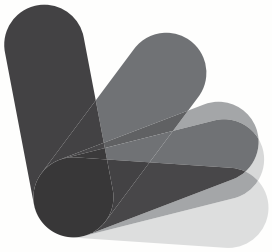
• Ad Emmen, International Desktop Grid Federation • Adam McNamara, Ariadne Computing Ltd. • Adam McNamara, University of Surrey • Aina Pascual, Biodiversity Assessment Unit Intern • Aires Alexandre, Jaime Cortesão Secondary School • Alexa Joyce, European Schoolnet • Alexander Y Dunsford • Alexandra Sowka, Hanover University of Music, Drama and Media • Alexandre Quintanilha, ICBAS & Member of the EC President's Science & Technology Advisory Council • Alfonso Tarancón, Universidad de Zaragoza – BIFI Alison Smith, Plymouth University • Álvaro Rodríguez Resino • Amílcar Falcão, University of Coimbra • Amy Robinson, MIT (EyeWire) • Ana Maria Alves, Senior University of Esmoriz • Ana Raquel Riedel von Teschenhausen, University of Leipzig • Anabela Ramos • Andrea Sforzi, Museo di Storia Naturale della Maremma • Andreas Lieberoth, Aarhus University, Centre for Community Driven Research • Andy Donnelly, Cambridge Science Centre • Angelika Wurbs, Leibniz Centre for Agricultural Landscape Research • Anne M. Dijkstra, University of Twente • Antonio González, TECNARA Cluster TIC Aragón • António Monteiro, Museu da Ciência da Universidade de Coimbra • António Sousa, Student of the Senior University of Águeda • António Vieira, Senior University of Esmoriz • Anxo Sanchez, Universidad Carlos III de Madrid • Arminda Vita, Senior University of Esmoriz • Augusto Semedo, Senior University of Águeda • Barbara Brayshay, Mapping for Change, University College London • Barbara Kalumenos, STM • Barbara Kieslinger, Zentrum für Soziale Innovation • Barbara Saracino, University of Florence • Beatriz Antolí, Universidad de Zaragoza – BIFI • Belén Barroeta, University of Alcala-UAH • Ben Segal, CERN • Cai Qing • Cândida Silva, Universidade de Coimbra • Caren Cooper • Carlos Val, Fundación Ibercivis • Caroline Manahl, Zentrum für Soziale Innovation • Chandra Clarke, Citizen Science Center • Charlene Belanger, Université du Québec à Montréal • Chris Lennard, Cambridge Science Centre • Christian Nold, University College London • Christian Voigt, Zentrum für Soziale Innovation • Christoforos Pavlakis, ICT&S Center • Christopher CM Kyba, Leibniz Institute of Freshwater Ecology and Inland Fisheries • Cindy Regalado, University College London • Claudio Mirasso, IFISC, Universitat de les Illes Balears • Coral Victoria de la Iglesia Meleiro, FAMUNCYT • Daniel Lombraña, CCC, Shutthleworth Foundation • Daniel López Bruna, LNF–Ciemat • David Anderson, Space Science Laboratory, University of California • David Curren, www.openscientist.org • David George Foster, CERN • David Slawson, Imperial College London / Open Air Laboratories (OPAL) • Dirk Helbing, Swiss Federal Institute of Technology Zurich • Doreen Werner, Leibniz Centre for Agricultural Landscape Research • Drew Hemment, FutureEverything • Eduardo Actis, CSIC • Eduardo Lostal, Fundación Ibercivis • Elizabete Marchanet, Centre for Functional Ecology • Erich Prem, eutema • Erinma Ochu, The University of Manchester • Fermín Serrano Sanz, Universidad de Zaragoza – BIFI – Ibercivis • Fernando Tomás • Filippo Addarii, The Young Foundation • Francesco Rodriguez, York University • Francisco Brasileiro, Universidade Federal Campina Grande • Francisco Castejón, CIEMAT • Francisco Sanz García, Universidad de Zaragoza – Ibercivis • Francisco Vigalondo, Universidad de Zaragoza • Francois Grey, Citizen Cyberscience Centre (CCC) • Giuliana Rubbia, Istituto Nazionale di Geofisica e Vulcanologia - INGV Roma • Greg Newman, Natural Resource Ecology Laboratory, Colorado State University • Helena Figueiredo, José Estêvão Secondary School • Helena Mendes, University of Coimbra • Hélia Marchante, Centre for Functional Ecology (UC) • Ian Morgan, Optimat • Ilse Marschalek, Zentrum für Soziale Innovation • Irene Lapuente, La Mandarina de Newton S.L. • Irina Castro, Centre for Social Studies (UC) • Isabelle Bonhoure, Universitat de Barcelona • James Borrell • Jan Theunis, Environmental Risk and Health • Javier Garcia Tobio, Centro de Supercomputacion de Galicia (CESGA) • Jayne Fenton Keane, Inspiring Australia • Jennifer Lynn-Shirk, Cornell Lab of Ornithology • Jesus Marco, CSIC • João Arriscado Nunes, Centre for Social Studies (UC) • Joaquim Fresco, Student of the Senior University