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EMBEDDING CITIZEN SCIENCE INTO RESEARCH POLICY

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Abstract

Citizen science, i.e. the active engagement of citizens in scientific knowledge production, is a mode of research that can be applied in a wide variety of scientific fields and is valuable for addressing a broad range of policy priorities. Technological and societal drivers, such as the digital transition and raised public awareness and interest in science, are underpinning a growth in citizen science. This report is primarily intended for research policymakers in ministries and funding agencies to help them recognise the potential for the use of citizen science and to plan, implement and evaluate effective citizen science policies. It includes a set of overall recommendations, linked to a policy framework and policy options and combined with analysis of illustrative national and international initiatives.

Foreword

Over the past decade the number of citizen science initiatives has increased across the world, with different policy approaches being adopted in different countries and contexts. Digital tools have amplified the possibilities for citizen involvement in research and have been used to crowd-source solutions and tap into expertise from outside scientific institutions to address fundamental and applied research questions. The COVID-19 pandemic highlighted the importance of citizens in identifying and addressing urgent research and policy needs (e.g. 'long Covid' was identified by patient groups) and in collecting and providing critical research data. With a long history of deployment in environmental research and potential for promoting societal awareness and engagement, citizen science is an important tool for addressing the Sustainable Development Goals (SDGs).

Despite its growing popularity, there are a number of policy concerns or challenges regarding citizen science. These include barriers to participation of under-served groups, ethical concerns in data collection, and quality assurance for data and research provided by citizens. Many citizen science organisations and fora have been established to promote citizen science and provide guidance based on good practices and common principles, but these tend to focus on the operational level rather than the broader policy level. There is still a need for a shared understanding at the policy level of why, when and how citizen science should be promoted.

In 2023 the OECD Global Science Forum (GSF) launched a new project entitled 'Citizen science: policies to promote citizen engagement in the production of scientific knowledge'. This builds on previous GSF work on societal engagement in science and science policy, including work on open science, citizen engagement and transdisciplinary research. The main output of the new project, which is described in this report, is a framework to help policymakers integrate considerations of citizen science across different policy domains and promote broader understanding and policy consensus on the roles and value of citizen science. The framework is complemented by policy options (see Table 1), which articulate specific actions that policymakers can take, as well as illustrative examples of policies and initiatives (see Annexes D and E), which are being implemented in different countries.

Acknowledgements

This work was overseen by an international Expert Group (see Annex A), nominated by GSF member countries. The Expert Group (EG) was co-chaired by Jeremy Kerr, Canada, and Melanie Knetsch, the United Kingdom. This final policy report is the product of that Group's work. It was drafted by the OECD-GSF Secretariat, Masatoshi Shimosuka and Gemma Volpicelli, and edited by Carthage Smith, with input from all Expert Group members. In addition, a number of other individuals made important contributions. This includes 25 additional experts who participated as presenters or panellists in a two-day dedicated project workshop that focused on sharing experiences, challenges and good practices, from a diversity of stakeholders.

Table of contents

FIGURES

TABLES

Executive Summary

Citizen science, i.e. the active engagement of citizens in scientific knowledge production, is a mode of research that can be applied in a wide variety of scientific disciplines and is valuable also for addressing broad Science, Technology and Innovation (STI) policy priorities. There are 3 main policy rationales for promoting citizen science: i) increasing data coverage and analysis and accelerating scientific discovery, ii) addressing societal needs and challenges more effectively, and iii) promoting the democratisation, legitimacy and uptake of policies informed by scientific knowledge. Citizen science should be considered as an integral part of open science.

Citizen science has potential value for providers and users of scientific knowledge, not only in fields where its value is already recognised, such as the environment, biodiversity, health and astronomy, but also in many sectors, from energy and the digital transition to transport and urban design. Citizens possess important insights and knowledge (e.g., local, historical or expert knowledge) in all of these areas. They can help collect and analyse critical data and, most importantly, they can formulate novel research questions that are pertinent to them. Citizen engagement in research is critical for addressing many of the complex challenges embedded in the sustainable development goals.

There are several technological and social drivers under-pinning the growth of citizen science. The digital transition has hugely expanded the capacities and capabilities for citizens to contribute to scientific research. A growing number of virtual citizen science platforms are providing opportunities to contribute to a plethora of different projects. Mobile apps have facilitated the collection, verification and analysis of data, and access to powerful computing capacity and software tools has become much more widespread. New opportunities for engagement are being coupled with a growing awareness and interest from many citizens. Demographic and educational trends in many countries mean that many highly skilled people are spending longer periods in active retirement and, in certain research areas, these represent a major proportion of citizen scientists. At the same time, citizen science is a mechanism to engage specific social groups, including traditional and local knowledge holders, and integrate their perspectives into scientific research.

Many OECD countries have embraced citizen science initiatives, yet there remains significant untapped potential to further harness its power in addressing both scientific and societal challenges. Therefore, this report presents recommendations, a policy framework and policy options - with examples of existing policies and initiatives - to help policymakers in ministries and funding agencies decide why, when and how citizen science should be promoted. These are based on an analysis of the literature and publicly available data, as well as de novo collection of information from 15 countries and organisations and expert consultations.

The policy framework consists of three pillars to help ensure a coherent and effective integration of citizen science into research policy: 1. Making the case for citizen science, 2. Step-by-step guidance, and 3. Implementation considerations. The case for citizen science depends on the policy rationale(s). Citizen science can be leveraged to advance research and achieve multiple policy aims simultaneously. The step-by-step guidance and implementation considerations can assist policymakers in planning, implementing and evaluating citizen science. The guidance in this document consists of six steps, from problem definition to evaluation, in order to assess the potential value and feasibility of promoting citizen science in different

scenarios. The implementation considerations cover issues, such as citizen engagement, quality assurance and ethics, as well as the design and management of effective funding programmes.

The recommendations and policy framework are complemented by a set of concrete policy options (see Table 1) together with a list of illustrative policies and initiatives that are being deployed within and between countries (see Annex D). These focus on research funding and 5 other enabling factors that need to be addressed for citizen science to flourish: the national legal and policy environment; institutional research culture; capacity building and networks; supporting infrastructure; and, societal dialogue. The key features of a number of funding programmes that aim to promote citizen science have also been analysed separately (see Annex E).

The diversity of existing citizen science policies and initiatives emphasises the differences between countries. Each country has its own unique research governance system and is at a different stage of citizen science development. Countries also have different policy goals for citizen science. Hence the relevance and feasibility of the policy recommendations and related policy options, as well as the actors responsible for implementation will vary across countries.

Ultimately, as citizen science is associated with multiple actors and interactions between them, the full potential of citizen science can only be realised through the combined efforts of governments and funding agencies (top-down initiatives) working in close cooperation with a variety of grassroot actors, including citizens, professional scientists, research institutions and local communities (bottom-up initiatives). Dedicated citizen science groups and entities, including public and private intermediary agents, networks and associations, can play a key role across these interfaces.

Recommendations

The overall analysis in this report leads to ten recommendations that need to be addressed to promote citizen science (i.e. the active engagement of non-professional scientists in scientific knowledge production). These recommendations reflect the complexity of actors and interactions that are active in a thriving citizen science ecosystem and they underscore the requirement for a systemic policy approach.

Why and when to promote citizen science?

1. **Policy and decision makers across government, including ministries and funding agencies, should recognise the value of citizen science for science and society**. From the research policy perspective, there are 3 main rationales for promoting citizen science: i) **increasing the scope of data collection and analysis and accelerating scientific discovery**; ii) **addressing societal needs and challenges more effectively**; and iii) **promoting the democratisation, legitimacy, and uptake of policies informed by scientific knowledge**.
2. **Science policymakers should embed citizen science into their considerations when formulating policies**. It can be leveraged in all research domains and is also valuable for addressing a number of transversal STI policy priorities, including open science and public engagement.

How to support citizen science?

3. **Senior level commitment (in ministries, research agencies and institutions) is critical to drive wider acceptance of the value of actively engaging citizens in research.** This is important for creating an enabling environment and unlocking the necessary resources over the long-term.
4. **Top-down and bottom-up approaches need to be combined and supported effectively to promote citizen science** as it requires engagement from multiple actors and good interactions between them. Communication between policymakers and these other actors, including academia and civil society, is key to ensuring that their perspectives are incorporated into effective policymaking and implementation, including the development of appropriate funding instruments.
5. **A variety of citizen science community groups and entities, including public and private intermediary agents, networks and associations, should be recognised and supported accordingly**. They can play an important role in enabling citizen science and translating its outputs into policy action and social benefit.

Overcoming obstacles and challenges

6. **The rigour and quality of citizen science, as well as the management of potential bias, must be ensured** for citizen science to be widely accepted. In order for practitioners to address these issues, particular policy attention is required, including the development of appropriate data infrastructure and review and support mechanisms.
7. Throughout policy planning and implementation, **recognition that citizens are a very heterogeneous group with different motivations, interests and barriers for getting involved**

with research is important. Depending on the specific rationales and aims, inclusion of diverse social groups in citizen science is a worthy objective and it may, in some instances, be essential for success. Research ethics frameworks and review mechanisms may need to be adjusted to address under-representation and other ethical issues related to citizen participation.

8. **Citizen science collaborations across countries can make a significant contribution to tackling global challenges.** This requires shared cooperation on data standards, infrastructures and funding, as well as support for international networks.

Systemic change and assessing impact

9. **The science community and its institutions should embrace citizen science as a valuable mode of research that can complement and improve traditional research activities**. This requires a shift in academic research culture that can be supported by providing appropriate career pathways and systems of reward for citizen science practitioners.
10. **Monitoring, evaluation and assessment of the impacts of citizen science should reflect the different rationales for its deployment** and, in many cases, the most important impacts will not be fully reflected in traditional bibliometric performance measures. Methods for ex-ante and ex-post impact monitoring, evaluation and assessment for citizen science should continue to be developed and disseminated, while recognising that important impacts may only appear in the long-term and that the impact on citizen participants themselves is one of the critical outcomes .

These meta-recommendations are supplemented by a policy framework and policy options with examples of existing policies and initiatives. The **policy framework (see the chapter on Policy Framework)** provides guidance to help ensure coherent and effective integration of citizen science into research policy, wherever it can be useful. The **policy options (see Table 1)** complemented by **a list of existing policies and initiatives (see Annex D)** and **key features of funding programmes (see Annex E)** can help policymakers formulate and design effective policies for citizen science.

1 Introduction

Recognition of citizen science is growing across different policy areas and wider society. In an age of multiple crises (climate change, biodiversity loss, disease pandemics, etc.), Science, Technology and Innovation (STI) need to support transformative change across all socio-economic sectors (OECD, 2024[1]). The OECD Agenda for Transformative Science, Technology and Innovation Policies, which was endorsed by science and technology ministers in April 2024, underlines the need for effective and inclusive engagement of society in STI activities and policymaking. Citizen science was explicitly highlighted and can be extremely valuable in this regard.

The opportunities for citizen engagement in the science have increased with digitalisation and the recent policy emphasis on open science. Recent OECD work has focused on citizen participation processes to inform government decision-making (OECD, 2022[2]) and engaging citizens in innovation policy (Paunov and Planes-Satorra, 2023[3]) . More specifically, this project builds on previous work by the OECD Global Science Forum (GSF) on frameworks for open science (Dai, Shin and Smith, 2018[4]) and on citizen engagement in setting research agendas (OECD, 2017[5]). Prior work on transdisciplinary research to address societal challenges (OECD, 2020[6]) also covers some aspects of citizen science, particularly where multiple disciplines work together and co-design and co-production processes are involved.

This report focuses on the active engagement of non-professional scientists in scientific knowledge production (see the definition in the section of What is citizen science? in the next chapter). It is primarily intended for research policymakers in ministries and funding agencies to help them recognise the potential for the use of citizen science and to plan, implement and evaluate effective citizen science policies. Together with a set of overall recommendations it includes a policy framework and policy options with illustrative policies and initiatives from different countries. The policy framework is designed to help policymakers decide why, when and how citizen science should be promoted. The policy options (see Table 1) articulate specific actions that policymakers can take to implement the recommendations. The examples of policies and initiatives (see Annexes D and E) can be used to formulate specific citizen science policies.

These outputs complement existing documents, guidelines and frameworks from a number of organisations, particularly in Europe, which provide illustrative citizen science practices[1] and operational guidance[2] for citizen science practitioners or programme managers. In particular this project extends these earlier products to a broader audience of research policymakers in OECD countries and beyond.

The report describesthe project methodology, and provides an overview of citizen science, including a brief history, policy relevance and definitions. Building on this, it then outlines the analysis of citizen science policies and initiatives across countries, including key policy challenges and policy options to promote citizen science. This is followed by a policy framework that is supported by examples of good practice from different countries. All of these chapters are brought together in a set of overarching recommendations that are positioned at the start of the report.

Methodology

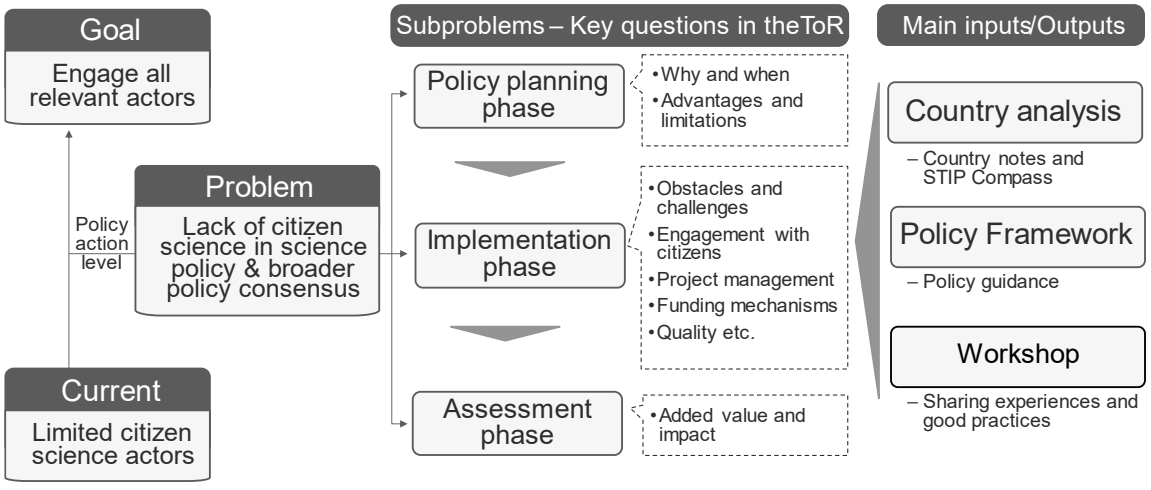
This project combined desktop research on existing resources, inputs from experts, the de novo collection of information from countries, and an international workshop. The work has been overseen by an international Expert Group (EG), whose members (Annex A) were nominated by the national delegations of the GSF. The Terms of Reference (ToR), which were approved by the GSF in April 2023, specify the development of a policy framework that can provide guidance for policymakers with the key questions on why, when and how[3].

The Expert Group held eight meetings and the members presented their different perspectives on citizen science, provided their insights, collected relevant data and information and indicated additional useful resources. Country notes were generated from 15 countries and organisations: Belgium (BEL), Canada (CAN), Switzerland (CHE), Colombia (COL), Germany (DEU), France (FRA), United Kingdom (GBR), Japan (JPN), Korea (KOR), Netherlands (NLD), Norway (NOR), Poland (POL), Portugal (PRT) and South Africa (ZAF), and European Commission. These notes included information on the national STI context and policy issues, citizen science policies and initiatives, and dedicated resources and infrastructure for citizen science.

Towards the end of the project, a two-day international workshop was organised to share experiences, challenges and good practices and engage with citizen science practitioners, experts and policymakers from across the globe to help develop the policy framework. The Expert Group also conducted a rapid foresight exercise to think 'out of the box' in terms of what citizen science might look like a decade from now. This exercise was designed not to be prescriptive or predictive but rather to stretch and inform considerations for policymakers in the final report. A separate report of the workshop and rapid foresight exercise is available [DSTI/STP/GSF(2024)10/FINAL].

Figure 1 shows the overall framing of the project that connects the problems, key questions in the ToR and the main project inputs and outputs.

Figure 1. Overall project framing



Source: author's design.

2 Overview of Citizen Science

This chapter presents a brief review of the scholarly and policy literature on past and current citizen science practices and introduces the definition of citizen science that is adopted in this report.

1. Citizen engagement in research: past and present

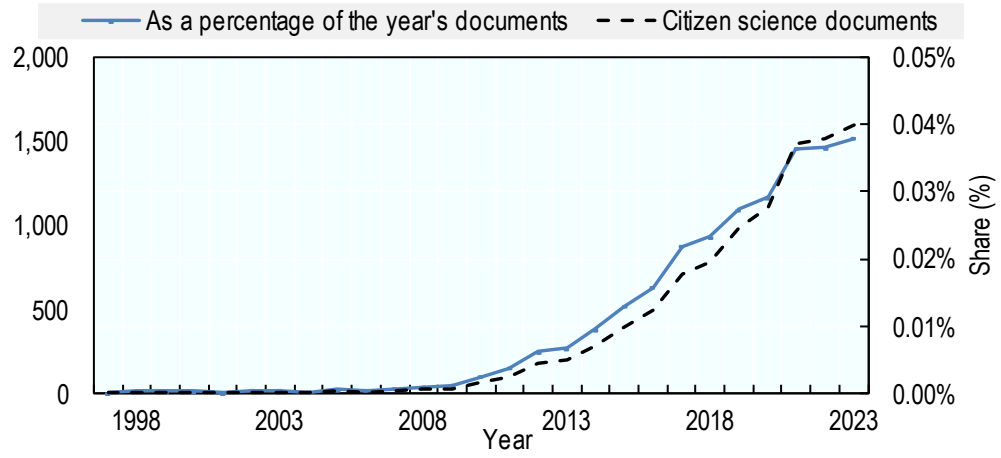
Scientific research by citizens who are not professional scientists is not new. Indeed, science as we know it today has its origins in citizen science. One of the earliest examples of this can be traced back to 801 AD in Kyoto, Japan, when merchants, politicians, monks, and others observed and documented the flowering of cherry trees (Aono and Kazui, 2007[7]). In Europe, the participation of non-professional scientists in research predates modern science, which emerged in the middle of the 16th century. From the 16th to 19 centuries, science relied mostly on lay expertise and lay assistance by members of society, and it was mainly a side activity of wealthy, educated, and male elites (European Commission et al., 2022[8]). It was only after the professionalisation of science in the 19th century[4] that there was a separation between professional science and wider society, including amateur scientists (European Commission et al., 2022[8]).

