



# Open Science and its Benefits and Challenges: an Overview from the European Perspective

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# Agenda

- Open Science Definition and Principles
- Open Science in Europe
- Open Science in Germany
- Benefits and Challenges of Open Science
- Responsible Research & Innovation



# Open Science Definition and Principles



# Definition Open Science

„an inclusive construct that combines various movements and practices aiming to **make multilingual scientific knowledge openly available, accessible and reusable for everyone**, to increase scientific collaborations and sharing of information for the benefits of science and society, and to **open the processes of scientific knowledge creation, evaluation and communication** to societal actors beyond the traditional scientific community.“

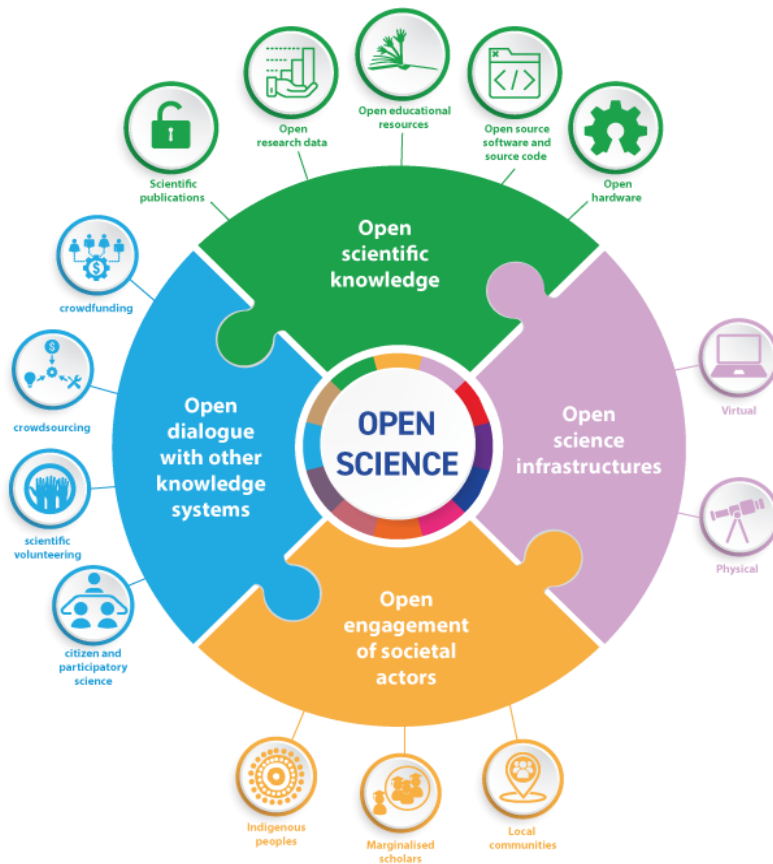


# Goals of Open Science

→ increase transparency, re-use, participation, cooperation, accountability and reproducibility of scientific knowledge

- speed up research progress
- increase trust in research results
- avoid waste of resources
- reduce inequality, particularly in access to science
- make publicly funded research public

# Key Pillars of Open Science



Open Scientific Knowledge: scientific publications, research data, software, source code and hardware in the public domain or under an open license

Open Science infrastructures: scientific equipment or sets of instruments, knowledge-based resources such as collections, repositories, archives and scientific data, open computational and digital infrastructures

Open engagement of societal actors: citizen and participatory science and other extended collaboration between scientists and societal actors beyond the scientific community, opening up practices and tools that are part of the research cycle and by making the scientific process more inclusive and accessible to the broader inquiring society

Open dialogue with other knowledge systems: recognition of complementarities between diverse epistemologies, incl. indigenous knowledge systems

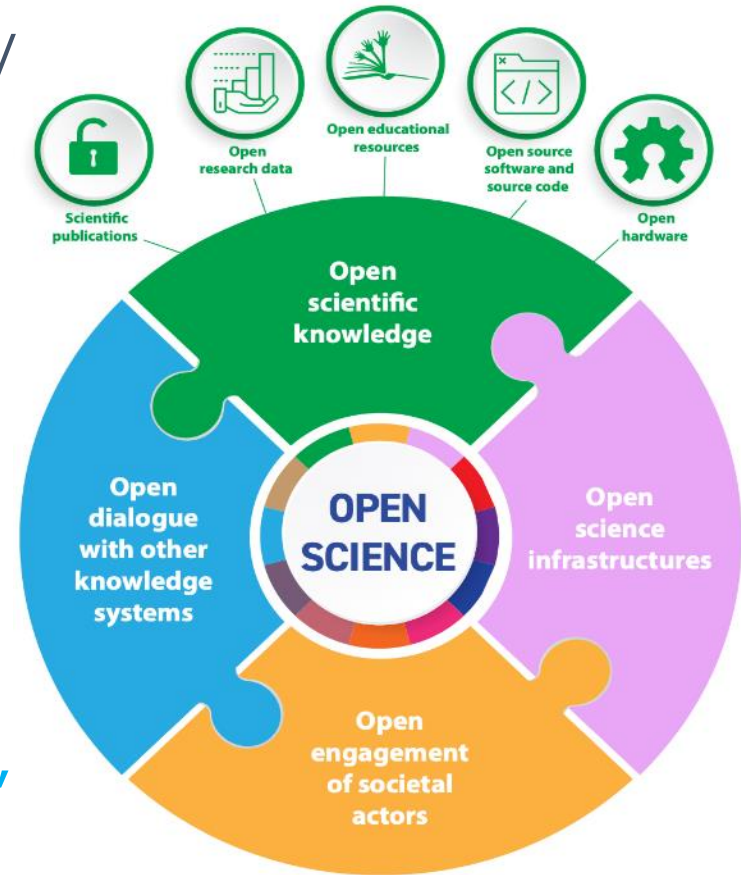


# Open Scientific Knowledge

open access (OA) and public domain / open license for:

- scientific publications
- research data
- open educational resources
- software and source code
- research methodologies
- evaluation processes