of Águeda • Joaquin Huerta, Universitat Jaume I • John Bratton • John Prpic • Jonathan Silvertown, The Open University • Juan Hindo, IBM – World Community Grid • Julia Schnetzer, MPI for marine microbiology, Bremen * Karl Donert, EUROGEO • Kat Austen, University College London • Kate Martin, Imperial College London / Open Air Laboratories (OPAL) • Katia Smith-Litière, Cambridge Science Centre • Keren Limor-Waisberg, University of Cambridge • Kieran Hyder, Cefas * Kirsti Ala Mutka, European Commission • Kshitiz Khanal • Kutoma J Wakunuma, De Montfort University, United Kingdom • Laura Ferrando, CSIC • Laura Gosling, Imperial College London / Open Air Laboratories (OPAL) • Lesandro Ponciano, Universidade Federal Campina Grande • Libby Hepburn, Atlas of Life • Linda Davies, Centre for Environmental Policy • Lotta Tomasson, Vetenskap & Allmänhet, VA (Public & Science) • Luca Montabone, Space Science Institute - Laboratoire de Meteorologie Dynamique Paris - University of Oxford • Lucy Robinson, Natural History Museum London • Luísa Catarino, José Estêvão Secondary School • Luz Guenaga, DeustoTech Learning • Maite Pelacho, Colegio Sansueña de Zaragoza • Manuel Pérez, TECNARA Cluster TIC Aragón • Maria Manuel Moreira, Pedro Hispano Institute • Maria Palma, José Falcão Secondary School • María Ponti, University of Goteborg • Mari Carmen Ibañez, Fundación Ibercivis • Mariluz Guenaga, Deusto Research • Martin Felix Gajdusek, ZSI - Centre for Social Innovation • Matt Postles, Bristol Natural History Consortium • Melinda Hughes-Wert, Nature Abounds • Michail Kalogiannakis, University of Crete, Department of Preschool Education • Michelle Brook, Open Knowledge Foundation • Miguel Luengo-Oroz, Universidad Politecnica de Madrid • Miika Tuisku • Mónica Lara, CSIC * Monica Lobo, British Science Association • Monique Luckas, Leibniz Centre for Agricultural Landscape Research • Muki Haklay, University College London • Nazareno Andrade, Universidade Federal Campina Grande • Nicola Fraser, Southern Cross University • Nuno Negrões, Biology Department, Aveiro University • Oleg Lodygensky, CNRS • Oswaldo Somolinos, Universidad de Zaragoza • Pamela L. Gay, Southern Illinois University Edwardsville • Paolo Gurisatti, Università Ca'Foscari Venezia • Paula Paiva, José Falcão Secondary School • Paulo A. M. Marques, ISPA-IU and MUHNAC • Paulo Gama Mota, Museu da Ciência da Universidade de Coimbra • Pawel Szczesny, Institute of Biochemistry and Biophysics PAS * Pedro Russo, Leiden University • Philip Poronnik, The University of Sydney • Pieter van Boheemen, Waag Society's Open Wetlab • Pilar Perla, Heraldo de Aragón • Pilar Tigeras, CSIC • Poppy Lakeman Fraser, Imperial College London / Open Air Laboratories (OPAL) • Ramon Sangüesa, La Mandarina de Newton SL • Raymond Lewis, Marine Care Rickets Point Inc • Rémy, Euro-Mediterranean Seismological Centre • Rhonda Smith, Minerva • Ricardo Cavero, Ayuntamiento de Zaragoza • Rita Gabriela Monteiro da Rocha, Mundo Científico, Lda. • Rita Serra, Centre for Social Studies (UC) • Robert Bray • Robert Lovas, MTA SZTAKI / International Desktop Grid Federation • Roger Fradera, Imperial College London / Open Air Laboratories (OPAL) • Ronald Smallenburg, Science in Action • Rosa Arias • Rosalia Vargas, Ecsite – Ciência Viva • Rosina Malagrida, IrsiCaixa • Rui Brito, University of Coimbra • Sara Oliveira, Senior University of Esmoriz • Sarah West, Stockholm Environment Institute • Science Communicator, IBMC • Steve Cinderby, Stockholm Environment Institute • Steven Bamford, University of Nottingham • Steven Bishop, University College London • Stuart Pearson, University of New South Wales, Canberra • Suraj Rai • Susana C Gonçalves, Centre for Functional Ecology, University of Coimbra • Susanne Hecker, Leibniz Centre for Agricultural Landscape Research • Teresa Holocher-Ertl, Zentrum für Soziale Innovation • Teresa Xavier, Agrupamento de Escolas Vale do Tamel • Tony Fox, chair of People's Parks • Ulf Gärdenfors, Swedish Species Information Centre • Valentim Gomes, Senior University of Esmoriz • Vickie Curtis, The Open University • Victor Castelo, CSIC • Victor Lucea • Virginia Brussa • Xavier Querol Pascual • Yael Kisel, University of Göttingen • Yuri Gordienko, G.V. Kurdyumov National Academy of Sciences •

