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Green Deal Projects Support Office

Citizen science within the framework of the **Horizon 2020 Green Deal Call** projects

Independent Expert Report

Research and Innovation

Citizen science within the framework of the Horizon 2020 Green Deal Call projects – Report One

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Citizen science within the framework of the **Horizon 2020 Green Deal Call** projects

Green Deal Projects Support Office

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About the Green Deal Projects Support Office

The Green Deal Projects Support Office has been developed to facilitate coordination between projects funded under the Horizon 2020 Green Deal Call and to maximise their positive impact in the longer term. The Green Deal Projects Support Office will operate until November 2026 and its key activities will include supporting Green Deal projects to implement effective collaboration, providing networking and knowledge exchange opportunities to develop synergies, and helping projects to rojects Support Office will support networking, knowledge exchange and common capacity-building activities through five working groups:

For more information on the Green Deal Projects Support Office, please contact: **support@greendealprojects.eu**

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What is citizen science?

Citizen science is described as the voluntary participation of non-professional scientists in research and innovation at different stages of the process and at different levels of engagement[1]. Citizen scientists can be involved in a range of activities, from shaping research agendas and policies to gathering, processing, and analysing data, and assessing the outcomes of research.

Employing citizens in scientific initiatives can greatly increase the quality and quantity of data that is collected, often enabling innovative and creative approaches to gathering that data. It also ensures that the research being undertaken aligns with society's needs, expectations, and values, and is, therefore, more likely to trigger desired behavioural change. And, finally, it increases the openness, transparency, and societal understanding of the science, increasing public trust in research outputs.

Citizen science is understood to be an integral part of the *"democratisation of knowledge production"*[2] and of increasing the societal relevance of publicly funded research[1]. It has been attributed to the participatory turn in science policy. It is also claimed that citizen science can facilitate the democratisation of science by shifting it from being a closed activity to being more inclusive and accessible. For example, the European Commission is currently investigating the potential of citizen science as an input for environmental policymaking, and is supporting citizen science in its research funding programmes (e.g. Citizens' Observatories, Responsible Research and Innovation). Taking this agenda into account, funding agencies have started to promote citizen science with tailored programmes, such as the European Horizon 2020 *"Science with and for Society (SwafS)"* programme.

[1]Heigl, F., Kieslinger, B., Paul, K.T., Uhlik, J. and Dörler, D., 2019. Toward an international definition of citizen science. Proceedings of the National Academy of Sciences, 116(17), pp. 8089–8092.
[2]Irwin, A., 1995. Citizen science: A study of people, expertise and sustainable development. Routledge.

Open science, including citizen science and societal engagement, are the modus operandi of the Horizon Europe programme. This opens up huge opportunities for the projects funded under the Horizon 2020 Green Deal Call; it will enable these projects to follow up their science engagement activities beyond their lifespan and to achieve long-term impacts. They will also contribute to the delivery of the five European Union (EU) Missions on several fronts, including by sharing methods, results and lessons with the Mission projects, by building capacities and awareness in their pilot regions about the value of supporting research and innovation initiatives, by participating in co-creation and stakeholder engagement processes, and by networking with other similar regions (among others).

Within the **Horizon Europe programme**, citizens and civil society organisations can get involved in project activities in three different ways (see Figure 1):

1. **Co-design** of activities, such as workshops, focus groups, or other means of developing research and innovation agendas and policies. This will often include exploring the implications, ethics, benefits and challenges of research and innovation approaches and technology development.
2. **Co-creation**, involving citizens or end users directly in the development of new knowledge, often through user-led innovation.
3. **Co-assessment**, such as assisting in the monitoring, evaluation and feedback relating to a project's governance, policies or programmes on an iterative or even continual basis.

Figure 1 Ways of involving citizens and civil society organisations in project activities

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Citizen science in European Commission research and innovation policies and programmes

This section explains how citizen science has been incorporated into research and innovation policies and programmes in Europe. It presents citizen and social engagements within Horizon Europe, and how they can be mainstreamed.