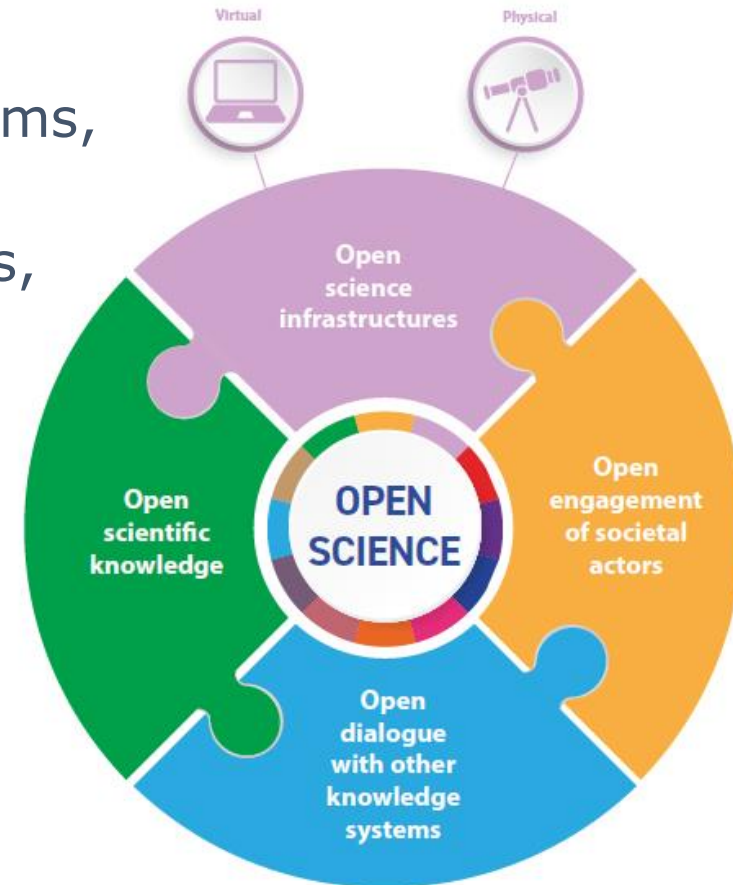
→ improve access, re-use, repurpose, adaptation and distribution



# Open Science Infrastructures

- scientific equipment or instruments
- publication and research data platforms, repositories, archives
- current research information systems, bibliometrics systems
- virtual research environments and digital research services

→ enable collaborative and multidisciplinary data analysis

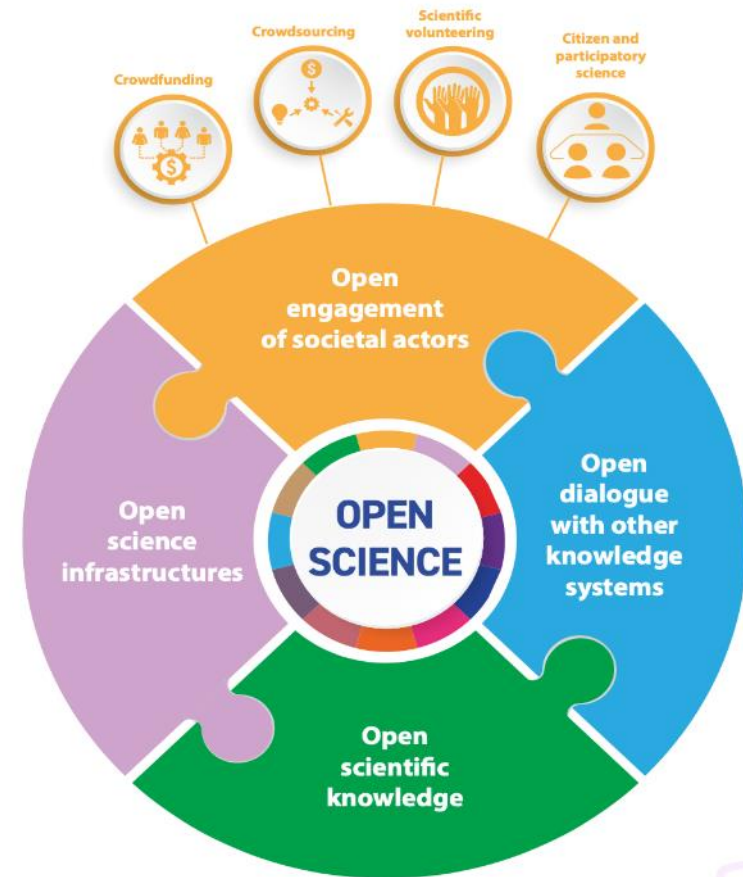




# Open Engagement of Societal Actors

- opening up practices and tools
- making the scientific process more inclusive and accessible to the broader inquiring society (citizen science)
- crowdfunding, crowdsourcing and scientific volunteering

→ extend collaboration between scientists and societal actors

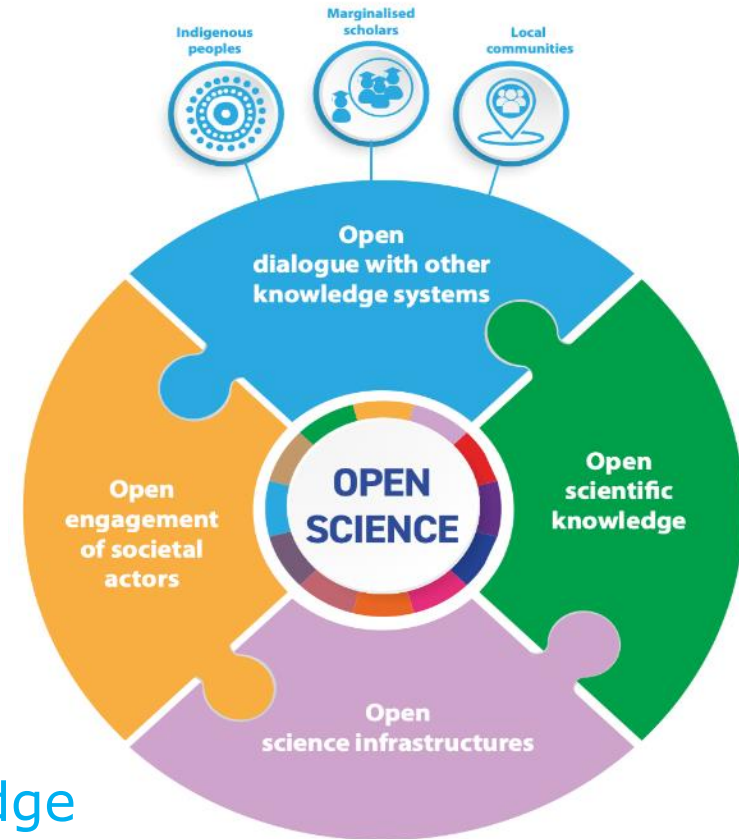


# Open Dialogue with other Knowledge Systems



- inclusion of knowledge from marginalized scholars
- adherence to international human rights norms and standards
- respect for knowledge sovereignty and governance
- recognition of rights of knowledge holders