WHITE PAPER

ON CITIZEN SCIENCE FOR EUROPE



socientize

WHITE PAPER
ON CITIZEN SCIENCE FOR EUROPE

European Commission

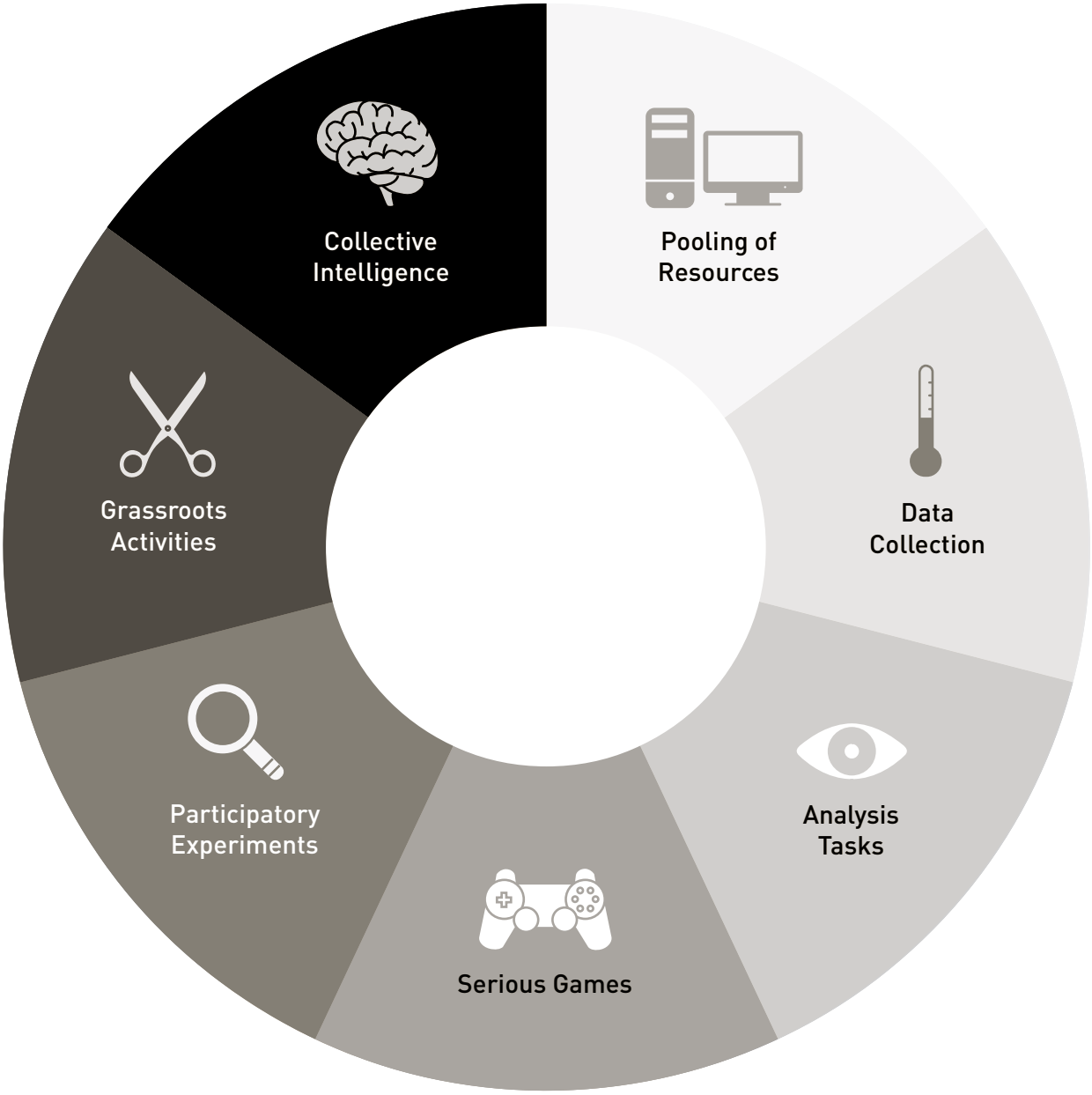
1

Introduction to Citizen Science

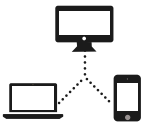
CITIZEN SCIENCE

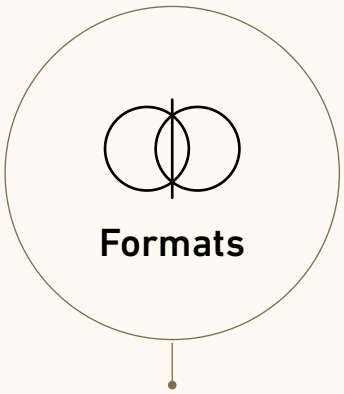
Citizen Science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources.

MODELS OF CITIZEN ENGAGEMENT IN SCIENCE



In Citizen Science, a broad network of people collaborate. Participants provide experimental data and facilities for researchers, raise new questions and co-create a new scientific culture. While they add value, volunteers acquire new learning and skills and gain a deeper understanding of the scientific work in appealing ways. As a result of this open, networked and transdisciplinary scenario, science-society-policy interactions are improved, leading in turn to a more democratic research based on evidence and informed decision-making.

VALUES	ATTRIBUTES		
 **Open** (culture)	◆ Trusted ◆ Transparent ◆ Global	◆ Engaging ◆ Self-learning ◆ Accessible	◆ Reusable ◆ Participatory ◆ Collaborative
 **Social** (by all/for all)	◆ Co-created ◆ Amateur ◆ Scattered	◆ Collective ◆ Democratic active ◆ Public assessment	◆ Creative ◆ Inclusive
 **Digital** (infrastructure)	◆ Powerful ◆ Ubiquitous ◆ Pervasive ◆ Massive	◆ Immediate ◆ Traceable interactions ◆ Networks	◆ Devices ◆ Empowerment ◆ Effective
 **Research** (innovative)	◆ Unexplored ◆ Inspiration for innovations ◆ Transdisciplinary	◆ Innovative ◆ Educational ◆ Common ◆ Responsible	◆ Sustainable ◆ Skilled ◆ Experimental