Citizen science in the European research and innovation policy

Citizen science is a part of the Pact for Research and Innovation in Europe that lists societal responsibility as a main principle, and active citizen and societal engagement in research and innovation as a priority area for joint actions. Promoting this engagement can increase:

- **the excellence** of research and innovation, by enlarging the scope of research and innovation and the quality and quantity of data that is collected, discussed and analysed, enabling innovative and creative approaches and leveraging collective intelligence
- **the effectiveness**, relevance and uptake of the results, by ensuring that research and innovation aligns with the needs, expectations and values of society and triggers behavioural changes
- **society's trust in science**, by increasing openness, transparency, science literacy and the confidence of the public in research

Member States have also taken part in mutual learning exercises to strengthen their national policies and initiatives on citizen science. These activities enabled them to exchange lessons learnt and best practice, as well as exploit synergies and upscale suitable (cross-) national citizen science initiatives across the European Research Area (ERA).

As a result, five thematic meetings were organised in 2022 involving 11 Member States and Associated Countries (Austria, Belgium, France, Germany, Hungary, Portugal, Romania, Italy, Slovenia, Sweden and Norway). The final report will be available in early 2023, and will focus on ensuring

good practice and impact, maximising the relevance and excellence of citizen science, creating enabling environments and sustaining citizen science, and scaling up citizen science.

Citizen and societal engagement in Horizon Europe

Opening the research system towards society, and vice-versa, is a policy priority that is embedded within the new ERA policy agenda, in which the practice of open science is addressed in the following ways:

- **In the excellence criterion for evaluating proposals:** "Soundness of the proposed methodology, including the underlying concepts, models, assumptions, interdisciplinary approaches, appropriate consideration of the gender dimension in research and innovation content, and the quality of open science practices including sharing and management of research outputs and engagement of citizens, civil society and end users where appropriate".
- **Inclusion under the methodology section during proposal evaluation:** "Describe how appropriate open science practices are implemented as an integral part of the proposed methodology".
- **In Key Impact Pathways (KIP):** "KIP 6 Strengthening the uptake of Innovation in Society" and "KIP 3: Fostering diffusion of knowledge and Open Science".

The Horizon 2020 SwafS programme

The objectives of the programme are:

- to build effective co-operation between science and society
- to foster the recruitment of new talent for science
- to pair scientific excellence with social awareness and responsibility

In the Horizon Europe Work Programme 2018–2020 there are three strategic orientations addressing citizen and societal engagement:

- building the territorial dimension of SwafS partnerships
- exploring and supporting citizen science
- building the knowledge base for SwafS

The SwafS project portfolio includes the following areas:

- Citizen science and engagement: covering all areas of science and innovation, from public health and ecology to computer science and frontier physics.
- Responsible Research and Innovation (RRI).
- Impacts and implications of citizen science and citizen engagement.
- Hubs of activity to foster growth and encourage the very best practices.

Horizon Europe citizen and societal engagement dedicated support

Investments made by Horizon Europe to deliver on EU policy priorities and to contribute to the United Nations Sustainable Development Goals include the European Green Deal, the Circular Economy Action Plan, the EU Biodiversity Strategy for 2030, the Farm to Fork Strategy, the European data strategy, the European Hydrogen Strategy, and the New Industrial Strategy for Europe.

With the aim of widening participation in, and strengthening, ERA, the Horizon Europe Work Programme 2021–22 included the development of an open science policy and the adoption of open science practices, such as citizen science, societal engagement, science communication and responsible research and innovation within ERA.

The expected impacts of this are:

- increased capacity in the EU research and innovation system to conduct open science and to set it as a modus operandi of modern science
- increased engagement of citizens with research and innovation
- increased alignment of strategic research with society's needs, expectations and values
- increased trust in science and research and innovation outcomes within society, and greater two-way communication between science and society

Citizen science has the potential to improve the excellence and impact of research and to deepen the relationship between science and society. It can contribute to science and innovation in a meaningful way, from environmental observation to improvements in the health and the energy sector.

The involvement of citizens in co-design, co-creation and co-assessment processes are foreseen across Horizon Europe activities, notably in the context of Missions and Clusters. Moreover, the Horizon Europe citizen engagement is an aspect of the excellence criterion and methodology for proposal evaluation, and of the key impact pathway monitoring approach.