The resurgence of citizen engagement in research in the 20th century emerged from the 'science for the people' and social responsibility movements of the 1970s, which advocated for a more conscious and responsible science that served the interests of the broader public. It was given momentum by the so-called participatory turn of the 1980s and 1990s (Jasanoff, 2003[9]). In this context, a more inclusive and democratic approach to scientific research and policymaking emerged, characterised by an increasing involvement of non-experts in the scientific process and the necessity for collective discussion on common issues (Schade et al., 2021[10])[5].

The term 'citizen science' was only introduced in the 1990s and it has become increasingly popular since then. The term was first formally defined by Alan Irwin (Irwin, 1995[11]) and Rick Bonney (Bonney, 1996[12]) in different contexts[6]. It has gained wide international recognition, although there continues to be considerable differences in how it is interpreted and how it relates to other modes of research practice, such as participatory science, co-creation and transdisciplinary research (see discussion ahead). Despite these different interpretations, citizen science is now widely recognised as a critical element of open science (UNESCO, 2021[13]; Wehn and Hepburn, 2022[14]).

Today we are witnessing an increase and extension in citizen science practices, at international, national and local levels, across a wide range of research domains as illustrated in Figures 2 and 3.

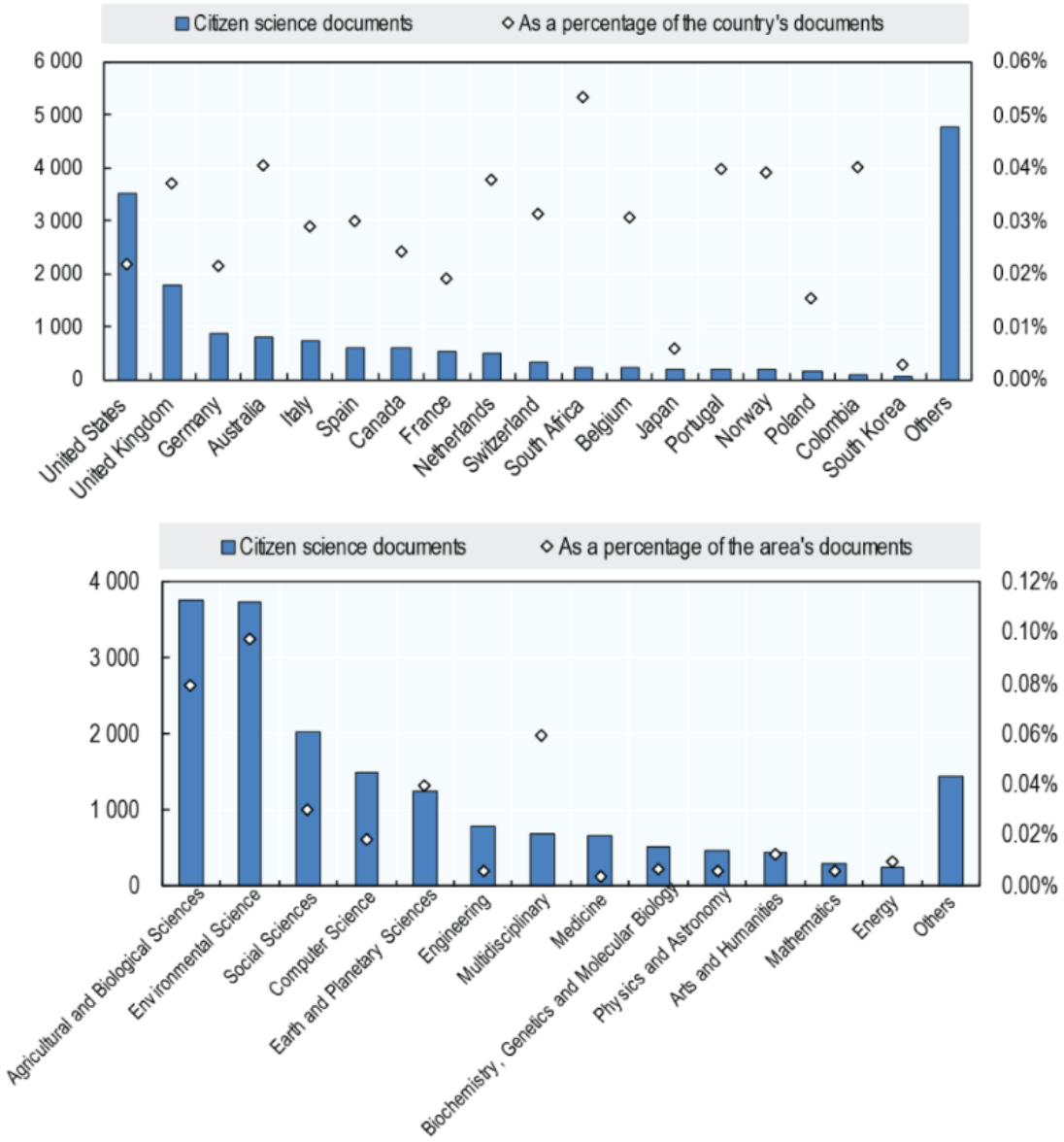
Figure 2. Growth of documents related to citizen science



Note: The documents (articles, conference papers, etc.) containing the phrase '"citizen science"' in the title, abstract, or as keywords from 1997-2023 on Scopus. The share is a percentage of the total document number of the year, which were found by searching for 'PUBYEAR > 1996 AND PUBYEAR < 2024' in the advanced search bar. The share represents a small percentage of total publications (under 0.04%), and this does not include documents that do not specify the term 'citizen science' (e.g., documents that use other related terms, or documents that do not explicitly refer to citizen science even if they are related[7]) and cannot capture citizen science practices that are not linked to documents. Searching for other related terms (participatory research, transdisciplinary research, co-creation and open science) also shows a similar growth trajectory.
Source: OECD based on Scopus analysis (Accessed on 18 February 2025)

Citizen science extends across a range of countries and subject areas. Figure 3 shows the number of documents that explicitly mention citizen science on Scopus (1997-2023) by country/territory and by subject area. These are more concentrated in some countries and regions, but publications are spread across the world. Regarding subject areas, the most common published usage is in agricultural and biological sciences, followed by environmental science and social sciences. Citizen science has been used for many years in environmental and biodiversity monitoring, public health, astronomy, and more recently in transportation, irrigation, and agriculture (Hecker et al., 2018[15]). At the same time, there is increasing adoption of citizen science for research on sustainable development and energy transition[8].

Figure 3. Documents related to citizen science: by country/territory and by subject area



Note: The documents (articles, conference papers, etc.) containing the phrase "'citizen science"' in the title, abstract, or as keywords on Scopus (1997-2023). The shares are percentages of the total document number of the country/territory or subject area. The country/territory of a document is defined on Scopus based on the country/territory that is specified in the affiliation address of an author.
Note: The countries displayed on the horizontal axis are the ten countries with the most citizen science documents, and then the countries that participated in the EG, selected in order from the most citizen science documents. The subject areas displayed on the horizontal axis are those with >200 citizen science documents, listed in order of number.
Source: OECD based on Scopus analysis (Accessed on 18 February 2025)

Citizen science is not just spreading across countries and research domains but is also extending qualitatively in the way it is applied. For instance:

- In research fields, such as psychology, where citizens have traditionally been research objects, new approaches are beginning to incorporate active citizen participation in the design and execution of research (Van den Bussche et al., 2024[16]).

- It is usual practice for professional scientists to verify inputs from amateur contributors, but these roles can also be reversed. For example, volunteers are rechecking the accuracy of maps of the fruit fly brain produced by academic neuroscientists (Nature, 2024[17]).
- Citizen science offers new ways of conducting research when resources are limited. For example, in a project on seismology, in Nepal, despite the absence of local funds or local government aid, the adoption of a citizen science approach — analysing seismological data in schools — has enabled effective scientific monitoring, whilst also increasing population awareness (Subedi et al., 2020[18]).

As illustrated by these examples, citizen science complements and enriches traditional research methods.

The growth in citizen science has been driven by: the widespread adoption of digital tools; the growing desire of some societal groups to participate in science; and the demand for new knowledge to address societal challenges. As these drivers gain momentum, the importance of citizen science at the practice and policy levels continues to grow.

Smartphone apps, networked databases, generative artificial intelligence (AI) and machine learning have changed - and are changing - how people can participate, making it easier to connect peers and the scientific community, improving access to data, and processing it more efficiently and effectively[9].

Another key driver is the public's desire and awareness to be actively involved in scientific processes. This reflects societal trends, such as the increasing value placed in science and the wish to participate in providing evidence for urgent societal problems (Hecker et al., 2018[15]). The Special Eurobarometer survey shows that citizens (greater than 10%) consider increasing their engagement with science and technology through actively taking part in scientific projects, indicating considerable unexploited potential for citizen science (European Commission: Directorate-General for Research and Innovation, 2025[19]).

The rise in tertiary education in many countries also offers potential for citizen science to expand further. While a common assumption about citizen science is that participants are "ordinary citizens", a recent analysis shows that the vast majority of participants have a background in science, be it an occupation or a university level background (Strasser et al., 2023[20]). For certain types of citizen science projects, over 70% of survey respondents have a bachelor's degree, indicating a high level of scientific literacy among participants (ibid.). The worldwide increase of students with a tertiary degree in the last decade (OECD, 2024[21]) presents an opportunity for more people to potentially engage in citizen science.

There is a long history of using data collected by citizens to assess the impact of policies, particularly in areas such as the invasive species management and biodiversity monitoring (Vohland et al., 2021[22]). In recent years, citizen science has emerged as a powerful tool also for tackling societal challenges in areas such as public health, environmental protection, innovation, and education (Hecker et al., 2018[15]). In many important areas, citizen science can act as catalyst for broader public understanding and engagement[10].

Citizen science is becoming institutionalised worldwide through networks and associations, which serve as valuable sources of expertise and support for policy. Associations[11] are key players in raising awareness, providing tools and training to practitioners, and setting standards and best practices. Meanwhile, networks at both a national and global level[12] foster collaboration, build communities, and facilitate the spread of citizen science activities within and across borders.

2. What is citizen science?

There are a variety of definitions of citizen science, but they share common elements, including participation of members of the general public in the scientific research process (Hecker et al., 2018[15]; Haklay et al., 2021[23]). There have been initiatives to develop an international definition of citizen science based on a minimum set of criteria (Heigl et al., 2019[24]), and general frameworks that group common

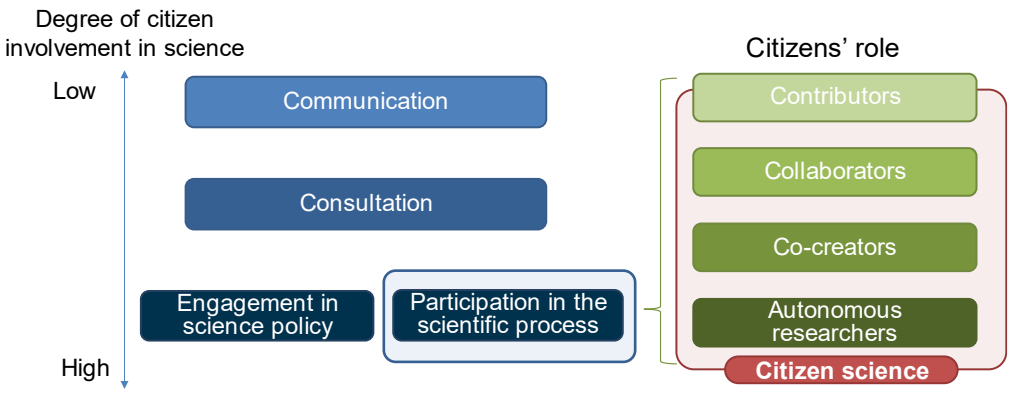
principles have emerged (e.g., Ten principles of citizen science (ECSA (European Citizen Science Association), 2015[25])). However, the consultations that were conducted for the present report, clearly indicate that, in practice, people's understanding of citizen science varies considerably.

In this report, citizen science is defined as 'the active engagement of non-professional scientists in scientific knowledge production'. This is consistent with other definitions[13], although it is narrower in scope than some of these. Importantly, this definition focuses on the active scientific knowledge production process. It does not include the role of citizens in other science related activities, such as: consultation processes; science policymaking; research agenda setting; and review processes for research funding and evaluation. It also does not include the engagement of citizens as passive contributors to research (e.g., patients who participate in clinical trials). Notably however, citizen science as defined here spans across a broad range of scientific disciplines and can contribute to the evidence base for many areas of government policy.

Figure 4 illustrates the scope of this citizen science definition used in this report. It shows the different mechanisms for involvement of citizens in science, which range from communication and consultation activities to engagement in science policy and participation in the scientific process (see blue shading in Figure 4). Whereas the first two types of involvement aim to inform citizens and collect their views on specific issues, the last two types involve citizens in either science policymaking or scientific knowledge production. There are different degrees of citizen participation in research: citizens can be contributors, collaborators, co-creators, or autonomous researchers[14] (Bonney et al., 2009[26]; Shirk et al., 2012[27]; Sauermann et al., 2020[28]; Haklay, 2013[29]) (see green shading in Figure 4).

Citizen science is related to other modes of research, such as participatory research/sciences[15], transdisciplinary research and co-creation. These terms are frequently used in policy circles and all of them include citizen engagement in research (see (OECD, 2020[6]) for a discussion of some of these terms). Given the evolving definitions and usage of these overlapping terms, it is important to recognise commonalities rather than emphasising differences[16].

Figure 4. The scope of citizen science in this report



Source: author's design, based on (Paunov and Planes-Satorra, 2023[3]; Haklay, 2013[29]; Bonney et al., 2009[26]; Shirk et al., 2012[27]; Sauermann et al., 2020[28])

3 Country Analysis and Policy Options

This chapter presents the policy landscape, challenges and options for promoting citizen science (as a mode of scientific knowledge production). This cross-country analysis is based on the dedicated country notes developed for this project by the EG members and ancillary materials, including systematically collected information on national STI policies from the EC-OECD STIP Compass.

1. Policy landscape

Reflecting the growing policy interest in citizen science over the past decade, many countries now have STI strategies that either include, or are specifically focused on, citizen science. There are also a number of cross-national policy activities analysing and/or promoting citizen science and citizen engagement with science[17].

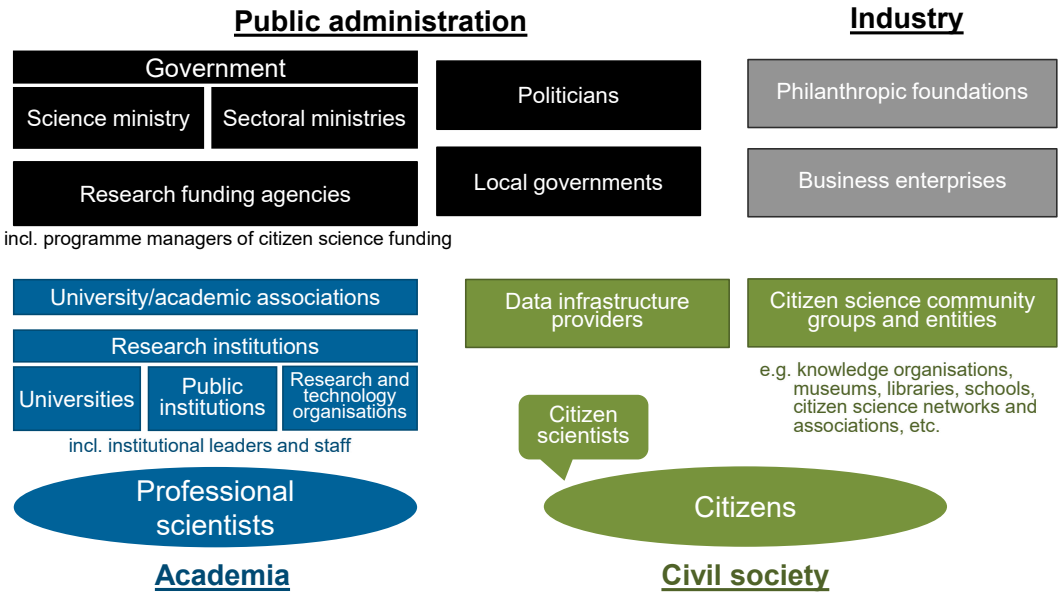
Policy rationales for promoting citizen science are diverse. Citizen science can be embraced in national strategies for STI under multiple themes including: open science; participatory research/sciences; public engagement and participation; science communication; science in/with/for society. It is also identified as an important tool in specific research areas (e.g., biodiversity, environment, energy, ocean, health, digital and AI)[18] and for addressing the SDGs[19]. The wide variety of policy priorities with which citizen science is associated reflects different rationales for pursuing citizen science at the policy level (see further discussion ahead under Policy Framework chapter for citizen science policy rationales).

A wide variety of policies and initiatives for citizen science are being implemented for different purposes. These policies and initiatives are mainly focused on research funding and 5 other enabling factors: i) National legal & policy frameworks, ii) Institutional internal policies & culture, iii) Capacity building & networks, iv) Supporting (data) infrastructures, and v) Societal dialogue (European Commission et al., 2023[30]). A mix of actors have responsibility for these different enabling factors. Figure 5 illustrates these various actors in the citizen science ecosystem. What actors play what role depends on the governance of the research system in a country/region and the specific context, including the policy aims for promoting citizen science.

Although policies and initiatives differ by country and contexts, citizen engagement in the production of scientific knowledge is driven through two main mechanisms. It can be a direct result of government policies, including national research funding and national strategies (i.e. a top-down approach). It can also be driven by individual research professionals or citizens, or local communities (i.e. a bottom-up approach). These mechanisms are not exclusive; rather, there is usually a mix of drivers, whose balance varies considerably across countries and jurisdictions.

It is important to effectively strengthen and combine top-down and bottom-up approaches in a way that is sensitive to specific contexts and dynamics of actors in order to realise an enabling environment for citizen science (see DSTI/STP/GSF(2024)10/FINAL for the workshop report[20])[21].

