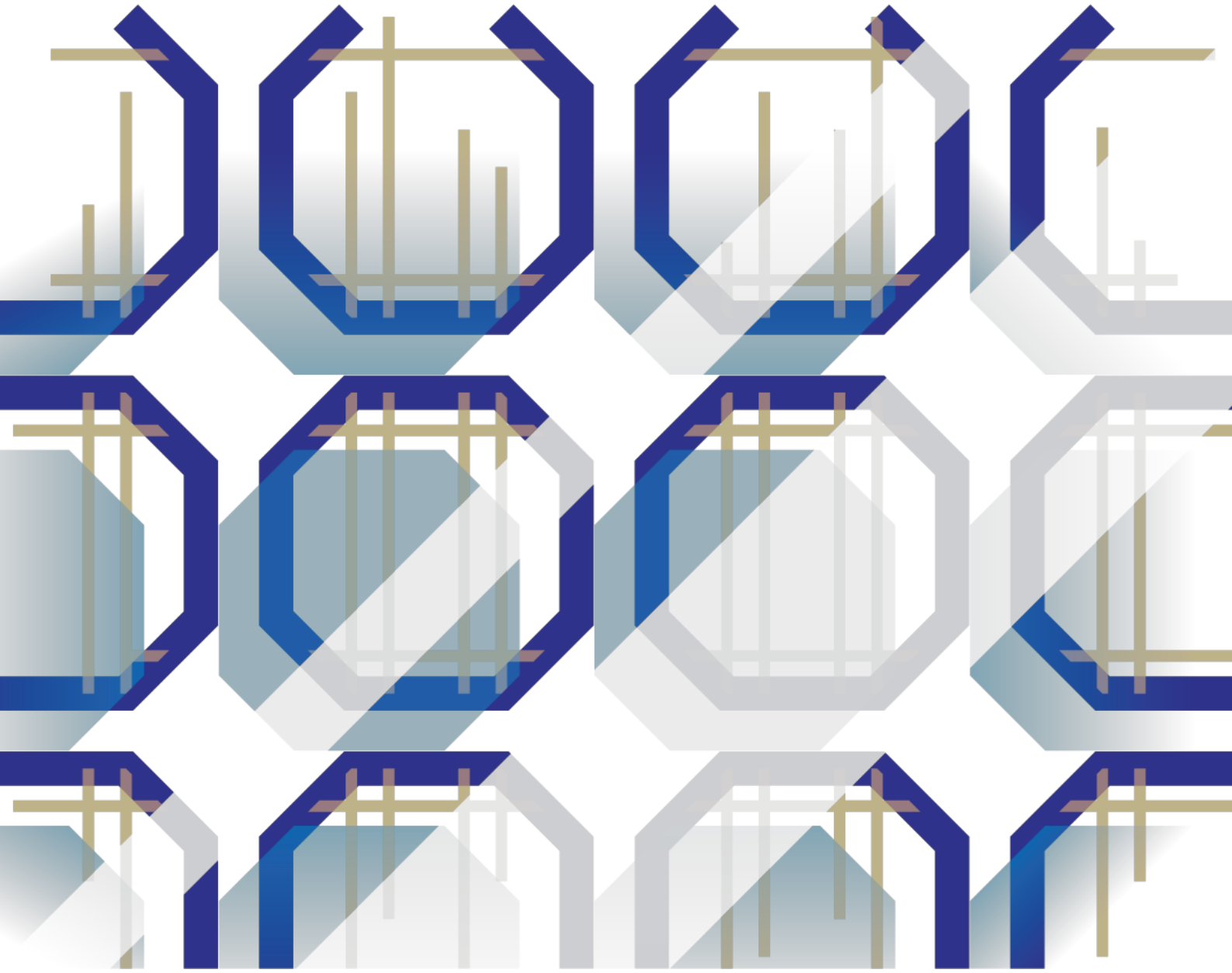
GRECO

PRACTICAL GUIDE ON OPEN SCIENCE

For researchers



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2020

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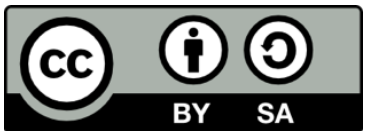

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Summary

For two years, the project GRECO has conducted a survey to analyse the opinions, doubts and experiences of researchers on 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 on Open Science. The experience of researchers from the PV field is useful for other fields too. So, this document is a **Practical Guide for Researchers** and 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, structured in 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 experts on the field and other researchers that have tried and applied OS in its different forms. At the end of the document there are two additional sections. One with the benefits expressed by the researchers in our survey and another that comments on 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.

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CHAPTER (CATEGORIES)	Checklist	WHERE TO START?	OPEN DATA	OPEN ACCESS	OPEN TO SOCIETY
PAGES	p. 09	p. 13	p. 20	p. 25	p. 36
DESCRIPTION	A list of concrete actions to do, step by step	This section will give you resources to get to know Open Science (OS)	Here we'll answer questions about opening data and research outputs	This section is dedicated to solving doubts about open access to journals and publications	Public Participation is an essential part of OS and here you'll get to know it better
FAQs	CHECKLIST TO OPEN SCIENCE	**1)** Where can I find more information about Open Science? **2)** Are there different levels to implement OS? **3)** Where can I find examples of projects that have applied Open Science? Are there any specifically of my field? **4)** Are there networks to discuss Open Science? **5)** Does the definition of Open Science include Public Participation?	**6)** How to ensure the data shared is well interpreted and useful? **7)** Is there still privacy for confidential data? **8)** Doesn't "closed" data have better quality than open? **9)** When shall I open my data? **10)** How can I put in practice the FAIR principles? Is it difficult? **11)** How is archiving data going to give me some benefit as a researcher?	**12)** Are there different levels of open publications? Can I choose which one to use? **13)** What is an embargo period? Is it the same for publishers and funders? **14)** Where can I know about journals' open access policies? **15)** How much does Open Access cost and where can I get funds to publish in Open Access? **16)** Does Open Access also imply Peer Review? Is Open Access going to mean more criticism on my publications? **17)** Is there any way to comply funders' requirements, journal policies and do not pay for opening my paper? **18)** What are repositories and how can they be used? Which one should I select? **19)** Should I archive data and publication in the same repository?	**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?

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OTHER OPEN PRACTICES	PROPERTY	RESOURCES	POLITICS	METRICS and INCENTIVES	BENEFITS and GENDER
p. 42	p. 47	p. 51	p. 57	p. 60	p. 63 - 65
This section collects information about other OS practices	OS is usually associated with loss of property. Here you'll find out this is false	Do you need extra resources to implement OS? Find the answers in this section	If you want to know more about the regulatory aspect of OS, check this part	What about recognition and incentives for OS? To know that, read this last part	Click to go directly! Quotes from researchers on OS benefits and a short gender analysis of OS
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, procedures be openly shared and reviewed?	**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? **29)** Is the competitivity between companies going to decrease because of the need to publish in Open Access? If so, how can this be handled?	**30)** I already have tons of work; does it mean more? Can I do it on my own? **31)** Will I need additional time to apply OS? **32)** Is Open Science more expensive? **33)** Does Responsible Research and Innovation (RRI) and OS mean more bureaucratic work? **34)** Will I need powerful infrastructure, IT or other resources alike?	**35)** Is Open Science a requirement for funding? **36)** How do we know if we are doing Open Science according to the law? Where can I get legal advice? **37)** Will there be less funding for certain fields of research?	**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?	

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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 lack of knowledge to cope with the demands[1]. The EU-funded project GRECO is a pilot that tries to implement Open Science (in all its levels) into solar 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 knowledge from practice, and to encourage the implementation and the critical reflection on Open Science practices all around the world.

Although this guide targets mainly researchers, we want to stress that moving towards Open Science requires actions in several levels: It cannot rest entirely into the researchers' shoulders. There is a necessity for 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*

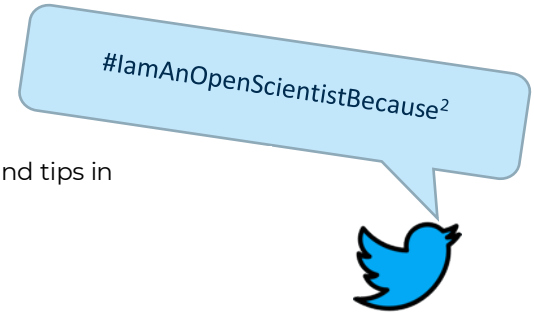
This guide is structured in four parts:

1- **Checklist** for OS. A list of concrete statements to consider and implement.

2- **Q&A**. Frequent questions asked by researchers and the corresponding answers from experts on the field and other investigators that have applied OS one way or another.

