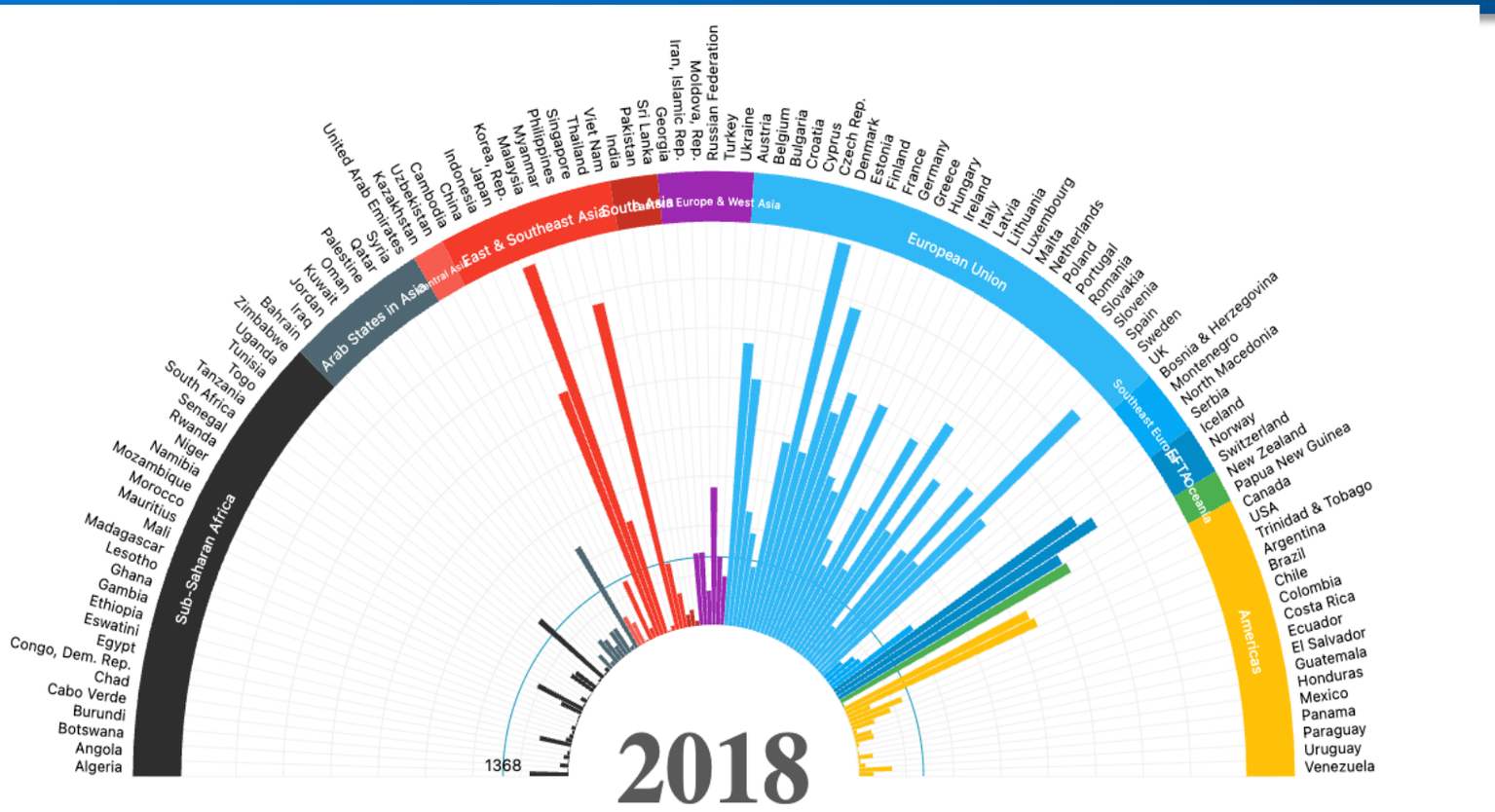
UNESCO Recommendation on Open Science

What is so closed about science?



Where are the world's researchers?

Limited access to knowledge products, like papers and datasets

Haphazard cooperation, collaboration and engagement

Restricted access to decision-making about science, including its funding

Why UNESCO Recommendation on Open Science?

- Need for an **international policy** and **action framework**
- Need for **a common definition of open science**, **shared set of values and principles**

In **2021**, **193 Member States** adopted **the first international standard-setting instrument on open science** in the form of a **UNESCO Recommendation on Open Science**.

Why Open Science in UNESCO?

- Need for **science** to be **more connected to societal needs** and **more accessible for all**.
- Need to **bridge the STI gaps between and within countries**.

Achieving SDGs and overcoming the global challenges require an efficient, equitable, transparent, collaborative and inclusive science, that can lead to innovative and sustainable solutions.