Research driven / socially driven

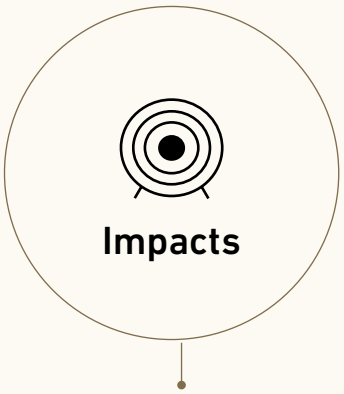
Online / offline

Amateur / Professional

Formal / Informal

One-day / permanent

Local / global



Scientific

Inspirational

Educational

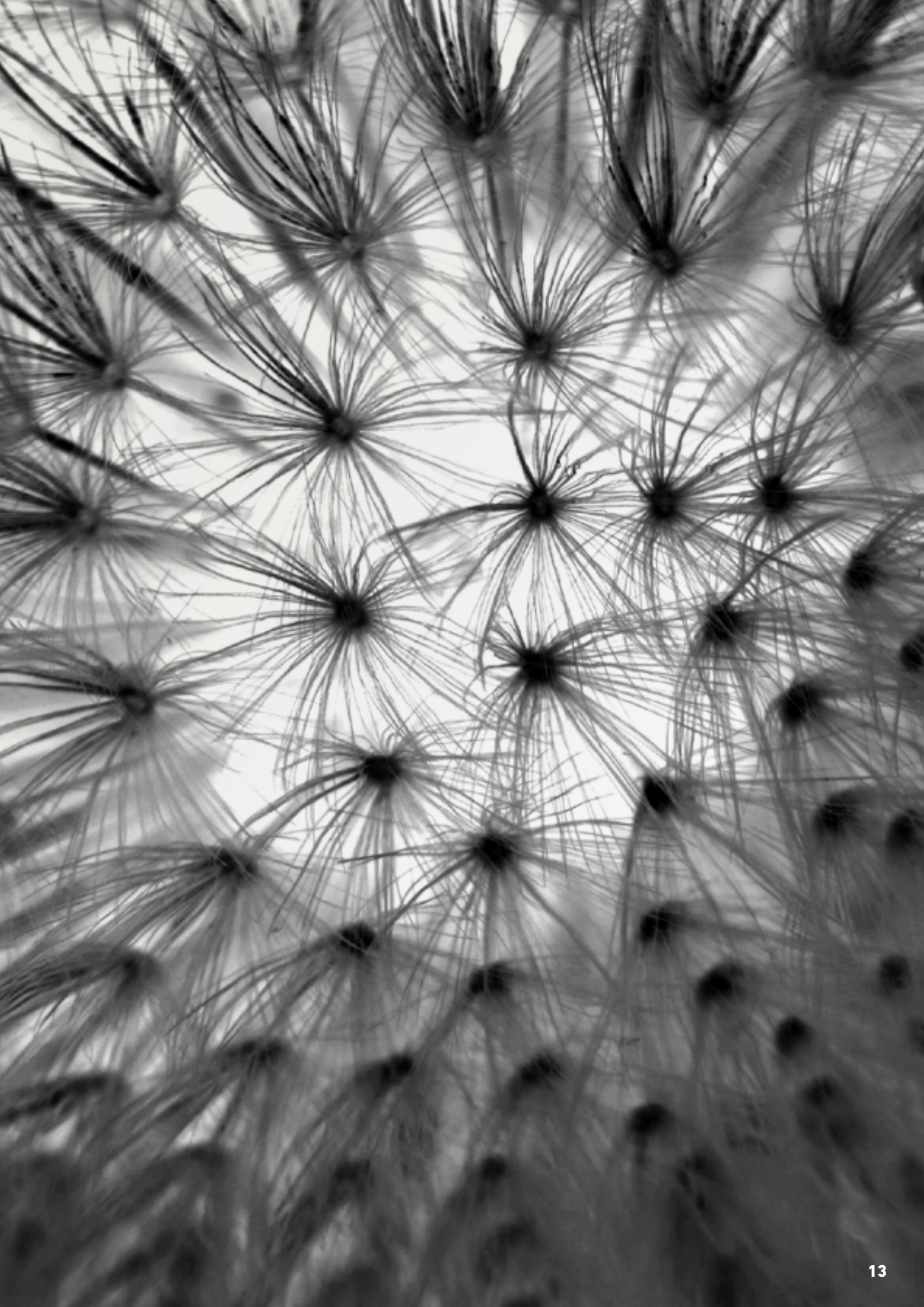
Social

Economic

Environmental

Political

Citizen Science encompasses a wide range of activities carried out by several actors at multiple levels. We find massive and occasional virtual interactions on a global scale as well as regular, proactive and continuous involvement in local environments. There is no single definition of Citizen Science but rather a series of definitions that reveal the dynamics of this research approach which is continually evolving and implies new collaborative activities and shared objectives between the main stakeholder groups.

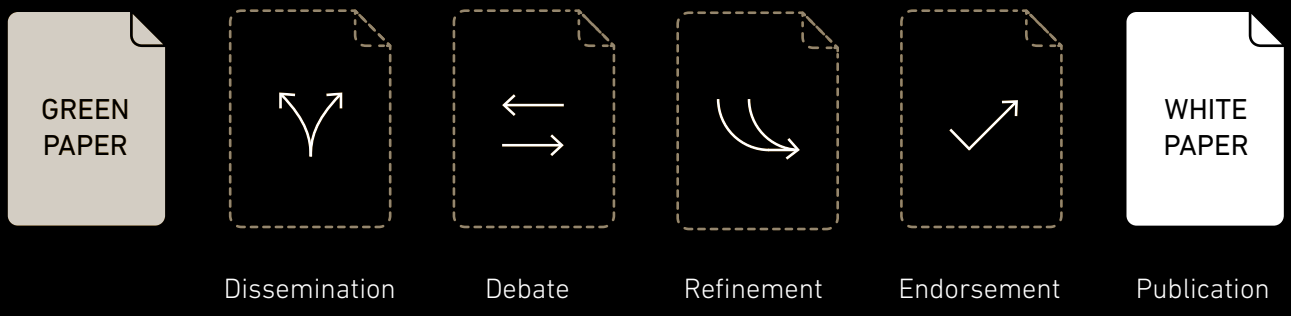


2

Approach to this White Paper

The SOCIENTIZE Project aims at improving the understanding and uptake of the impacts associated with Citizen Science. These concepts are fuzzy, since amateurs engage in research, researchers group themselves in mediator clusters and, as members of a community, we all become policy makers albeit using a language different from theirs.

In the past two years, we mapped ongoing activities, institutions, funding programs and initiatives as a first step in deciding the way in which to improve citizen engagement in science. Once we analysed emerging trends and exemplary cases of citizen engagement in research processes and science-related policy making, we proceeded to gather collective knowledge, involving experts and amateurs alike. To raise awareness and encourage the uptake of these ICT-enabled, open and social scientific practices, we consistently applied the concept of trusted collaboration at all levels. We encountered a heterogeneous landscape made up of complex multi-actor, multi-level, transdisciplinary communities. The initial findings were published in the Green Paper and subsequently refined, endorsed and supplemented by findings from a broad consultation process and published in the present White Paper. When providing policy recommendations, we attempted to strike a proper balance between the different alternatives by addressing several issues and stakeholders at the same time and by paying special attention to the openness and emergence of this innovative approach to science.