Figure 5. Citizen science in scientific knowledge production: a complex ecosystem



Note: The colours of the actors (black, blue, grey and green) reflect the quadruple helix components (consisting of public administration, academia, industry and civil society, respectively) (Carayannis and Campbell, 2009[31]). Depending on the specificities of a particular national or local ecosystem, actors may belong to other quadruple helix components - for instance, data infrastructure providers and/or citizen science community groups and entities may be part of civil society but can be in academia or industry.
Source: author's design

2. Policy challenges

Although there are significant differences between different countries and jurisdictions, there are also number of common policy challenges that emerge from a cross-country analysis. These include:

- **Achieving policy consensus**. There can be a struggle to reach a common understanding of the ,aims for, and outcomes from, using citizen science. This can translate into a lack of (dedicated) mainstream funding and resources for citizen science. Awareness and understanding amongst policymakers need to be improved.
- **Coordination across various actors**. There are multiple actors operating at different levels in the citizen science ecosystem and there can be challenges in working together and combining top-down and bottom-up approaches. This can result in, and be a result of, overlapping policies and initiatives and there is a need for better coordination between actors.
- **Bridging the gap between policy goals and citizens' expectations**. Higher-level policies can be perceived as being too far removed from the daily lives of citizens, which makes it harder to engage them, especially when there is no clarity on how their contributions will be used to achieve the stated policy goals.
- **Integrating citizen science data or evidence into policymaking**. Scepticism – from both policymakers and professional scientists – as to the rigour and quality of citizen science data can be a barrier to its uptake. Certification and quality control processes can help address this. More broadly, there is a need to ensure the knowledge and capacity to integrate citizen science evidence, insights and data into policymaking.
- The lack of **academic career pathways and systems of rewards** for citizen science and need to encourage **research institutions to provide expertise and support** to enable citizen science.

Traditional scientific culture and assessment processes, with a focus on individual disciplinary excellence, do not value citizen science activities.

- **Acknowledging citizens' contributions** and avoiding **potential exploitation** of citizens. It needs to be ensured that citizens have access to research insights. The participation of citizens is often not fully acknowledged in publications and other research outputs. This accentuates power differentials and can lead to a lack of ownership and sense of exploitation.
- **Ensuring inclusiveness in citizen participation**. The importance and nature of inclusivity varies depending on the aims and nature of citizen science activities. However, in many situations the lack of incentives for participation, technical restraints (e.g., access to an internet connection) and/or language barriers can constrain efforts to achieve inclusivity. Language may hinder effective international collaboration and global dissemination of research results.
- **Supporting data platforms** and **international cooperation around data**. Establishing and maintaining open access platforms is challenging, since public funding is often directed towards new technological developments rather than the maintaining or expanding what already exists. Some citizen science data, including sensitive personal data, requires specific security and access protocols that are not always built into existing platforms. Global challenges may require global interoperability of data, but achieving this requires building a broad consensus on standards and vocabularlies, between diverse stakeholders.
- **Developing effective funding mechanisms** (grant procedures, conditions, assessment criteria, etc.). Traditional funding mechanisms may need significant adjustment; for example, the application process may be too complex for citizens to apply; reviewers may need specific training to properly evaluate proposals; and the minimum requirements and criteria for proposals may be too ambitious for the promotion of bottom-up citizen science practices.

Responsibilities for addressing these various challenges are shared amongst the various actors in the citizen science ecosystem (see Figure 5).

3. Policy options

An overall analysis of existing policies and initiatives that countries are implementing to promote citizen science leads to the identification of a variety of policy options that address different enabling factors. Some of these can be related to the specific policy challenges listed in the previous section but many of them cut across several of these challenges. They are categorised in Table 1 in terms of funding and 5 other key enabling factors (see previously and (European Commission et al., 2023[30])).

Table 1. Enabling factors and policy options for promoting citizen science

Enabling Factors	Policy Options for Promoting Citizen Science
National Research Funding	• Provide national research programmes that are adapted to support citizen science (see also 3.2. Funding management of Policy Framework).
National Legal & Policy Framework	• Embed citizen science into national STI strategies and/or establish a dedicated national citizen science strategy. • Facilitate the inclusion of citizen science data and results in policy and decision-making. • Mandate or incentivise public institutions to implement citizen science and/or play a specific role in citizen science. • Develop national evaluation frameworks for research (and research policy) that accommodate broader impacts beyond scientific publications.

Policy & Culture of research institutions	• Develop research and funding strategies within research funding bodies that embrace citizen science. • Foster efforts by research institutions and local governments to promote citizen science (e.g., integrating citizen science into their strategies, establishing dedicated functions for citizen science, training and capacity building). • Encourage cross-institutional activities that foster organisational change. • Reward and recognise professional scientists engaged in citizen science activities. • Promote research assessment reform for research institutions.
Capacity Building & Networks	• Create (dedicated) knowledge centres to enable citizen science. • Provide tools and training for professional scientists to deploy citizen science. • Recognise, support and/or organise conferences, networks/partnerships and/or associations for facilitating knowledge exchange, training and showcasing best practices. • Provide funding support to enhance capacity and networking of local communities. • Foster capacity building for policymakers with regard to citizen science.
Supporting (Data) Infrastructures	• Provide a portal website that collects citizen science practices. • Support and/or develop online platforms for (FAIR)[22] data gathering, analysis and preservation. • Support and/or develop data integration platforms.
Societal Dialogue	• Strengthen communication between professionals and citizens. • Conduct national surveys on citizens to understand public opinions and attitudes. • Engage with citizens in research agenda setting. • Encourage citizens to participate in capacity building and networks.

These various policy options can be selected and combined by policymakers to enable citizen science. More information on specific policies and initiatives from different countries, collected during this project is provided in Annex D. Taken together, Table 1 and Annex D are an important complement to the policy framework which is described in the next Chapter and can assist policymakers in formulating policy interventions for different scenarios.

4 Policy Framework

An effective policy framework needs to embrace the policy challenges and enablers described in the previous chapter and help answer the key questions of why, when and how citizen science should be promoted. Such a framework should be useful not only for science policymakers in science ministries and funding agencies but also policymakers who have a responsibility for research in other ministries or agencies at national or local levels (hereafter, these policymakers are referred to as 'research policymakers')[23]. Depending on a country's research system, the use of citizen science may be promoted by ministries and agencies with responsibility for specific sectors, in addition to science ministries and funding agencies.

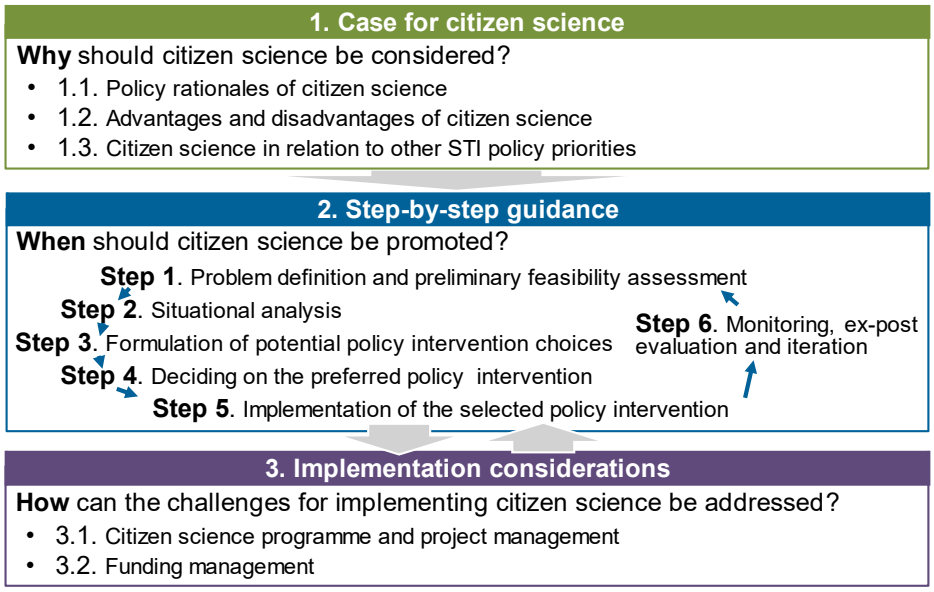
It is noted that policymakers who consider applications of citizen science beyond research, such as its use in regulatory or innovation policy, may have to apply additional considerations. For instance, the policy framework described here does not highlight regulatory legislation development for sectoral goals and related innovation policy instruments e.g., fablabs, living labs and hackathons (cf. recent OECD work on citizen engagement in innovation policy (Paunov and Planes-Satorra, 2023[3])).

The framework laid out in this chapter can be summarised as follows:

- **Aim**: To promote broader understanding and policy consensus on the role(s) of citizen science (as a mode of scientific knowledge production) and embed it across research policy thinking as a valuable tool for achieving scientific and societal goals.
- **Audience**: 'Research policymakers' - defined as policymakers who have a responsibility for research regardless of their ministry or agency at international, national or local levels.
- **Key components**: Guidance for research policymakers on why, when and how citizen science should be promoted as a valuable research approach.

The policy framework is built around three pillars: 1. Case for citizen science, 2. Step-by-step guidance, and 3. Implementation considerations. Each pillar is necessary to answer the key questions of why, when and how citizen science should be promoted (see Figure 6).

Figure 6. Policy Framework Structure



Source: author's design

1. Case for citizen science – why should citizen science be considered?

1.1. Policy rationales for citizen science

A wide variety of citizen science practices and contexts, typologies[24] and rationales[25] can be articulated. From the perspective of creating better research policy, there are 3 main rationales for considering citizen science[26] (see Annex B for illustrative cases against these 3 distinct rationales):

i. Increasing the scope of data collection and/or analysis and accelerating scientific discovery,
ii. Addressing societal needs and challenges more effectively, and
iii. Promoting the democratisation, legitimacy, and uptake of policies informed by scientific knowledge.

Citizen participants can expand or enrich research data collection. The data may be more geographically or temporally extensive or have a higher resolution than can be routinely collected by professionals. This has been well-recognised in many research areas, ranging from ornithology to astronomy. Citizen involvement may enable researchers to obtain (and securely manage) sensitive personal data that is valuable for health or social science research. Citizens can also participate in experimentation or analysis by processing some tasks or interpreting data and, in some cases, this may be more cost-efficient. Citizen science may be a viable approach when other traditional research methods that are entirely dependent on professional scientists are not feasible. Citizen contributions can go beyond the crowdsourcing of data and analysis and involve unique research whose scope may not be conceived by disciplinary professionals. Citizen science can foster a diversification of research ideas and approaches[27].

At the same time, citizen science enables research to include various sources and forms of knowledge from a broader public that can be important to address societally relevant problems[28]. Citizen participation enables research questions to be re-focused towards issues that are needed, or of concern to, citizens, including marginalised and under-served groups. The knowledge provided by citizens is critical for addressing complex challenges that require not only technological innovation but also societal transformation. Citizen engagement in the research process can facilitate public acceptance of the generated results and the widespread dissemination of those results. Citizen science has the potential to fill gaps that exist in traditional science.

Citizen engagement can generate additional benefits for society beyond scientific knowledge production that are important for addressing societal needs and challenges. Examples include the enhancement of scientific literacy and knowledge, public awareness and behavioural change, community/network building and improved social cohesion, and increased interest in research and scientific careers. These benefits enable citizens to participate in public debates involving scientific issues in an informed manner and can contribute to addressing mis-/dis-information and distrust of experts. The engagement can also contribute to policy development, such as environmental or biodiversity monitoring regulations.

Citizen science can contribute to democratisation of science, strengthen the legitimacy of science and scientific authorities, and ultimately enhance uptake of evidence-based policies. Citizen participation in scientific knowledge production means opening up and democratising research processes. When this is done with transparency and inclusivity, it can increase the legitimacy of, and trust in, science, policy and scientific authorities (OECD, 2017[32])[29]. This results in improving not only the uptake of the research policy but also the uptake of policies informed by scientific knowledge that is generated by, or together with, citizens.

Although citizen science policies and initiatives do not always fit neatly into a single category, understanding these major rationales from the research policy perspective is important for understanding why citizen science matters. For research policymakers, citizen science should contribute directly to addressing policy challenges and the delivery of an overall mission or ambition (Office of Science and Technology Policy (OSTP), 2015[33]).

1.2. Advantages and disadvantages of citizen science

The potential disadvantages are often the flip side of the advantages discussed above (1.1). For the scientific advancement rationale, volunteer participation in research may raise issues regarding the scientific quality of outputs, increase uncertainty by decreasing direct research control, require additional expenditure, and generate unfamiliar legal and ethical issues.

Citizen science has a variety of potential positive impacts on society, but a gap between policy goals and citizens' expectations can make the realisation of these benefits difficult (see also 2. Policy challenges in the previous chapter). Traditional short-term evaluations may not be able to capture longer term impacts. This is a challenge for assessing the impact on scientific literacy or public awareness and behavioural change, where it can be difficult to clearly establish causality (Sauermann et al., 2020[28]). There may be trade-offs between these societal benefits and scientific knowledge production (Sauermann et al., 2020[28]; Chase and Levine, 2016[34]). In some situations, especially when citizens contribute to intellectual activities beyond specific tasks (e.g., data collection and analysis), the engagement of citizens may unintentionally exacerbate conflicts and distrust rather than generating social cohesion and trust (LERU, 2016[35]) (see the related considerations in sections 3.1.3. Quality assurance and potential bias avoidance and 3.2.3. Research security and integrity).

While citizen science opens science to the public, which can strengthen the democratisation, legitimacy, and uptake of policies, there can be a demographic bias in participation that reinforces polarisation within society. A lack of transfer of control from professionals to citizens, or changes in power relations can induce tension with traditional scientific stakeholders (Sauermann et al., 2020[28]).

Table 2 provides a summary of the policy rationales, impact domains, and perceived advantages/benefits and disadvantages/challenges of citizen science.

Table 2. Rationales, impact domains, and perceived advantages/benefits and disadvantages/challenges

<table>
<tr><th>Rationale</th><th>Impact on</th><th>Advantages/benefits</th><th>Disadvantages/challenges</th></tr>
<tr><td rowspan="2">Data collection and/or analysis, and scientific discovery</td><td rowspan="2">Science</td><td>• Expansion of data coverage (spatial and temporal extent and resolution) and/or analysis
• Acceleration of scientific discovery
• Cost efficiency
• Research diversity – e.g., research outside the scope of professionals and publications</td><td rowspan="2">• Scepticism or concerns raised about scientific quality and rigour
• Participants management and output validation: investment in money, resources and time
• Uncertainty regarding success: data acquisition and analysis, and resource access become outside of the direct control
• Legal and ethical issues – e.g., safety, privacy, intellectual property and confidentiality</td></tr>
<tr><td rowspan="2">Societal needs and challenges</td><td>• Inclusion of various sources and forms of knowledge
• Research relevance – e.g., research questions that society/community prioritises
• Research dissemination – e.g., technology use and acceptance</td></tr>
<tr><td>Society</td><td>• Scientific literacy and knowledge
• Public awareness and behavioural change
• Community/network building and social cohesion
• Interest in research and scientific careers
• Policy development – e.g., environmental or biodiversity monitoring regulations</td><td>• Potential gap between policy goals and citizens' expectations
• Uncertainty or potentially a longer-period of commitment to demonstrate success: the benefits may not be captured by traditional short-term evaluation; difficulty in establishing causality
• Unintended conflicts and distrust between actors: hostile discussion, public criticism and credibility loss</td></tr>
<tr><td>Democratisation, legitimacy, and uptake of policies</td><td>STI ecosystem (Governance)</td><td>• Democratisation – e.g., openness/transparency, equity, inclusiveness, social empowerment
• Legitimacy of, and trust in, science, policy and scientific authorities
• Uptake of policies informed by scientific knowledge</td><td>• Potential lack of: inclusiveness of the participants; transfer of control
• Unintended tension with traditional scientific stakeholders</td></tr>
</table>

Note: These categories and components are not fully exclusive
Source: Author's analysis, incorporating existing foundations (Pocock et al., 2014[36]; LERU, 2016[35]; Sauermann et al., 2020[28]; Hecker et al., 2019[37]).

1.3. Citizen science in relation to other STI policy priorities

Analysis of national science, technology and innovation (STI) strategies (see section on Policy landscape in the previous chapter) reveals that citizen science is being used to address a number of policy priorities, including:

- Open science
- Public engagement and participation

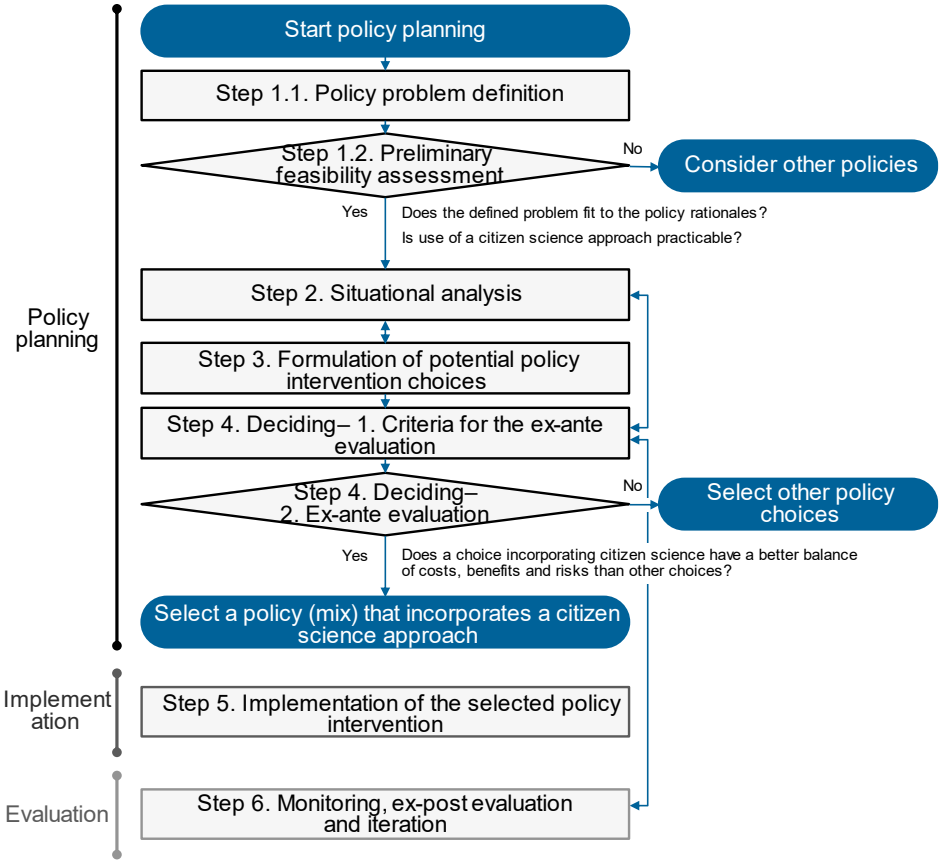
- Science communication
- Science in/with/for society
- Specific research areas: biodiversity, environment, energy, ocean, health, digital and AI, etc.
- Sustainable Development Goals (SDGs)

These policy priorities leverage the rationales and advantages/benefits of the citizen science approach. It is important for research policymakers to recognise that a citizen science approach can be deployed to achieve multiple policy priorities. The adoption of a citizen science approach may be supported, or may even be required, to deliver existing STI policy priorities.