In summary, citizen science can contribute to improving research and innovation and adding value to research projects. Horizon Europe aims to promote citizen science by acknowledging its value in the following ways:

- Recognising that citizen science has the **potential to improve the excellence** and impact of research and to deepen the relationship between science and society.
- Recognising that citizens can **contribute to science and innovation in a meaningful way**, from environmental observation to improvements in the health and the energy sector.
- Being cognisant of the fact that citizen engagement, which includes citizen science, is **at the core of the Pact for Research** and Innovation and is a cross-cutting priority of the new ERA.
- Foreseeing the involvement of citizens in co-design, co-creation and co-assessment processes across Horizon Europe activities, notably in the context of Missions and Clusters.

- Making citizen engagement an aspect of the **excellence criterion and methodology for proposal evaluation within Horizon Europe**, and of the key impact pathway monitoring approach.
- Offering **dedicated support to citizen science in the Widening Participation and Strengthening the European Research Area (WIDERA)** part of the programme. WIDERA aims to ensure wider participation in ERA, and to spread excellence, as well as to reform and enhance the European research and innovation system. The essence of this component is the full use of Europe's scientific potential and ensuring that the benefits of an economy based on knowledge and innovation are widely spread across all countries of the continent[3].

[3]WIDERA - Project WIDE_NET (ncpwidenet.eu)

3

Challenges and barriers in implementing citizen science projects, and potential mitigation strategies

Citizen science approaches boast an array of benefits; however, there remain a few barriers that impact the effectiveness of implementation. With careful consideration and planning, these challenges can be mitigated. This section highlights five limitations and suggests ways to remedy them, as shown in Figure 2.

Maintaining citizen engagement

In the initial engagement with citizens it is imperative to persuade them to participate, and to foster a willingness to do so, as well as then having a clear strategy on maintaining participation. The barriers that could potentially prevent engagement must be identified in advance – such as language, poverty, gender issues, the lack of an inclusive work environment for ethnic minorities, etc. The local context must be understood, with targeted measures in place to engage with citizens that are at risk of social exclusion.

Moreover, the role that citizens will play in the project must be defined at the start, and should be communicated with them, so that participants understand which part of the research process they will be involved in. This will facilitate a shift away from top-down, hierarchal approaches and will allow citizens to lead from the bottom up.

In order to maintain citizens' participation and increase their productivity, motivation mechanisms can be employed throughout the project. For example, frequent feedback, sharing relevant knowledge, engaging in entertainment activities, providing access to information, and gamification are all examples of how participants can be kept informed or engaged, which will make them feel more connected to the work that they are doing.

Figure 2 Limitations of adopting citizen science approaches in research projects

Some general strategies for maintaining engagement include the following:

- **Making it fun**, by creating a social element during participation in projects, and having an appealing reward system.
- **Allowing citizens to work closely with scientists (which is something they appreciate)**. This can be through formal training or allowing them to work alongside lead researchers during the project.
- **Allowing them to actively participate in data analysis and validation**. Citizens value being involved in crucial elements of the research process.
- **Building trust and maintaining the purpose of, and motivation for, their involvement**. This can be achieved through fostering a community feeling around the project, networking, and creating a personal connection with local actors, the context or a particular cause.

Data quality

When data is dispersed it is difficult to access and re-use, which poses a challenge to the quality of the data itself. Automatic data validation mechanisms remain costly, data sharing between projects can be difficult, and a data-centric approach is not always systematically adopted: all of which can make it difficult for researchers to assess, measure and compare results and impact. As a result, ensuring the data collected in the project is robust can remain a hurdle if it is not considered early on in the research. Some approaches to mitigate these challenges include the following:

- **Check for pre-existing tools that can be of use.** Platforms (or webtools/mobile apps) that help to centralise the data that is collected can be especially useful.
- **Connect with similar projects to share knowledge and approaches.** A community of participants or practitioners can help to validate the data.
- **Offer training workshops to maintain a consistent high quality of data.**
- **Compare the project's data with official data.** Combining official data with the project's own data, visualisation and interpretations can enable it to be replicated in other contexts.

Demonstrating impact

It is quite difficult to devise indicators for measuring the impacts of citizen science that are both useful to the project itself and applicable at the relevant scale (local, national, regional or Europe-wide level). However, by publishing the final results and justifying the evaluation metrics used, not only can this contribute to the discourse and overall recognition of Citizen Science as a research method, but it can also create an academic impact in and of itself.