3

A. EUROPEAN CHALLENGES
Researchers, Industry, Policy-Makers and Civil Society

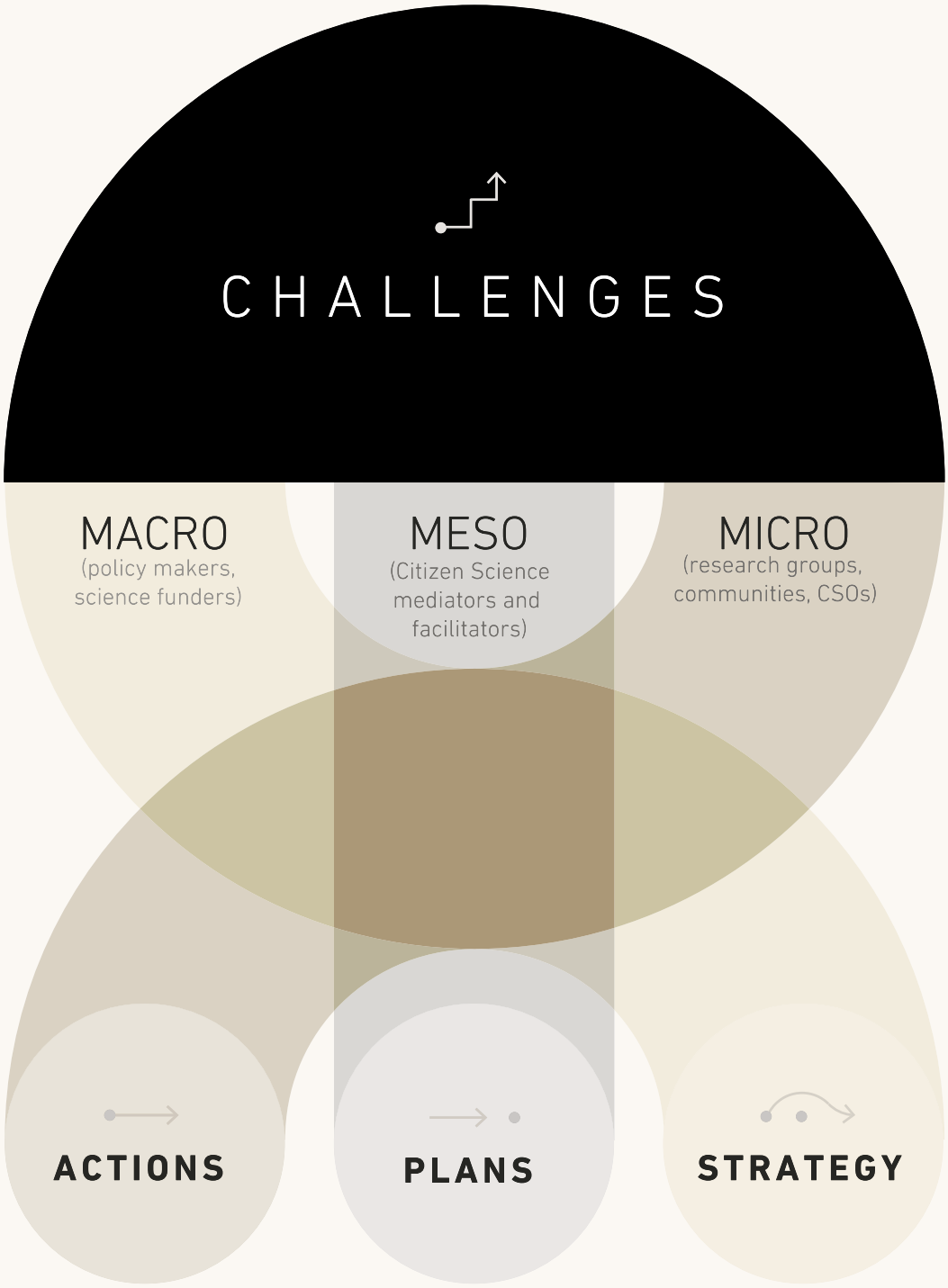
- Our society requires a *paradigm shift*, a new contract between all societal actors in order to address global challenges with a **stronger focus on scientific and social values, and not only economic ones**.

- New politics are needed that prioritize science-society-policy **interactions fostering knowledge-based, intelligent and responsible selection of choices**.

- We need **structural reforms** to increase the openness and the diversity of actors, narratives and
scenarios in order to **encourage creativity opening new opportunities for all and new joint solutions**.

- **ICT fosters open, efficient and agile systems**. Digital solutions help turn ideas into the actions required to mobilize individual and collective engagement for the **co-creation of a sustainable future**.

B. Proposed Solutions



4

Proposed Solutions

4.1
MACRO LEVEL:
POLICY FRAMEWORK

We need common **strategies across Europe to overcome domestic barriers as well as a coordinated plan involving Member States and the EU to design effective programmes and investments aimed at supporting structural reforms** at European, national and local levels considering the different cultural, policy and economic realities. The development of such framework conditions must revolve around three key issues: **public engagement, trust and education**.

▪ Proposed Action 1: ***Targeted Programming***

Designing funding schemes and launching programmes specific to Citizen Science. Targeted calls will achieve a broader uptake and will keep already-established networks and systems going. Programmes should contribute to a deeper analysis of Citizen Science practices and outcomes. Fostering co-production of knowledge will bring science into new scenarios with an even greater diversity of actors in the field of research to achieve higher creativity. The challenge lies in the design of these programmes which should allow for participation of grassroots initiatives driven by either civil society organisations or independent citizen scientists. Broad dissemination and support activities will be needed as well as minimal bureaucracy. The creation of a committee of researchers and citizens involved in the decision-making process regarding such funding programmes is recommended.

▪ Proposed Action 2: ***Mainstreaming Citizen Science***

Embedding Citizen Science into existing funding schemes. Just as science communication, Citizen Science should become an integral part of ongoing scientific activities. Research should be given greater credit for the inclusion of Citizen Science strands covering multiple disciplines, addressing the public's needs and concerns.

For the proposed action, a series of support measures should be provided in order to guarantee a sustainable success.

Support Measure 1: *Education*

Updating educational programmes in order to promote and to recognise new forms of community engagement and digital skills in the curriculum. New tools and educational materials should foster citizens' autonomy and responsibility for change at an early age (encouraging curiosity, criticism, self-learning, self-expression) through lifelong learning. Educational programmes should stress collaboration between schools and scientific institutions, which needs to be reflected in scientific and educational value systems.

Support Measure 2: *Evaluation and Assessment*

Expanding current academic reputation systems and evaluation criteria to account for social impact and engagement. Finding alternative metrics and incentives for scientific curricula that recognise social engagement. Potential social impact and citizen involvement should become selection and evaluation criteria in both existing and future funding schemes. Consequently, citizens and amateurs should take part in the evaluation and selection process.