Everyone has the right to freely share in scientific advancement and its benefits.
Article 27 of the **Universal Declaration on Human Rights**

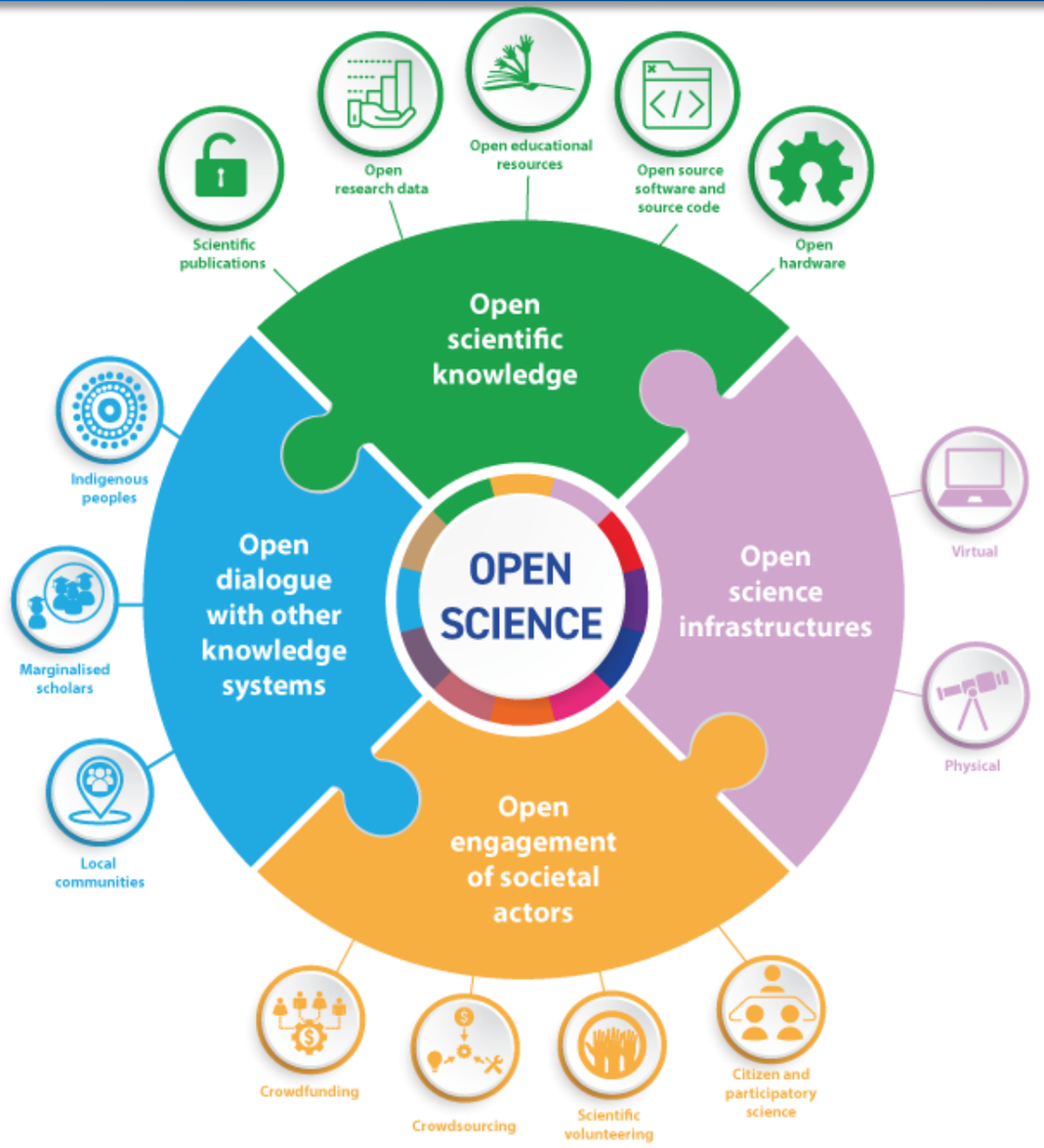
Highlights of the Recommendation

- It is the first **international normative instrument** on Open Science;
- it contains the first **internationally agreed definition** of Open Science;
- it spells out the consensus **core values and guiding principles** of Open Science;
- it addresses **multiple actors and stakeholders** of Open Science;
- It recommends **actions on different levels** to operationalize the principles of Open Science;
- it proposes **innovative approaches for Open Science at different stages** of the scientific cycle;
- it calls for development of a **comprehensive Open Science monitoring framework**.

Definition of open science

Open Science:

- makes scientific knowledge openly available, accessible and reusable for everyone,
- increases scientific collaborations and sharing of information for the benefits of science and society,
- opens the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the conventional scientific community.