A few strategies to improve impact evaluation include the following:

- **Prioritising the impact areas and creating a strategy that aligns with existing policy and social agendas.**
- **Engagement with policymakers:** Producing policy documents resulting from the project to inform existing agendas and planning political advocacy/ communities.
- **Being flexible:** Running ex-ante and ex-post impact assessments to monitor the project's progress.

Sustainability

Near the completion of the project, resources are typically depleted and thus often little attention is paid to the sustainability of the project. For example, technological tools (e.g. apps or platforms) that help to retain engagement and raise awareness can be costly and therefore their maintenance can be overlooked. Furthermore, the upscaling and replicability of projects can be compromised due to limited funding and the short-term perspective that sometimes governs projects.

To better ensure project sustainability, the following should be considered:

- Defining the long-term plan and new business models at the beginning of the project.
- Finding additional resources (either public or private) beyond grant funding.
- Planning the scale-up or roll-out of the activities, outcomes and impacts of the project.

Academic scientists and scientific recognition

Institutional changes in academia are needed in order to increase the scientific recognition of citizen science. Significant efforts are underway to pursue this, such as the European Commission's inclusion of citizen science in its Open Science Agenda.

Some of the barriers to the involvement of academics is that they lack the familiarity and skills required to implement citizen science projects. Training in this area is therefore required. However, there remain limited incentives for academics to undertake such training, as they can be reluctant to enrol in a more complex and less controlled research scheme. This is coupled with the lack of scientific and academic career recognition for participation in such projects.

Possible strategies for tackling this include the following:

- **Establishing an interdisciplinary team.** A European platform exists to connect scientists around Europe, through shared information, possibilities for publishing papers, new funding schemes, and networking opportunities.
- **Emphasising the policy impact and research elements of the project to incentivise academic participation.** Similarly, it can be useful to reiterate how citizen science enhances societal trust in science.

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Examples of citizen science in Horizon 2020 GREEN DEAL CALL projects

Citizen science is currently being applied by a number of the Horizon 2020 Green Deal Call projects. However, the implementation of citizen science methodologies in these projects has faced a number of challenges and barriers. This has prompted the projects to develop strategies and formulas to address these challenges and barriers, which can be shared as 'good practices'. Thus, the boxes in this section summarise three of the Horizon 2020 Green Deal Call projects that are applying citizen science, highlighting the research opportunities and barriers that were identified by the project coordinators.

GREEN SCENT
SMART CITIZEN EDUCATION FOR A GREEN FUTURE

GREENSCENT – Smart Citizen Education for a Green Future aims to educate and empower the people of Europe to change their behaviour towards the environment by fostering empathy for the planet. GreenScent believes that behavioural change is vital in order to achieve the objectives set out by the European Commission's Green Deal of climate neutrality on the continent of Europe by 2050.

This project is empowering children to monitor the air quality around their schools and raising awareness of the links between air pollution and health.

Opportunities

The project is giving students and pupils a say on the future Green Competence Framework and curriculum. It is expected that this will:

- make education more relevant
- increase students' and pupils' awareness of the Green Deal
- engage young people in the Green Deal and motivate them to act

Barriers

These have yet to be determined but it is suspected that engaging young people over a period of several years will be a challenge.

The PSLifestyle project aims to close the gap between climate awareness and individual action by engaging people to take an active role and endorse more sustainable lifestyles. It does so through the PSL digital tool. On the one hand, the tool enables the collection, monitoring and analysis of an individual's lifestyle patterns; on the other, it builds awareness about individuals' carbon footprint, while empowering them to make changes in their lifestyle behaviours towards more sustainable ones.

To ensure the PSL tool reflects the needs and expectations of its users within the context of their local realities, the PSL tool (content and features) has been co-created with citizens from eight European countries (Portugal, Finland, Estonia, Germany, Italy, Slovenia, Greece, and Turkey) through Citizen Science Labs. The opportunities and challenges set out below related to the process of conducting the labs in the project's pilot regions.

