

Every company has trade secrets, such as production process parameters or design files. However, transparent access to performance and field test data of a product or technology can help customers to better understand the benefits and added value compared to competing options. Open Access is an obvious choice for disseminating such information in order to increase the readership and its diversity, and provide maximal visibility for the company.

Publishing in Open Access will help find business and collaboration opportunities, and therefore increase the company's competitiveness rather than decreasing it. Open Access publication and trade secrets are compatible: for example, the functionality and operating principle of a device can be described without the need to explain details of the production process that enables its cost-effective production.



RESOURCES

Responses by:
Carlos del Cañizo, Luisa Barbosa, Ana B. Cristóbal, Sabine Haas and Oscar Corcho

30

I already have tons of work; does it mean more? Can I do it on my own?

Embracing Open Science currently means more work, for sure. More work which is difficult to do on your own: you should have the support of your research group. You should all share the belief that OS and Responsible Research and Innovation (RRI) are important and a bonus for your research. You should build a common strategy under which this extra work is distributed. However, most of the processes are going to be integrated in your daily routine at the end and they will not be seen as a load but as a way to contribute to better science.

In any case, the main challenge is not the extra work, but the need to reframe the way you conceive your research. Because you have competences in a specific research topic, sometimes very specialised, where you honestly think that you can contribute. Seeking to align with societal demands implies a fresh mindset: it is not about going from your expertise to society, but about "listening to society" (which is not an easy task!) and keeping your ear to the ground and adapting your research, if needed.

This new mindset also involves recognising that you do not know everything: you will need to talk to and work with people from other disciplines which are sometimes far removed from yours.

Example from open coding

"I often hear people say that OS means extra work in terms of learning new tools. At least for open source development I cannot fully agree. If you have worked in software development before, you should have already used a version control programme and a tool for communicating with your fellows. So, you will easily get into GitHub. There'll be slight differences, but this also occurs when you're forced to update to the newest Windows version! Every change requires some extra work (open or not). I would say open coding comes into its own when done in teams and communities. However you can, of course, start a project by yourself. If you find interested people, you will be able to get feedback and maybe even motivate them to contribute."

Sabine Haas

31

Will I need additional time to apply OS?

Yes you will. And this time will not be recognised in your research career nor will it produce tangible results in the short time. That can hurt. However, you have to distinguish between two stages: as many other things in your research career, first you'll have to develop the methodologies and the tools that work for you. This implies time, effort and resources, of course. But once you have them running, they will require less attention and become "business-as-usual" practices.

Being part of a research group where other researchers and support staff help to deploy these OS methodologies will make things much easier. The burden of extra work will be spread out, your OS practices enriched through contrast and debate, and the feeling that you are not alone will motivate you.

Furthermore, there are now many tools available for Open Science and Citizen Engagement (see chapters “Where to start?” and “Open to society”): lots of collaborative tools and platforms to choose from according to your needs. Many of these have Open Access arrangements allowing their reuse and further development.

Example from open coding

“How much additional time, if any, you need for writing open instead of closed code depends on the standards you usually want to follow. Writing open code means to produce clean code, adding comments and preparing a good documentation for others to understand and, moreover, to use a code structure that is easy to extend. To my mind, this should also be done for closed code, as you can save yourself and your colleagues a lot of time by following these recommendations.”

Sabine Haas

Example from energy research

“Opening data and publications will require inserting proper metadata in a repository. Open Data practices will require more time from you since the preparation of FAIR datasets is not standardised. In our experience, you will need extra time to learn Open Code or Open Software practices for other open science practices you could be interested in.”

Ana Belén Cristóbal

32

Is Open Science more expensive?

It is hard to quantify. Although currently there are some concrete fees for implementing OS (as for infrastructure and services) [26], the costs saved are not measured. For instance, it has been estimated that a world fully turned to Open Access could result in annual savings of around £400 million for the UK, €133m for the Netherlands and €80m for Denmark [27].

From GRECO’s experience, we can identify three lines that would result in concrete costs for implementing OS:

Time

Although it is even harder to estimate its price, certainly the shift towards OS requires new knowledge and skills. Therefore, investing time to learn is crucial (see question 31).

Article processing charges (APCs)

Article processing charges (APCs) in the Gold Open Access path. APCs cost around €1,000 - €1,200 per article (see question 15). In the solar energy sector, our researchers have paid on average €2,000 per article.

Engagement activities

Currently considered as something external to the research profession, opening science to society requires proper planning, human resources and consumables. Many institutions may have a supporting communication department to collaborate with. If that’s not the case, a professional science communicator will need to be hired. Moreover, some engagement actions such as Citizen Science (see questions 21 and 22) involve developing IT tools that may lead to an increase in costs of several thousands of euros.