3- **Benefits** for OS as expressed by the researchers in our survey; and

4- The **gender perspective** on OS practices, by Giuliana Rubbia, vice president of the Italian Association Women and Science and member of 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

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The Universal declaration of Human Rights states:

"Everyone has the right freely to 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)

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1. Checklist

WHERE TO START

- Read and watch videos about Open Science (OS) – *Here and there*
- Check the rainbow of OS practices - *Here*
- Find examples of OS projects made in your field to get inspiration – *Here*
- Take part on small trainings– *Here or there*

OPEN DATA

- Make your data clear and comprehensible, following the FAIR principles and providing 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 for processing your data.
- Upload your data in an open repository (specific of your field or generalist)

***Remember**: make your data as open as possible and as close as necessary!*

OPEN ACCESS

- Contact the librarians from 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

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research questions, collecting data, helping with the analysis and more!

PROPERTY

- Specify the license of your scientific products. When possible, use a Creative Commons License 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 do the proper use and attribution

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 to boost for Open Science
- Discover which funding programs incorporate and assess positively Open Science practices

METRICS

- Follow the new proposals for career assessment, as in the Open Science Policy Platform and Altmetrics
- Be open to the new publishing tendencies and reconsider your personal assessment of what impact of research is

[3] "Checklist - by tezar tantular" © The Noun Project | CC-BY-4.0

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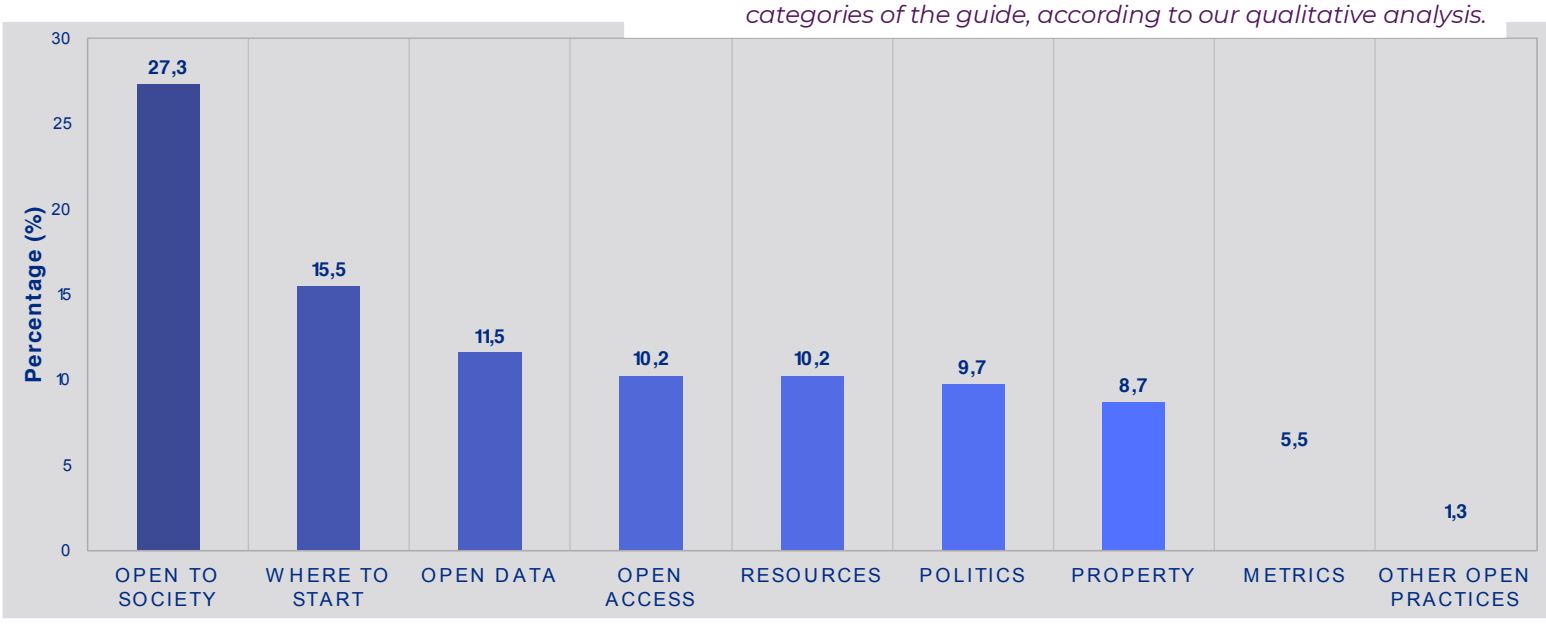
Frequently Asked Questions (FAQs)

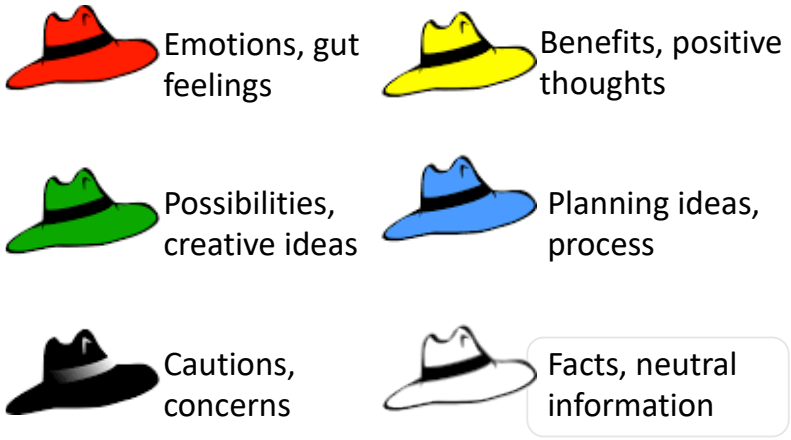
This guide presents a compilation of 39 questions frequently asked by researchers in regard to Open Science (OS). For two years, the project GRECO surveyed researchers from various geographical locations, mainly in the field of engineering and photovoltaic (PV) energy. This is outstanding, as we addressed a field of knowledge that has very little participation in the OS movement but possesses concerns and inputs 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. Also, as the graph clearly shows, the majority of comments gathered 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 took place coinciding 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.





The six thinking hats are a tool to structure thinking from different perspectives. We used this tool to gather information from researchers in relation to Open Science. "6 thinking hats" © Needpix.com | CC-BY-4.0

Moreover, although other categories of Open Science are quite familiar to researchers, as they clearly relate them to their professional tasks (collecting data, referencing, publishing, etc.), the category "Open to Society" faces a lot of criticism and concern. Many researchers agree that public engagement and science communication is not part of their task. In another study, Llorente *et al.*, (2019)[4] shows that some researchers consider that the task of communicating science outside academia lies in the hands of specialized 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, there is a high possibility of acceptance". Although positive, this statement does not imply action or engagement of 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 necessity to encourage science communication skills and purpose in early career researchers, as a way to Open Science, also to the non-expert part of society. 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."

[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

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WHERE TO START?

I guess I should read a lot to know what works.

Is it **worth it**?

This approach is **new** for me, I don't know much about it

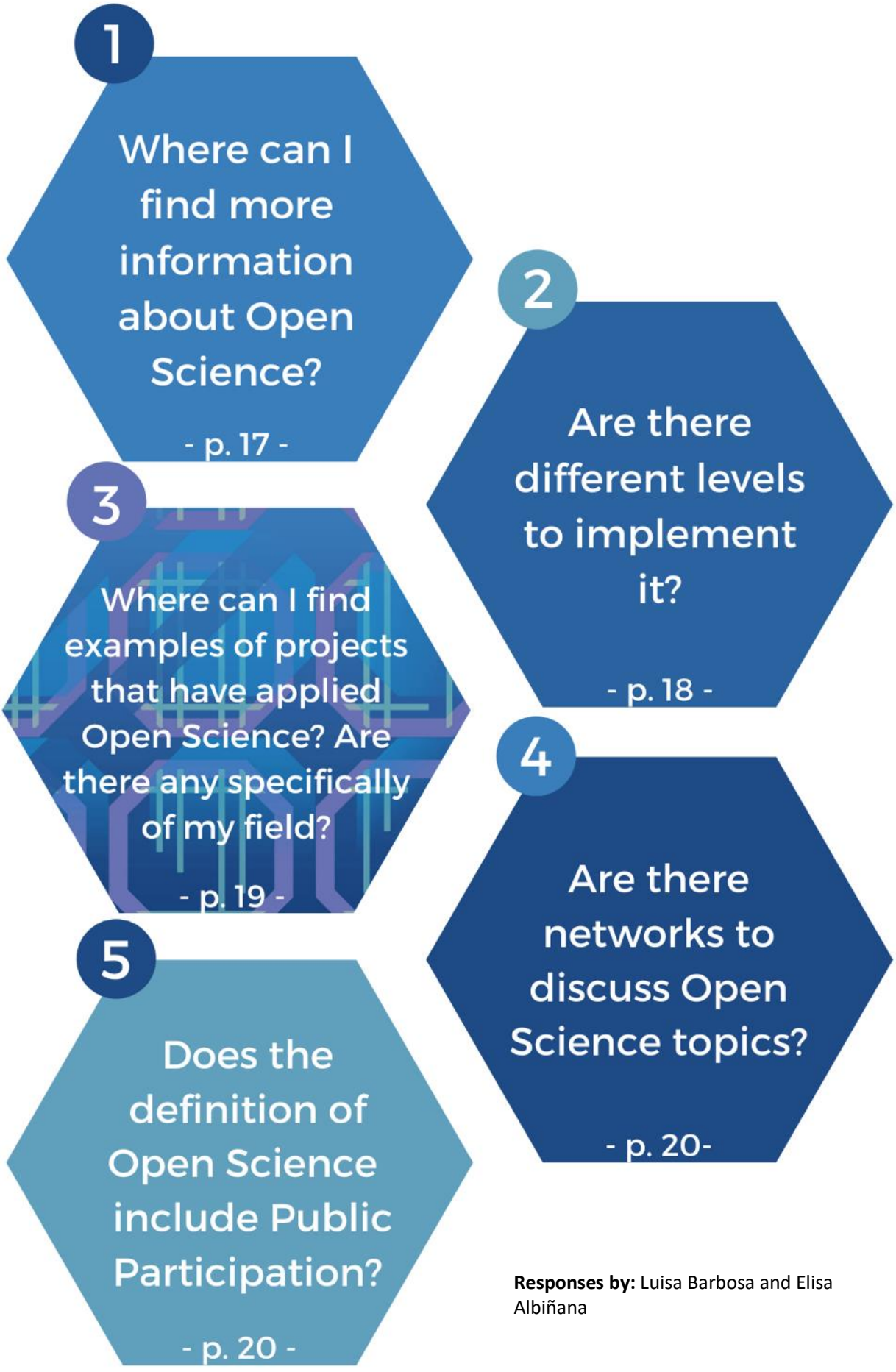
Like the rest of aspects of our society, I feel there is too much information and options that I usually **get lost**.