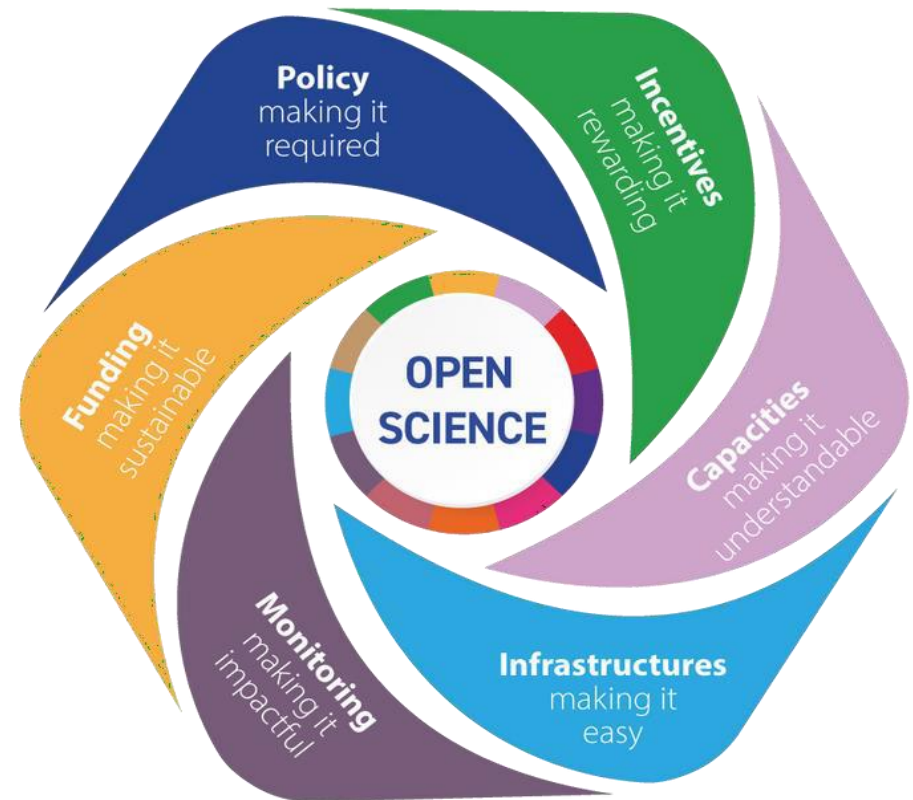
→ recognizes the diversity of knowledge systems and knowledge producers



# How to Implement Open Science?

→ In order to effectively implement Open Science, behavioral change needs to be implemented at the societal, institutional and individual levels.

→ Science policy, funding and research assessment play a major role.







# Open Science in Europe



# Plan S



- CoalitionS started in 2018: research funders (incl. Gates Foundation, Wellcome Trust, European Commission, European Research Council) to support open access transformation
- Plan S: 10 principles to guide open access

“all scholarly publications on the results from research funded by public or private grants provided by national, regional and international research councils and funding bodies, must be published in Open Access Journals, on Open Access Platforms, or made immediately available through Open Access Repositories without embargo.”

# Horizon Europe

- 2021-2027 research funding initiative by the European Commission
- Mandatory open access to peer-reviewed publications, generated research data (as open as possible) and data management plans
- Open Research Europe = open access publishing platform
- Numerous projects for the European Open Science Cloud (EOSC)

„Open science practices are addressed and evaluated under ‘excellence’ as they are considered a part of the methodology.“  
(Horizon Europe Programme Guide)



# Research Integrity Guidelines

- rules and modes of behavior to ensure good scientific practices
- reproducibility of research results as a core requirement
- European Code of Conduct for Research Integrity

“Open Science can be understood as a toolbox of digital practices that make assumptions, processes and results of research transparent, reproducible and reusable and facilitate their open communication.”

# FAIR Principles

- developed in the context of Force 11: coalition to reform the publishing system
- FAIR = Findable, Accessible, Interoperable, Reusable research data
- guide research data management initiatives (e.g. EOSC, NFDI)
- specifications in different disciplines
- FAIR ≠ open: access restrictions are compatible with FAIR principles



# OpenAIRE



- Open Access Infrastructure for Research in Europe
- EU funded since 2008, since 2018 independent legal entity
- service catalog of open scholarship services (e.g. Zenodo)
- network of 37 National Open Access Desks incl. country pages with information

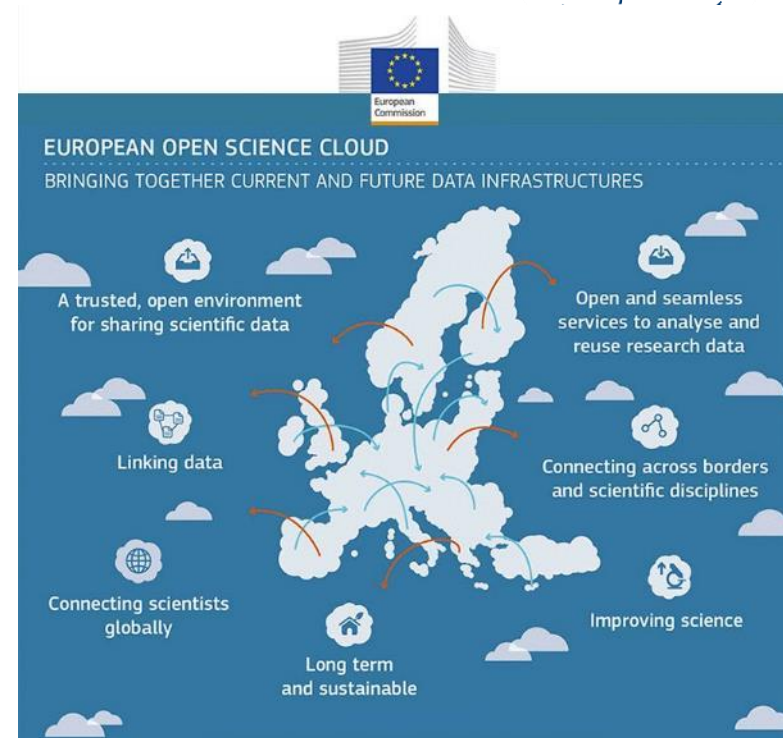


→ “improve discoverability, accessibility, shareability, reusability, reproducibility, and monitoring of data-driven research results”