Definition of open science

Open engagement of societal actors

collaboration between scientists and societal actors beyond the scientific community, opening up practices and tools that are part of the research cycle by making the scientific process more inclusive and accessible to the broader inquiring society

Open scientific knowledge

scientific publications, research data, software, source code, hardware and educational resources available in the public domain or under copyright, released under an open license

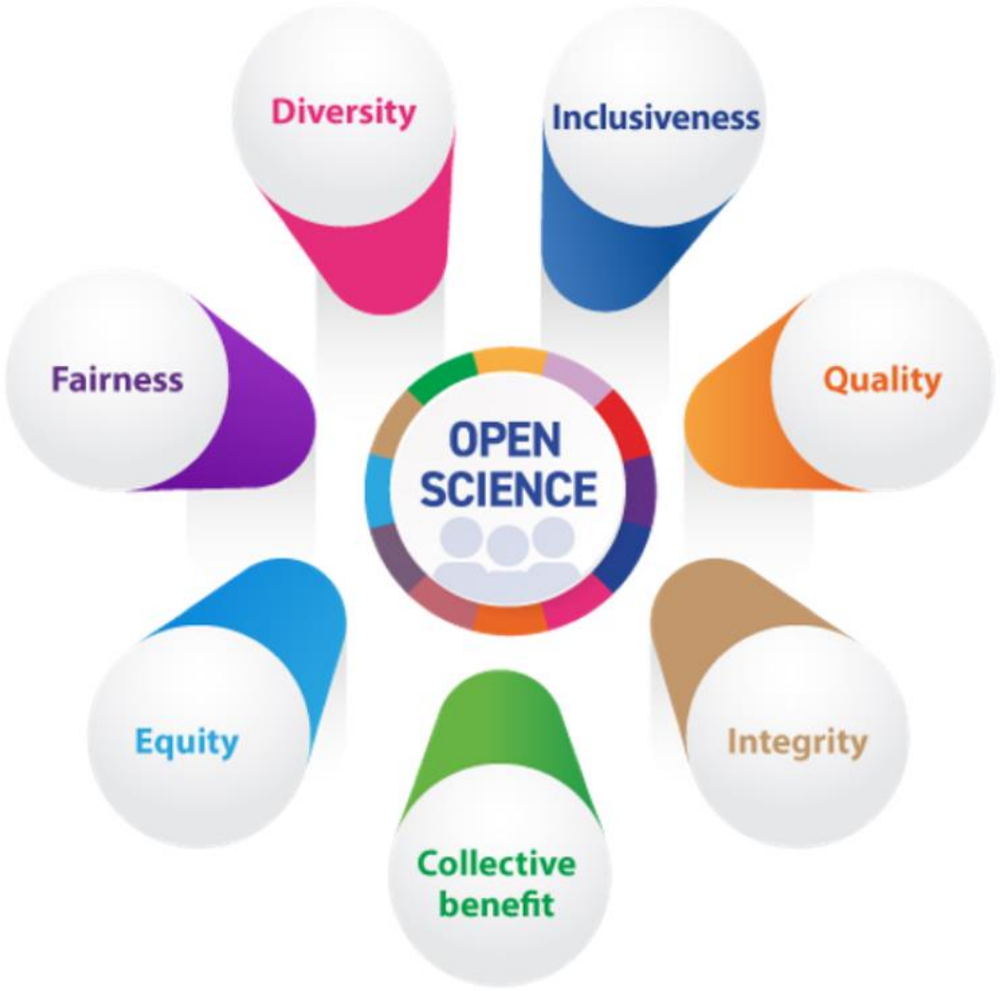
Open dialogue with other knowledge systems

recognition of richness and complementarities between diverse epistemologies, including indigenous knowledge systems

Open Science infrastructures

scientific publications, research data, software, source code, hardware and educational resources available in the public domain or under copyright, released under an open license