2. Step-by-step guidance – when should citizen science be promoted?

The step-by-step guidance laid out here consists of six steps for research policymakers to plan, implement and evaluate a citizen science policy (see Figure 7). By following these steps, research policymakers can assess the potential value and feasibility of promoting citizen science in any particular situation.

Figure 7. Decision flowchart in the step-by-step guidance



Source: author's design

Step 1. Problem definition and preliminary feasibility assessment for citizen science

- Define the policy problem (or aim) aligned with the research policymaker's missions without specifying policy intervention approaches.

- Consider relevance of a citizen science approach to the defined problem as an initial feasibility test – does the problem align with the benefits that a citizen science approach can offer (see previous section on Case for citizen science)?
  - For expanded data collection and/or analysis and scientific discovery, the required geographic or temporal scale of data, size of analysis, and/or scientific quality and rigour should be considered. If the problem only needs a small number of data, limited analytical effort or efforts that can be substituted by computers, or a very high degree of scientific rigour, a citizen science approach may not be worth pursuing.
  - For addressing societal needs and challenges more effectively, the key question is: is it essential to reflect public needs, preferences or insights, stimulate collective intelligence, or foster scientific literacy or public awareness and behavioural change in order to address the policy problem? The policy relevance should be reviewed not only from the perspective of policymakers but also from citizens in order to manage the expectations between higher-level policy goals and citizens' interests.
  - For the democratisation, legitimacy, and uptake of policies, the required inclusiveness and empowerment of citizen participants should be considered. If the problem needs a process where diverse citizens take a role in delivery of scientific knowledge, citizen science becomes a strong candidate for inclusion in the policy response.
- If the defined problem is likely to benefit from a citizen science approach, start preliminary assessment of other feasibility issues before taking further steps (Tweddle et al., 2012[38]; Pocock et al., 2014[36]; Pettibone et al., 2016[39]; Blaney et al., 2016[40]). These are sometimes known as practicability criteria in public policy (Bardach, 2012[41]):
  - Operational issues: citizen participants (e.g., target participants; their motivations and accessibility; ensuring the right diversity); additional funding, resources and time required; relevant experience and capacity of related actors (see Figure 5)
  - Legal and ethical considerations: required regulations, safety, privacy, intellectual property and confidentiality (see ahead, implementation considerations)
  - Political acceptability (ensuring senior level support): needs to address uncertainty or potentially a longer-period of commitment to demonstrate success; plan for unintended consequences (e.g., conflicts and distrust between actors; tension with traditional scientific stakeholders)
- If the defined policy problem significantly conflicts with the use of a citizen science approach either in terms of policy relevance or practicability in the preliminary feasibility assessment, then there is no need to proceed to step 2.

Step 2. Situational analysis

- Assemble the evidence to clarify the defined problem (Step 1). This evidence can then be used to formulate potential policy intervention choices (Step 3) and conduct ex-ante evaluation of those choices (Step 4). Evidence should address the following:
  - The nature and extent of the defined policy problem. It is helpful if the problem can be quantified.
  - The particular features of the policy situation – considering the stakeholders that influence the current policy landscape and that are expected to play a role in the implementation of potential policy intervention choices (see Step 3), with considerations for assessing the practicability criteria (see Step 1). Existing policies and initiatives related to the defined problem should be collected if applicable.
  - Previously successful policies to address issues similar to the defined problem, in other policy jurisdictions, or at other times.

- In order to identify potential policy interventions, reference can be made to the EC-OECD STIP Compass and dedicated citizen science platforms (see Annex C). Annex D also summarises examples of policies and initiatives that have been implemented in different countries.
- Proceed to the next steps with the collected evidence and return to this step to gather more information if necessary.

Step 3. Formulation of potential policy intervention choices

- Formulate potential policy intervention choices by using the information gathered in Step 2 and considering enablers and barriers.
- When addressing the defined problem through a policy that incorporates a citizen science approach, the main enablers should be considered: research funding and 5 other factors: i) National legal & policy frameworks, ii) Institutional internal policies & culture, iii) Capacity building & networks, iv) Supporting (data) infrastructures, and v) Societal dialogue (European Commission et al., 2023[30]).
  - The policy options for promoting citizen science (Table 1) help to formulate relevant potential policy intervention choices. Associated examples can be found in the summary of existing policies and initiatives (Annex D) and key features of citizen science funding programmes (Annex E).
  - A systematic approach that addresses different actors and multiple enabling factors to effectively combine top-down and bottom-up initiatives may be necessary. A potential choice may be a mix of several options for promoting citizen science.
  - Depending on the current policy portfolio, citizen science may be integrated into existing research policies and activities. For instance, if there is a funding programme that targets a similar policy problem, it might be appropriate to revise the programme to enable citizen science to be included (see ahead, section 3.2. Funding management).
- Gather feedback on potential policy intervention choices through the situational analysis (Step 2). The barriers to a policy (mix) that incorporates a citizen science approach can be derived from the practicability criteria (see Step 1).
- Initiate discussion and collaboration with key actors who have experience with citizen science and/or may be interested in it (see Figure 5 for related actors)30. This can help to improve policy design and/or increase political support for the policy.
- If the feedback from the situational analysis suggests that a policy (mix) that incorporates a citizen science approach is promising, take the next step.

Step 4. Deciding on the preferred policy intervention

- Select criteria and conduct an ex-ante evaluation of the different policy intervention choices that were formulated in Step 3 (including a policy (mix) choice that incorporates a citizen science approach). Ideally, the preferred policy intervention will have the best balance of costs, benefits and risks (Bardach, 2012[41]; HM Treasury, 2022[42]; Blaney et al., 2016[40]).

Step 4.1. Criteria for the ex-ante evaluation

- Select criteria in line with the defined policy problem (see Step 1), embracing broad quantitative and qualitative criteria that go beyond scientific excellence and cost efficiency.
  - It can be helpful to focus initially on the principal criteria indicated by the defined policy problem (Bardach, 2012[41]), but even then, a variety of outcomes should be considered. For science in general, there is already a growing movement towards assessing multiple research outputs (e.g. publications, data and software) as well as wider societal and policy outcomes that are

best assessed qualitatively (Raff, 2013[43]). This is particularly relevant for citizen science[31], where traditional publications may not be the main output.

- It may be helpful to review the advantages and disadvantages of citizen science (see section 1.2.) in order to identify potential outcomes and then define tailored criteria for science, society and governance domains. The criteria may also be informed by ex-post evaluation (see Step 6) as ex-ante and ex-post evaluation should be aligned with each other (HM Treasury, 2011[44]).

- Prioritise different criteria.
  - The potential trade-offs between the various outcomes in a policy that incorporates a citizen science approach may need to be considered. For example, citizen participation can be characterised by its scale (number of participants), degree of participation and diversity of participants, and there may be trade-offs between these factors and between the distinct benefits of scientific knowledge production and citizen learning (Sauermann et al., 2020[28]). These trade-offs may make it difficult to reconcile one criterion with another, and there is no normative value judgement for different benefits (European Commission et al., 2022[8]).
- Include important practicability criteria – operational issues, legal and ethical considerations and political acceptability (see Step 1).
  - With regards to political acceptability, uncertainty or the likelihood of requiring a longer-period of commitment to demonstrate success in a policy that incorporates a citizen science approach is an important consideration. Policy flexibility can help to accommodate this (U.S. General Services Administration, 2015[45]; Wiarda et al., 2023[46]). However, the need to pilot a new policy (mix) that incorporates citizen science may result in additional risks, delays and costs (Blaney et al., 2016[40]), which also need to be taken into account (see also section 3.2. Funding management).

Step 4.2. Ex-ante evaluation and decision-making

- Estimate the outcomes against the selected criteria for specific policy intervention choices by combining the information gathered in the situational analysis (Step 2).
- Compare the outcomes and decide the preferred policy intervention that has the best balance of costs, benefits and risks[32].
- After selection of the preferred policy intervention, communicate with broader actors (beyond key stakeholders for citizen science discussed in Step 3). As citizen science may cause unintended tension with the professional scientific community, it is important to deliver a consistent message that citizen science is not a substitute for traditional science but complements it. Likewise, it does not conflict with scientific autonomy but brings mutually beneficial interactions between professional scientists and citizens (see also the workshop discussion at DSTI/STP/GSF(2024)10/FINAL).

Step 5. Implementation of the selected policy intervention

- See the implementation considerations ahead to identify critical considerations when implementing a policy (mix) that incorporates citizen science in the process of delivering scientific knowledge.

Step 6. Monitoring, ex-post evaluation and iteration

Monitoring:

- Specify indicators that are required to measure inputs, outputs, outcomes and impacts, and collect and analyse them.

- Monitoring is important for understanding 'progress against objectives' (Department for Business, Energy & Industrial Strategy, 2020[47]), and selected indicators should be aligned with the defined policy problem (Step 2) and ex-ante evaluation criteria (Step 4).
- Logic models, which describe the chains from inputs to impacts and are often used for policy assessment, have been developed for citizen science. Examples include an evaluation framework (Kieslinger et al., 2018[48]), a user guide for evaluating individual learning outcomes (Phillips et al., 2017[49]), and a case study for a citizen science project (Skarlatidou and Haklay, 2021[50]). Discussion with key stakeholders can inform views of how a selected policy intervention is likely to work (HM Treasury, 2011[44]).
- Examples of impact indicators for citizen science can be found in the Measuring Impact of Citizen Science (MICS) Impact Indicator Explorer[33] and its conceptual framework (Wehn et al., 2021[51]). The MICS Explorer lists indicators that are grouped into five domains: science and technology, society, economy, environment, and governance. These domains map onto the impact domains that have been adopted in this policy framework (see Table 2)[34].

Ex-post evaluation:

- Consider both quantitative and qualitative impacts and evaluate them.
  - Evaluation ideally involves 'the systematic assessment of the design, implementation and outcomes of an intervention' (Department for Business, Energy & Industrial Strategy, 2020[47]). A policy intervention needs to be assessed against the originally defined policy problem. Evaluation is important for both learning and accountability.
  - For the evaluation of a policy (e.g., a research funding programme), quantitative metrics can be useful to demonstrate some aspects of policy impact, but these should be complemented by qualitative narratives to explore wholistic impacts. Evaluation may be conducted after a longer period (e.g., 5-10 years) than monitoring (e.g., annually) (see DSTI/STP/GSF(2024)10/FINAL for the workshop report). Programme evaluation is often conducted by combining project-level assessments (see Annex F on Evaluation example).
  - Given the uncertainty or a longer-period of commitment to demonstrate success of citizen science, the process rather than the impacts can also be assessed, often within a shorter timeframe, to maximise the likelihood of a policy delivering optimal value. An example of a framework for this purpose is one that has been developed by the UK HM Treasury (HM Treasury, 2019[52]).

Iteration:

- Improve the policy based on the monitoring and evaluation results.
  - Early learning from monitoring and evaluation enables agile changes of policy design (Treasury, 2020[53]), which can be critical for optimising a policy (mix) that incorporates a citizen science approach (see also section 3.2.1. on Funding mechanisms).

3. Implementation considerations – how can the challenges for implementing citizen science be addressed?

This section discusses key considerations for policymakers (from ministries and funding agencies) in implementing a citizen science approach. These considerations have implications also for policy design. Addressing them is a shared responsibility between policymakers and those with day-to-day responsibility for policy implementation, i.e. programme or project managers ("research managers"). The role of policymakers is not to prescribe every small detail but rather to make sure that the responsible research managers properly perceive and deal with the challenges. A number of useful toolkits and guides for managers to implement citizen science already exist[35].

3.1. Citizen science programme and project management

Ultimately each research programme or project has its own purpose and should be fit for purpose (Office of Science and Technology Policy (OSTP), 2015[33])[36]. Nevertheless, there are a number of recurrent issues that can undermine the effective implementation of a citizen science approach.

3.1.1. Citizen participants – demographics, motivation and barriers to participation

Citizen participants may not reflect certain demographics (e.g., gender, age, race, education, income), and targeted efforts may be required to ensure diversity and inclusion (Paleco et al., 2021[54]). In order to properly manage participants, research managers need to:

- Consider the specific engagement requirements – scale of citizen participation, degree of engagement [37] and diversity (e.g., reflecting the diversity of society or focusing on marginalised/under-served groups) – to achieve the project aims.
- Understand the demographics and motivations of participants and establish a community building plan, which includes recruitment and communication channels (these could differ by community) and ways to reduce barriers to participation (Fraisl et al., 2022[55]; U.S. General Services Administration, 2015[45]).

Other barriers to participation may be related to: location and physical access; accessibility of technologies for participation; availability of time; financial opportunity costs of participation; and, institutional structures (Wiarda et al., 2023[46]; UNDP Bureau for Policy and Programme Support, 2018[56]).

Language is a common barrier to participation. Studies show that the use of local languages has a positive impact on citizen participation and motivation (Spellman et al., 2019[57]; Terenzini, Safaya and Falkenberg, 2023[58]; Heinisch, 2021[59]). Currently, English is the common language in scientific outputs[38] and is often an entry point for citizen science on large platforms[39] (Heinisch, 2021[59]; Desjardins, 2020[60]). In citizen science projects that are international or require local communities, it is critical to consider translation needs (Heinisch, 2021[59]). Choice of language is important to disseminate research results and encourage actions by stakeholders, including the general public and policymakers[40].

3.1.2. Incentives for citizens to participate and engage

As citizen participation depends on their incentives, research managers need to:

- Communicate with prospective participants to better understand their motivation (U.S. General Services Administration, 2015[45]). Motivations may be different to a priori expectations.
- Use appropriate approaches to motivate participants, such as: enrichment opportunities (e.g., enjoyment or learning opportunities); action-oriented research (e.g., research aligned with participant interests)[41]; public recognition; academic recognition[42]; intellectual property (e.g., copyright, patents, or trademarks); and reimbursement for travel and time[43] (Cooper, Rasmussen and Jones, 2022[61]).
- Provide timely[44] feedback to participants and manage their expectations from the beginning of the project, and keep communicating/acknowledging their efforts after completion (Tweddle et al., 2012[38]; Cooper, Rasmussen and Jones, 2022[61]; U.S. General Services Administration, 2015[45]).

3.1.3. Quality assurance and potential bias avoidance

Citizen science projects need to be aligned with the scientific quality and integrity standards that are embraced in the relevant research area (ECSA (European Citizen Science Association), 2015[25]; Wiarda et al., 2023[46]). Professional scientists tend to be concerned about quality, although it is well established that 'citizens are able to make valuable and scientifically valid contributions that are on par with professional scientists when appropriate quality assurance methods are deployed (Fritz et al., 2019[62]). Quality

concerns often relate either: 1) the habits of participants and/or 2) skills of participants, both of which can be addressed in programme or project design and implementation[45] (Fraisl et al., 2022[55]).

When citizens participate in research activities beyond a specific task (e.g., data collection or analysis) this can increase the risk of divisive discussions, biased conclusions and unintended conflicts. Carefully designed dialogue processes, expert facilitation and neutral convening spaces can help to alleviate these risks (Paunov and Planes-Satorra, 2023[3]).

3.1.4. Ethical issues

Research managers need to take into account legal and ethical issues that can potentially arise due to citizen participation. These are often linked to copyright, intellectual property, data sharing agreements, confidentiality, attribution of outputs, or environmental impact by citizen participation (ECSA (European Citizen Science Association), 2015[25]). More broadly, ethical considerations can relate to multiple aspects of project design, implementation and dissemination. The EU-funded PRO-Ethics project has developed an ethics guide for funding agencies to implement participatory activities, including citizen science (Wiarda et al., 2023[46]). The guide specifies:

- Determining which types of participants are targeted, how they should be recruited and participation barriers can be removed;
- Identifying the ethical issues by systematically considering both general issues (e.g., informed consent, research integrity standards) and risks to participants. The latter risks can be categorised as: physical (direct harm, long-term harm); psychological (traumatising methods, sensitivity of questions, etc.); and, social (stigmatisation, discrimination, etc.). These risks, in turn, often relate to data protection, privacy, confidentiality and the insurance status of participants;
- Considering how equitable and meaningful dialogue can be fostered; and
- Establishing effective monitoring and reflection processes.

3.2. Funding management

Research funders need to introduce the considerations detailed in the previous section into the design and management of their various programmes and activities (Annex E summarises the key features of a range of citizen science funding programmes).

3.2.1. Funding mechanisms

Mechanisms for citizen engagement need to be supported and enabled in line with the overall aims of a specific programme. For example, if the main aim is related to addressing societal needs and challenges (see sections 1.1. and 1.2.) it may be important to require professional scientists to engage with citizens in formulating the research questions. Inclusion of participants' perspectives in the design of research can also increase their motivation and commitment (Senabre, Ferran-Ferrer and Perelló, 2018[63]).

There are several methods to incorporate citizen views into formulation of research questions. Research funding programmes can incorporate a process for formulating relevant research questions with citizens and then launch calls for proposals (see the Amai! programme and Research along Routes by Consortia (NWA-ORC) in Annex E). If the engagement with citizens is left to the funding applicants, the process may need to be covered by the provided support[46] (see the Co-Create programme and Programme ENGAGEMENT in Annex E). In most cases, the lead applicants for research funding are professional researchers but, in some circumstances, funders may also accept proposals from individuals and communities who are not affiliated with universities or traditional government contractors (Office of Science and Technology Policy (OSTP), 2015[33]) (see the Northern Contaminants Program (NCP) and Experimentation Fund in Annex E).

The aim or expected outputs are critical in determining the nature of a funding programme. A call for proposals may specify citizen science as a requirement (i.e. a dedicated citizen science programme) or may mention it as a potential approach and leave room for the applicants to decide whether to use it (see the NWA-ORC in Annex E). Practitioners can be more familiar than funders as to when a citizen science approach is relevant. It should also be noted that the development or adoption of citizen science methodologies may require flexibility in time and resources[47] and adjustment of the detail settings of calls for proposals[48].