Support Measure 3: *Access to Technology*

Broadening access to technology and improving the systems required to make the most of the power of networked communities, paying special attention to the digital divide in Europe. Encouraging citizens to be actively involved in the development and deployment of technologies and educational materials.

Support Measure 4: *Data Policy*

Clear ethical guidelines are needed for EU-wide data policy. We support a culture of openness for data and access to data. We ask stakeholders to extensively share public datasets collected and research data infrastructures (quality, reliability, interoperability) as well as data handling tools and methods (algorithms, descriptive, predictive, visualization, decision-making.) This implies handling data in a very sensible way, taking into account intellectual property rights, fundamental personal data protection rights, ethical standards, legal requirements and scientific data quality.

Support Measure 5: *Dissemination and Support*

All strategies and policy actions must be communicated by providing appropriate knowledge-based guidance. Citizen Science communication, dialogue and training programmes (actors: public officials, researchers, journalists....) should aim at achieving broad dissemination and support activities that are consistently applied and communicated throughout EU science and innovation policies; and demonstrating the usefulness of and the need for new knowledge generation and application in Europe.

RECOMENDATION

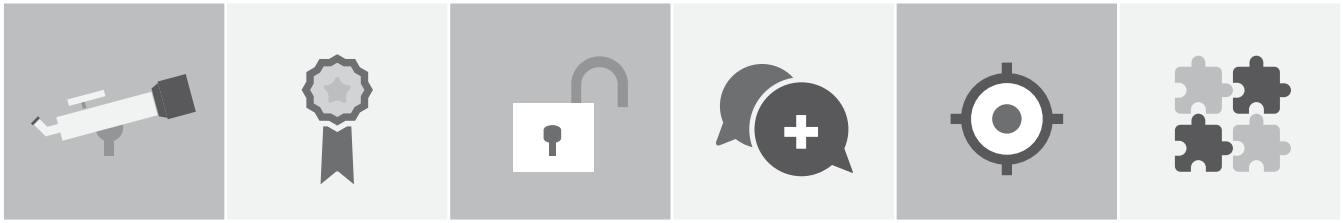
CITIZEN SCIENCE
THINK TANK

Creating a thematic working and reflection group on Citizen Science via inclusive planning with delegates from all EU countries. The initiative could create a framework to facilitate the coordination, monitoring and evaluation of European Citizen Science institutions, programmes and actors while looking for synergies among Member States. It needs to endorse a wide vision with diverse models, formats, outcomes and actors that takes into account the singularities of different Member States (e.g. different languages.) This platform should promote new projects; exchange methods and good practices between Citizen Science groups; define standards, ethical guidelines; promote overarching data archives, annual conferences etc.

To reinforce the uptake of Citizen Science, similar clustering initiatives at national level are also recommended. The following section outlines the nature of such networks.

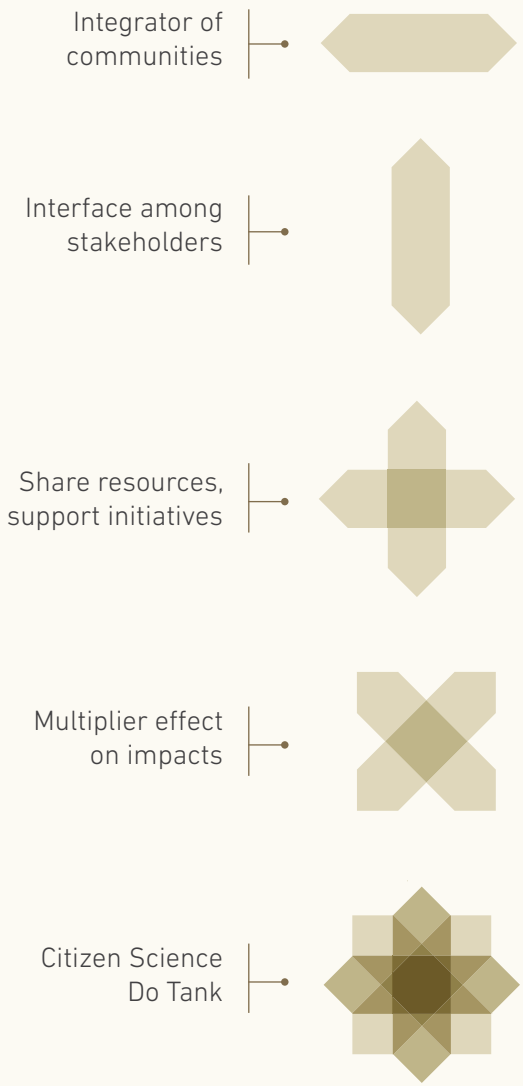
Recommendations are proposed not only at European level, but also and more urgently at the national, regional and local levels. Only close collaboration between different policy stakeholders can guarantee the implementation of successful measures and transformation in the long run.

Remember the **key principles** of **good governance**



Long-term vision | Quality | Openness | Accountability | Effectiveness | Coherence

4.2
MESO LEVEL:
COMMUNITY FRAMEWORK, CITIZEN SCIENCE MEDIATORS



Given the heterogeneity and emerging nature of Citizen Science, the development of mediating infrastructures may have a positive **multiplier effect** in the community. Such facilitation initiatives should engage the different stakeholders into a shared framework with common means of communication. It shall facilitate the interaction between the micro and macro levels as well as within the community. In order to ensure efficiency, it is important that these initiatives share knowledge, resources, infrastructures and tools in a consistent fashion. We would also like to stress that this should not be a top-down, established, single entity. Instead, we suggest disseminating a set of bottom-up designed initiatives that address community needs.

▪ Proposed Action 1: ***Identification, Coordination and Support of Ongoing Initiatives***

Citizen Science is a thrilling environment characterised by a wide range of models and outcomes and a growing number of actors. We currently see a need for coordinated action to obtain a complete and up-to-date picture of the whole set of funding programmes, research groups, open laboratories or participatory experiments available.