26 Confederation of Open Access Repositories (COAR). (2020, May 31) Input to UNESCO Consultation on Open Science. https://www.coar-repositories.org/news-updates/unesco-open-science-consultation/

27 Houghton et. al (2009) Economic implications of Alternative Scholarly Publishing Models: Exploring the Costs and Benefits. Swan, A. (2010) Modelling scholarly communication options: costs and benefits for universities

33

Does Responsible Research and Innovation (RRI) and OS mean more red tape?

From our experience, Open Science does not imply more bureaucracy. It does, however, require researchers to be aware of societal and ethical rules such as the Data Protection Regulations and to have good plans in place to engage citizens and third parties in your work (consider, for instance, consent sheets). Your funder or your institution, or both, will want to see that these issues have been thought through.

In general, **researchers increasingly** need to satisfy a wide range of **bureaucratic obligations** laid down by funders and research institutions. Responsible Research and Innovation should not be seen as yet another set of rules (or paperwork) that hampers research but an opportunity to engage openly with a wider cohort of participants who will enrich research outcomes.

It is important that RRI does not deter researchers from adopting these new tools and remains a positive experience.

Institutional support is important to encourage the growth and development of RRI and Open Science. There is a grass roots desire among researchers to ensure that their research produces meaningful outcomes for society whilst top down pressure now exists for institutions to promote RRI. These trends can be reinforced if institutions recognise and reward leading researchers who apply RRI and Open Science and direct resources to research projects that adopt these principles.

34

Will I need powerful infrastructure, IT or other resources?

Not necessarily. There are general-purpose and domain-specific platforms that should serve your needs in most cases (e.g., Zenodo for dataset archival). For very specific cases where large IT infrastructures are needed in order to handle datasets, there will be support provided by data centres and similar.

POLITICS

Responses by:
Eva Méndez and Luisa Barbosa

35

Is Open Science a requirement for funding?

It depends on the funder. It should be an unquestionable requirement for funding, ex ante (based on predictions or plans) and ex post (based on actual results) of the grant. The current model of funding requires Open Science practices in relation to the results of a funded project. This is ex post. But it should also be a requirement ex ante, meaning: to demonstrate, before you get funding, that your previous research has also been following Open Science practices.

36

How do we know if we are doing Open Science according to the law? Where can I get legal advice?

There is no need to worry. Open Science practices in research **cannot get you into legal trouble.** Some "legal" aspects of OS worth considering are:

Licences
Be sure you use open licences according to their disclaimers.
- Preserve the rights of data owners.
- Promote correct use of the data.

Sensitive information
Protect sensitive information like personal data.

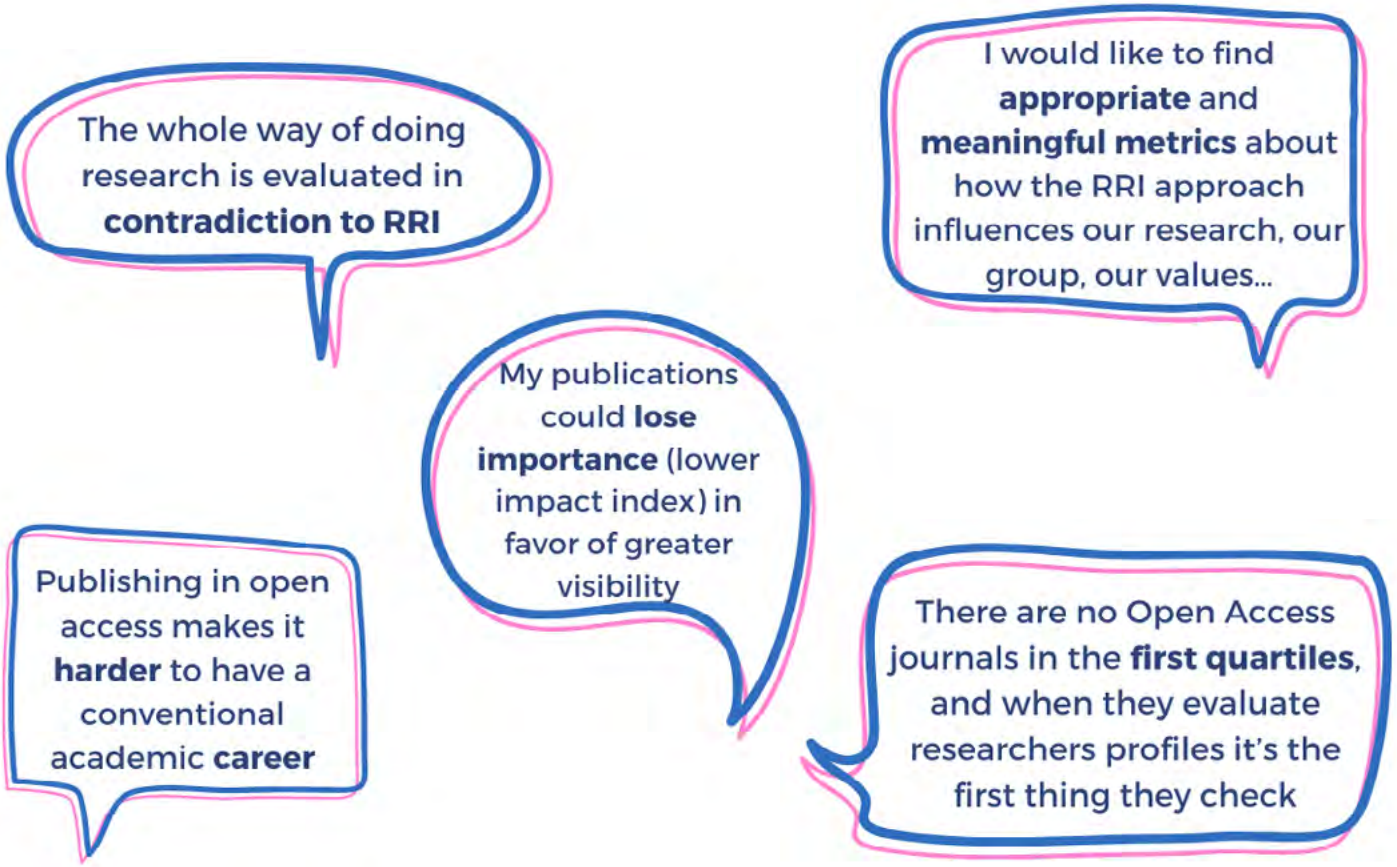
OpenAIRE addresses the issue of handling → **sensitive information** and you can always explore the licences description in the → **Creative Commons website.**