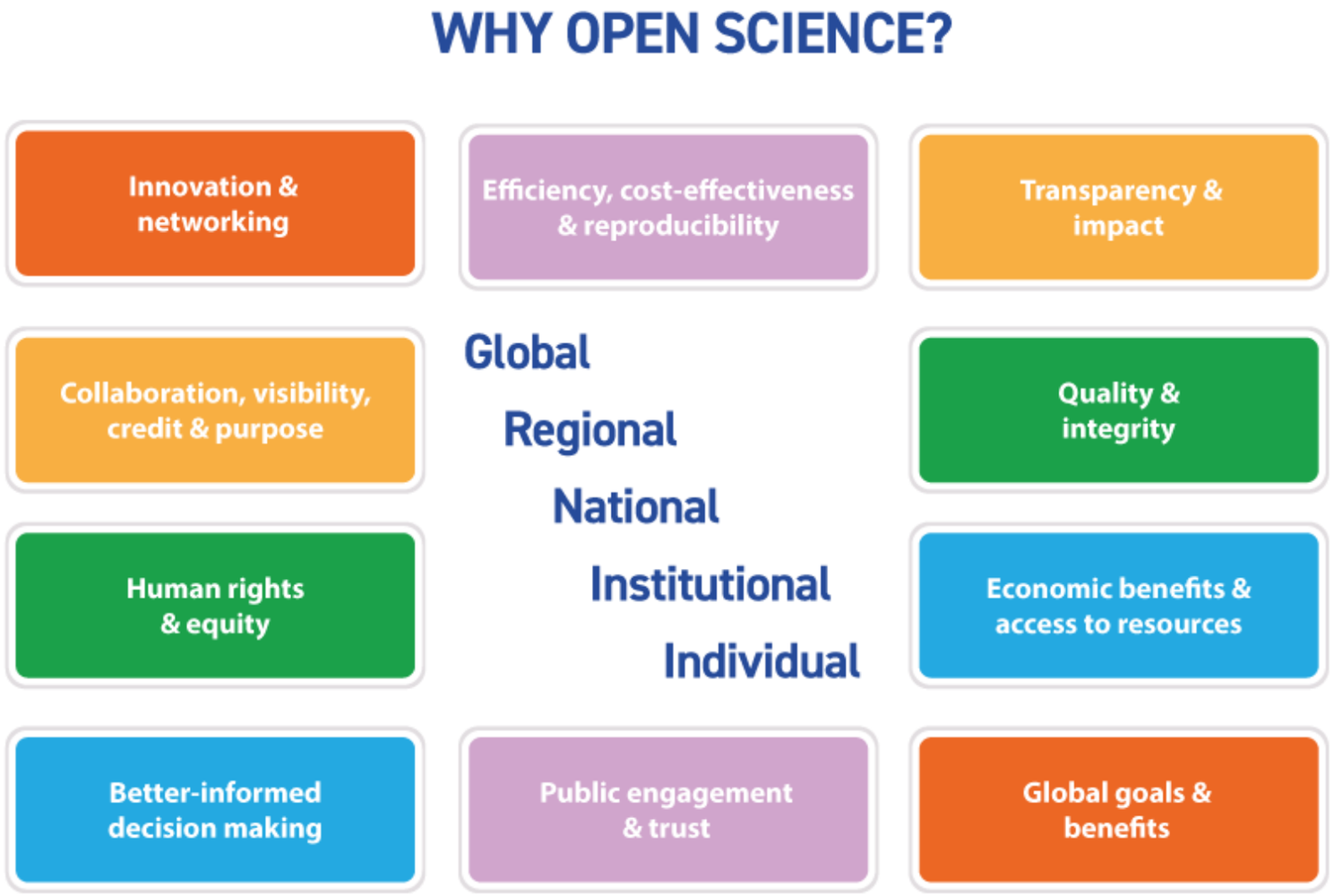
Shared values and principles



Open science requires **a shift in the culture of science** guided by the **common values**