I would appreciate clearer guidelines and procedures

I feel **insecure**. I don't have the right background nor the right thinking framework

It has a **limited scope**: easier in basic science, more difficult in applied sciences and engineering

I am **forced** to **follow** this path without understanding it deeply



Responses by: Luisa Barbosa and Elisa Albiñana

1. Where can I find more information about Open Science?

There are different places where you can get informed and stay current about Open Science (OS).

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 a great amount of expenses, making several recommendations to implement it.*

The EU Open Science Policy Platform is the group that counsels the European Commission about which steps to take in order 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 walked 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 stablish the next move: to create a Shared Research Knowledge System by 2030, which would foster OS and all the practices that contribute to share and reuse reliable knowledge.

> You can keep up with their work following them on Twitter!

The Science, Technology and Industry Policy department from the Organisation for Economic Co-operation and Development (OECD) published in 2015 a report 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: Realizing a Vision for 21st Century Research" from the US National Academies of Sciences, Engineering, and Medicine, contains a chapter with OS design strategies and 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 re-use of data. Together with OpenAire, they provide technical infrastructure to harvest research outputs. Here you can find lots of info for open data management.

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

2. Are there different levels to implement 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, and describe examples and the corresponding tools for each one. Rainbow refers to that 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:

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, doing presentations or posters, you can use an open license, 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 that aims to involve society in the process of research (more about it the chapter "Open to Society").

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

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

There are platforms like the Center for Open Science (COS) which goal is to help researchers and projects to implement Open Science, assuring they're doing it 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 established a partnership with 68 journals [6] to use OS badges, icons that signal that the content of a paper is available and certify its accessibility in a persistent location. You may search for OS badges in the journals of your interest 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.

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

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 has been created by OpenScience4OpenSocietes, a non-profit organisation formed by scientists, research managers and media experts whose goal is to facilitate the implementation of OS.

[6] Current numbers in July 2020

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4. Are there networks to discuss Open Science?

FOSTER is a basic tool if you want to know more and learn about Open Science practices. They provide lots of training resources. In some of their courses, you can engage in debate with other colleagues, or contact the organisers in case you have a concrete question. FOSTER provides an OS toolkit, formed by ten online courses; and an OS training handbook, full of information and methods.

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 the questions you need in order to implement OS.

Finally, OpenAire is a pan-European interoperable 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.

5. Does the definition of Open Science include Public Participation?

Yes, Open Science includes public participation. Engaging with people outside academia is an essential practice if you want to implement OS completely; even though sometimes it's considered as something completely different and that lies outside of the research profession (see FAQs, p.11). 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, or in other words: the general public.

The line 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 make science useful and more directed to societal needs.

[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.

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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 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.

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OPEN DATA

Open data is not often available or the one that is available is **not as good** as private data

Data with open access, if not well explained, can lead to **interpretation problems**

Open data can promote **collaborations** or can benefit people who do not share

Sharing the research data is going to make us **lose competitivity** in our field

You can easily access public databases and repositories, so you get a better **understanding of the background** of a research

6

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

- p. 24 -

7

Is there still privacy for confidential data?

- p. 24 -

8

Doesn't "closed" data have better quality than open?

- p. 25 -

9

When shall I open my data?

- p. 25 -

10

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

- p. 26 -

11

How is archiving data going to give me some benefit as a researcher?

- p. 26 -

Responses by: Oscar Corcho, Sabine Haas and Pilar Rico

6. 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. No matter if it's open or closed, if you want someone else to use the data, it should always be well documented.

A good documentation is reached by adding metadata to your data, which provides additional information. It should include aspects that go from description and units of the parameters, to sources and copyright information. There are existing schemes that you can use, both general-purpose (e.g., Data Catalog Vocabulary, DCAT) for the representation of data such as authorship, update frequency, available formats, etc., and domain-specific for the description of aspects that are relevant to a specific scientific domain or format (e.g., the specification of a bounding box and scale in geography-related datasets).

This information ensures findability, accessibility, interoperability and the reuse of your data (FAIR principles). It's useful to create an ontology to find a common way of expressing things which then helps to ensure the correct understanding of metadata and data.

A set of concepts and categories in a subject area that shows their properties and the relations between them.

7. Is there still privacy for confidential data?

Yes, of course! OpenAIRE has developed a data anonymisation tool called Amnesia. Amnesia allows to remove identifying information from data. Amnesia not only removes direct identifiers like names, Social Security Numbers, etc. but also transforms secondary identifiers like birth dates and postcodes so that individuals cannot be recognised in the data.

Here you find a guide on how to deal with sensitive data according to OS principles.

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8. Doesn't "closed" data have better quality than open?

Not necessarily. Quality does not need to be associated to the openness or closedness of data, but to the processes that are used for data acquisition, curation and preservation, which 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 stablished. 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.

9. 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 do not wait until the results of your experiments are published.

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

10. How can I put in practice the FAIR principles? Is it difficult?

The **FAIR principles** are: **F**indable, **A**ccessible, **I**nteroperable and **R**eusable!

It 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 is archiving data going to give me some benefit as a researcher?

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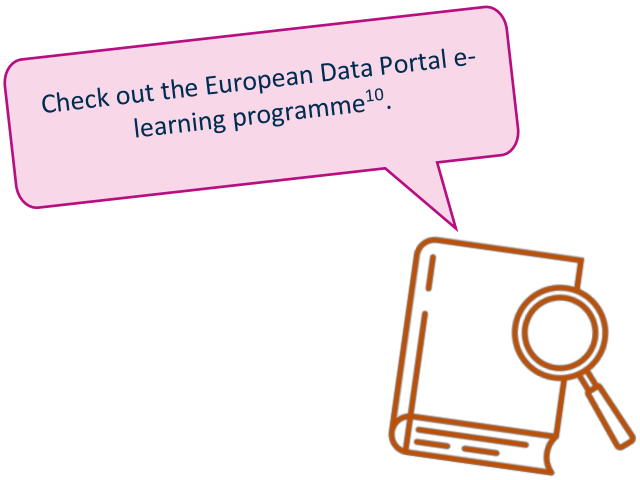
First of all, having a good archival and preservation strategy will provide you the guarantee that you will never lose that data that you needed so much time to capture and curate (something that may happen if you do not have a specific strategy and you store your data files in, e.g., Dropbox). Besides, 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 research data sharing from the researchers' point of view. In 2014, they published the report "Incentives and motivations for sharing research data, a researcher's perspective". The repot stresses that data sharing actually keep your research safe and secure, increase your research efficiency and improve its integrity, make your outputs more visible and encourage 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