In addition to traditional research support programmes (grants), funders have an important role to play in creating an enabling environment for citizen science, e.g. by using funding to incentivise changes to the internal policies & culture of research institutions and support capacity building & networks[49].

3.2.2. Peer review

Reviewing citizen science proposals requires the integration of diverse perspectives and peer review processes should reflect this. Review panels may include not only disciplinary professionals but also other types of 'experts' [50]. These include citizens who have participated in citizen science before and professionals who have experience in citizen science or relevant research (see the NCP and Experimentation Fund in Annex E). Review panel members may also need training for reviewing proposals which include citizen science approaches and weighting different criteria.

The operation of review or funding panels may also need to be adapted. A traditional review outcome may be based on the average of individual review scores, but this cannot fully reflect various reviewers' perspectives. Organising review panel meetings can reconcile those perspectives by enhancing mutual learning between reviewers (see Programme ENGAGEMENT in Annex E). In addition, proposals may be assessed not only by experts but also by the public through a citizen panel or a broad public vote (see Amai! in Annex E).

It is often easier to adapt review processes in dedicated citizen science programmes. It can be more difficult in generic programmes that aim to enable citizen science without mandating it. Ultimately, the processes should relate to the overall aim of a programme. However, in many research areas where citizen science can make a substantial contribution, it is not sufficient to simply mention citizen science as an option in a funding call and review proposals and allocate funding using traditional processes. The peer review mechanism of the funding needs to be adjusted to properly incorporate citizen science approaches.

3.2.3. Research security and integrity

It is generally accepted that citizen science projects need to be aligned with established principles of scientific integrity (LERU, 2016[35]; Wiarda et al., 2023[46]). However, the implications of research security (i.e. preventing undesirable interference in research processes and misappropriation of research outputs) for citizen science have attracted less attention. Even though citizen science projects that directly focus on national and economic security may be rare, the risks of foreign interference and unauthorised information transfer are likely to increase as citizen science becomes more prevalent across different domains. A variety of citizen groups have 'anti-science' agendas and some of these are known to be supported by State actors. Citizen science is a potential target for such groups. The security risks associated with citizen science policies, programmes and projects need to be assessed and managed in the same way that is beginning to happen for other science activities (see the OECD report for the risk mitigation approaches for research security and integrity (OECD, 2022[64])).

5 Concluding Remarks

In order to test some of the preliminary conclusions emerging from this project and the robustness of the proposed policy framework, a short foresight/visioning exercise was conducted with Expert Group members (see DSTI/STP/GSF(2024)10/FINAL). The overall conclusion of this exercise was that the opportunities and challenges for citizen science can be expected to become more pronounced in the near future and that cultural shifts and institutional support are required to sustain and advance citizen science practices. Specific issues that were highlighted include: the potential of citizen science to **transcend polarisation and political divides**; the need to **ensure the rigour and quality** of citizen science data and research results; the **importance of inclusivity** and ensuring the participation of vulnerable sections of the population, i.e. not creating a new 'elite' of citizen scientists; and the need to **foster local initiatives**, while scaling up to global collaboration.

The results from this short foresight exercise reinforce the overall analysis for the project and the main recommendations laid out at the start of this report (see Recommendations chapter). It is clear that citizen science has a valuable role to play now and in the future in **addressing scientific and societal challenges and generating the new knowledge** that is necessary to inform policy and decision making across many government sectors. It is an essential tool for generating the new scientific knowledge that is required for urgent socio-economic transformations (ref OECD Agenda for Transformative Science, Technology and Innovation Policies). The preconditions for achieving this begin with **wider recognition and acceptance of the value of citizen participation** in science together with the design and implementation of policies that promote citizen science. Direct support, in terms of funding, is important but can only be effective if policy actions are implemented also to create the necessary **enabling conditions** for citizen science, including infrastructure and incentives.

This report, which provides a framework, including a step-by-step policy support tool, as well as policy options and good practice examples, is intended to assist research policymakers in assessing why, when and how to deploy citizen science in their policy formulation. The framework describes the main rationales for citizen science and its potential benefits and drawbacks for addressing different aims as well as guidance on policy intervention choices and design. It is recognised that **many different actors need to work together to produce a thriving citizen science ecosystem**. The role of policy, and the aim of the framework, is to support the development of this ecosystem.

The wide variety of policies and initiatives that are already being used to support citizen science demonstrates the growing importance of this field and also emphasises the differences between countries, which have different research governance systems and are at different stages of embedding citizen science into their research policies. Overall policy goals for citizen science and the relevance and feasibility of different policy options, vary across countries and sectors. The framework provided in this report is designed to be broadly applicable and is the product of a mutual learning and co-design process involving experts from many countries. However, it cannot replace the **continuing need for international exchange and cooperation** for citizen science to realise its full potential and provide solutions for some of the major questions facing science, society and policy.

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Notes

[1] For example, the European Citizen Science (ECS) project specifies twelve impact stories from citizen science practices across Europe (Schürz, Schaefer and Kieslinger, 2024[116]).

[2] It includes the backcasting approach that has recently been developed by the EU Mutual Learning Exercise (MLE) on Citizen Science Initiatives (European Commission et al., 2023[30]). This is for setting a strategic vision for citizen science within the national research and policy-making landscape. This EU MLE publication and a report for the UNESCO Open Science Toolkit (Wehn and Hepburn, 2022[14]) have summarised recent progress on relevant policies and practices in different countries. Some resources, such as by the EU-funded TIME4CS project and UK-funded National Co-ordinating Centre for Public Engagement (NCCPE), also aim to induce cultural change in research institutions. See also the Implementation Considerations on the Policy Framework for useful resources for implementing citizen science.

[3] The key questions in the ToR were:

- Why and when does citizen science need to be promoted? What are the advantages and limitations of citizen science in different contexts?
- What are the main obstacles and challenges for promoting citizen science and effectively engaging citizens, including those from marginalised groups? How can these obstacles and challenges be addressed?
- How might project management, peer review, ethical review, funding mechanisms, incentives and research assessment need to be adapted to promote citizen science?
- How can quality be assured and potential biases be avoided, when engaging citizens in research?
- How can the added value and impact of citizen science be measured and evaluated, taking into account both scientist and citizen perspectives?

[4] The term ‘scientist’ was introduced in the English language in the 1830s.

[5] At the European policy level, the emergence of societal and citizen engagement in Research and Innovation (R&I) policy dates back early 2000 (European Commission Staff Working Paper, 2000[94]). An action plan in 2001 brought science policies closer to citizens by centring the STI activities around the needs and aspirations of Europe's citizens (European Commission: Directorate-General for Research and Innovation, 2002[95]). The Rome Declaration in 2014 embeds the Responsible Research and Innovation (RRI) principles: all societal actors work together in order to better align the whole R&I process and its outcomes with the values, needs and expectations of European society (Rome Declaration, 2014[96]). Citizen science is recognised as one important dimension of open science in the 3 O’s strategy in 2015 (European Commission, 2016[97]), and the Council recognized citizen science as an open science priority (Council of the European Union, 2016[98]).

[6] Irwin claimed that science should focus on the concerns of citizens and serve the needs of society, while Bonney realised the value of data collected by naturalist amateurs and volunteers for research. Bonney is an ornithologist, and his observation is that in the field of ornithology, public participation is inherent and necessary. The need to cover very large areas and collect multitudes of records means that it is not

possible to carry out such research with the traditional scientific methods, it is necessary to work together with amateurs and volunteers. (European Commission et al., 2022[8])

[7] It is known that many publications do not explicitly specify 'citizen science', and the contribution that citizen science is actually making to science is more significant than that identified by searching the literature with the single term 'citizen science' (Follett and Strezov, 2015[86]; Kullenberg and Kasperowski, 2016[106]).

[8] For example, a citizen science approach is being used to develop knowledge about the impact of renewable energy technologies in Uganda (Step Change, 2024[80]). There is another example that addresses energy consumption by engaging citizens to input their energy usage into a mobile app (AURORA, 2024[79]).

[9] Participation in online citizen science has grown consistently, for example in the collection of biodiversity observation data, through platforms such as iNaturalist or eBird (Strasser et al., 2023[20]). Advancements in AI and machine learning are helping citizen scientists to process vast amounts of data, such as transcribing historical materials (e.g., Japanese Minna de Honkoku project (Minna de Honkoku, 2024[81])) or monitoring traffic (e.g., Telraam project (Telraam, 2024[82])). They are increasingly integrated into many citizen science projects on the Zooniverse platform (see DSTI/STP/GSF(2024)10/FINAL for the workshop report).

[10] There is a positive trend in the recognition of citizen science within public policies, accompanied by a certain degree of mainstreaming on some issues (Schade et al., 2021[10]).

[11] For instance, the Australian Citizen Science Association (ACSA) (Australian Citizen Science Association, 2024[76]), the European Citizen Science Association (ECSA) (European Citizen Science Association, 2024[77]), and the Association for Advancing Participatory Sciences in the United States (AAPS) (Association for Advancing Participatory Sciences, 2024[78]).

[12] For example, the Citizen Science Network Austria (Österreich forscht, 2024[74]), Citizen Science Network in Germany (mit:forschen!), Citizen Science Nederland Network (Citizen Science Nederland, 2024[75]), or the Citizen Science Global Partnership (CSGP) (Citizen Science Global Partnership, 2024[73]).

[13] For instance, the definitions in White Paper on Citizen Science for Europe (Serrano Sanz et al., 2014[83]).

[14] Contributors are the individuals who help professional scientists typically by collecting data, and collaborators usually go a step further by analysing the data or disseminating the findings. Co-creators are usually involved in all or most stages of scientific research, including the identification of research questions. Autonomous researchers (also known as independent researchers/scholars or DIY scientists) are non-professionals who independently carry out all stages of a research project, with varying levels of recognition from professionals or institutionalised science.

[15] Participatory research/sciences has various definitions (Vohland et al., 2021[22]), but according to the Association for Advancing Participatory Sciences (AAPS), 'participatory sciences include community science, citizen science, community-based monitoring, volunteer research, and more — research and monitoring efforts that depend on knowledge, insights, or observations from members of the public'.

[16] Grassroots efforts have been initiated to develop complementary relationships among the distinct communities that identify with these different terms. For example, in Germany, a new society that aims at

bridging the transdisciplinary and participatory research communities was founded in 2023: *Gesellschaft für transdisziplinäre und partizipative Forschung* (Society for Transdisciplinary and Participatory Research; https://www.gtpf.science/).

[17] For example, the EU Mutual Learning Exercise (MLE) on Citizen Science, G7 Science Academies 2019 Statement on citizen science (Summit of the G7 Science Academies, 2019[99]), UNESCO Open Science Recommendations (UNESCO, 2021[13]), and OECD projects on open and inclusive collaboration (Dai, Shin and Smith, 2018[4]), transdisciplinary research (OECD, 2020[6]), citizen participation processes (OECD, 2022[2]) and citizen engagement in innovation policy (Paunov and Planes-Satorra, 2023[3]).

[18] For instance, the White Paper Citizen Science Strategy 2030 for Germany (Bonn et al., 2022[109]) shows that different federal ministries, with responsibilities for science, digital affairs, transport, environment, food, agriculture, family affairs and health, incorporate citizen science into their goals and strategies.

[19] For example, the G7 Science Academies (Summit of the G7 Science Academies, 2019[99]) and International Science Council (ISC) (de Sherbinin et al., 2021[110]) pointed out the importance of citizen science to SDGs. There are also growing citizen science practices that contribute to monitoring SDGs (for example, (Fraisl et al., 2023[100])).

[20] In the USA, the OSTP issued a memorandum titled 'Addressing Societal and Scientific Challenges through Citizen Science and Crowdsourcing' to the federal agencies in 2015 after collaborative efforts across agencies. The memorandum (Office of Science and Technology Policy (OSTP), 2015[33]) clarified principles for citizen science that agencies should embrace and requested agencies to take specific actions to promote citizen science, including the designation of an agency-specific coordinator for citizen science and provision of a federal citizen science website. The OSTP also encouraged agencies to use a citizen science approach in the formulation of FY 2017 Budget (Office of Science and Technology Policy (OSTP), 2015[72]).

[21] Public research funding as an enabling factor is a top-down approach but has impacts on the behaviours of individual scientists and then the entire scientific system. Studies clarify that funding is correlated with total publications and their citations of researchers (Mongeon et al., 2016[93]; Jacob and Lefgren, 2011[92]), both of which often influence employment and promotion in research institutions.

[22] FAIR data is data that meets the FAIR principles (Findable, Accessible, Interoperable and Reusable).

[23] By targeting a broad audience of research policymakers and helping them integrate considerations of citizen science into their plans, the framework complements existing guidance. This includes the backcasting approach that has recently been developed by the Mutual Learning Exercise (MLE) on Citizen Science Initiatives – Policy and Practice (European Commission et al., 2023[30]). This backcasting approach is for setting a strategic vision for citizen science within the national research and policy-making landscape, and it starts by mapping the current status of citizen science in a country to identify the pathways and potential steps towards achieving this vision (European Commission et al., 2023[85]). The new framework for research policymakers to incorporate a citizen science approach also complements broader guidance on citizen participation processes, including citizen science, from the OECD (OECD, 2022[2]).

[24] The degree of participation from contributors to autonomous researchers is one of the examples for categorisation. The forms of citizen science, consisting of long running citizen science, citizen cyberscience and community science, is another example (European Commission et al., 2022[8]).

[25] Examples include: scientific and societal (social) contributions by the Canadian Standing Committee on Science and Research (SCSR) (Standing Committee on Science and Research, 2023[102]) and French report commissioned by the ministers of Education, Higher Education and Research (Houllier and Merilhou-Goudard, 2016[103]); science, education and democracy from a Swiss report commissioned by the Swiss Science Council (SSC) (Strasser and Haklay, 2018[104]); science, society and education by the US OSTP (Office of Science and Technology Policy (OSTP), 2015[33]) and Dutch National Programme Open Science (NPOS) Citizen Science Working Group (Putten et al., 2020[114]); organisation, volunteer and wider society by the final report on behalf of UK Environmental Observation Framework (Blaney et al., 2016[40]); researchers, research in general, public and society by the Research Council of Norway (Research Council of Norway, 2023[105]); science, members of society, and policy (Hecker et al., 2019[37]).

[26] In public policy, the first two rationales [i and ii] can be understood as 'performance values' (what is achieved) including effectiveness and efficiency, while this third rationale [iii] is referred to as 'procedural or process values' (how procedures are conducted) (Ingrams, 2018[68]; OECD, 2017[32]). From the perspective of public engagement, the first two are interpreted to as substantive imperatives, while the last is associated with normative or instrumental imperatives (National Co-ordinating Centre for Public Engagement, 2024[69]; Stirling, 2007[70]; Fiorino, 1989[111]).

[27] For traditional publications, a bibliometric analysis shows that the work of unaffiliated researchers (independent researchers) has been creating a substantial impact in medical and natural sciences (Lund et al., 2023[84]). It is also known that there is a correlation between identities, such as race and gender, and research topics, and the diversity of the science workforce affects the portfolio of scientific knowledge produced (Kozlowski et al., 2022[91]). This suggests that as the diversity of people participating in research increases, the diversity of the research undertaken may also increase.

[28] Sauermann et al argue that the different rationales for citizen science reflect different views on the role of science in society (Sauermann et al., 2020[28]).The first rationale of expanding the scope of data collection and/or analysis and scientific discovery can be understood based on the premise that scientific knowledge is intrinsically valuable for society, whereas other rationales are based on on the premise that the value of scientific knowledge depends on the needs and preferences of the public.

[29] An OECD Survey on Drivers of Trust in Public Institutions numerically suggests that empowering citizens with clear information and engaging them adequately in policy decisions helps to enhance their trust (OECD, 2024[107]).

[30] Relevant communities, such as those focused on open science and transdisciplinary research, can also provide valuable input and support (see also the section of What is citizen science? on Overview of Citizen Science).

[31] The ECSA Ten Principles of Citizen Science also emphasises evaluation for the scientific output, data quality, participant experience and wider societal or policy impact (ECSA (European Citizen Science Association), 2015[25]). The emphasis on both scientific as well as societal outputs and impacts in ex-ante and ex-post assessment is also recommended and discussed for transdisciplinary research (OECD, 2020[6]).

[32] The step of estimating the costs, benefits and risks and comparing the policy intervention choices is often known as a difficult process. Estimation can be supported by previously implemented policies, which are collected in Step 2. There are also several initiatives for citizen science that provide quantitative estimation tools (e.g., (Blaney et al., 2016[40])) and evidence (e.g., (Sauermann and Franzoni, 2015[71])). For comparison, it may be helpful to review multi-criteria analysis methods for ex-ante evaluation in public policy, such as summarising an outcome matrix against policy intervention choices and selected criteria (see (Bardach, 2012[41]), (European Commission: Joint Research Centre and Giuseppe, M., 2017[117]) and (OECD, 2025[108])).

[33] https://about.mics.tools/guidance/measure/indicators

[34] It is noted that the domains of science and technology as well as economy (society and environment) in the MICS indicators correspond to the domain of science (society) in this framework.

[35] The examples of toolkits and guidelines include Citizen science for all (Pettibone et al., 2016[39]); Guide to Citizen Science (Tweddle et al., 2012[38]); US Federal Crowdsourcing and Citizen Science Toolkit (U.S. General Services Administration, 2015[45]); ECSA Ten principles of citizen science (ECSA (European Citizen Science Association), 2015[25]), Characteristics of Citizen Science (Haklay et al., 2020[112]), and Explanation Notes (Haklay et al., 2020[113]); Citizen science in environmental and ecological sciences (Fraisl et al., 2022[55]); and Guidance on engaging the public with your research (UK Research and Innovation, 2024[101]). There are also thematic toolkits and guidelines, such as: A Toolkit for Data Ethics in the Participatory Sciences (Cooper, Rasmussen and Jones, 2022[61]); and Data Quality in Citizen Science (Balázs et al., 2021[66]).

[36] For example, if a project requires a specific degree of data coverage, level of scientific quality or inclusion of demographic groups, this in turn determines the ways to recruit, communicate and incentivise participants and the associated ethical issues.

[37] For example, citizens as contributors, collaborators, co-creators or autonomous researchers; frequency; time length; place (offline/onsite).

[38] It should be noted that a substantial portion of scientific documents remains non-English, depending on scientific disciplines; a study found 35.6% of 75,513 documents on biodiversity conservation published in 2014 were still in languages other than English (Amano, González-Varo and Sutherland, 2016[89]).