COMPETITION	»	COOPERATION
SCIENCE AS A PRODUCT	»	SCIENCE AS A PROCESS
SCIENCE FOR A SELECTED FEW	»	SCIENCE FOR ALL

Benefits of open science



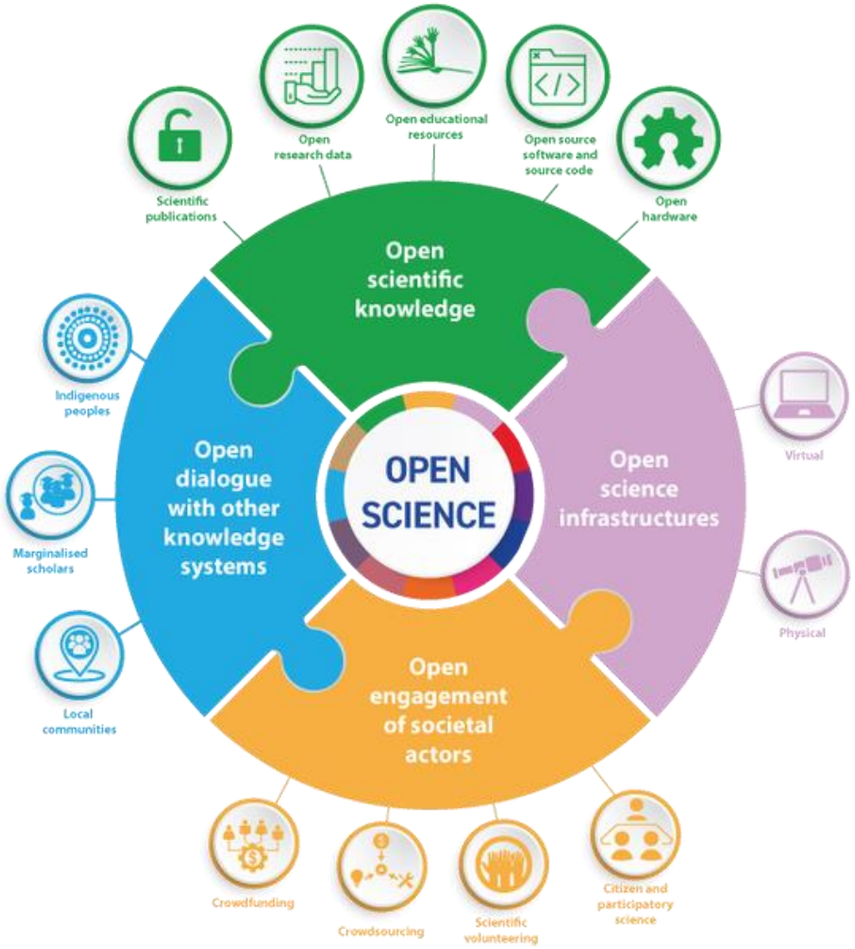
Open Science

Open and equitable global science system	Open access to scientific knowledge	Open science infrastructures	Open engagement of societal actors	Open dialogue with other knowledge systems
An open science culture in an enabling policy environment with sustained resource commitments increases collaboration for the benefit of science and global society.	All scholarly outputs are published in a fully open access outlet or posted in an open repository, with free, immediate readership/ usership rights.	Sustainable community-led open infrastructures, both physical and digital, are available to all, regardless of location, language or ability.	Multiple entry points permit engagement. External actors contribute/initiate design, creation and application of scientific knowledge.	Diverse knowledge bases spark innovation and equitable decision-making.
A culture of open science is fostered with effort to align incentives, [illegible] science. Investment in human resources, training, education, digital literacy and capacity building for open science.	Data, software and other outputs are FAIR* and openly shared [illegible] with.	Platforms permit usership for all. Digital architecture [illegible] in different languages and accessibility need.	Capacity for societal engagement is integrated into project [illegible] plans.	Capacity for ethical, open dialogue is integrated into training and [illegible] at project and institutional levels.
Innovative approaches for open science are promoted at different stages of the scientific process.	All scholarly outputs are made freely available to read, in a journal or an open repository, after an embargo of no more than six months.	Open infrastructures are available to those who have existing access or commit to specified partnerships.	Societal actors have a few, defined, points of contact with scientific processes.	Dialogue is built into policies, creating time, opportunities and incentives for dialogue.
International and multi-stakeholder cooperation is initiated without a view to reducing digital, technological and knowledge gaps.	Scholarly outputs are shared without clear licensing or copyright.	Infrastructure sharing is opportunistic.	Stakeholder engagement is opportunistic.	Dialogue is facilitated in one-off events, with uneven expertise.
There is no common understanding of open science and its benefits.	Scholarly outputs are not published or are published under restrictive copyright.	Digital gaps and subscription costs hinder the use of scientific infrastructures.	Science is separate from "outreach". Science communication is one-way, outwards.	Science is separate from "outreach". Other topics or communities are research subjects.

'Closed' Conventional Science

The spectrum of openness is within reach of all.

Assessment of open science



Strengthening the focus on people, not just products

Assessment of open science

Strengthening the focus on people, not just products

Assessing engagement and dialogue

Engagement and **dialogue** are ***not*** yet among **mainstream factors** considered in training, practice or monitoring of open science.

Citizen scientist Beth Reille takes a water clarity reading on the Hutt River. [Photo: Dave Allen, NIWA]

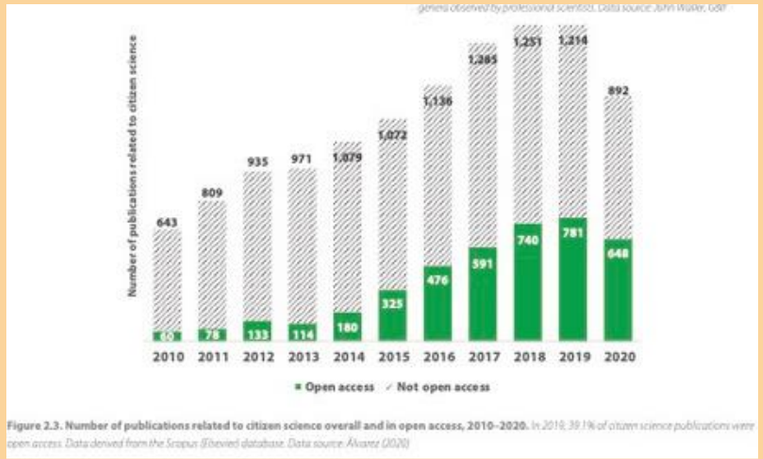


Figure 2.3. Number of publications related to citizen science overall and in open access, 2010–2020. In 2019, 39.1% of citizen science publications were open access. Data derived from the Scopus (Elsevier) database. Data source: Álvarez (2020)