# European Open Science Cloud (EOSC)



- started in 2016 to improve exchange of research data
- goals: seamless access, FAIR management, reliable reuse of research data / other digital objects
- diverse projects to work on operationalization



“provide European researchers, innovators, companies and citizens with a federated and open multi-disciplinary environment where they can publish, find and re-use data, tools and services for research, innovation and educational purposes.”





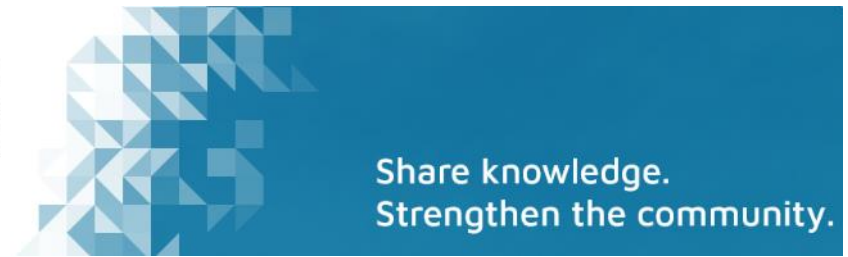
# Open Science in Germany



# Federal Ministry of Education and Research (BMBF)



- regulatory and funding measures
- secondary publication right for scientific articles = can be made publicly accessible after a period of twelve months if research publicly funded
- funds OA network information platform and other OA projects (24 in 2024)
- 2021: Action Plan Research Data: measures and project funding for data infrastructures, improving data literacy and data sovereignty





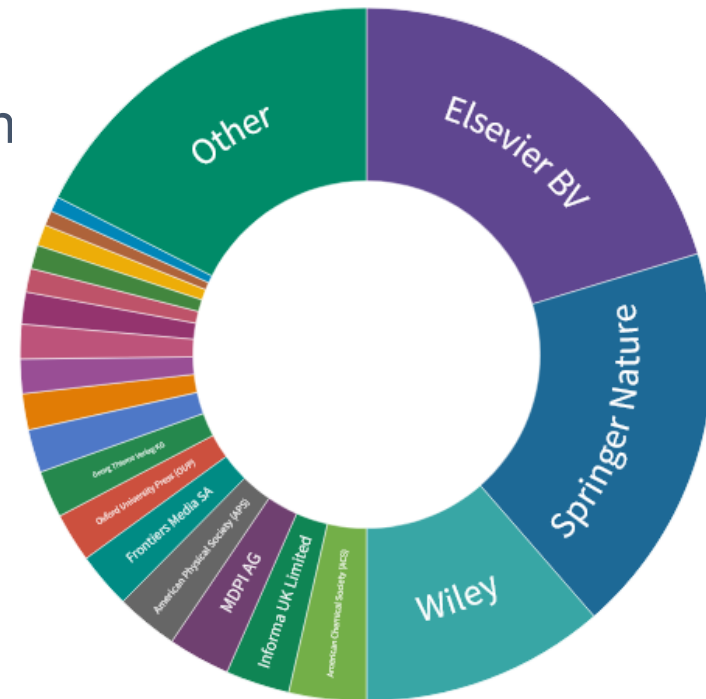
# German Research Foundation (DFG)



- funding programs for:
  - implementation of OA (e.g. infrastructures, journals, publication costs)
  - development of open science infrastructures (data, software)
- participation in (inter-)national networking and policy initiatives
- contributions to the development of (inter-)national open science infrastructures (e.g. EOSC)

# DEAL Open Access Project

- 2014 initiated by the German Alliance of German Science Organizations
- negotiate nationwide OA licenses with Elsevier, Springer Nature & Wiley
- all German publications OA + access license for participating German institutions
- Publish and Read (PAR) Fee
- consortium contracts until 2028
- supportive funding from DFG for institutions