37

Will there be less funding for certain fields of research?

Not at all! Open Science should be the new normal, the default situation. This means it should be the rule, not just a trend.

The funding depending on the discipline does not need to be affected by Open Science practices. Open Science will only affect the way you perform research (with more collaboration, transparency and participation), the way you communicate the results (openly) and the outcomes you share (not only papers but also research data, methodologies, software, etc.).



METRICS & INCENTIVES

38 Doesn't Open Science affect my academic recognition as Open Access journals have a lower impact factor?

39 Are there any incentives or ways of assessing my career that consider societal impact or responsibility?

Responses by:
Eva Méndez

38

Doesn't Open Science affect my academic recognition as Open Access journals have a lower impact factor?

This is one of the common misconceptions of Open Science. We're trying to place Open Access and other open knowledge practices into a scientific communication system that happens to be narrow and out of date.

Open Access (OA) to scientific publications does not only mean Gold Open Access Journals (see question 12), it is also about sharing the results in repositories, as in Green OA, which increases the likelihood of being cited. Open Access and further Open Science practices will bring about greater IMPACT for your research. Academic career assessment should not be based only on the Journal Impact Factor (JIF), which measures the impact of the journal, not the impact of the researcher or even the publication. Open Science does not affect your academic career. Science will be harmed if JIF is perpetuated as the only means of recognition.

39

Are there any incentives or ways of assessing my career that consider societal impact or responsibility?

Incentives and research evaluation are changing, making room for new research career paths and developments. Some examples include the Dutch approach, called **→ Room for Everyone's talent: towards a new balance in recognition and rewards of academics,** that focuses on diversifying career paths and stimulating Open Science practices.

There are also new research evaluation frameworks that are changing national scenarios for research careers: for example in the UK (**→ Research Excellence Framework, REF**) or Australia (**→ Excellence in Research for Australia, ERA**). More and more, transfer and social impact are being considered in the new indicator frameworks.

BENEFITS

The following comments highlight the benefits of Open Sience according to researchers:

A more "open" sientific community will also be a more **honest** scientific community

Open it up to more people will allow the **problem** to be **recognised**

Open Sience **feels right,** working in black boxes doesn't

The use of RRI is necessary, especially in countries where the **resources** for research are very **limited.** It provides more **opportunities** to sientists with less resources

It allows for a better communication of research results and quicker **dissemination**

I will get **funding** easily because the funding agencies like it

I think this is a great way to **democratise** public-funded research and innovation

There will be results more **"socially robust"**

It could improve the **reproducibility** of the results, solve real problems of the society, and **save time** (and money) avoiding redundant research and promoting **synergies**

OS helps **gathering resources** of several researchers: finding bugs, working together. This leads to outcomes with **higher quality**

Reduce the "rejection" of **fear** towards science

The collaboration with the **industry** will be **easier** with open innovation, and this is a **key point** for a researcher

It promotes interesting projects for society in collaboration with other groups to obtain **different approaches**

It is obvious that Open Access and Open Data allow science to **spread**

OS allows **transparency,** scientific advance, **reliability** of results and reproducibility

GENDER AND OPEN SCIENCE

The researchers interviewed recognise gender as a current and urgent issue. Furthermore, they consider gender equality as profitable; as can be seen in the speech bubbles below. Hence, there is a tangible **need for action,** and there is a genuine need to know which measures to implement.

