Guidelines for localising Sustainable Development Goal targets to neighbourhood, city and regional levels

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This deliverable was submitted as part of the IMPETUS project in June 2023. These guidelines will be revised and edited throughout the course of the IMPETUS project (2022-2026) as they are tested and refined through planned activities with decision makers. This document is therefore not the final version of the guidelines, but a draft version.

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Summary

There is a gap between national Sustainable Development Goal (SDG) reporting requirements and local action such as data and evidence resulting from citizen science. Many sustainability targets are not adapted to the regional or city level where most citizen science happens. Many of the SDGs in and of themselves are too abstract for monitoring, or the indicators associated with them are less relevant to different local contexts to be able to achieve progress towards them. For this reason, some regions are making efforts to localise the SDG framework and analyse the SDG ecosystem from a territorial perspective.

Citizen science data is highly valuable for monitoring and also potentially achieving the SDGs, and can support decision making at all levels of local, municipal and regional policy. However, it is still underused and progress needs to be made towards mainstreaming citizen science as an accepted methodology and source of data for SDG monitoring and reporting. Much also needs to be done to create a trusted environment in which citizen science data are accepted as a credible source of inputs for statistical reporting at the national level. Linking efforts between national and regional citizen science projects and the relevant statistical agencies and offices will also help to increase the contribution of citizen science to SDG monitoring.

These guidelines aim to simplify the process of localising SDGs for local-level administrations across Europe. They also demonstrate the central role of citizen science in achieving the ambitious vision outlined in the SDGs and the European Green Deal. Throughout the guidelines we provide examples of best practice to support the integration of citizen science outputs into policy development, and to raise awareness about the potential of citizen science data to monitor progress towards local, national and global sustainability targets.

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1. Introduction

This deliverable (D4.1) outlines draft guidelines for how to localise the Sustainable Development Goal (SDG) targets to neighbourhood, city and regional levels and the specific role citizen science can play in this. A comprehensive monitoring framework with well specified national-level indicators, such as the SDGs, is key to designing more coherent policies that are able to foster an aligned international approach to sustainable development.[1] Localising the SDGs to ensure comparable monitoring strategies and robust local outcome indicators is also essential to achieving the 2030 Agenda for Sustainable Development.[2] However, a balance needs to be struck between customising and standardising the local dimension of the SDGs, since the context of each neighbourhood, city or region is different, and will require a locally-appropriate pathway to achieving a particular goal.

Currently, most sustainability targets are not adapted to regional or city level. For example, in the case of air quality monitoring, there are two SDG indicators linked to air quality: (1) Indicator 3.9.1: 'Mortality rate attributed to household and ambient air pollution'; and (2) Indicator 11.6.2: 'Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)'. However, these indicators do not provide the actionable information that cities and communities need to manage their local conditions, nor do they contribute to an increased understanding of the health impacts of air pollution.[3]

Local governments stand at the frontline of social, economic and environmental challenges, and even more so in times of emergencies and disruptive changes. At a time when the United Nations General Assembly President, Csaba Kőrösi has articulated his vision to 'turbocharge' the UN SDGs' implementation at all levels[4], there is a lack of guidance about how to do this

[1] Siragusa, A., Stamos, I., Bertozzi, C. and Proietti, P., European Handbook for SDG Voluntary Local Reviews - 2022 Edition, EUR 31111 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53390-0, doi:10.2760/218321

[2] https://unstats.un.org/sdgs/files/SDG-DSD-Guidelines.pdf

[3] Fritz, S., See, L., Carlson, T. et al. Citizen science and the United Nations Sustainable Development Goals. Nat Sustain 2, 922–930 (2019). https://doi.org/10.1038/s41893-019-0390-3

[4] https://sdg.iisd.org/news/move-our-common-agenda-from-ideas-to-action-un-secretary-general/https://www.un.org/pga/77/2023/02/13/pga-remarks-to-briefing-by-the-sg-on-our-common-agenda/

well. The guidelines in this report aim to simplify the process of localising SDGs for local-level administrations across Europe. They also demonstrate the central role of citizen science in achieving the ambitious vision outlined in the SDGs and the European Green Deal. Throughout the guidelines we provide examples of best practice to support the integration of citizen science outputs into policy development, and to raise awareness about the potential of citizen science data to monitor progress towards local, national and global sustainability targets.

What's in this deliverable?