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OPEN ACCESS

Publications in open journals are going to be more **expensive** for us

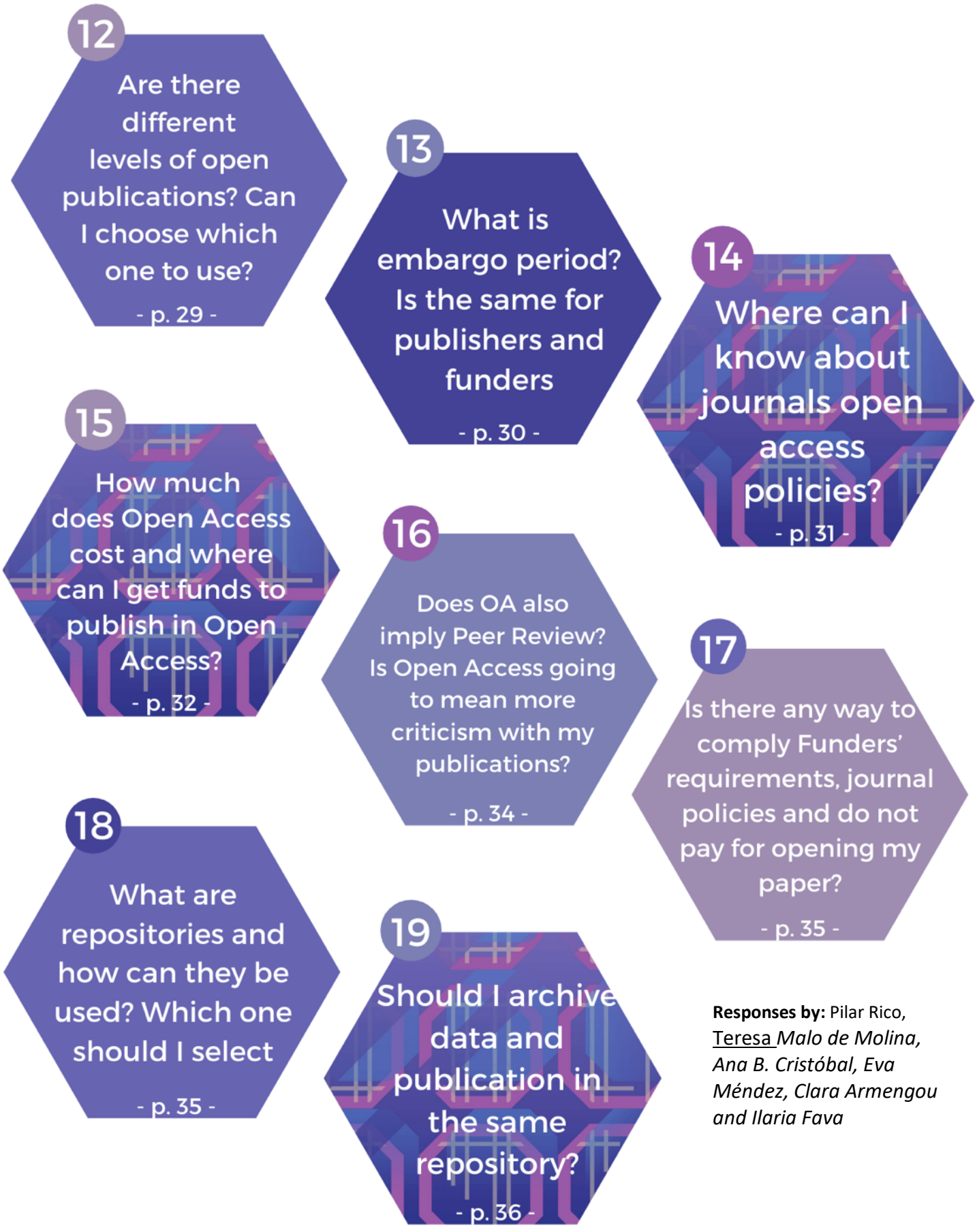
Open journals **make money** out of it

It **saves time** (and **money**) avoiding repeating research and promoting synergies

Making all results and findings open will expose them to more **criticism**

Surely journals and companies that make money of publications don't want them to be open, as they will lose subscribers.

I believe it's a difficult subject because **money** is involved



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, neither to the researcher 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 since 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

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publishers' agreements. These costs are called Article processing charge, or APC.

- ✓ In some paywalled 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, 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 in an institutional or thematic repository an OA version of their published work – no matter if it had been published in an open access journal or in a subscription access journal.[11]

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 goes from the formal publication of the article until its Open Access publication (authors can't put it in an OA repository meanwhile). 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 go from 6 months until a couple of years. Each publisher and journal have its own policy about this aspect.

The concept is the same for publishers and funders. However, embargo periods imposed by publishers to authors may be longer than embargo periods allowed by

[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

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funders. With the Hybrid model of OA, authors pay the corresponding APCs to the journals to get the possibility of OA to some of the articles. By this, the author complies 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 made with public funds, allow short embargo periods. In Horizon 2020 from the European Commission, the embargo period is 6 months, but it can be expanded to one year in the case of social science and humanities. Other national laws establish maximum 1 year for an embargo period.

14. Where can I know about journals open access policies?

The Open Access policies can vary from one publisher to another, but also within the same publisher in different journals. In order to know about open access policies of a publisher or a journal, the copyright issues and if there is a possibility of including it in a repository, there are some data bases that you should know: Sherpa Romeo is the international one. 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 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.

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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 to have a document in Open Access. For instance, some journals allow you to publish the preprint version (which is not Peer Reviewed) in an open status somewhere else, others allow publishing openly the postprint version (which is already Peer Reviewed but not in the journal layout) and others allow making available the open publication of the publisher's version in PDF 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 journal meets with your funder or institution requirements, your academic goals and they 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 paywalled journals that are recognised inside their scientific field. The route called Gold Open Access means these journals publish openly. It doesn't necessary imply that you'll have to pay for opening your paper, but journals could demand a publication payment called Article Processing Charge (APC) that depends on the publisher's policy.

Nowadays, the publishing pathway of some renown scientific journals require 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

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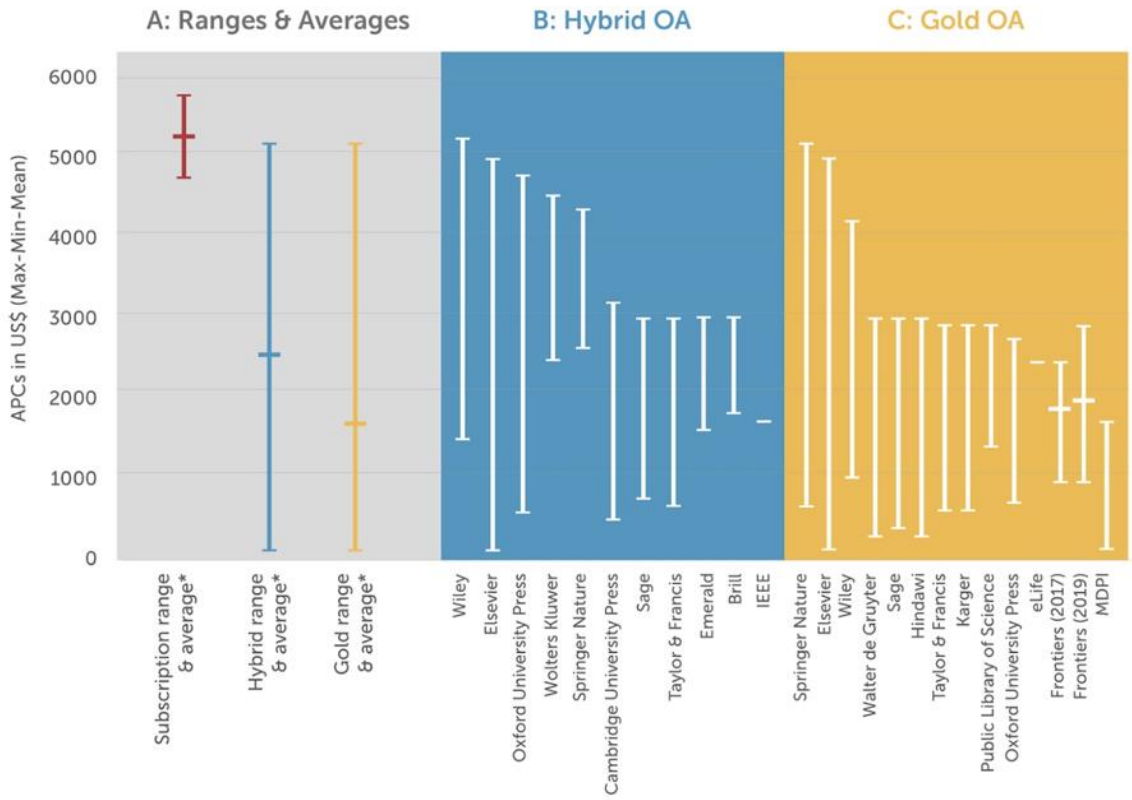
depends mostly on the impact factor of the journal (IFJ), the knowledge discipline and the number of pages of the article.



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 upcoming years.

APCs are eligible direct costs for most funding agencies. Generally, if the Funder demands you open publications or data, the charges will be included in your project financing. The problem is when your financing is not that good so it's difficult to cover all the costs. Sometimes, institutions cover the fees of an 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

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by universities and other Higher Education Institutions, funders or national consortia and is published on GitHub under an open database license.

Example from the energy field

In the area of energy and physics, Green OA tends to be allowed freely without 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 can be rejected). Another problem may arise if your funder sets a maximum embargo period and a specific repository. This embargo period may not agree with 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 take less than 5 minutes to read.