Rise of interest in scientific projects incorporating **societal engagement:**

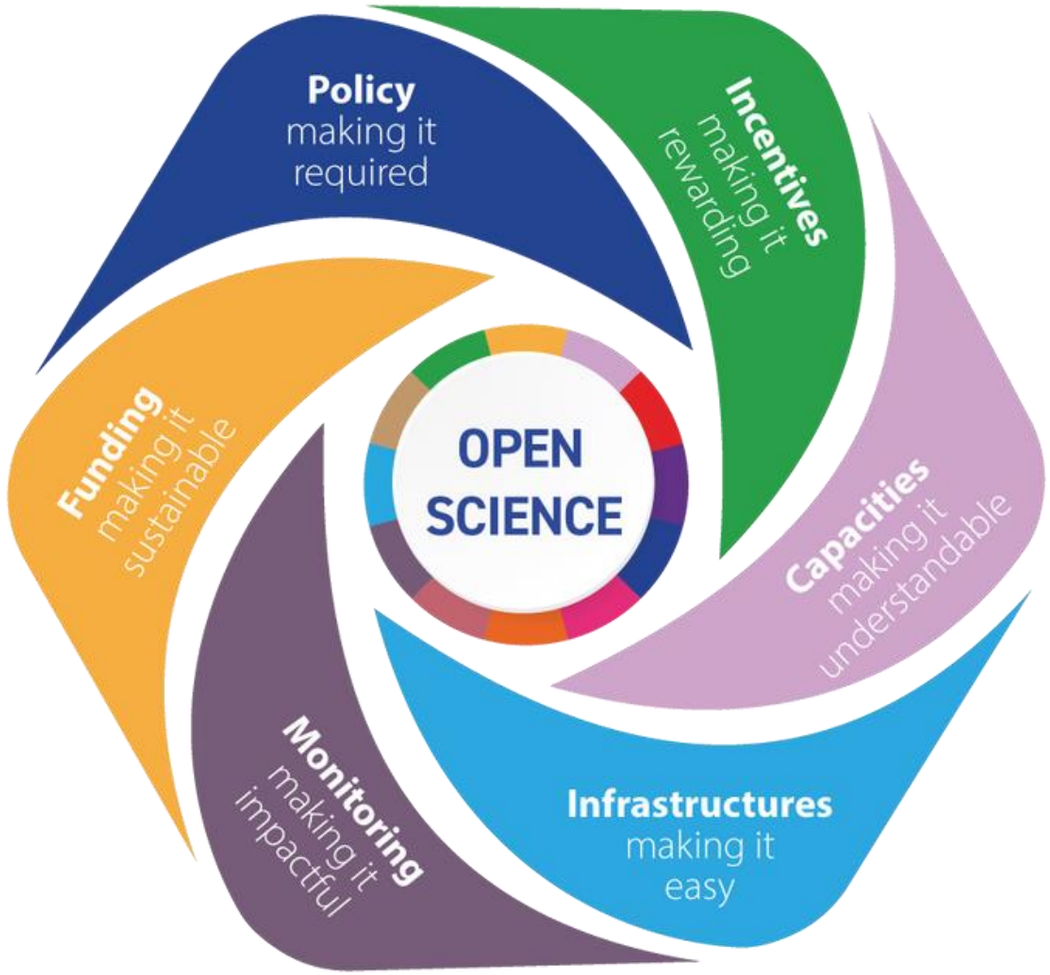
- Increase in funding
- Increase in recorded numbers of citizens engaging in science or producing data products
- Increase in number of scientific publications related to citizen science