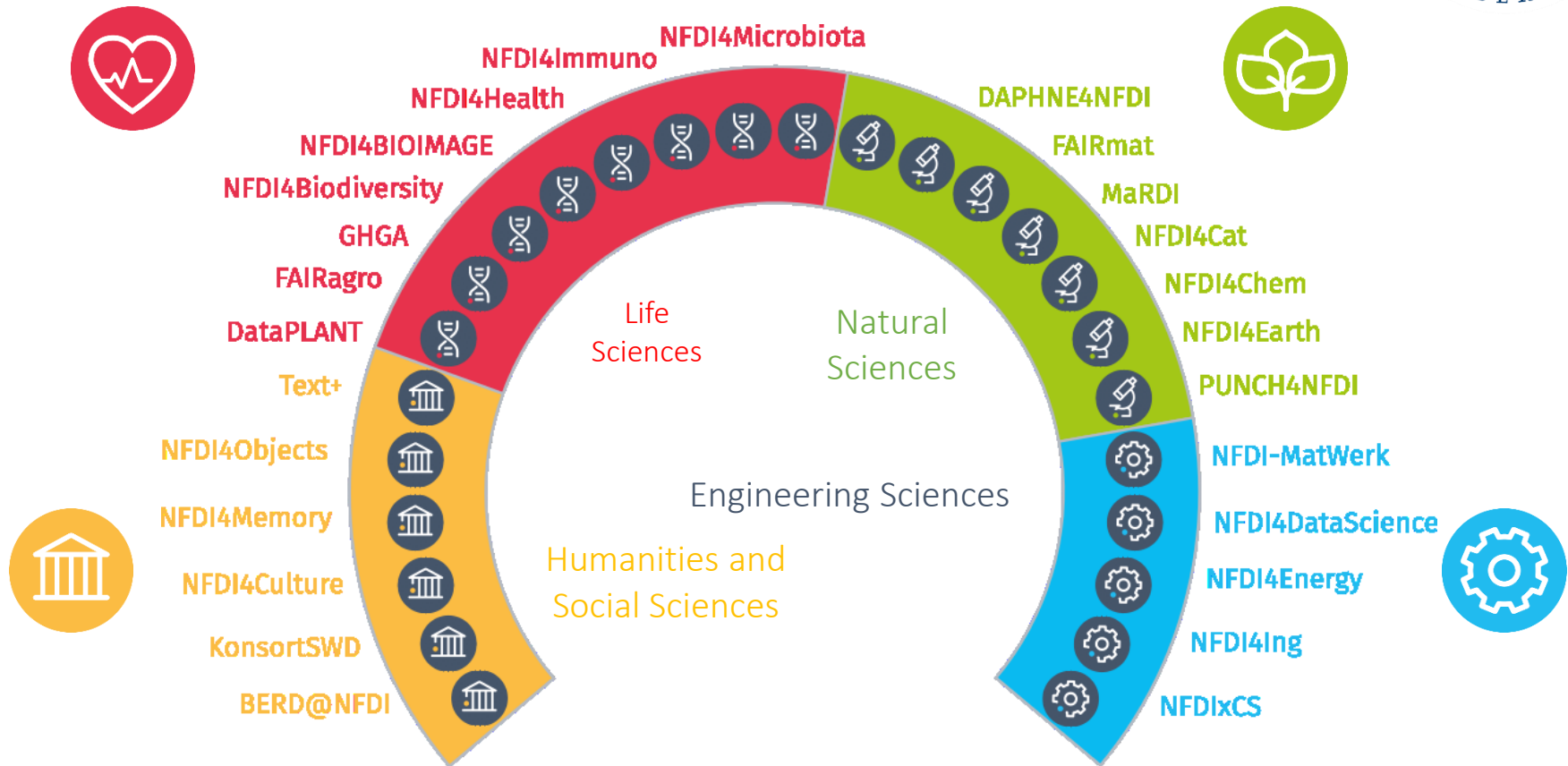
# National Research Data Infrastructure (NFDI)



“Data as a common good for excellent research, organised by science in Germany.”

- based on recommendation by the German Council for Scientific Information Infrastructures in 2016
- 2018-2028 government funded program (ca. 900 Mio. €)
- create coordinated, networked, legally compliant, interoperable and sustainable data infrastructures
- establish processes and procedures for a standardized research data management in all research areas
- educate people in data literacy and new careers

# NFDI Consortia



26 domain-specific consortia + Base4NFDI for base services



# Benefits and Challenges of Open Science





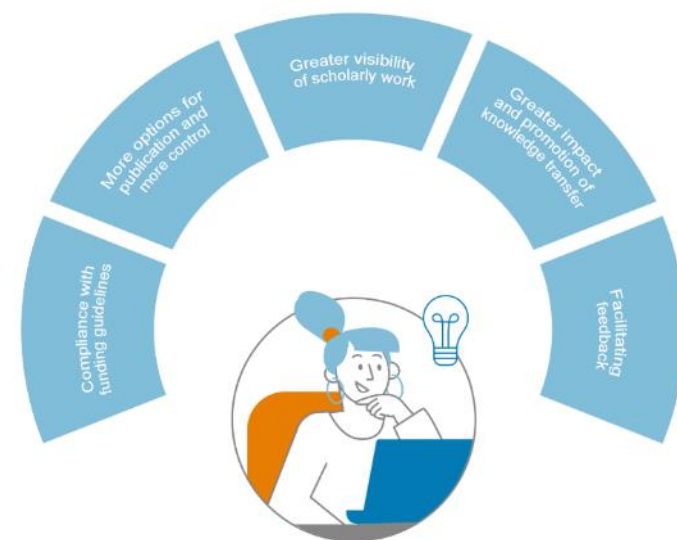
# Benefits of Open Science





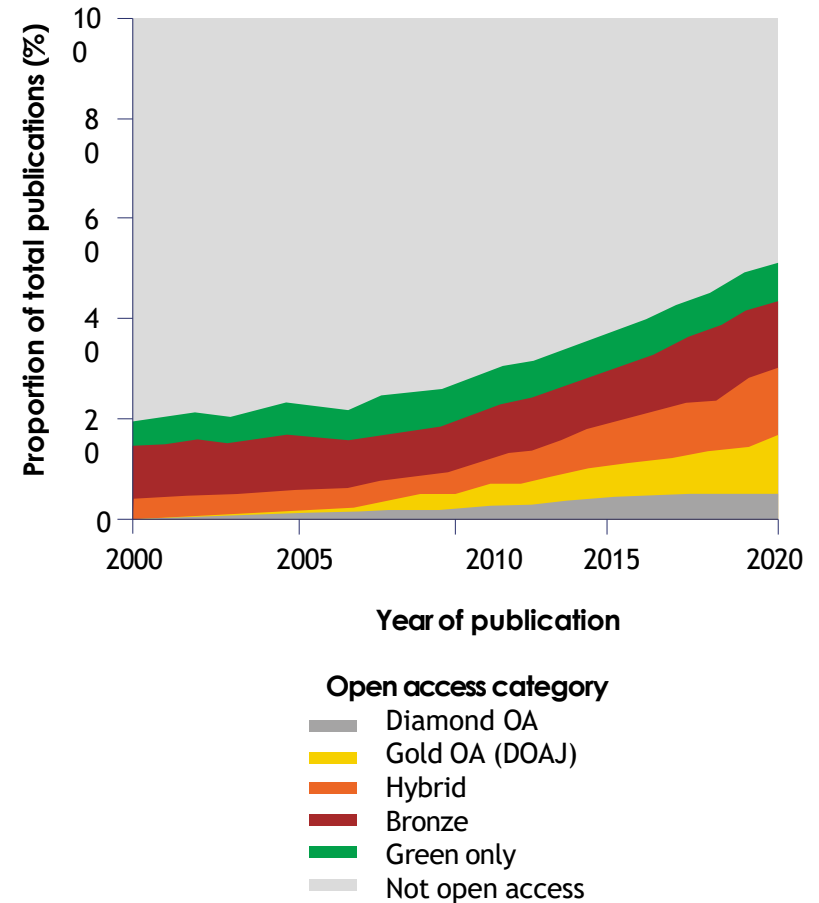
# Individual Benefits of Open Science

- greater visibility of scholarly work
- greater impact and promotion of knowledge transfer
- more options for publication and more control
- compliance with funding guidelines
- facilitate feedback