Opportunities

- People are curious about understanding their environmental impact and tracing it back to their specific lifestyle patterns/behaviours.
- Collaborating with various (local) organisations/ multipliers is helpful for recruiting lab participants.
- Tangible incentives (e.g. social gatherings and new experiences) help to bring participants on board, as well as keeping them engaged.
- A diverse set of communication materials and channels increases the effectiveness of participant recruitment.
- Starting from people's local realities and needs helps to incite people's curiosity more, as opposed to speaking about sustainability in general.
- Sharing the ownership of the process with participants is a success factor with regard to keeping participants interested throughout the entire journey.

Challenges

- Recruiting and retaining participants seems to be slightly more difficult post-pandemic, due to fears of possible Covid-19 infection and/or wanting to spend one's time differently.
- It is difficult to bring on board people from different backgrounds due to differences in values: for example, sustainability concerns are not considered a priority for some social groups over ensuring their personal welfare.
- Participants were impatient about the project's future plans. Providing an overview of the entire process upfront helps people to create an impression of the entire context.
- The ambitious sustainability targets (i.e. 1.5°C lifestyles) can lead to feelings of hopelessness and risk undermining people's beliefs in their self-efficacy. Highlighting the individual's role complementary to other people, as well as actors in a system, helps to offset such impressions.

AURORA is demonstrating how people can make a difference through the choices they make, reducing 13–20% of all greenhouse gas emissions linked to residential energy use and 13% linked to transport choices. In addition, the project will empower people to take ownership of new community solar energy projects.

Opportunities

- Transforming university communities into Citizen Science Hubs by creating renewable energy communities.
- Understanding the underlying motivations (social and environmental benefits) of participants through conducting surveys.

Barriers

- Inflexibility of public administrations.
- Surveys revealed concerns about the financial and legal implications of participations (i.e. return on investment).

5

Communicating impact: communicating impact stories from projects to stakeholders

Citizen science is a rapidly emerging mode of research and innovation, and one which the projects funded under the Horizon 2020 Green Deal Call are increasingly using to engage citizens in adapting to and tackling climate change.

A body of knowledge is being developed that describes the types of impacts of citizen science initiatives, including how to monitor and analyse these projects, but discussing how to capture and convey the impacts to both policymakers and the wider public is equally important.

In citizen science research, a lot of outputs are delivered in the form of reports, policy briefs and publications that disseminate knowledge and key findings, but it can be quite easy for the key impacts to get lost within the piles of paperwork that land on a policymaker's desk. It is also difficult to scale up the impact, whereby other stakeholders take on best practices to other regions, as the knowledge-sharing networks and the technological infrastructure that can facilitate this would need strengthening.

The power of pictures

In the 'Plastic Spotter' project, in which volunteers studied the macroplastics found in the canals of Leiden, the Netherlands, pictures were used to showcase the nature of activities and the work that volunteers were involved with and this was particularly useful in demonstrating the outcomes of the research. For example, the impact of Covid litter was illustrated through the picture of a small fish trapped within a medical glove (Figure 3). This proved to be a very powerful image that was picked up by news outlets, including The Guardian and National Geographic.

Figure 3 Fish caught in medical glove

Storytelling

A significant element of reaching new people is how you frame your work and how you tell your story. Leveraging the art of storytelling is therefore an exceptional asset for citizen scientists, and is especially useful in addressing the following challenges:

1. awareness and engagement of citizens
2. acceptability: the added value of citizen-driven science to decision-making and policymaking

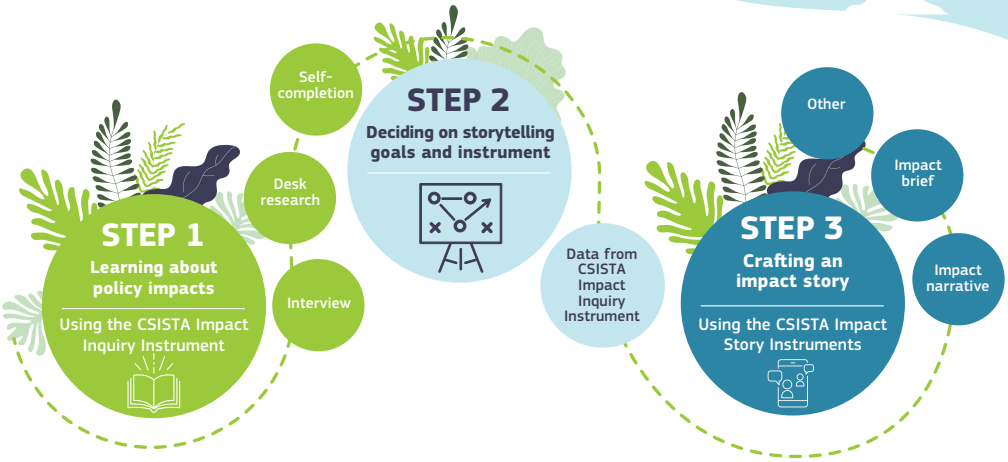

Figure 4 Storytelling approach used in We Observe project

3. sustaining the ecosystem of support and scaling up.