For Citizen Science projects to increase their impact, expertise and facilities need to be shared. This model of sharing personnel, methodologies, infrastructures and other resources may be viewed as "**Citizen Science as a Service**" and thus contribute to the sustainability of existing and new projects, boosting in turn awareness and efficiency. Generic guidelines addressing key issues of Citizen Science and describing good practices and success stories are important support measures. Targeted and customised assistance should be provided based on the project characteristics and the actors involved.

▪ Proposed Action 2: ***Building Dynamic and Inclusive Communities by Defining New Interaction Channels between Policy Makers, Scientists and Society***

Community management models must be flexible in Citizen Science in order to respond to the changing nature of the environment. We strongly support the inclusion of a citizens' committee in all Citizen Science initiatives to engage the general public in the decision-making process on a regular basis. We see great potential here for new communication channels at both the macro and micro level. At the micro level, actors will be informed by their own peers about the values, strategies, calls for contributions and funding opportunities defined at the macro level. Similarly, issues raised by the general public need to be communicated at the macro level for evidence-based policy making.

▪ Proposed Action 3: ***Integrating Research Initiated and Conducted Directly by the Public***

We recommend the development of mechanisms at the institutional level designed to recognise and integrate every ongoing outsider research initiative without the support of established organisational structures. Emerging alternative funding mechanisms such as crowdfunding

allow for projects to be funded in more direct and democratic ways by the public. We should see this as a wake up call for policy makers and research funders to understand the impact of such practices and to acknowledge personal contributions (e.g. tax relief.)

New institutional arrangements are needed to promote the validation of bottom-up knowledge claims. We also suggest the need for reassessing the role of institutions in supporting existing and ongoing grassroots efforts as well as the creation and nurturing of communicative spaces that incite people to engage in research in their own terms and through their own means. Such an approach would recognise the role of people as social agents capable of affecting change as well as their hopes and beliefs, interests, skills, and aspirations.

Below, we introduce some key support measures to be carried out by the Citizen Science mediators:

▪ Support Measure 1: ***Education – Training and Learning***

Providing an educational plan on key aspects of Citizen Science that encompasses all phases of the life-long learning process, from early childhood to continuing adult education. Plans should be adapted to the different cultural settings found across Europe. They should also provide educational strategies for Citizen Science actors and address, among others, scientific procedures, technical issues, community management, sociological aspects or learning methodologies, as well as specific training for policy makers on Citizen Science methodologies.

▪ Support Measure 2: ***Technologies, Development and Support***

Developing, managing and sharing an open Citizen Science platform for participation, simulation and data gathering. An important goal should be to reuse and share the existing resources, including those provided by citizens, and to develop and share new tools for the different models of participation. This measure should provide easy-to-find, easy-to-use, easy-to-improve technologies and datasets and encourage the adoption of standard identification mechanisms. Technical assistance and support are essential to facilitate and foster the uptake of the technologies developed.

▪ Support Measure 3: ***Dissemination, Awareness Raising, Outreach***

Dissemination and engagement plans for all stakeholders are needed that include specific strategies and activities designed to maximize the impact across the general public, the scientific community and other actors. This measure goes hand in hand with the development of attractive communication material on Citizen Science topics and innovative communication strategies for greater awareness-raising. Collaborations need to be sought with artistic and culture-related initiatives as well as with existing science communication organisations and initiatives. Strategies and communication means to better link grassroots movements and civil society initiatives to scientific institutions and actors are also required.

▪ Support Measure 4: ***Metrics, Monitoring, Collective and Dynamic Evaluation***

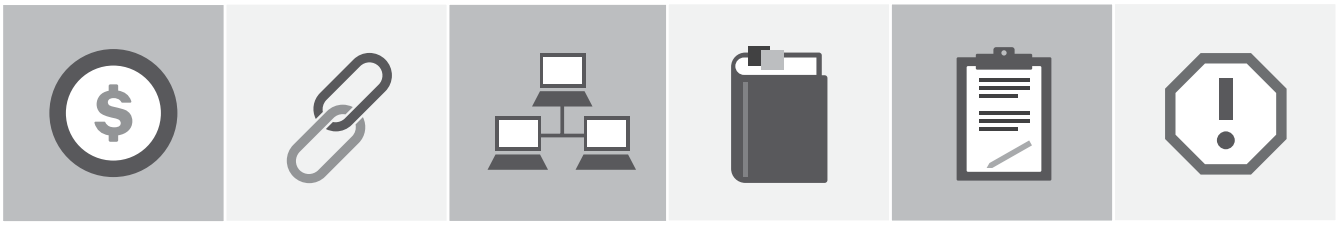
The design and provision of a well-defined set of measurement indicators and metrics to assess the impact achieved at different levels (scientific, societal, economic, environmental, behavioural...) that can be adapted to each project context is an important tool to identify and promote the results and impacts of Citizen Science projects. New indicators and instruments for evaluation and impact assessment should include feedback from all stakeholders and enrich the analysis of Citizen Science outcomes, helping to assess public engagement activities for effectiveness of funding.

▪ Support Measure 5: ***Data Policy***

Exchange of experiences and data is vital and needs to be reinforced. Deploying centralised repositories for data storage that integrate and link the existing datasets could be useful. We also propose a specific Citizen Science data plan along with quality guidelines that address the handling of sensitive personal information, policy restrictions, ethical aspects and intellectual property rights in Europe. It is important to facilitate the exchange and interoperability of different Citizen Science data archives and public datasets following the standard formats, e.g. Linked Open Data standards.

Citizen Science Do Tank

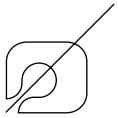
with **specific/adaptable/dynamic** guidelines



Funding opportunities | Engagement plan | Shared technologies | Learning materials | Evaluation metrics | Data issues

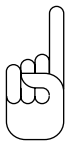
4.3
MICRO LEVEL:
CITIZEN SCIENCE HANDS-ON, MAKING THINGS HAPPEN

Who is driving Citizen Science? It's the enthusiasm, engagement and dedication of many individuals. Their passion for science is key in bringing forward new ways of doing research and unlocking the potential of the crowd. Still, in order to make things happen, actors need support to face challenges, stay motivated and engage others.