16. Does Open Access also imply Peer Review? Is Open Access going to mean more criticism on 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.[12] Open Access does not mean more criticism on 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 collaborations and opportunities to new funding sources. It also saves the time researchers invest 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)

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17. Is there any way to comply funders' requirements, journal policies and do not pay for opening my paper?

Yes! Many funder's OA requirements are based on Green Open Access, like Horizon 2020. The obligation to archive in an institutional or thematic repository an OA version of the published work is free of charge if authors do not give up their copyright in favour of the publisher for a longer period than funders allow them to do so. [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 at the Publisher 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 watch out if you are meeting 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 to identify, locate and preserve the data. The metadata and the access protocols follow international standards. The most spread access protocol is the OAI PMH,

[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*, Nº. 15, 2019. https://revista.uclm.es/index.php/ruiderae/article/view/2166

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which allows the interoperability of every repository that follows it, so that you can recollect 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 correct 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 has a robust preservation plan to ensure the data is preserved permanently.

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 to choose 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 politics 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. That is why many repositories make a differentiation between the two of them.

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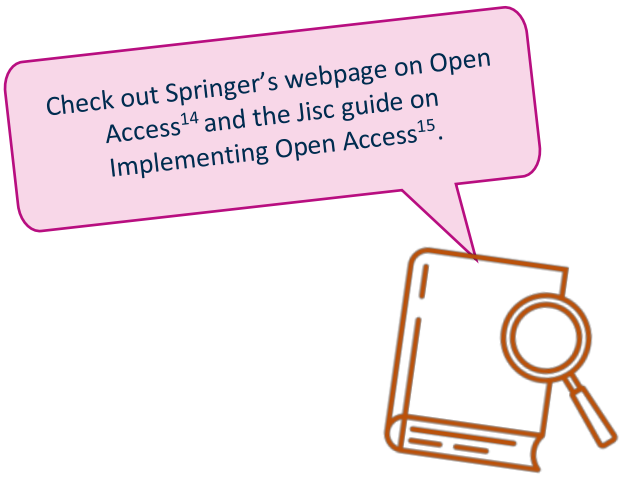
As a researcher, you should consider the FAIR Data Principles when depositing data (Findable, Accessible, Interoperable and Reusable, see question 6 and 10). There are some conditions in order to obtain this: data must have a unique identification assigned, present a detailed metadata, data and metadata must have an accessible license 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

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OPEN TO SOCIETY

I fear greater **complexity** because of differences in viewpoints and opinions

I feel a bit **skeptical** about citizen science

Dialogue with stakeholders makes it possible to see from different angles: having a **higher understanding** of the whole scientific problem.

It will make my project better, more **pluralistic in views**

The **human being** is the focus, not the Nobel prize or the budget of the institutions

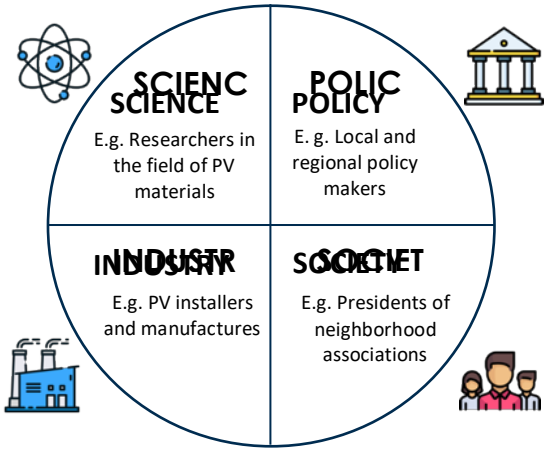
Do I really want citizens to intervene?

Responses by: Luisa Barbosa, Gema Revuelta and Elisa Albiñana

20. Who else should I engage outside academia and how?

The stakeholders 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 simple, you should be considering representatives of the following sectors:

People or organisations who have an interest in your research, affect or are affected by its outcomes.



These two websites present different methods to open your project and instructions on how to choose and do.

ActionCatalogue
http://actioncatalogue.eu/search

involve
http://www.involve.org.uk/resources

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
Mobilization and Mutual Learning (MML)
Dialogue events that allow stakeholders to share their opinions, expectations and concerns on a certain topic

Some 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 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?

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 actually made up of all kinds of people with wide range of expertise. Some examples of scientific debates with citizens in the field of Artificial Intelligence, solar photovoltaics and neuroenhancement 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, policymakers 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 define which solution would be most beneficial and relevant, considering the possible impacts of each one.

SuperMI (NERRI project)

SuperMI was a series of citizen debates about neuroenhancement to increase cognitive abilities in healthy people (to have a better memory, calculate faster, etc.). 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.

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22. Is Citizen Science useful?

Researchers that use citizen science can a) conduct studies that would be impossible otherwise because of the amount of time or 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.

Citizens can be involved in the research process from different angles:

DEFINE RESEARCH QUESTIONS: E.g. CitieS-Health

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

COLLECT DATA: E.g. Generation Solar

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 developing more accurate models of future energy systems and helps promote clean energy.

ANALYSE THE DATA: E.g. Galaxy Zoo

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.

[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).

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WRITE AND PUBLISH PAPERS: E.g. EteRNA

EteRNA is a game where users solve puzzles to figure out the folding of RNA molecules or 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, 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/

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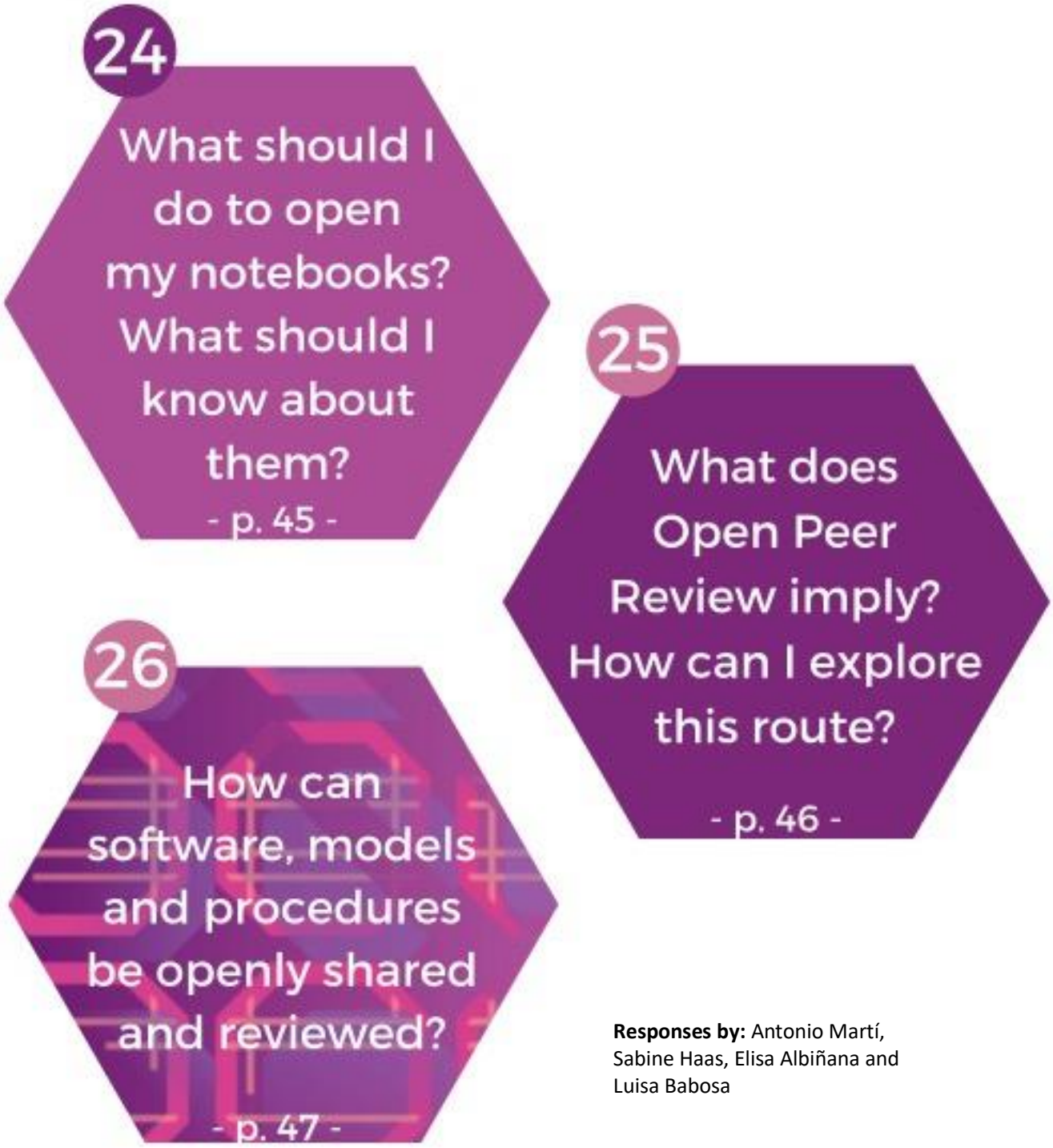
OTHER OPEN PRACTICES

What **tool** is good for having open **notebooks**?