[39] There are aspirations from the platform users and efforts of platform providers and other actors to address the issue. In addition to translation efforts at the project level, a Citizen Science Translation Hub has also been set up (Sheppard, 2020[90]).

[40] A study shows that a language barrier limits the access to the knowledge generated from research results that policymakers should receive (Amano, González-Varo and Sutherland, 2016[89]).

[41] The motivation of the participants tends to be high when the purpose is related to tackling sustainability or issues directly related to persons daily lives (e.g., air pollution, health and urban planning) in a specific region, or stimulating hobbyist interests (e.g., ornithology and astronomy) (Sauermann et al., 2020[28]; Follett and Strezov, 2015[86]; Van Brussel and Huyse, 2018[87]; Land-Zandstra, Agnello and Gültekin, 2021[88]). However, the number of participants can decrease over time, unless measures are taken to maintain motivation (Sauermann and Franzoni, 2015[71]).

[42] In general, the research publications and other research outputs from citizen science projects should acknowledge citizen scientists (ECSA (European Citizen Science Association), 2015[25]).

[43] Financial compensation can be an option but needs to be carefully considered depending on the research culture, country and socio-economic status of participants (Haklay et al., 2020[112]).

[44] For example, monthly updates to participants through email and web may be appropriate (Tweddle et al., 2012[38]).

[45] As the habits of participants may cause unrepresentative sampling and bias, they should be considered from the project design stage. For the improvement of the skills of participants, frequently used methods include: volunteer training and continuous feedback, such as by volunteer testing; comparison with equivalent work from professional scientists; expert validation; peer review (calibration among volunteers); and, statistical weighting by volunteer performance (Kosmala et al., 2016[67]; Fritz et al., 2019[62]; Fraisl et al., 2022[55]).

[46] It is a recognised challenge that the work done during the application process is not often paid (Swiss Expert Group for Citizen Science, 2024[115]).

[47] The programme of 'Amai!' (Flemish exclamation for 'wow!') has evolved through multiple calls for proposals. Based on the experience of the 2021 and 2022 calls, the 2023 call opened a lot earlier, introduced matchmaking co-creation sessions across the country, and started working with a pre-application (2 stage submission) with feedback and guidance in between. The amount of funding (up to) and period of each project were also increased. The process changes were designed to address the problems of low attention and interest in the programme and resulted in almost four times more applications (Duerinckx et al., 2024[65]).

[48] In calls for proposals, funders may limit their focus to truly prioritised criteria and carefully consider asking for other wish lists (e.g., a wide variety of scientific and societal contributions) beyond the necessary ones (e.g., scientific quality and ethical considerations). If there are too many criteria for applicants to tick a box in proposals, the projects may end up not being able to address any of them in depth. This is because the applicants usually try to tick all the boxes to obtain a higher reviewing score even if there are less important criteria and trade-offs between the criteria.

[49] The French ministry supports the institutional efforts of universities in developing new interfaces for dialogue between science, research and society through the Label of Science avec et pour la société (SAPS) (Science with and for society) (see Annex D). In order to enable the development of capacities and networks, Germany funds the competition "On your marks! Citizen Science in your city", which offers prize money for the best ideas that improve the local environments of cities and municipalities (see Annex D).

[50] A multi-stakeholder review is recommended for transdisciplinary research as well (OECD, 2020[6]).

Annex A. Expert Group membership

Country/ Organisation	Name	Affiliation
BEL	Annelies Duerinckx	Head, Scivil - Citizen Science Flanders, RVO-Society vzw
CAN	Jeremy Kerr (co-chair)	Chair, Department of Biology, University of Ottawa
	Claire Zhou	Policy Advisor, Innovation, Science and Economic Development Canada
	Tenzing Kuyee	Policy Advisor, Innovation, Science and Economic Development Canada
CHE	Tiina Stämpfli	Deputy Managing Director and Head of Citizen Science, Foundation Science et Cité, Swiss Citizen Science Network Schweiz forscht, Swiss Academies of Arts and Sciences
	György Hetényi	Professor, University of Lausanne
COL	Angela Patricia Bonilla	Advisor, Directorate for Knowledge Capabilities and Appropriation, Social Appropriation of Knowledge Group, Ministry of Science, Technology and Innovation
	Pablo Julián Moreno	Contractor, Directorate for Knowledge Capabilities and Appropriation, Social Appropriation of Knowledge Group, Ministry of Science, Technology and Innovation
	Doris Daniela Tolosa Oliveros*	Ministry of Science, Technology and Innovation
	Nicolas Alejandro Ortega Rodríguez*	Ministry of Science, Technology and Innovation
DEU	Susanne Hecker	Head of Science Programme Society & Nature, Museum für Naturkunde - Leibniz Institute for Evolution and Biodiversity Science (MfN)
ESP	Luis Sanz-Menendez	Research Professor, CSIC Institute of Public Goods and Policies (IPP), Ministry of Science and Innovation
FRA	Frédérique Chlous	Directrice du département scientifique, Muséum National d'Histoire Naturelle (MNHN)
	Valérie Fromentin	Responsable du département sciences humaines et sociales, Agence Nationale de la Recherche (ANR)
	Anne Nivart	Head of the Department of Relations between Science and Society , Ministry of Higher Education and Research (MESR)
GBR	Anthony Whitney	Head of Public Engagement with Research, Department for Science, Innovation and Technology (DSIT)
	Melanie Knetsch (co-chair)	Deputy Director: Impact and R&I Resilience, UK Research and Innovation (UKRI)
JPN	Kazuhiro Hayashi	Director of Research Unit for Data Application, National Institute of Science and Technology Policy (NISTEP)
	Rieko Yamamoto	Principal Fellow, Center for Research and Development Strategy (CRDS), Japan Science and Technology Agency (JST)
	Shiho Hamada	Fellow, CRDS, JST
KOR	Inkyoung Sun	Head of Sustainable Innovation Policy Research Office, Science and Technology Policy Institute (STEPI)
	Yeonsil Kang	Curator, National Science Museum
NLD	Margaret Gold	Coordinator of Citizen Science Lab, Leiden University

NOR	Anila Nauni	Team Manager, Public Sector and Healthcare Services, Research Council of Norway (RCN)
POL	Marek Niezgódka	Professor, Silesian University of Technology
PRT	Sandra Fernandes	Science and Technology Manager. Foundation for Science and Technology (FCT)
ZAF	Isaac Ramovha	Director of Science Promotion, Department of Science, Technology and Innovation
European Commission	Gabriella Leo	Directorate-General for Research and Innovation (DG RTD)
OECD	Carthage Smith	Senior Policy Analyst, Lead Co-ordinator, Global Science Forum (GSF)
	Frédéric Sgard	Project Administrator, GSF
	Andrea-Rosalinde Hofer	Policy Analyst, GSF
	Masatoshi Shimosuka	Policy Analyst, GSF
	Gemma Volpicelli	Junior Policy Analyst, GSF
	Chrystyna Harpluk	Project Co-ordinator, GSF

* Doris Daniela Tolosa Oliveros replaced Nicolas Alejandro Ortega Rodríguez in August 2024.

Annex B. Projects and programmes illustrating different citizen science rationales

These are selected examples that illustrate the three main policy rationales for citizen science (see the chapter on Policy Framework). Many other examples can be found via citizen science platforms (see Annex C).

1. Data collection and/or analysis, and scientific discovery

The *e-Butterfly* project started in Canada: The aims are to gather 'the form of butterfly checklists, archive it, and freely share it to power new data-driven approaches to science, conservation and education'; Citizens have providing qualified data (broad regions, resolution, species richness, early records) and the data are now used to help manage species at risk in Canada.

Source: https://www.e-butterfly.org/en/content/about

The *Isala* project started in Belgium: The aims are to study 'the female microbiome and its influence on our health and wellbeing' including by collecting and analysing lactobacilli in 'samples from the skin and the vagina'

Source: https://isala.be/en/research/; https://ars.electronica.art/citizenscience/en/isala-citizen-science-map-of-the-vaginal-microbiome/

The *Everyone's Liver Research* initiative in the *Human Organoid Project* in Japan: The aims are to gather data on 'liver echo, heart rate, saliva, and body measurements, as well as lifestyle and well-being surveys' and conduct 'dialogues leading to behavioural changes for health' and exchange of 'opinions on organoid research' in order to 'elucidate Non-Alcoholic Fatty Liver Disease (NAFLD), a disease in which fat accumulates in the liver due to causes other than alcohol'

Source: country note provided by the Experts and https://www.miraikan.jst.go.jp/events/202312223297.html

The *Galaxy Zoo* project: Citizens help to classify telescope images of distant galaxies according to their shapes in order to 'understand how galaxies formed'

Source: https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/

The *Foldit* project in the US: Citizens play a protein folding computer game in order to contribute to 'research in protein design to treat diseases like influenza and COVID-19, small molecule design to invent new drug compounds, and protein structure solving to map the molecules that drive biology'

Source: https://fold.it/about_foldit

2. Societal needs and challenges

The *Amai!* (Flemish exclamation for 'wow!') programme in Belgium: 'The program invites participants to voice their ideas for AI or societal problems they wish to solve through AI and to be involved in the development of citizen-driven research projects. Using a citizen science approach, ideas are collected

through a centralized platform and eventually realized through an open project call with partners from industry, civil society, and research institutions.'

Source: (Duerinckx et al., 2024[65]), https://amai.vlaanderen/over-amai and https://www.scivil.be/en/project/amai-citizen-science-and-ai.

The *Dutch Research Agenda (NWA) - Research along Routes by Consortia (ORC)* in the Netherlands: The aims is 'to encourage research that is set up and carried out by interdisciplinary consortia that include representatives from the full breadth of the knowledge chain as well as relevant societal (public and/or private) partners, including citizens. The research will address so called wicked problems, focused on themes that are proposed by NWA-route networks and based on one or more of the 140 cluster questions.'

Source: https://www.nwo.nl/en/calls/dutch-research-agenda-research-along-routes-by-consortia-2024-nwa-orc-2024.

The *Science Shop* in South Africa: The aim are to 'i. provide research support in response to concerns and issues experienced by communities or civil society; ii. contribute to the development of research skills in young people; and iii. Showcase real-world situations where problems or challenges encountered by citizens are addressed through multi-disciplinary and/or interdisciplinary research – interfacing social sciences and/or humanities with natural sciences.'

Source: https://www.saasta.ac.za/programmes/research-and-development/science-shop/understanding-science-shop.

3. Democratisation, legitimacy, and uptake of policies

The *Programme ENGAGEMENT* in Québec, Canada: The aims are 'to actively involve citizens in a scientific process based on a question that interests them; to support the development of new citizen research and participatory science practices and help stimulate diverse research in Québec; to promote the democratization of scientific knowledge within Québec society.'

Source: https://frq.gouv.qc.ca/en/program/engage-program-2024-2025.

The *Experimentation Fund* in Colombia: The aim is to encourage 'the promotion of citizen science and develops a culture of openness, dialogue, inclusion and social responsibility that includes the wide diversity of knowledge-generating actors.'

Source: https://web.karisma.org.co/un-fondo-de-experimentacion-para-la-ciencia-ciudadana-en-colombia.

Annex C. Citizen science platform examples

Name	URL	Description	Themes
EU-Citizen.Science	https://eu-citizen.science/platforms/	platform listing citizen science initiatives globally (EU + US for now)	diverse
Platforms for hosting participatory science projects	https://participatorysciences.org/resources/platforms-for-hosting-participatory-science-projects/	a website that summarises platforms designed specifically to support the scientific work of and people engaged in participatory science projects	diverse
Zooniverse	https://www.zooniverse.org/	platform for people-powered research, calling for volunteers in a variety of projects	diverse, including social sciences
SciStarter	https://scistarter.org/	online citizen science hub listing thousands of projects to which people can sign up	diverse, including social sciences
iNaturalist	https://www.inaturalist.org/	an online platform and mobile app where users can record their observations and learn about plants and animals, while generating data for science and conservation	biodiversity, conservation
AnecData	https://www.anecdata.org/	an online platform for citizen and community science listing diverse projects that can be joined	diverse
CitSci	https://www.citsci.org/	a global citizen science support platform where people can register their projects	diverse
The Globe Program	https://www.globe.gov/web/norway-citizen-science/home	An international science and education program to foster scientific literacy. Globe = Global Learning and Observations to Benefit the Environment. The website includes a map of citizen science initiatives across the globe.	environment
FieldScope	https://www.fieldscope.org/	a platform where people can either launch or join a citizen science project	diverse
eBird	https://ebird.org/home	a platform where you can explore and submit bird observations	birds
Project Noah	https://www.projectnoah.org/	a platform with different missions to photograph and learn about wildlife	wildlife, ecology, conservation
iSpot	https://www.ispotnature.org/	a citizen science platform for biodiversity where people can post photos of observations + a list of projects inviting people to participate	biodiversity
Earthwatch	https://earthwatch.org/	an organisation that pairs scientists with non-scientists in research locations all around the world. Users can sign up and pay to go on expeditions.	environment and climate change
Humanitarian OpenStreetMap	https://www.hotosm.org/	an international team dedicated to humanitarian action and community development through open mapping.	map data

Note: See also the Supporting (Data) Infrastructures item of Annex D, which provides a relevant list of country's policies and initiatives.

Annex D. Citizen science policies and initiatives

Enabling Factors	Policy Options for Promoting Citizen Science / [Country] Policies and Initiatives
National Research Funding	**Provide national research programmes that are adapted to support citizen science.** [BEL] Amai!: funding for citizen science AI-projects (Scivil, 2021-) [BEL] Calls for funding for citizen science (Flemish government, 2017 and 2019) [BEL] Citizen Science Food (VLAIO (Flemish Agency for Innovation & Entrepreneurship), 2023) [BEL] Co-Create (Innoviris (Brussels Regional Institute for Research and Innovation), 2015-)[1] [CAN] Northern Contaminants Program (Crown-Indigenous Relations and Northern Affairs Canada, 1991-) [CAN] Programme ENGAGEMENT (Québec) (Fonds de recherche du Québec (FRQ), 2019-) [CHE] Agora Funding Scheme (Swiss National Science Foundation) – aimed at collaborative projects between academia and non-academic organizations, such as participatory science [COL] Citizen Science Experimentation Fund (Fundación Karisma, 2022) [DEU] Funding Call for Citizen Science (BMBF (Federal Ministry of Education and Research), Date of publication: 2016 and 2019)[2] [FRA] Calls for proposals as a part of the multi-annual Science and Society program (ANR (National Agency for Research)) – 'Recherches participatives 1' (Participatory Research 1) (2022), 'Recherches participatives 2' (Participatory Research 2) (2023), 'Ambitions innovantes' (Innovative Ambitions) (2023) [GBR] How UKRI supports public involvement in research and innovation (UKRI); Citizen Science Collaboration Grant (UKRI, 2020) [JPN] Project for Methodization of 'Convergence of Knowledge' in Marine Domain through Citizen Participation (MEXT (Ministry of Education, Culture, Sports, Science and Technology), 2023) [NLD] Citizen science in the Open Science Fund (NWO (Dutch Research Council), 2020-) [NLD] Citizen science in the Research along Routes by Consortia (NWA-ORC) (NWO, 2018-) [NLD] *Citizen Science voor Gezondheid en Zorg (CS4GZ)* (Citizen Science for Health and Care) (ZonMw (Dutch National Organisation for Health Research and Healthcare Innovation), 2021) [NLD] *Onderzoek voor en door jongeren* (Research for and by young people) (ZonMw, 2023) – not exactly citizen science but an example to give more 'power' to non-academics leading/initiating the research [NOR] *Støtte til nettverks- og kompetansebyggende aktiviteter for folkeforskning* (Support for networking and competence – building activities for citizen science) (Research Council of Norway (RCN), 2023) [POL] *Nauka dla Społeczeństwa* (Science for the Society) (Ministry for Education and Science, 2022) [ZAF] Science Shop (National Research Foundation (NRF), 2022) [European Commission] Framework Programme: Science and Society of the 6th programme (2002-2006), Science in Society of the 7th programme (2007-2013), Science with and for Society (SwafS) of the 8th programme, Horizon2020 (2014-2020); Widening participation and strengthening the ERA' (WIDERA) of the 9th programme - Horizon Europe (2021 – 2027): In Horizon Europe citizen and societal engagement, including Citizen Science, is also mainstreamed across the programme parts and call topics and in the EU R&I Missions.
National Legal & Policy Framework	**Embed citizen science into national STI strategies and/or establish a dedicated national citizen science strategy.** [BEL] Policy Note 2019-2024. Economy, Science Policy and Innovation (Flemish Government, 2019) – committing regular calls for Citizen Science projects in cooperation with the Scivil knowledge centre for citizen science. [BEL] Flemish Science Communication Policy Plan 2022-2030 (Flemish Government, 2022)[3] – including Amai! Project [BEL] Flemish Action Plan Artificial Intelligence (Flemish Government, 2019) – The Amai! Project was set as part of the outreach component of this policy. [BEL] Flanders Food Strategy for Tomorrow (Flemish Government, 2019) – citizen science as a part of 'Strategic Pillar 4: Food connects farmers to citizens' [CAN] Report on The Role and Contribution of Citizen Scientists (Standing Committee on Science and Research (SRSR), 2023) and Government Response (Minister of Innovation, Science and Industry, 2024) –pointing out including 'civic engagement in the criteria for evaluating funding applications' in Recommendation 4. [COL] National Open Science Policy 2022-2031 (*Política Nacional de Ciencia Abierta 2022-2031*) (Ministry of Science, Technology, and Innovation, 2022) – including development of guidelines with a priority on citizen science (goals 3 and 7) [DEU] Policy Paper of the Federal Ministry of Education and Research on Science Communication (*Grundsatzpapier des Bundesministeriums für Bildung und Forschung zur Wissenschaftskommunikation*) (BMBF (Federal Ministry of