# Open Access Achievements

- 24% OA 2002-2011
- 42% OA 2012-2021
- Differences in publishing models, by subject area and country



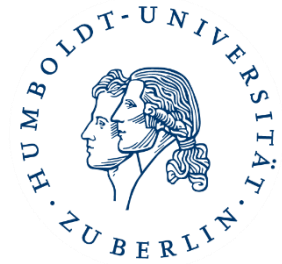
→ 85% of COVID-19 related publications are openly available

# Effects of Open Access

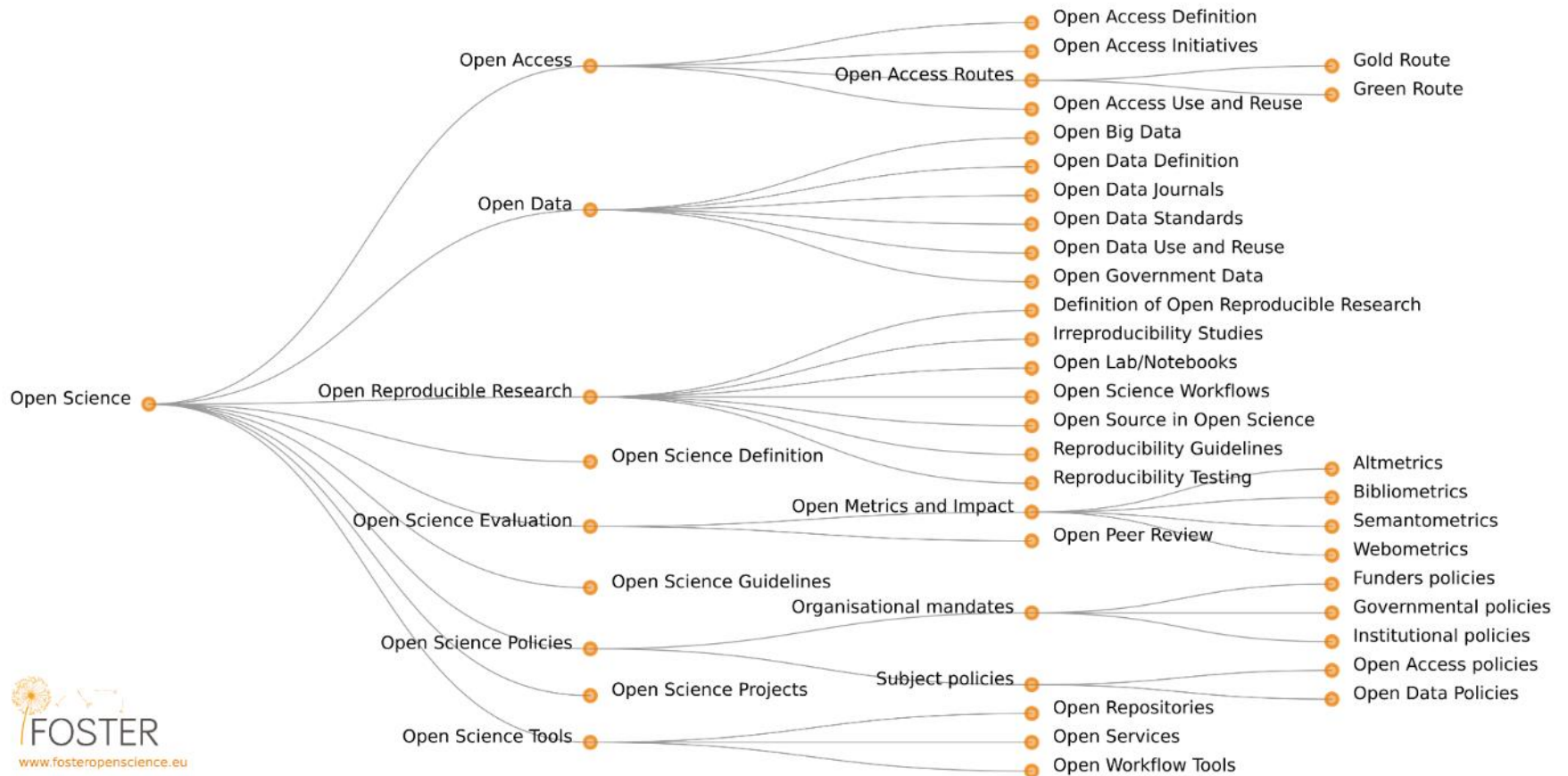
- higher download numbers and page views
- higher number of references from the non-scientific area (patents, news) to OA publications
- no quality differences between OA and restricted access publications
- shortens the time between submission and acceptance for publication of articles
- savings in access costs and transaction costs
- citation advantage (but not fully empirically proven)

→ Other Open Science effects are much less studied.