The We Observe project, which aims to improve the coordination between existing Citizen Observatories, uses a storytelling approach. **Figure 4** shows a graphic of the template designed during the project as guidance on what to keep track of.

- **Step 1:** How is the instrument being used? Will it be used during interviews, or will it be used at the end for reflecting and using the grey literature to complete?
- **Step 2:** Looking at the instrument itself and what its goals are: who is it for? Policymakers? Funding bodies?
- **Step 3:** With that audience in mind, the narrative can be designed. Is it a policy brief? Poster? Video?

The greatest challenge that remains is measuring the impact in a quantifiable way, as impacts can be manifested over long periods of time and in many different directions. Core aspects of projects, including meaningful engagement, are difficult to measure, and it is often easy to use metrics purely because they are measurable, as opposed to the metric providing information about what the nature of the impact really is. An example that was discussed in our recent webinar was how an increase in Twitter followers is not reflective of engagement with projects or their reach: rather, deeper metrics, such as the number of retweets or click-throughs, would be more appropriate. Yet this still fails to capture the action taken. So, although measuring impacts is encouraged, a deeper interrogation of whether it is a false/vanity metric must be considered.

6

Summary and conclusions

Citizen science is the practice of public participation and collaboration in scientific research to increase scientific knowledge. This rapidly emerging mode of research and innovation shows substantial potential in terms of achieving greater societal impact and increasing trust in science, by leveraging collective societal capabilities, by enlarging the scope of research and innovation, and by increasing the relevance, responsiveness and transparency or research. Several projects funded under the Horizon 2020 Green Deal Call are working on solutions that will enable citizens to get involved in Green Deal implementation, through, among other approaches, citizen science and observation initiatives.

Citizen and societal engagement are programme principles and an operational objective of Horizon Europe, which aims to "promote co-creation and co-design through the engagement of citizens and civil society"[4]. Looking at "Horizon 2025-2027 – public consultation", more citizen science projects are expected to come through.

Meanwhile, the use of citizen science will not be limited to the Horizon Europe research projects. The implementation of the Horizon Europe research and innovation Missions on cancer, climate-neutral cities, oceans, smart cities, and soil and food, foresees user-led innovation, citizen science and public engagement activities.

People, whether in their role as citizens or consumers, are an important stakeholder to scientific research, hence it is pivotal to consider and bring them on board with more active roles when it comes to designing and shaping our current socio-economic frameworks. Furthermore, considering citizens'/consumers' reality, thinking and behavioural patterns is an important element in ensuring the effectiveness of the solutions (existing or new ones) that address the improvement of our consumption and production systems in the context of sustainability. Citizen science allows for building such understanding.

Finally, it is important to note that citizen science can be regarded as an important activity in itself: getting citizens in touch with science, engaging with local issues and also with each other. However, it becomes even more important when placed in the broader context, including the wider framework of open science and innovation. Citizen science therefore not only needs political support but can itself be a source of support and an opportunity for many European initiatives.

[4]REGULATION (EU) 2021/695 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 28 April 2021 establishing Horizon Europe – the Framework Programme for Research and Innovation, laying down its rules for participation and dissemination, and repealing Regulations (EU) No 1290/2013 and (EU) No 1291/2013. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R0695

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This report introduces citizen science and its incorporation into research and innovation policies and programmes in Europe, and looks at citizen and social engagements within Horizon Europe, and how they can be mainstreamed Although it boasts an array of benefits there remain a few barriers that impact its effectiveness, and we examine and provide suggestions to remedy them. Finally we delve into three of the Horizon 2020 Green Deal Call projects that are applying citizen science, and highlight the research opportunities and barriers that were identified by the project coordinators.

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