Open Science is **not only Open Data**. I think there is a risk of staying only there

It does not help at all because there are many **mistakes** and it's **not useful**

I can improve my research by getting **feedback**



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 to 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 by learning the choice is not easy. 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. Price on commercial solutions can increase with time. Will you be able to afford the payment of the software license 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 improve your choice 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 also time for that.

4) Once you decide to do the move, encourage everybody to use it.

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

Open Peer Review (OPR) was originally defined 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 license. Besides, the decision letters after the review and author responses will be public too (for accepted papers only). Referee names will only be disclosed under 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).*

For instance, PubPeer is a non-profit 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.

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

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement N°787289

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 license, you can make it available for everyone, free of charge and allow to use it according to the terms of the license.

The GitHub workflow[22] enables discussions, code reviews and easy collaborations. The development of the software is made transparently, because discussions are archived (in so-called "issues") and changes in the code are 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

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PROPERTY

I fear getting innovations and **ideas stolen**:

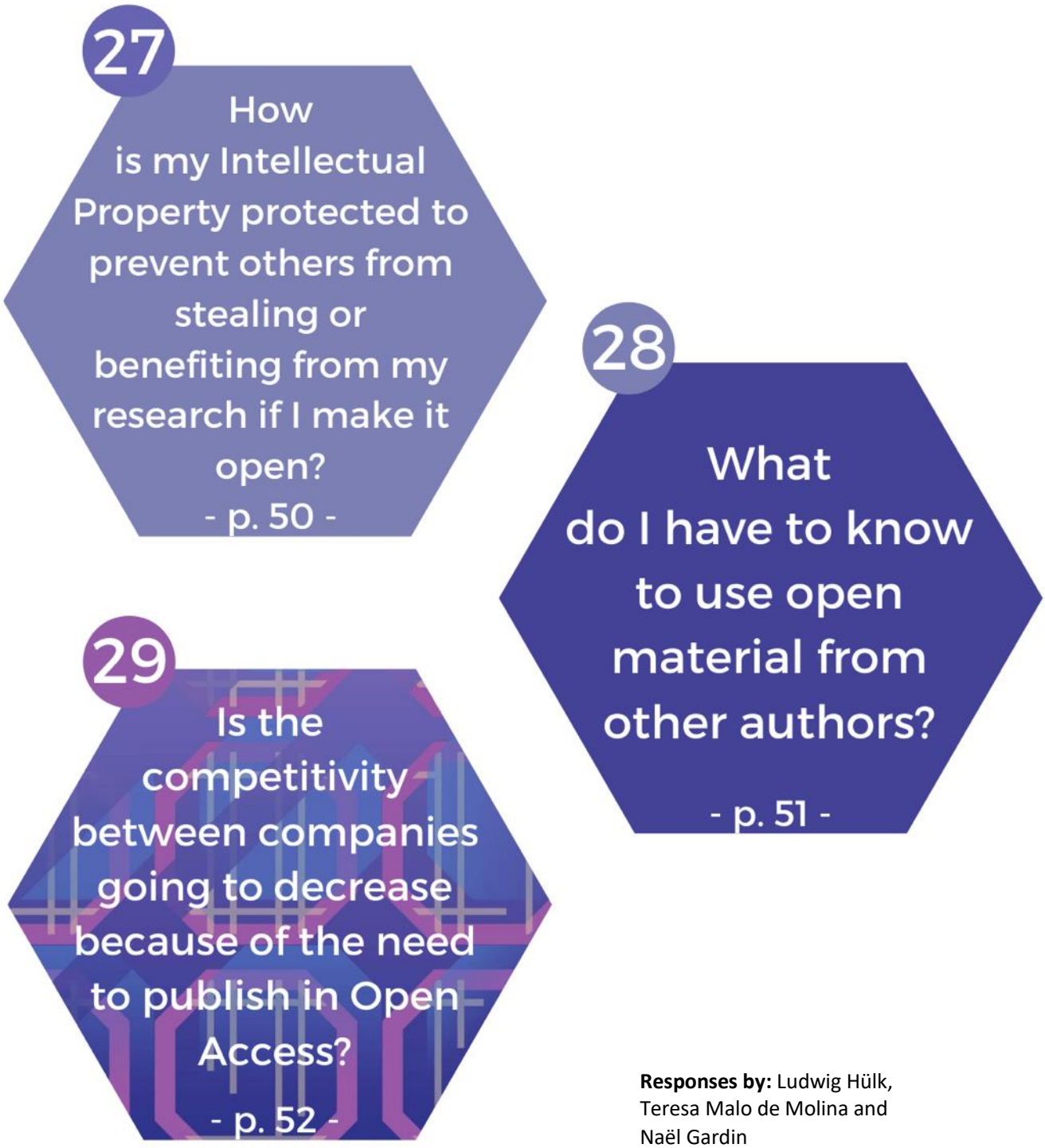
If me or my institute is not acknowledged, we don't get funding any more

Conflict of **interest** with patenting and economic usage?

Are there **control** and prevention systems to ensure intellectual property?

Public money, **public good**: It's enough that you are payed you don't have to be mentioned!

Greater **competition**. It can be a problem for companies because there is a need to share everything.



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

27. How is my Intellectual Property protected to prevent others from 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 side, the underlying data, methods (models, processing scripts) and results (plots, graphics) are still protected. Publishing and applying suitable open licenses to these materials grant the "rights" (also called freedoms) to hold a copy, 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 the audience of a certain scientific journal. Open Science provides the right tools and methods for this. In contrary, when research is done using public funds, it has been already paid 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 licenses increase the scientific credibility and legitimacy, and the improvement of cooperation and collaborative development. Current identified barriers are the need for knowledge and experience of the legal implications, additional effort, and the personal and institutional reservations in a performance-based science system.

28. What do I have to know to use open material from other authors?

If you want to use open material from other authors, you should first know the license they have adopted or signed so you can use their work properly. This license will indicate the type of openness the author is using and what actions you are

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

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allowed to take. In the Open Science field, it's recommended to use a Creative Commons License, which is based on four principles:

- Attribution, the author requests that their authorship is always recognised.
- Equal Sharing, the author requests that any other publication that is based on theirs must use the same Creative Commons License that the first author has used.
- No By-products, the author doesn't authorise any alteration of their work; and
- No Commercialisation, the author wants to prevent their work from commercialisation.

The combination of these four principals leads to six different kinds of licenses, two of which are totally open:

- CC BY: The recognition of authorship is requested.
- CC BY SA: The authorship as well as Equal Sharing are requested.

Another option would be to adopt the Public Domain license (Ø), which does not include any restrictions and is the one recommended in the Open Science field.

29. Is the competitivity between companies going to decrease because of 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 get a better understanding of 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 not incompatible: 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.

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RESOURCES

We lack **time**... and **capabilities**! (OS has too many aspects; it is good for a team, not for a person)

You **need money** to actively be an open scientist

It can **increase** the already huge **workload** of scientists

It will consume **time** I need for research

There might be a large amount of additional work. However, **I like the idea**

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, sharing with your colleagues 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 a 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 on a specific research topic, sometimes very specialised, where you honestly think that you can contribute. Making the exercise to align with the societal demands implies a change of mind: it is not about going from your expertise to society, but to "listen to society" (which is not an easy task!) and keep questioning and re-orienting your research, if needed.

Another point in this change of mindset is that you will have to recognise that you do not know everything: you will need to talk to people from other disciplines, sometimes far from those that you are familiar with, and learn to work together.

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 used already 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 to its best when done in teams and communities, however, of course you can start a project on your own. If you find interested people you will be able to get feedback and maybe even motivate them to contribute. *-Sabine Haas*

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31. Will I need additional time to apply OS?

You will. And, what may be more painful, it will not be time recognised in your research career, nor time that will produce tangible results in the short time. But 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 distributed, your OS practices enrichen through contrast and debate, and the feeling that you are not alone will motivate you.

Also, note that nowadays there is a huge number of tools available to facilitate the practice of Open Science and Citizen Engagement (see chapters "Where to start?" and "Open to society"): lots of collaborative tools and platforms from where to pick those that better suit 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 close 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 it 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

To open data and publications will require to insert proper metadata in a repository. Open Data practices will request more time from you since the preparation of FAIR datasets is not standardised, it needs some work from you to adapt. From our experience, for other open science practices you could be interested in, you will need extra-time to learn Open Code or Open Software practices. *-Ana Belén Cristóbal*

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32. Is Open Science more expensive?