"Not clear what 'gender action' in my field of research even means" says a researcher. "Can we benefit by using male/female differences in communication campaigns or initiatives?" The answer will be "yes, of course!": using gender-sensitive language we speak directly to men and women and talk explicitly about them, their needs and roles in the society. Beyond inclusive communication, we have a variety of methods available to improve both researchers' lives and quality of research from a gender perspective. **Research results will be more acceptable to society** if the research mobilises different stakeholders and mixed teams and collects gender-disaggregated data. Work environments can be more productive by encouraging **mixed teams, mentoring, networking, allowing for work-life balance, contrasting violence in the workplaces.**

Claudine Hermann, president of the → **European Platform of Women Scientists** says that "for cultural and historical reasons, the place of women and men in society is still different. Consequently, they have different views of the problems on which research and innovation are working, for which they could provide different and innovative solutions. It would be a waste of talent if women were not involved in technical solutions. It is not only about a gender balance in the team, but also – what is much more difficult – trying to make women express their needs and possible solutions. This is particularly relevant for Citizen Science, citizens being both women and men". To help address this and other gender issues in Open Science, it is worth looking at a → **report** on Strategic Advice for Enhancing the Gender Dimension of Open Science and Innovation Policy (2019), published by the European project → **Genderaction.**

The report stresses that current OS and Open Innovation policies and expert studies tend to be gender blind and do not really address gender issues. However, gender equality can be fostered as synergies exist between OS and gender studies, relying on co-operation and transparency for a broader access to knowledge and the whole research process, as in Open Science.

Document history

This guide has followed an open peer review and participatory process with many people involved. Below you will find the history of the such revisions.

V	Date	Description	Participants
1	20/07/2020	First version delivered by the list of authors and contributors listed	Barbosa, L.; Albiñana, E.; del Cañizo, C.; Cristóbal, A.B.; Revuelta, G.; Haas, S.; Rico, P.; Corcho, O.; Malo, T.; Rubbia, G.; Hülk, L.; Nardin, G.; Méndez, E.
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4	05/11/2020	Revision and discussion done as part of the workshop on Open science during the Campus Gutenberg Cosmocaixa 2020	30 professionals or students in the field of science communication.
5	21/20/2020	Revision and discussion in a workshop with researchers from the Group of Education Research in Health Sciences (GRECS) from the University Pompeu Fabra	Carrió, M.; Pérez, J.; Cambra, I.; Llerena, M.; Costa, M.; García, J.; Moyano, E.; Lope, S.; Rosa, N.; Cumplido, S.; Liñán, S.; Llorente, C.; Revuelta, G.; Barbosa, L.
6	23/09/2020	Virtual distribution and discussion among the attendees to the UNESCO regional consultation on Open Science for Latin America and the Caribbean	Various representatives from universities and research centres in the region.
7	10/09/2020	Revision of the chapter on Gender by the president the European Platform of Women Scientists	Hermann, C.
8	21/09/2020	Revision of the chapter on Open Access by the Project and Communications Manager of the Directory of Open Access Journals (DOAJ)	Armengou, C.; Fava, I.

V	Date	Description	Participants
9	02/12/2020	Revision by the Social Advisory Board of the project GRECO, with expert representatives in the field of Open Science, OS policies, Citizen Science, Gender, Sustainability and Photovoltaic research.	Brocklehurst, M.; Rubbia, G.; Topic, M.; Méndez, E.; Grigorov, I.
10	15/12/2020	Second public version of the guide delivered by the Studies Centre on Science, Communication and Society upon all previous revisions.	Barbosa, L.; Revuelta, G.
11	25/01/2021	First version of the professional design of the guide.	Schwald, R.; Ramsch, M.; Thompson, M.
12	19/02/2021	Revision of questions 6 and 28 regarding open licenses and metadata.	Hülk, L.; Muschner, C.; Hofmann, C.
13	01/03/2021	Final public version of the guide.	Barbosa, L.; Revuelta, G.; Schwald, R.; Ramsch, M.; Thompson, M.

GRECO

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