# How many Open Sciences?

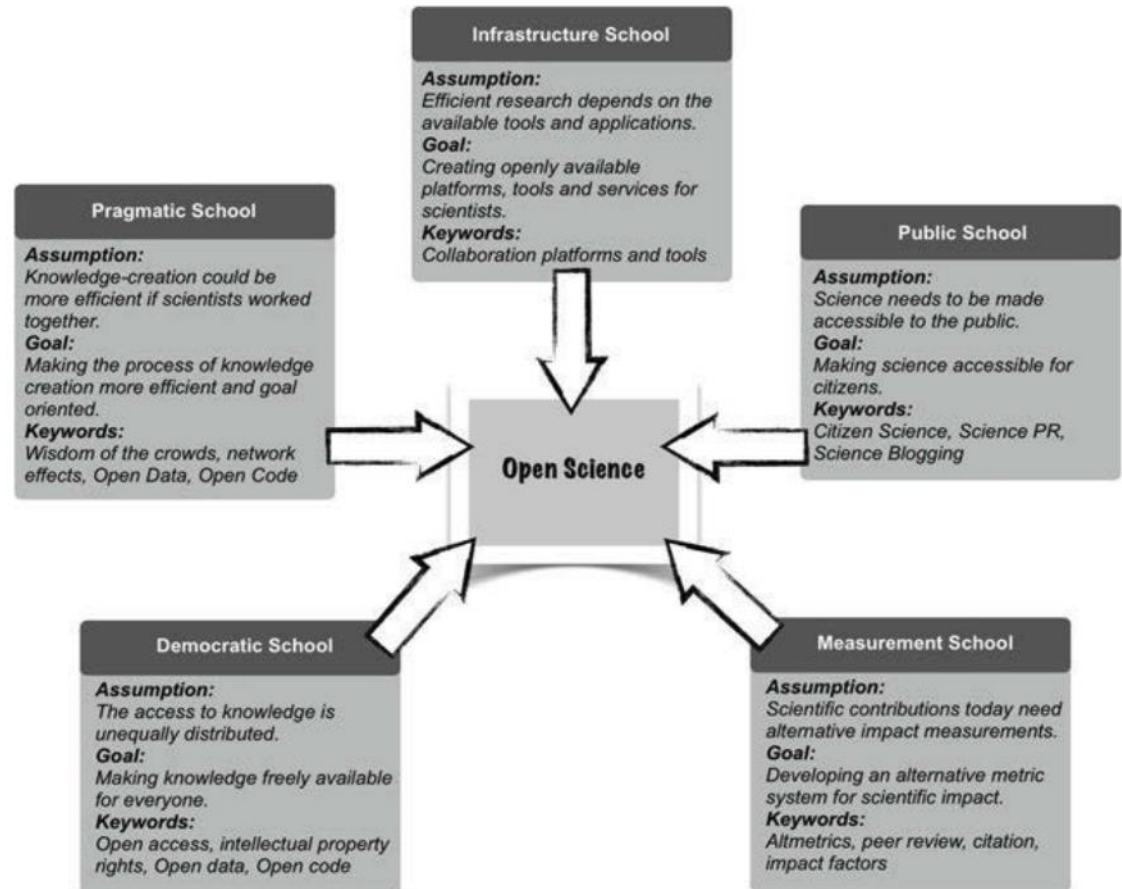


## Open Science Taxonomy



# Open Science Schools

Open Science is not a unified movement, but has different actors with diverse motivations.



# Restrictions to Open Science

## Not everything can be opened:

- protection of human rights
- national security
- confidentiality
- right to privacy
- respect for human subjects of study
- legal process and public order
- protection of intellectual property rights, personal information, sacred and secret indigenous knowledge, and rare, threatened or endangered species



# Barriers and Challenges to Open Science

- competitive disadvantage (also vs. industry)
- lacking incentives
- workload to make outputs / infrastructures available
- restrictions
- costs, but no reward or compensation
- loss in context information (e.g. qualitative data)

- benefits of open science not demonstrated
- citizen science does not make science more „democratic“ or increases the public's trust in science
- disadvantages global South and other epistemologies („data capitalism“ / colonization)
- openness vs. quality

# Sharing in a Reputation Economy

→ If open science is so beneficial, why are so few researchers sharing their data?

- other researchers could publish before me
- sharing is too much work
- want to publish everything before sharing
- data could be misinterpreted (or falsified)
- too much effort for data collection to simply share

→ social dilemma: data sharing is not a reputable / recognizable output, why work on it?

→ no incentive for open science

# Research Assessment Reform

- San Francisco Declaration on Research Assessment (DORA)
  - started in 2012
  - Almost 25,000 signatures
- Coalition for Advancing Research Assessment (CoARA)
  - started in 2022
  - 600 member institutions
- April 2024: Barcelona Declaration on Open Research Information



- responsible assessment (careful about metrics)
- recognize diverse outputs and practices of research
- open research information systems

# Predatory Publishing & Paper Mills

- pressure by publish or perish paradigm
  - promise of quick turn-around and peer review
  - difficult to distinguish from quality publishing venues
- Predatory Publishing: charge for publication without quality checks
  - Paper Mill: sell authorships on fake research publications

→ Problem also before open access, but increased?

## Think

Are you submitting your research to a trusted journal or publisher?  
Is it the right journal or book for your work?

## Check

Use our check list to assess the journal or publisher.

## Submit

Only if you can answer 'yes' to the questions on our check list.

# An Open Access Transformation Trap?

early OA vision

- no access costs
- transform publishing monopolies

commercial publishers adapt

- charge authors not readers: article processing charges (APC)

current discussion

- Diamond OA: no APC, non-commercial publishing

- German project DEAL: stable price for all organizations, but lock-in
- Elsevier PAR for Cell Press: 6500€ (ca. 227,000 TWD) with annual increase of 3-4%
- Elsevier = „global leader in open access“
- contract ends in 2028

→ What constitutes transforming the publishing landscape?

# Generative AI and Open Science

- „AI tools discriminate, disrespect different cultures, violate privacy and security, automate inequality.“
- AI training data comes from Open Science efforts

→ How can Open Science activities be prevented from doing harm?



Generative artificial intelligence

Open science

**Generative AI often reuses open science outputs to train harmful tools.** Modified by Julián Buede from *The Turing Way Community & Scriberia* (2023). Illustrations from *The Turing Way*, CC-BY 4.0.



# Open Science in Context

- consider all perspectives and incentives of stakeholders
  - study unforeseen risks and potentially harmful use
  - beware of lock-in effects and surveillance mechanisms
  - account for commercial interests and predatory practices
  - no guarantee for good scientific quality
- 
- contributes to good scientific practice (stewardship and documentation) and more responsibility
  - increases international and interdisciplinary collaboration
  - huge potential for research progress, but protected spaces are also necessary



# Responsible Research & Innovation



# Responsible Research & Innovation (RRI)



- RRI is an inclusive approach to research and innovation to ensure that societal actors work together during the whole research and innovation process.
- RRI and Open Science both share the fundamental values of openness, inclusion and democracy.