It is hard to quantify. Although currently there are some concrete fees that have to be paid in order to implement OS (as for infrastructure and services)[26], the saved costs 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 movement towards OS implies acquiring new knowledge and skills. Therefore, investing time to learn is crucial (see question 31).
- Article processing charges (APCs) in the Gold Open Access path. APCs cost around €1.000 - €1.200 euros 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 (to involve other publics) requires proper planning, human resources and consumables. Many institutions may have a supporting communication department to collaborate with. If that's not the case, there is a need to hire a professional science communicator. 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.

33. Does Responsible Research and Innovation (RRI) and OS mean more bureaucratic work?

[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

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From our experience, Open Science does not imply more bureaucracy. It does, however, require researchers to be aware of societal 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 and or your institutions 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 are a blockage to research but an opportunity to engage in an open way with a wider cohort of participants that will enrich research outcomes. It is important that RRI does not deter researches 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. A bottom up desire exists from researchers to ensure that their research produces meaningful outcomes for society whilst top down pressures now exist for Institutions to promote RRI. These trends can be reinforced if institutions recognise and reward leading researchers applying RRI and Open Science and direct resources to research projects that adopt these principles.

34. Will I need powerful infrastructure, IT or other resources alike?

Not necessarily. There are general-purpose and domain-specific platforms that will normally 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 alike.

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POLITICS

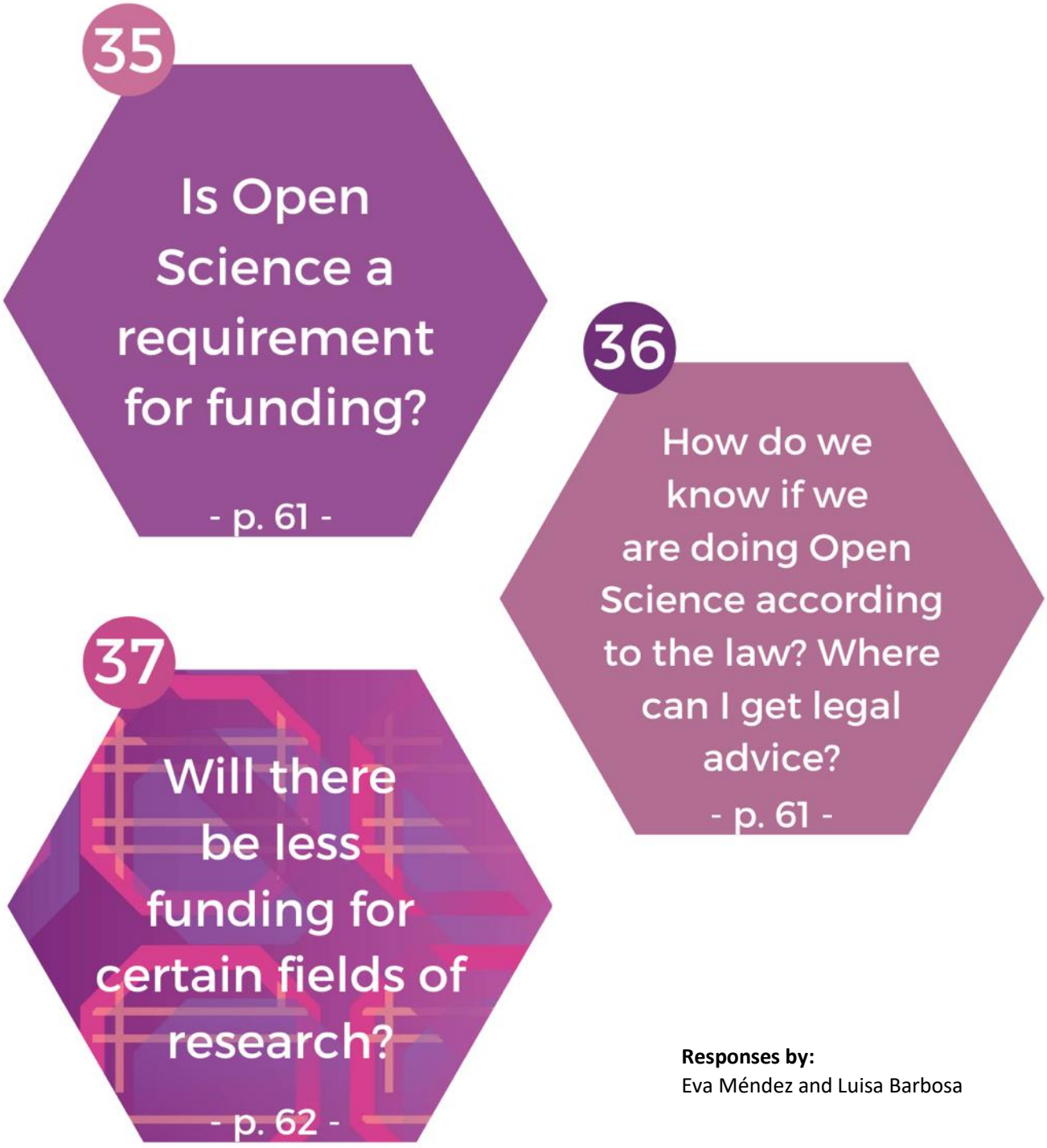
Am I in danger of **loosing funding** if I do not meet requirements or expectations?

Society and researchers can push to promote changes, but the current **system has to change** in terms of politics and science evaluation

This does not have the **acceptance** of my superior

I fear I might do something **illegal**

Is it a **condition** for all Funding Programs?



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 troubles. Some aspects from OS you should consider from this "legal" perspective are:

Licenses. Be sure you use open licenses 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 licenses 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. Meaning 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.).

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METRICS & INCENTIVES

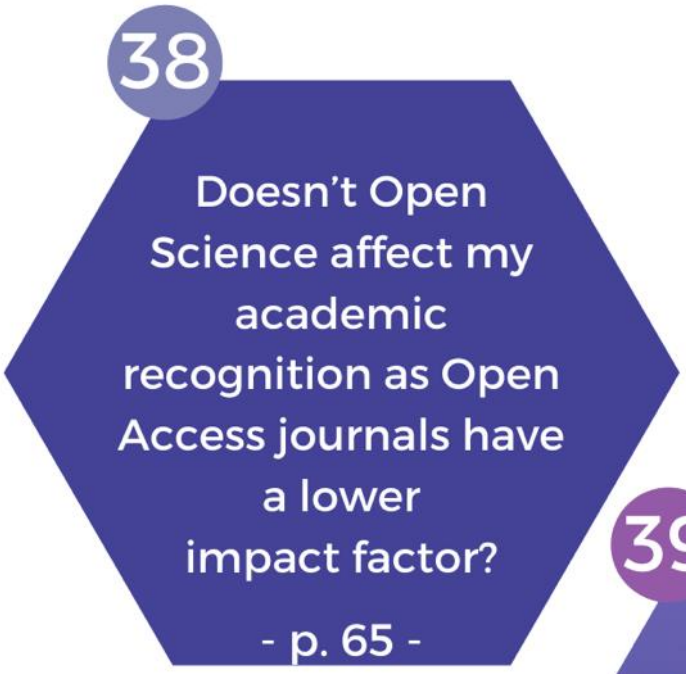
The whole way of doing research is evaluated in **contradiction to RRI**

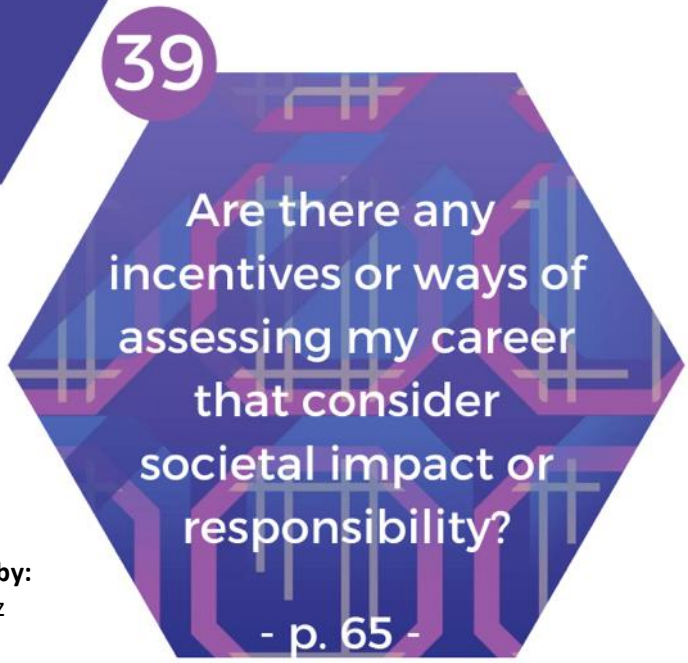
My publications could **lose importance** (lower impact index) in favor of greater visibility

Publishing in open access makes it **harder** to have a conventional academic **career**

I would like to find **appropriate** and **meaningful metrics** about how the RRI approach influences our research, our group, our values...

There are no Open Access journals in the **first quartiles**, and when they evaluate researchers profiles it's the first thing they check





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 since we're trying to place Open Access and other concepts related to the open knowledge practices in the current narrow and out-of-date scientific communication system.