Researchers ask themselves:

What do I gain by working with volunteers?



Volunteers ask themselves:

What do I gain by working with scientists?

▪ Support Measure 1: ***Education – Training and Learning***

Citizen Science has an educational value, implicit or explicit. Schools are considered primary targets for the introduction and promotion of Citizen Science. **Collaboration with teachers** can give Citizen Science a boost and increase educational and media repercussion. Early collaboration between teachers and researchers during the development of collaboration activities is essential for success in adapting participative research activities of students to the national curricula and the specific school contexts.

Customized Training Material for Specific Target Groups: exploiting the full range of media, e.g. online and offline guidelines and handbooks, interactive multimedia, games, scientific protocols, etc. to produce high-quality learning material and teaching unit plans for each target group. Ideally, this material would be designed, developed and tested in a participatory way, involving representatives of the specific target groups.

▪ Support Measure 2: ***Appropriate Technologies for Engagement***

Today, Citizen Science occurs to a large extent online. Project developers are expected to deliver **platforms** capable of providing and managing an appropriate virtual research environment. Designers are required to strike a balance between rigorous procedures, informal practices and **user experiences,** allowing volunteers to contribute individually and to design the project themselves.

Gamification, competitions and discovery challenges can be beneficial for continuous participation. Initially, easy tasks may lead to more complex activities for skilled and trained participants. Engagement is also closely linked to empowerment. Thus, we suggest that projects provide tools that allow for new ideas to be generated, guarantee equal opportunities for all and encourage participants to build on the contributions of others. Similarly, tools designed to offer a two-way communication between researchers and participants are strongly encouraged.

Early involvement of the different stakeholders in the project design process is important in order to understand the different experiences and challenges of participating groups and to adapt the project design accordingly.

▪ Support Measure 3: ***Dissemination, Awareness Raising and Outreach***

Community engagement needs to be considered at the onset of any Citizen Science project. Scientific and social objectives, methodologies and outcomes must be communicated to the public in a way that is transparent, easily understood and appealing. **Feedback, incentives** and **acknowledgement** are critical to build trusted interactions and to sustain motivation.

Scientific research questions and objectives defined in technical terms need to be translated into a common language, easy to understand for the public at large. Again, early involvement of stakeholders can help in this process and we recommend working with the existing organizations

and networks to make use of the available resources and shared tools. Nevertheless, successful practices need to be assessed individually and adapted to suit the features of each specific project.

Researchers continue to face the challenge of bringing science closer to the public, e.g. by organising exhibitions and participatory experiments in open scenarios. Quality content, artistic approaches and complementary narratives support outreach activities targeting a broader audience.

▪ Support Measure 4: ***Metrics, Monitoring, Collective and Dynamic Evaluation***

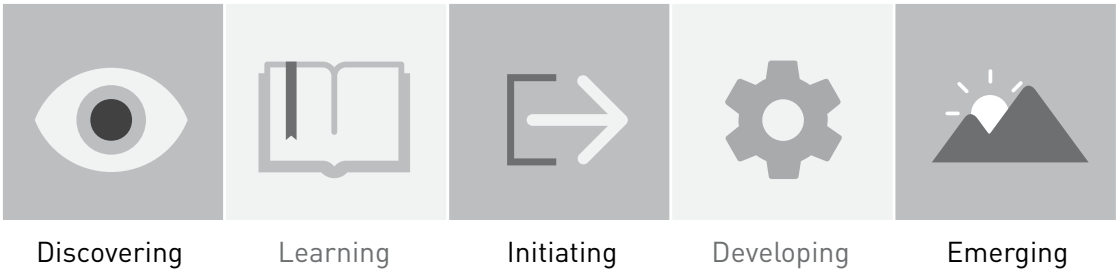
All projects should apply well-defined evaluation concepts which take into consideration both the validation of scientific outputs and the outcomes for individuals and socio-ecological systems. Due to the diversity of projects and the broad portfolio of outcomes as well as to the constant evolution of this scientific approach, no standardised measurement indicators can be applied. However, well-defined, measurement indicators and metrics of good practices from the meso-level could be adapted and enriched to suit the individual context of projects. We also recommend including a **public assessment** in scientific reviews and evaluations. Besides scientific and performance indicators, we need better metrics to understand the social outcomes and potential social impact of projects.

In addition, many projects need to be sustainable in time to gather long-term contributions. Successful projects may scale up to enrich its outcomes. Indicators should reflect this long-term perspective. Again, bringing expertise in different disciplines and local understanding to new, unexpected scenarios could bring about new cascades of creativity that may only become apparent in the long run.

▪ Support Measure 5: ***Data Policy***

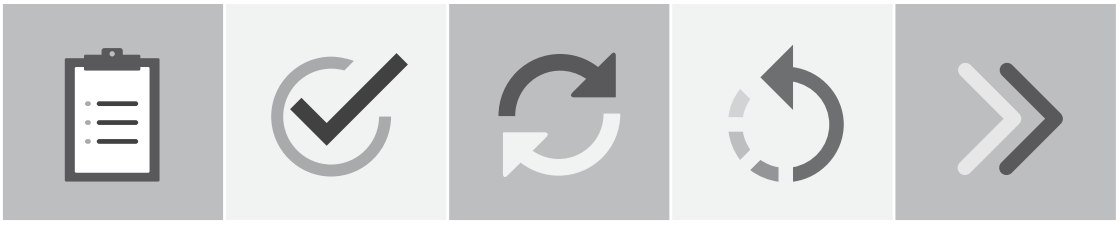
Citizen Science projects must provide for **data quality assurance** and comply at the same time with the basic principle of openness. The results of any publicly-funded research should be accessible to everyone. Methods and infrastructures for data collection should be clearly defined, subject to public verification and compliant with the ethical and quality guidelines developed by the community.
We recommend the standard description of data using meta-data about actors involved, protocols, conducted training and quality assurance measures, etc.

CITIZENS ARE...



Discovering | Learning | Initiating | Developing | Emerging

Supporting | Catalyzing | Participating | Using | Collaborating



Evaluating | Appraising | Changing | Shifting | Evolving

RESEARCH

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