Education and Research), 2019) – specifying citizen science in Measures (Maßnahmen)
[DEU] Prospects for Action for Science Communication (#FactoryWisskomm, 2021) – citizen science in recommendations for action of Science Communication and Participation. #FactoryWisskomm is a forum launched by the BMBF as committed in the Policy Paper in 2019.
[DEU] Strategy for Participation in Research (*Partizipationsstrategie Forschung*) (BMBF, 2023) – citizen science as one of the strengthened areas for participatory research; Participation in Research (BMBF)
[FRA] Research Programming Law for the period 2021-2030 (LOI n° 2020-1674) (2020) – including two actions and measures for citizen science: 1) creation of a citizen sciences prize by INRAE and MESR (*l'INRAE, en lien avec le ministère de l'enseignement supérieur, de la recherche et de l'innovation, décernera chaque année un prix pour récompenser les travaux d'un chercheur ou d'une équipe portant sur la recherche participative*.); 2) 1% of the budget of the ANR is devoted to sharing scientific culture (*Au moins 1 % du budget d'intervention de l'Agence nationale de la recherche est consacré au partage de la culture scientifique*)
[GBR] Science and Society (House of Lords Science and Technology Committee, 2000) – setting the framework for approaching embedding public voices and people across the science funding and policy landscape. (e.g., 'direct dialogue with the public' as 'a normal and integral part of the process' of 'science-based policy-making and to the activities of research organisations and learned institutions')
[JPN] 6th Science, Technology, and Innovation Basic Plan (FY2021-2025) (Cabinet Decision, 2021) – including improving 'the resolution of social problems through civic participation and citizen science'
[JPN] Long-Term Growth Strategy Under the Paris Agreement (Cabinet Decision, 2021) – specifying initiating a citizen movement while collecting scientific knowledge through Citizen Science
[JPN] 4th Basic Plan on Ocean Policy FY2023-2027 (Cabinet Decision, 2023) – including the accumulation of local experiential knowledge through marine big data and Citizen Science, as well as categorizing, visualizing and consolidating this information
[JPN] 4th Basic Plan to Promote Cancer Control FY2023-2027 (Cabinet Decision, 2023) – specifying consideration on mechanisms for further advancing patient and public involvement
[KOR] 2nd Comprehensive Plan for Solving Social Problems Based on the S&T and the Improvement of Infrastructure of Social Problem Solving (2018-2022) (National Science and Technology Council) – including citizen engagement in problem identification
[KOR] 3rd Master Plan for the Conservation of the Natural Environment (2016-2025) (Ministry of Environment) – including transition from nation-focused, expert-driven natural environment monitoring to local-focused, citizen and amateur scientist-driven monitoring
[NLD] National Plan Open Science (van Wezenbeek et al., 2017) – drawn by a broad coalition of concerned parties based on the request by the State Secretary for Education, Culture and Science; citizen science is not a main focus.
[NLD] Foundation of the National Programme Open Science (NPOS, 2017-) – including the Steering Committee, consisting of the directors of the largest research performing and funding organisations; focusing on three programme lines – Open Access, FAIR Data and Citizen Science.
[NLD] Kennis en krachten gebundeld - citizen science in Nederland (NPOS Citizen Science Working Group: Putten et al., 2020) – including creation of a new citizen science network
[NLD] Open Science 2030 in the Netherlands: NPOS2030 Ambition Document and Rolling Agenda (NPOS, 2022) – including citizen science in Strategic goals 1. Towards Societal Engagement and Participation; realisation of a clear governance structure for open scinece
[NLD] Policy Letter on Higher Education and Science to the congress (Minister Dijkgraaf, 2022) – including €20M/year for Open Science and a temporary 'Regieorgaan Open Science' (Open Science governing body) in collaboration with the Dutch Research Council (NWO)
[NLD] Open Science NL Citizen Science & Societal Engagement Programme
[NOL] Long-term plan for research and higher education 2023–2032 (Cabinet approval, 2022) – mentioning citizen science in the pillar of "Academic freedom and trust in research".
[POL] National Science Policy (*Polityka Naukowa Państwa*) (Ministry of Education and Science, 2022) – including citizen science as the third element of open science
[PRT] National Open Science Policy (Resolution of the Council of Ministers (RCM) nº 21/2016, 2016) – including open science for collaborative and participatory research processes (*processos colaborativos e participativos de investigação*)
[PRT] National Strategy for Environmental Education (RCM nº 100/2017, 2017) – including citizen science (*ciência cidadã*) as a complementary of administration, municipalities and NGOs
[PRT] Framework for Environmental Education for Sustainability (Editor: Ministry of Education, 2017) – including participatory science & citizen science in the Territory and Landscape theme; targeting from pre to high school
[PRT] Information Technologies and Communication (ITC) Strategy 2020 (RCM nº 108/2017, 2017) – including the effectiveness of citizen science (*ciência cidadã*) in decision-making in Measure 6 Transparency and Participation
[PRT] Revitalization Programme of the Serra da Estrela Natural Park (RCM nº 40/2024, 2024) considers two projects with citizen science activities related to the habitat recovery (3 1500 000€) and the local tourist profile (1 520 000 €).
[ZAF] Science Engagement Strategy (Department of Science and Technology, 2015) – including 'public engagement in research' in Strategic Aim 2.
[European Commission] Political basis for citizen and societal engagement: EC Science and Society Action Plan

	(2001); Rome Declaration on Responsible Research and Innovation in Europe (2014); Open Innovation, Open Science, Open to the World - a vision for Europe (EC, 2016) – citizen science as one important dimension of open science; Council Conclusion on the transition towards an Open Science system (Council of the European Union, 2016) – citizen science as an Open Science priority [European Commission] European Research Area Policy Agenda (for 2022-2024) (EC, 2021) – Action 14 'Bring Science closer to Citizens' results in the scale-up of the Plastic Pirates – Go Europe! Citizen Science initiative and the Mutual Learning Exercise (MLE) on 'Public engagement in R&I' [European Commission] Mutual Learning Exercise on Citizen Science initiatives: Policy and Practice (2022-2023) **Facilitate the inclusion of citizen science data and results in policy and decision-making.** [CAN] National Action Plan on Open Government 2022-2024 (Government of Canada, 2022) – including the development of 'an infrastructure … to facilitate uptake of citizen science in a health research context' [KOR] National Marine Debris Monitoring based on the Marine Environment Management Act (Ministry of Ocean and Fisheries) – engages citizens (including NGOs, fishers) monitoring of marine environment **Mandate or incentivise public institutions to implement citizen science and/or play a specific role in citizen science.** [BEL] Covenant of the Flanders Marine Institute (2022-2026) with the Flemish Region (Flemish government, 2022) – Flanders Marine Institute (VLIZ) as an information fub for Informal learning (including citizen science ('burgerwetenschap')) [FRA] Law – Article L123-5 of Code de l'education modified by Article 10 of law n°2013-660 (2013) – calling on research organisations to 'foster interactions between science and society' (*favorise les interactions entre sciences et société*) in particular by facilitating 'public participation in prospecting, data collection and the advancement of scientific knowledge' (*facilite la participation du public à la prospection, à la collecte de données et au progrès de la connaissance scientifique*) [NLD] Convenant regieorgaan Open Science (2023) – specifying that NWO shall establish the Open Science governing body [PRT] Establishment the legal regime for institutions dedicated to scientific research and development (Decree-Law 63/2019, 2019) – 1) requesting research institutions to promote public participation (*da participação do público*) in R&D to promote scientific and technological culture (article 9) and 2) specifying Ciência Viva – National Agency for Scientific and Technological Culture – as a responsible institution to foster scientific citizenship (*cidadania científica*) (article 35) **Develop national evaluation frameworks for research (and research policy) that accommodate broader impacts beyond scientific publications.** [CAN] Health Canada: Framework for Science and Research Excellence (Health Canada, 2022) – citizen science in the 'Innovation and Real-World Learning' pillar [GBR] Public Values Framework (HM Treasury, 2019) – including "User and Citizen Engagement" among the four pillars.
Institutional Internal Policy & Culture	**Develop research and funding strategies within research funding bodies that embrace citizen science.** [CHE] Strategic Multi-year Planning (Swiss Academies of Arts and Sciences): Mehrjahresplanung 2021 – 2024 (2019) – citizen science (*Bürgerwissenschaft*) in ten goals of the core mission of Science and Society (*Kernauftrag Wissenschaft und Gesellschaft*); Mehrjahresplanung 2025-2028 (2024) – citizen science as a part of the Digital Society and Open Science pillar [CHE] Swiss National Open Science Strategy, revised 2024 (swissuniversities and Swiss National Science Foundation (SNSF), 2024) – citizen science as a context of open science. The version 2 pointed out citizen science in one of the four main common objectives, 'Strengthening the dialogue between science and the society'. [CHE] Position papers (Swiss Science Council): Citizen Science: An Introduction - Exploratory study commissioned by the Swiss Science and Innovation Council SSIC (2017); Citizen Science: Expertise, Democracy and Public Participation (2018) [GBR] Research and innovation for all: UKRI's public engagement strategy (UKRI, 2022) – specifying "supporting culture change so that public engagement is seen as an integral and valuable part of every phase of research and innovation and is embedded in funding" and "investing in infrastructure and partnerships to build the skills, capacities and networks" as focuses. [GBR] How UKRI supports public involvement in research and innovation (UKRI) (reposted) [NOL] The Research Council Policy for Open Science (*Forskningsrådets policy for åpen forskning*) (Research Council of Norway (RCN), 2020) – a citizen science pillar in Measure 3 Strengthening public trust in science. [ZAF] NRF Vision 2030: Research for a Better Society (NRF, 2021) – specifying the need of 'engaged research … where society participates in knowledge production to identify societal challenges or policy needs, evaluate impact case studies, or gather data for research projects' [ZAF] NRF Engaged Research Framework (NRF, 2023-) – underpinning the NRF Vision 2030 See also DEU and NLD in National Legal & Policy Framework – creating a cooperation forum to establish national strategies

Foster efforts by research institutions and local governments to promote citizen science (e.g., integrating citizen science into their strategies, establishing dedicated functions for citizen science, training and capacity building[4]).

[BEL] Vrije Universiteit Brussel: General Strategic Plan (2023-2027) – Citizen Science as a part of an open organisation; Citizen Science Contact Point (2022) – launched a project call for citizen science projects

[BEL] KU Leuven: Strategic Plan for Research 2022-2026 – citizen science as a part of 'SG5 To utilise the ecosystem more effectively; strong together within our region'; Internal citizen science funding call; KU Leuven Roadmap for Open Science, including citizen science, given Open Science and its role in universities: A roadmap for cultural change (LERU, 2018)

[CHE] University of Zurich and ETH Zurich: Citizen Science Zurich; Seed Grants; Mercator Foundation Switzerland – supporting Citizen Science Zurich

[CHE] University of Lausanne: Le ColLaboratoire – Unit for participatory, collaboratory and action-research

[DEU] Helmholtz Association: Citizen science projects and the Impulse and Networking Fund

[DEU] Leibniz Association: Leibniz Citizen Science Working Group

[FRA] Label of *Science avec et pour la société* (SAPS) (Science with and for society) (MESR (Ministry of Higher Education and Research), 2021, 2022 and 2024)

[GBR] Guidance on engaging the public with your research (UK Research and Innovation, last updated in 2024)

[GBR] Creating a supportive culture for public engagement with research (NCCPE, last updated in 2024)

[POL] Citizen Science program (University of Silesia, 2024) – for the European City of Science 2024 in Katowice

[PRT] Valuing or requiring citizen science (*ciência cidadã*) experience in CV evaluation for scientific recruitment (teachers, researchers and managers) (especially 2018-)

University of Aveiro (Notice no. 794/2018),

Faculty of Sciences of the University of Lisbon (Notice no. 12343/2018; Notice no. 12344/2018)

National Institute of Agricultural and Veterinary Research (Notice no. 15851/2018)

Faculty of Social and Human Sciences of the University of Lisbon (Notice no. 11949/2021)

Faculty of Medicine of the University of Lisbon (Notice no. 5847/2022)

ARDITI - Regional Agency for the Development of Research, Technology and Innovation (Notice no. 20438/2022)

University of Coimbra (Notice no. 15742/2023)

[PRT] User Regulations for the library of the University of Minho (BPB) (Despacho nº 7094/2021, 2021) – allowing the general public to access the library to consolidate citizen science ("ciência cidadã")

[PRT] Incorporation of Citizen Science (*ciência cidadã*) concepts into the mission of offices in some municipalities (2018-): e.g., the Municipality of Viana do Castelo (Dispatch no. 4463/2018), Coimbra (Dispatch no. 13219/2022), and Oeiras (Dispatch no. 12771/2022).

[PRT] Regulation of affected equipment to the Organic unit of the Centre for Environmental Monitoring and Intrepretation of the municipality of Viana do Castelo (Regulation nº 693/2024).

[European Commission] In Horizon Europe, co-creation of R&I content with citizen is a programme principle and operational objective (Regulation (EU) 2021/695); TIME4CS project under Horison Europe

Encourage cross-institutional activities that foster organisational change.

[CHE] Swiss National Open Science Strategy, revised 2024 (swissuniversities and Swiss National Science Foundation (SNSF), 2024) (reposted)

[DEU] Green Paper – Citizen Science Strategy 2020 for Germany (Bonn et al., 2016) – the developing process was supported by the GEWISS project (Citizens Create Knowledge – Knowledge Creates Citizens)

[DEU] White Paper – Citizen Science Strategy 2030 for Germany (Bonn et al., 2022) – based on reviewing the implementation of the Green Paper

[FRA] Signing to the Charter for participatory science and research in France (*Charte des sciences et recherches participatives en France*) (2017-) – signed by higher education institutions, NGOs and associations at the MESR, following Houillier's report (2016)

[GBR] Setting up the National Coordinating Centre for Public Engagement (NCCPE) and six collaborative centres for public engagement (2008)

[JPN] University Coalition for Carbon Neutrality 2050 (Research Institute for Humanity and Nature (RIHN), and MEXT, METI and MOE, 2021-) – an inter-university network to enhance co-creation by various stakeholders, including citizens, and strengthen universities as regional centres of knowledge.

See also DEU and NLD in the item of National Legal & Policy Framework: creating cooperation forum to establish strategies.

Reward and recognise professional scientists engaged in citizen science activities.

[BEL] Science Communication Awards (Royal Flemish Academy of Belgium for Sciences and Arts) – including citizen science projects

[DEU] Knowledge of the Many - Research Prize for Citizen Science (*Wissen der Vielen – Forschungspreis für Citizen Science*) (Wissenschaft im Dialog gGmbH & Museum für Naturkunde Berlin, 2023-2025)

[FRA] Participatory Research Prize (*Prix de la recherche participative*) (National Research Institute for Agriculture, Food

	and the Environment (INRAE) and MESR, 2022-) – awarding to two types of projects: citizen data collection projects; co-constructed projects. [European Commission] Horizon Europe funded project IMPETUS 'Setting a citizen science innovation programme for exploring innovative funding schemes and boosting recognition' – The project launches on annual basis the 'EU Prize for Citizen Science', to award local citizen science initiatives for outstanding achievements, allowing them to continue and expand their work and showcase it to a broader audience. **Promote research assessment reform for research institutions.** [NLD] Position paper 'Room for everyone's talent' (VSNU (Association of Universities in the Netherlands), NFU (Netherlands Federation of University Medical Centres), KNAW (Royal Netherlands Academy of Arts and Sciences), NWO and ZonMw, 2019)[5] – a position paper on research assessment reform [NLD] Dutch Recognition & Rewards programme (UNL (previously known as VSNU), NFU, KNAW, NWO and ZonMw, 2019-)[6] Coalition for Advancing Research Assessment (COARA) – drafted by the European University Association (EUA), Science Europe, the European Commission, and Dr Karen Stroobants.
Capacity Building & Networks	**Create (dedicated) knowledge centres to enable citizen science.** [BEL] Scivil – a knowledge centre on citizen science (2019-) [CHE] Science et Cité (1998-) – a competence centre for dialogue [POL] Copernicus Centre of Science (*Centrum Nauki Kopernik*) (founded in 2010) – offering an extensive program of exhibitions and projects (including active participatory forms) **Provide tools and training for professional scientists to deploy citizen science.** See above knowledge centres, the efforts by research institutions and to support them under the items on Institutional Internal Policy & Culture, and data platforms (Annex C) **Recognise, support and/or organise conferences, networks/partnerships and/or associations for facilitating knowledge exchange, training and showcasing best practices.** [BEL] A position paper from the Young Academy of Flanders: Citizen Science in Flanders: Can we count on you? (Soen, Huyse, et al., 2016) [BEL] First exchange meeting of the Federal Scientific Institutes on citizen science (2023) – organised by the Royal Museum for Central Africa (RMCA) [BEL] Citizen Science Scan 2023: Landscape and Evolution of Citizen Science in Belgium (Scivil, 2024) [CAN] Citizen science activities by Canada's museums of science and innovation – Canada Science and Technology Museum, Canada Agriculture and Food Museum and Canada Aviation and Space Museum [CHE] *Citizen Science Network Schweiz forscht* (2014-) – capacity building, training opportunities and showcasing best practices (2015-), facilitating knowledge exchange (2018-), and organising conferences: Organizer and Host of the second Swiss Citizen Science Conference (2023) [CHE] Participatory Science Academy of the University and ETH Zurich (2018-2023) [CHE] the first Swiss Citizen Science Conference (Citizen Science Center Zurich, Participatory Science Academy, University of Geneva, Science et Cité and Citizen Science Network *Schweiz forscht*, 2021) [CHE] 10 Swiss Citizen Science Principles (Swiss Academies of Arts and Sciences, Science et Cité (Citizen Science Network *Schweiz forscht*), Participatory Science Academy, Citizen Science Center Zurich and Citizen Cyberlab Geneva, 2022) [CHE] Perception of and Experience with Citizen Science at Higher Education Institutes (HEI) (Science et Cité, 2019) [CHE] Advisory Board for the Swiss Citizen Science programme (Science et Cité); Swiss Expert Group for Citizen Science (Science et Cité) – a working group for analysing citizen science in Switzerland [CHE] Citizen Science in Switzerland: Taking Stock and Ways into the Future (Swiss Expert Group for Citizen Science, 2024) – commissioned by the Swiss Academies of Arts and Sciences (a+) in 2021 [DEU] GEWISS project (Citizens Create Knowledge – Knowledge Creates Citizens) (BMBF, 2014-2017) [FRA] Participatory science in France (Les sciences participatives en France) (Houllier and Merilhou-Goudard, 2016) – a report, including citizen science, commissioned by the ministers in charge of Education, Higher Education and Research in 2015; taking into account the European universities' interest on citizen science (e.g., Citizen science at universities: Trends, guidelines and recommendations (LERU, 2016)) [JPN] Recommendation: Toward the Construction of a Social System to Promote Citizen Science (Young Academy Japan, Science Council of Japan, 2020) [NLD] Citizen Science Nederland network (CS-NL) (2022-) [NOL] National network for citizen science (*Nasjonalt nettverk for folkeforsking*) [NOL] Citizen science in Norway - an overview of activities and actors (*Folkeforskning i Norge – en oversikt over aktiviteter og aktører*) (RCN, 2023) – mapping the citizen science landscape in Norway for the first time [PRT] Setting up of the Portuguese Citizen Science Network (CC.pt) – an informal and nationwide network arising after the National Citizen Science Meetings promoted in 2017 and 2019 [PRT] National Citizen Science Meeting (*Encontro Nacional de Ciência Cidadã* (ENCC))