Shifting the culture of science

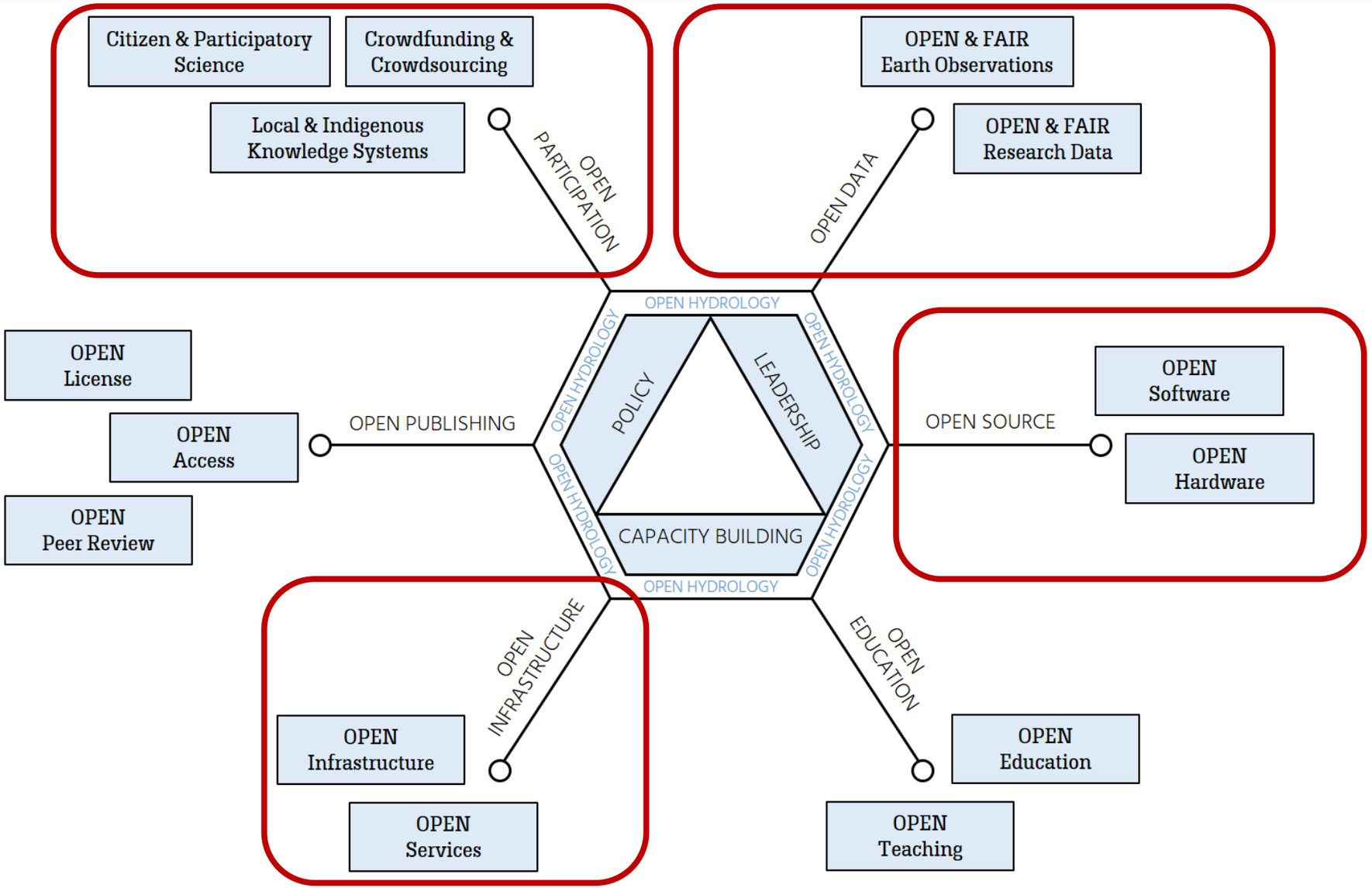
Need practical actions *and* cultural shifts

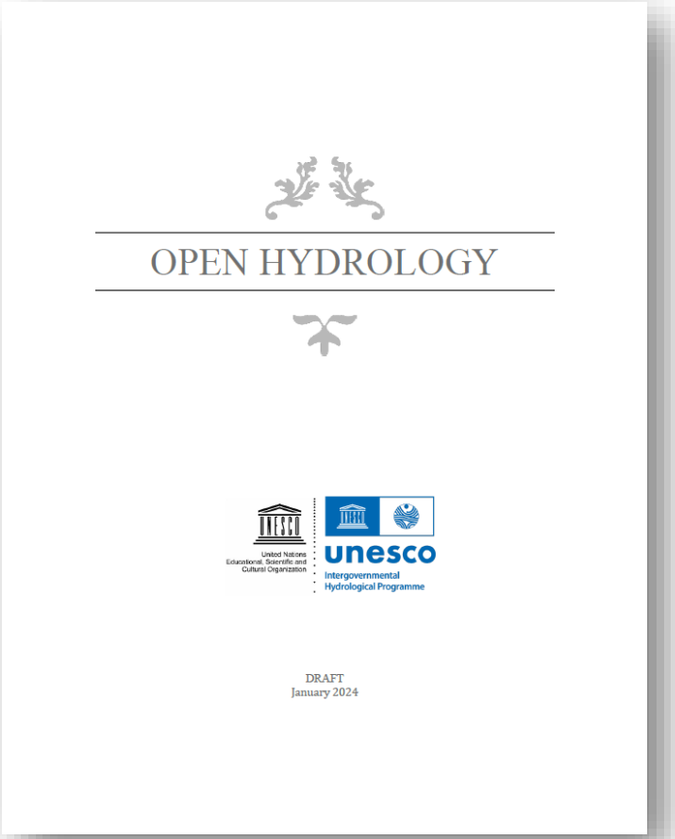
Equitable collaboration

Actions are underway around the world: Cases from all regions demonstrate opportunities