→ towards ethically acceptable, socially desirable and environmentally sustainable products and services



ETHICS



GENDER  
EQUALITY



GOVERNANCE



OPEN  
ACCESS



PUBLIC  
ENGAGEMENT



SCIENCE  
EDUCATION



# Responsible Research & Innovation (RRI)



Variety of researchers from different disciplines and broad range of stakeholders identified

**DIVERSITY & INCLUSION**

All relevant stakeholders invited to participate

**OPENNESS & TRANSPARENCY**

Meaningful, addressing purpose and context

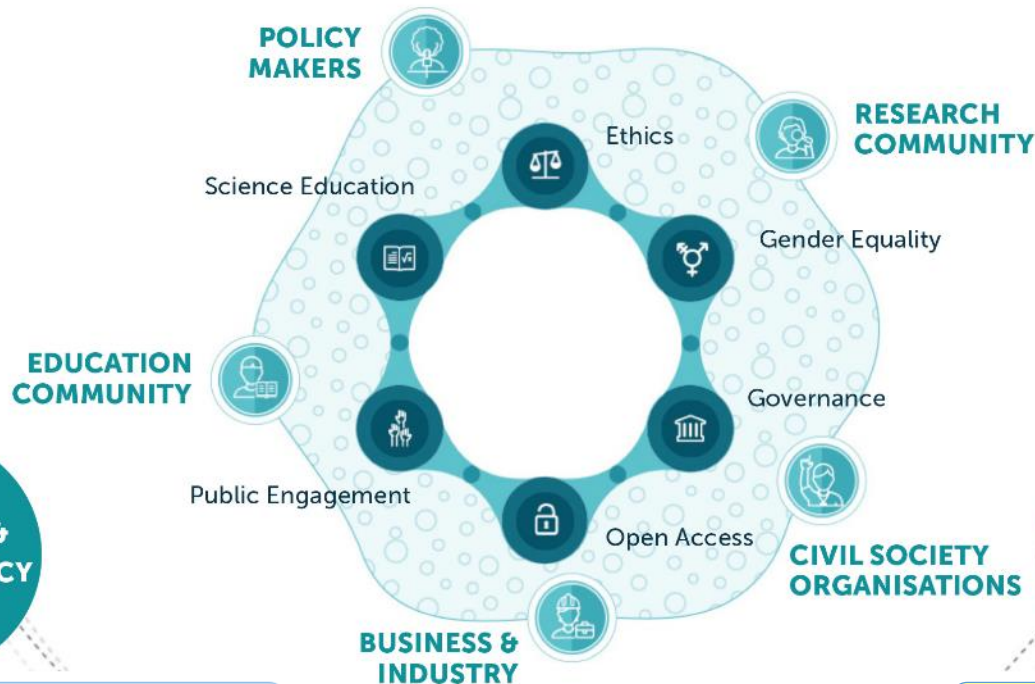
Imagining plausible and desirable futures and technology paths

**ANTICIPATION & REFLECTION**

Open to needs of others

**RESPONSIVENESS & ADAPTIVE CHANGE**

Ability to change process and paths

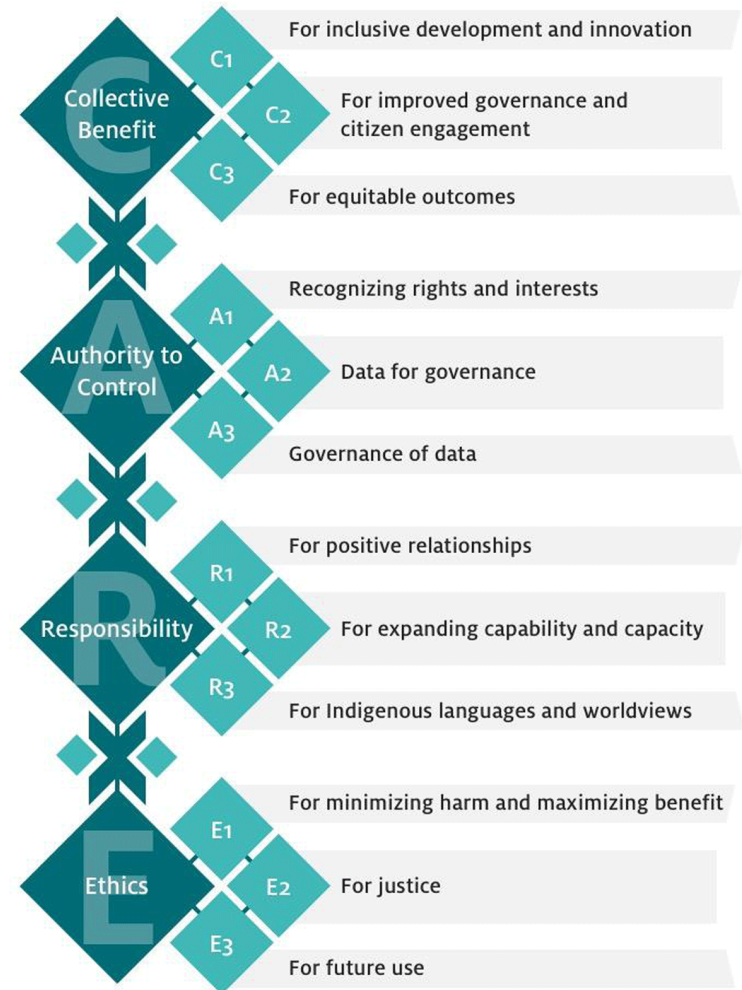


# CARE Principles for Indigenous Data Governance



„The articulation of Indigenous Peoples’ rights and interests in data about their peoples, communities, cultures, and territories is part of reclaiming control of data, data ecosystems, data science, and data narratives in the context of open data and open science.“

**CARE = Collective benefit,  
Authority to control,  
Responsibility, Ethics**





# How can you get started in Open Science?

1. What information would you like to know about a piece of research? What information needs to be protected?
2. Document your research for others accordingly.
3. Make your publications and data open, FAIR and CARE.





Where do we go from here?  
Thank you for your attention.

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All errors are my own.