	[ZAF] Establishment of a citizen science community of practice (2023) [European Commission] European Citizen Science (ECS) project **Provide funding support to enhance capacity and networking of local communities.** [DEU] On your marks! Citizen Science in your city (*Auf die Plätze! Citizen Science in deiner Stadt*) (Wissenschaft im Dialog gGmbH & Museum für Naturkunde Berlin, 2022-2024) – a competition/prize that supports actors in cities and municipalities implementing participatory actions. [NLD] Citizen Science Hubs (2024-) – a programme to strengthen the knowledge, expertise, and support for citizen science within Dutch research organisations by establishing citizen science hubs that act as central points of contact for expertise, resources and infrastructure [European Commission] see cited above the project IMPETUS **Foster capacity building for policymakers with regard to citizen science.** [CAN] Federal community of practice on citizen science – led by Health Canada, involving twelve other different departments and agencies to encourage citizen science within the national research eco-system [GBR] Sciencewise (2004-) – focusing on enabling dialogues and deliberative events that enables policymakers to develop socially informed policy; established based on the 2000 House of Lords report. [European Commission] Mutual Learning Exercise on Citizen Science Initiatives – Policy and Practice (EC, 2021-2023)[7]
Supporting (Data) Infrastructures	**Provide a portal website that collects citizen science practices.** [BEL] Flemish citizen science portal ('Iedereen Wetenschapper') (Eos Wetenschap, 2015-) – set up by the popular science magazine [CAN] Citizen Science Portal (Innovation, Science and Economic Development Canada (ISED), 2017)[8] [CHE] *Swiss Network Schweiz forscht* (Foundation Science et Cité, 2014-) [DEU] National Citizen Science Platform *mit:forschen!* (Wissenschaft im Dialog gGmbH and Museum für Naturkunde Berlin, 2013-)[9]; Website for Citizen Science (BMBF) [NLD] Citizen Science (NWO) [NOL] National network for citizen science (*Nasjonalt nettverk for folkeforsking*) (RCN) [PRT] Projects of Citizen Science (Portuguese Citizen Science Network) [PRT] Projects of Science and Society (Ciência Viva) [European Commission] eu-citizen.science platform **Support and/or develop online platforms for (FAIR) data gathering, analysis and preservation.** [BEL] DoeDat (Meise Botanic Garden) – a long-standing biodiversity monitoring platform [CAN] Proof of concept (prototype) development of a federal digital infrastructure for citizen science (Health Canada; Public Services and Procurement Canada (Laboratories Canada); Shared Services Canada) – to facilitate and streamline the collection, stewardship and exchange of data and information with the public further to commitments outlined in Canada's National Action Plan on Open Government See also Annex C for examples of citizen science platforms **Support and/or develop data integration platforms.** [BEL] Together for Clean Air (Flemish Environmental Agency) – integration of citizen science data with other data on air quality [ZAF] Science Engagement Information Management System (NRF-SAASTA, 2025-) – a database of raw and processed information required for measuring the performance of the science engagement programme and related assessments.
Societal Dialogue	**Strengthen communication between professionals and citizens.** [GBR] ESRC Festival of Social Science (Economic and Social Research Council: UKRI, 2002-) – aiming encouraging 'social science researchers to engage with non-academic audiences' and enabling 'the public to engage with social science research' [JPN] Research Lab and Open Lab at the Miraikan (Japan Science Technology Agency (JST), 2001-) – the National Museum of Emerging Science and Innovation provides spaces for external project teams to engage in cutting-edge research and science communication activities, e.g., the Everyone's Liver Research initiative of the Human Organoid Project. [POL] Science Festivals (academic institutions and organisations, 1996-) **Conduct national surveys on citizens to understand public opinions and attitudes.** [BEL] Study: The citizen in Flemish citizen science (Scivil, 2020) – a survey for the demography of citizen scientists in Flanders [CAN] Public opinion research (Health Canada, 2023) – exploring the motivators and barriers to participation in government-led participatory research/citizen science

	[GBR] Public Attitudes to Science Survey (PAS) (UK government, every 3 to 5 years) – to help understand public views on key topics and how public consume science and research information [European Commission] Special Eurobarometer survey 'European citizens' knowledge and attitudes towards science and technology' (2025) **Engage with citizens in research agenda setting.** See the item of National Research Funding (which is also discussed in 3.2.1. Funding mechanisms and Annex E) **Encourage citizens to participate in capacity building and networks.** see the item of Capacity Building & Networks

Notes

[1] Information on the EC-OECD STIP Compass

[2] Information on the EC-OECD STIP Compass

[3] Information on the EC-OECD STIP Compass

[4] For citizen science where citizens act as autonomous researchers, it is also known that universities often provide opportunities of visiting scholars/researchers so that they can use institutional affiliations and research resources, such as knowledge resources and networks. The National Coalition of Independent Scholars (NCIS) is an organisation that supports non-affiliated researchers (e.g., by membership that provides an affiliation).

[5] Information on the EC-OECD STIP Compass

[6] Information on the EC-OECD STIP Compass

[7] Information on the EC-OECD STIP Compass

[8] Information on the EC-OECD STIP Compass

[9] Information on the EC-OECD STIP Compass

Annex E. Key features of different citizen science funding programmes

Rationales	Funding programme	Aims	Application steps and applicants (Citizen engagement)	Quality assurance & Ethical issues & Research security	Project assessment criteria	Peer review (panels)
Data collection and/or analysis, and scientific discovery – Societal needs and challenges	[JPN] Project for Methodization of 'Convergence of Knowledge' in the Marine Domain through Citizen Participation ¥9.5M (~€56) or ¥15M (~~88k) per annum, for a maximum duration of 5 years	1) To implement citizen science projects with researchers and active citizens. 2) To develop methods for creating Convergence Knowledge specific to each area. 3) To develop universal methods for creating Convergence Knowledge	Applicants* provide proposals for citizen science as section leaders (who implement a citizen science project and develop a specific citizen science method) or an overall leader (who generalises citizen science methods from lessons learned by section leaders). * Researchers affiliated with domestic universities, research and development institutes or companies.	The 2023 call for proposals indicates additional awarded points for past experience of citizen-participatory research. It also specifies research integrity (security) in general considerations (not specific to citizen science).	Additional points for: a) Past achievements in citizen-participatory research (10 points) and interdisciplinary research (5 points) b) Operational structure for the project (e.g., a structure that includes various researchers and securing supporting staff) (5 points) c) Efforts in creating results: plans for citizen-participatory research (10 points) and collaboration across projects (10 points)	Experts (professional scientists in academia)
Data collection and/or analysis, and scientific discovery – Societal needs and challenges	[BEL] Amai! (Duerinckx et al., 2024[65]) €125k / 2 years	Inform citizens about AI and involve them in the development of new AI applications	Applicants* provide proposals toward the AI application ideas specified through Track 1 of three Tracks (below). They firstly need to submit pre-registration for proposals and can obtain feedback after that. • Track 1: Collecting questions for AI from public • Track 2: call for projects: which idea do you make a reality?	The 2023 proposal form requests the following information: • Target groups, recruitment ways, their motivations, and required training • Measures for guaranteeing data quality • Safeguarded for ethical and privacy aspects (e.g., data	Evaluation criteria: 1. Overview and objectives of the project (Score: /20) 2. Project design: methods, work plan and timetable (Score: /20) 3. Citizen science approach (Score: 10)	Two steps: 1) Assessed by experts 2) Assessed by the public – a citizen panel (20 citizens) and a broad public vote

			• Track 3: implementation of selected projects * A proposal needs to be submitted by a consortium consisting of organisations from at least two of the categories of organisations listed below. • Companies with expertise in technology or AI • Universities, colleges and research institutions • Non-profit organisations that focus on one of the four domains (Climate and environment, mobility, health, work) • Civil associations • Local authorities	ownership; recognition on citizen contributions; safety and privacy of participants; how to share the disclaimers, informed consents and privacy statements; inclusivity of participants; personal data treatments)	4. Data Plan (Score: /10) 5. Project Budget (Score: /10)	
Data collection and/or analysis, and scientific discovery – Societal needs and challenges	[NLD] Research along Routes by Consortia (NWA-ORC) €6.75 million / 4 years (of a duration of 6 to 8 years)	To support scientific breakthroughs and societal impacts on wicked problems that require long-term inter- or transdisciplinary research	Applicants* provide proposals toward the themes specified by the Dutch Research Agenda (NWA) process with public. * Professional scientists on behalf of the consortia consisting of: organisations from the entire knowledge chain; all of the scientific disciplines represented that are relevant to the research question; the relevant societal stakeholders; where relevant, citizens and/or their representatives. Citizen Science initiatives can be funded via the module 'material'. The call for proposals has two phases: 1. Registering an initiative and taking part in the collaborative workshops (to promote cooperation between researchers and parties interested in a specific theme and to support them in creating a joint proposal); and	The 'conditions on granting' of the 2023 call for proposals requests (not specific to citizen science): • Scientific integrity • Ethical statement or license • Compliance with the National Knowledge Security Guidelines	Substantive assessment criteria: 1. Problem definition and analysis (20%) 2. Envisaged impact and route to impact (20%) 3. Quality of the consortium (30%) 4. Quality of the research (30%)	Assessment through: • Peer review, • Pre-advice assessment committee, • Interviews, and • Meeting of the assessment committee,

			2. Submitting a proposal.			
Data collection and/or analysis, and scientific discovery – Societal needs and challenges – Democratisation, legitimacy and uptake of policies	[CAN] Northern Contaminants Program (NCP)	To engage northerners, including indigenous communities, in monitoring contaminants to support food safety in the Arctic and northern Canada.	Applicants* provide proposals for one of the NCP sub-programmes: Human Health; Community-Based Monitoring and Research; Environmental Monitoring and Research; Communications, Capacity and Outreach; and Program Coordination and Indigenous Partnerships. * There are no restrictions on who can apply for NCP research funding. Past applicants have included but have not been limited to: • Indigenous governments and organizations • Academic based researchers • Government based researchers • Not-for-profit organizations • Northern or Indigenous community groups or individuals In the proposal, signed Community Engagement form(s) and/or letters of community consent must be submitted.	The 2024 call for proposals specifies that all laboratories performing contaminant analyses for NCP research are required to participate in the quality assurance and quality control program. It also requests information about the relevant ethics review for proposals for human health research and social science research (i.e. Indigenous Knowledge).	Relevance Review: • the merit of the project • the project relevance Technical and External Peer Review: • the scientific excellence/ expertise of the project team • the clarity and scope of objectives • the adequacy of methodology • suitability of project design • appropriateness of time frame and budget Social/Cultural Review: • communications • northern priorities • capacity building and training • Indigenous Knowledge • northern consultation	The proposal review process includes: • Relevance Review by one of five review teams, consisting of representatives from northern organizations, other government departments, academia, and other areas of expertise; • Technical and External Peer Review; • Social/Cultural Review
Societal needs and challenges	[BEL] Co-Create The average amount: €120k per partner for 12 months	Aimed at Brussels residents looking to get involved in exploring new avenues for societal transitions	Applicants* provide proposals for the following three types of projects on the progressive innovation process: • Co-problematisation (15 months) • Co-research (36 months) • Co-development (36 months) * Any Brussels-based entity with a legal structure (business, non-profit organisation, research organisation, public institution, etc.) (with the signature of the application by the partners)	The 2024 proposal forms on all three projects request the information on: i) Equal opportunities –Any (in)direct discrimination against people, on the basis of gender, ethnic and cultural origin, sexual orientation, gender identity and expression, or social origin and situation ii) The criteria for responsible research and innovation (RRI),	Criteria: 1. Quality of the objective 2. Innovative character 3. The team 4. Project 5. Feasibility 6. Impact	Innoviris will assess whether it is appropriate to grant the requested subsidy. In this context, Innoviris reserves the right to: • request additional information;

				which includes the following aspects: • Diversity and inclusion • Respect for the integrity of research • Responsibility, anticipation and reflection (incl. ethics) • Reactivity and adaptability to change The forms for co-research and co-development projects include Risks and complexity (technical, social, ethical, legal, economic, etc.) and Project management (incl. ethical guidelines regarding data ownership, the knowledge produced and its dissemination).		• call on external expertise; • ask the project team to present and defend the project, possibly in the presence of external experts.
Societal needs and challenges – Democratisation, legitimacy and uptake of policies	[ZAF] Science Shop 3 years support	To achieve the following aims: i. Provide research support in response to concerns and issues experienced by communities or civil society; ii. Contribute to the development of research skills in young people; and iii. Showcase real-world situations where problems or challenges encountered by citizens are addressed through multi-disciplinary and/or	Applicants (South African public universities) provide proposals for the Science Shop, w here research that addresses societal challenges is conducted in a collaborative and participatory way and requires that researchers, the community and other stakeholders equally participate in most or all stages of the research process.	The 2021 call for proposals specifies 'ethical considerations' (not specific to citizen science)	The criteria include: • Proposal: Alignment to the strategic objectives of the Science Shops initiative; Scientific merit and feasibility • Collaborations: Academic collaborators; With the communities • Impacts: Community challenges and impact measurement • Track record of the research co-investigator, research staff and project leader or coordinator: Past research	Assessed by: • The eligibility and compliance; and • Evaluation of technical specifications ,

		interdisciplinary research – interfacing social sciences and/or humanities with natural sciences.				
Societal needs and challenges – Democratisation, legitimacy and uptake of policies	[CAN] Programme ENGAGEMENT (Québec) Canadian $15k for startup grant for exploring the topic together and developing an action plan (the first year); $30k for carrying out the plan (the second year); $15k for sharing experiences (the third year)	1) To actively involve citizens in the scientific process, 2) To support the development of new practices and help stimulate diverse research, and 3) To promote the democratisation of scientific knowledge.	The programme proceeds in the following steps: i) Citizens submit questions, which are then posted on the programme website for researchers to explore; ii) Connections are made between citizens and researchers with a common interest and the teams* develop proposals; iii) Successful teams obtain grant support that is provided in three phases. * Teams are made up of two people who together form a Duo, namely: A citizen AND A researcher. The Duo may choose a management organization (e.g., NPOs and museums) to manage part of the funding on behalf of the citizen (optional).	The 2024-2025 call request the following considerations as Other considerations: • Ethical and responsible conduct of projects • Requirements for citizen research and participatory science (the use of the knowledge acquired for research and teaching purposes)	The evaluation criteria are: 1. Quality and realism of the Plan (30 points): 2. Learning potential of the scientific method (40 points) 3. Potential for innovation in participatory science practices (30 points)	Evaluated by an evaluation committee, which includes citizens, meets at each transition phase.
Societal needs and challenges – Democratisation, legitimacy and uptake of policies	[COL] Citizen Science Experimentation Fund	To ensure that communities and initiatives have access to resources to finance research processes, without requiring affiliation or proximity to academia or any type of institution. It is an open door to the recognition of experiential and/or personal knowledge,	Applicants* provide proposals for citizen science. * including: • Natural persons (individuals), citizens over 18 years of age. • Foreign citizens over 18 years of age who can prove that they have been resident in Colombia for the last 5 continuous years. • Groups or collectives constituted (natural persons in a collective capacity), temporary alliance and/or grouping of 2 or more natural	Not specified	- Proposals with differential and territorial practices and approaches that promote inclusion and equity will be valued. - The use of methodologies in accordance with the project, the territory and its inhabitants (innovative, unconventional and diverse methodologies) will be valued.	The assessment by a diverse committee, including peasant communities, indigenous peoples, ethnic groups, plus a representative of local governments as appropriate to

		as inputs and products of research exercises.	persons who decide to join together to present and execute a project. • Community councils of black, Afro-Colombian, Palenquero, Raizal and Roma communities. • Cabildos, resguardos and indigenous associations. • Community action boards. • Public or community libraries. • Established or community museums and scientific collections. • Non-profit organisations. • Colleges or schools. • Territorial entities. • SNCTI actors.		- Impact on the community, cultural, economic and public health dynamics of the territory and its inhabitants, the generation of a common thread between the resources available to the territory, problem solving, attention to specific interests and results, and its impact on the strengthening of existing relationships between the problem, the research and the community.	the subject of the proposal.

Source: The links above (including call for proposals application guidelines) and the presentations in the international workshop in June 2024.

Annex F. Evaluation example – Canadian Northern Contaminants Program

The Northern Contaminants Program (NCP) is a Canadian research funding programme that 'engages Northerners and scientists in research and monitoring of long-range contaminants in the Canadian Arctic, that is, contaminants that are transported to the Arctic through atmospheric and oceanic processes from other parts of the world and which remain in the Arctic environment and build up in the food chain' (see also Annex E for the key features). Under the programme, 66 projects are funded for the 2024-2025 year. The evaluation process of the programme includes annual collection of the project metrics and a formal in-depth evaluation on outputs and outcomes every five to ten years (see below). The quantitative indicators are complemented by qualitative narratives.

Project Metrics:

Perspective	Project Metrics
Engagement & Communication	• Number of Northerners engaged in the project • Number of students involved in the project • Distribution of project materials/information and results
Publications	• Citable publications • Media articles related to the project
Data Management	• Data management plan • Discoverable data • Preservation and access to data
Knowledge Integration	• How are/will the project results, data, and information used, and by whom?
Knowledge Integration	• The amount and percentage of the annual project budget from NCP that was spent in the North and/or allocated to Northern recipients

Program Outputs and Outcomes & Indicators:

Program Outputs and Outcomes	Indicators
• Advancing science and knowledge production (publications, data, reports, workshops, conferences) • Impact of science/evidence (reducing contaminant levels; informing risk assessment) • Increase in awareness & capacity • Northern (citizen) engagement	• % of research, results and information that are made accessible • % of long-term contaminant monitoring datasets maintained • % of data/information collected that is connected to broader, relevant observation systems • # of datasets established as baselines for long term monitoring of plastic pollution in the North • % decrease in concentrations of previously identified contaminants in northern wildlife • % of research projects with metadata entered in Polar Data Catalogue • % of research projects with new entries in NCP publications database

Source: presentation in the workshop (4-5 June 2024, hosted by OECD) and the workshop report [DSTI/STP/GSF(2024)10/FINAL].