The Six Pillars of Open Hydrology





Publication launched at the IHP Council in June 2024

Thank you

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United Nations
Educational, Scientific
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Let's look at the Programme for the Week

Day	Date	Time	Open Hardware	Open Software
Monday	13/05/2024	9:00-10:30 (1h30)	Welcoming Presentation of UNESCO, IAEA, ICTP and key elements - Innovation and Open Hardware in Malawi - Introduction to the UNESCO Recommendation on Open Science	
		10:30-11:00 (0h30)	Break	
		11:00-13:00 (2h00)	- Introduction to Open Hardware/Open Software - Introduction of the Citizen Science application by Quartex	
			- Introduction to Internet-of-Things for SDGs - Open Hardware Solutions for environmental Sensing	Introduction to Open Software/Open Data + SWAT-co-SWAT
		13:00-14:00 (1h00)	Lunch	
		14:00-15:30 (1h30)	Lab: Getting started with Arduino	Lab: Introduction to the Soil and Water Assessment Tool (SWAT+version)
		15:30-16:00 (0h30)	Break	
		16:00-18:00 (2h00)	Lab: Getting started with Arduino	Lab: Setting up SWAT+ model
			Introduction to the assignment to be presented on Friday	
Tuesday	14/05/2024	9:00-10:30 (1h30)	- Building an environmental logger with Arduino - Communications options for IoT	Introduction to the SWAT+ toolbox for calibration and visualisation of the results. Climate Impact simulation using SWAT+

Let's look at the Programme for the Week

		10:30-11:00 (0h30)	Break	
		11:00-13:00 (2h00)	- SmartWater sensors for water quality - ARM education	Introduction to the SWAT+ toolbox for calibration and visualisation of the results. Climate Impact simulation using SWAT+
		13:00-14:00 (1h00)	Lunch	
		14:00-15:30 (1h30)	Lab: Automated water level sensing with Arduino (with telemetry)	Lab: SWAT+
		15:30-16:00 (0h30)	Break	
		16:00-18:00 (2h00)	Lab: Automated water level sensing with Arduino (with telemetry)	Lab: SWAT+
Wednesday	15/05/2024	07:15	Gathering of group	
		07:30	Departure	
		09:00	Arrival on site	
		09:00-12:30	IoT Sensors in Eerste Rivier: potential of real-time monitoring to support flood warnings	
			Demonstration of Citizen Science application in Cape Winelands Biosphere Reserve with 3 instruments (MiniSASS, Clarity, Streamflow) + smartphone application (Quartex)	
			Challenges and solutions with field installation pilot at Kruger to Canyons Biosphere Region	
		12:30-14:00	Lunch and transportation	

Let's look at the Programme for the Week

		14:00-15:00	Visit to the 'Smart University' and School for Data Science and Computational Thinking	
		15:00	Return to hotel	
Thursday	16/05/2024	9:00-10:30 (1h30)	Introduction to MQTT	J2000/J2000iso numerical rainfall-runoff model: Improving the ability to capture hydrological and anthropogenic change
		10:30-11:00 (0h30)	Break	
		11:00-13:00 (2h00)	Lab: Sending data via MQTT	Lab: Hands-on exercise using J2000
			AI and ML for water management	
		13:00-14:00 (1h00)	Lunch	
		14:00-15:30 (1h30)	Lab: Build your first AI model to support water management	
		15:30-16:00 (0h30)	Break	
		16:00-18:00 (2h00)	Lab: Build your first AI model to support water management	
Friday	17/05/2024	9:00-10:30 (1h30)	- Introduction to TinyML - Citizen Science applications in Biosphere Reserves: development, technology, back-end (Quartex)	
		10:30-11:00 (0h30)	Break	
		11:00-13:00 (2h00)	- Open Data and Software Applications for Water quality - An introduction to the Soil Moisture TOMST network	

Let's look at the Programme for the Week

		13:00-14:00 (1h00)	Lunch
		14:00-15:30 (1h30)	Network development (teamwork and presentations)
		15:30-16:00 (0h30)	Break
		16:00-18:00 (2h00)	Network development (teamwork and presentations)