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 to be cited. Open Access and further Open Science practices will have a bigger IMPACT of your research. The 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, what's more, perpetuating the JIF as the only means of recognition will damage science.

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 focused on diversifying career paths and stimulating Open Science practices.

There's also new research evaluation frameworks, that are changing national scenarios of 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 indicators' frameworks.

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BENEFITS

The following comments highlight the benefits of Open Science according to researchers

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

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

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

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

The use of RRI is necessary, especially in countries where the **resources** for research are very **limited**.

It provides more **opportunities** to scientists with less resources.

OS helps **gathering resources** of several researchers: findings bugs, working together.

This leads to outcomes with **higher quality**.

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

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**

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

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

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

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

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

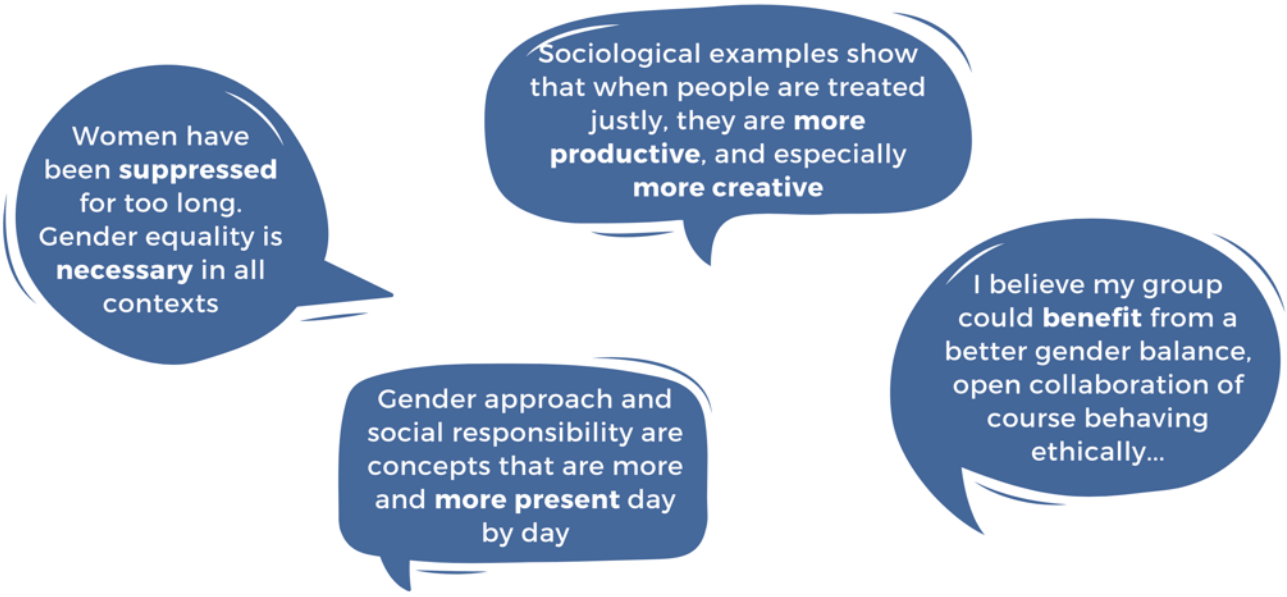
OS allows **transparency**, scientific advance, **reliability** of results and reproducibility

Gender and Open Science

Interviewed researchers recognize 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 actions**, and there is a genuine need to know which actions 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 a 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 actions available to improve both researchers' lives and quality of research from a gender perspective. **Encouraging mixed teams, mentoring, networking, allowing for work-life balance, contrasting violence in the workplaces** make the working environment more productive; mobilising different stakeholders and collecting gender-disaggregated data, to be analysed in combination with other factors, allow for more **societal acceptable research results**.

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



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research and innovation are working, for which they could provide different and innovative solutions. Not committing women in technical solutions would be a waste of new ideas. It is not only 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 approach this and other gender issues in Open Science, it is worth it to take a look 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 address gender issues in a way. However, as synergies can be found between OS and gender studies, relying on cooperation and transparency for a broader access to knowledge and the whole research process, as in Open Science, can help gender equality.

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Document history

This guide has followed an open peer review and participatory process with many people involved. Below you will find the history of 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.,
2	30/07/2020	Revision done by the European Science Communication Institute	Schwald, R., Barbosa, L., Albiñana, E., Revuelta, G.
3	16/09/2020	Revision done during a meeting organized by the project Super MoRRI with experts in the field of open science, citizen science and Responsible Research and Innovation	Meijer, I., Barbosa, Revuelta, G., L., Honrado, A., Cristóbal, A.B., Kriszt, B., Llorente, C., Quinti, G., Schwald, R., Daniel, O., Turkeli, S., Ceccaroni, L., Colonnello, C., Raul, Mahmoud, K., Hartman, A., Otero Hermida, P., Hülk, L., Stahl, B., Armengou, C., Philipp, S., Tash, A., Mariani, I., Wintjes, R., Schmittinger, F., Rashkowski, R.M., Rizzo, F., Fava, I., Holtrop, T.
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.

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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.
9	2/12/2020	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.

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GRECO

DISCLAIMER

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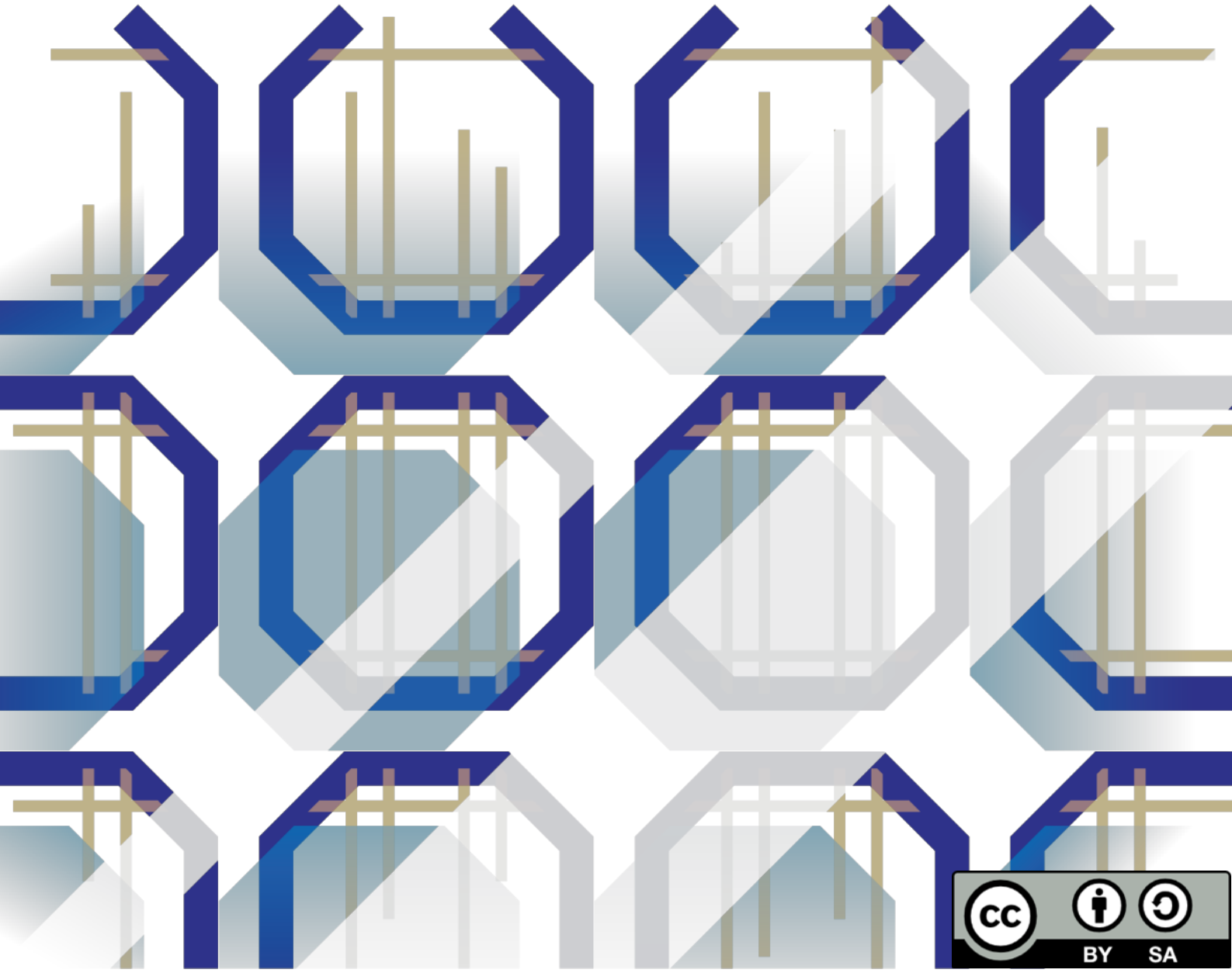

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