This deliverable provides an initial version of the guidelines for localising SDG targets to neighbourhood, city and regional levels, building on an analysis of evidence and best practice. The guidelines are practical recommendations for activities that policy makers can take to have greater impact towards sustainability targets by harnessing citizen science. They build on previous efforts to map the relevance of citizen science for the SDGs, such as Fritz et al.'s 2019[5] roadmap outlining how citizen science can be integrated into the formal SDG reporting mechanisms, and the work of Fraisl et al. in 2020[6] which presents the first systematic overview of where citizen science is already contributing and could contribute data to the monitoring of the SDG indicator framework. They also draw on other SDG localisation efforts, such as the Joint Research Centre (JRC) Handbook for SDG Voluntary Local Reviews (2022 edition)[7] and the work of 6 European cities in monitoring the 2030 Agenda and building datasets for the SDGS.[8]

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[5] Fritz, S., See, L., Carlson, T. et al. Citizen science and the United Nations Sustainable Development Goals. Nat Sustain 2, 922–930 (2019). https://doi.org/10.1038/s41893-019-0390-3

[6] Fraisl, D., Campbell, J., See, L. et al. Mapping citizen science contributions to the UN sustainable development goals. Sustain Sci 15, 1735–1751 (2020). https://doi.org/10.1007/s11625-020-00833-7

[7] Siragusa, A., Stamos, I., Bertozzi, C. and Proietti, P., European Handbook for SDG Voluntary Local Reviews - 2022 Edition, EUR 31111 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53389-4, doi:10.2760/355330, JRC129381.

[8] Siragusa, A., Proietti, P., Bertozzi, C., et al. Building urban datasets for the SDGs. Six European cities monitoring the 2030 Agenda, Siragusa, A., Proietti, P., and Bertozzi, C. editor(s), EUR 30855 EN, Publications Office of the European Union, Luxembourg, 2021, doi:10.2760/510439, JRC126179.

Who are these guidelines for?

These guidelines are for decision makers and sustainability teams working at the local, city or district level. They provide step-by-step practical guidance for these individuals to maximise the benefits of using data and insights from citizen science to help achieve sustainability targets, while minimising risks.

How were these guidelines developed?

These guidelines were developed by NESTA in collaboration with T6 Ecosystems based on a review of literature (including academic literature, policy reports and project reports, guidelines and toolkits), and expert interviews to validate the findings (including citizen science project leaders, policy consultants, EU policy institutions and monitoring organisations).

The objectives of the research were to:

- To provide practical support on how to rescale SDGs and monitor local policies accordingly,
- To synthesise, digest and make as accessible as possible the whole debate around monitoring of the SDGs,
- To raise awareness and facilitate institutional changes to increase the support for using citizen science data for SDG monitoring.
- To surface examples of current and future opportunities for citizen science to increase its contribution to the monitoring, improvement and achievement of the SDGs.

The resulting guidelines will be tested and refined throughout the course of the IMPETUS project (2022-2026) through planned activities with decision makers. In addition to the guidelines, this research is being used to develop training for the citizen science projects being supported by the IMPETUS accelerator programme.

This deliverable is part of the Horizon Europe-funded IMPETUS Coordination and Support Action[9] which aims to enhance the impact of citizen science. More

[9] https://impetus4cs.eu/

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specifically, IMPETUS is a capacity building accelerator programme to strengthen European citizen science. The 'Policy with and for citizen science' strand of work (work package 4 (WP4)) within the IMPETUS project explores how to consolidate existing impact pathways – for example, improving the flow of citizen science data into local, national and international environmental monitoring efforts, as well as identifying policy mechanisms that can allow citizen science to flourish in domains where it's currently underused.

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2. What is the issue these guidelines seek to address?

These guidelines for policy makers contribute towards addressing two main issues. First and foremost they seek to help set up ways to measure progress towards the SDGs at a local level. By improving our ability to measure local progress (or lack thereof) towards the SDGs, we hope to also contribute towards accelerating progress towards achieving the SDGs.

There is a gap between national SDG reporting requirements and local action such as data and evidence resulting from CSIs. Many sustainability targets are not adapted to the regional or city level where most citizen science happens. Many of the SDGs in and of themselves are too abstract for monitoring, or the indicators associated with them are less relevant to different local contexts to be able to achieve progress towards them. Some indicators do not have a suitable monitoring protocol defined, which represents an opportunity for citizen science. For this reason, some regions are making efforts to localise the SDG framework and analyse the SDG ecosystem from a territorial perspective.

Some SDG indicators are proxies and there is a clear need to collaboratively work on the localisation of indicators and targets, to understand data gaps, specially where indicators are not well defined. Whilst sustainability indicators can be useful proxies, they are often based on existing metrics out of convenience, and are not necessarily a holistic assessment of progress towards achieving a particular goal. Furthermore, the SDGs do not clearly align to or understand administrative boundaries or borders.[10] The ability to monitor progress against such targets and goals is unevenly distributed across national and regional areas, and there is a distinct opacity around national monitoring systems that further challenges successful progress.

Similarly, the European Commission's ambitions under the Green Deal will increase the need for non-traditional forms of data and additional sources of information to complement the knowledge base for environment policy

[10] Expert Interview

development and monitoring.[11] However, there is a lack of awareness about how practically local level efforts might be made towards this. In addition, there is no straightforward connection between the SDG and Green Deal indicators, which may generate a dilemma in terms of priorities and monitoring efforts for the regions and countries.

At the mid-way point towards 2030, the Special Edition report of the UN Secretary General on the progress made since 2015 against the global SDG indicator framework, finds that many of the SDGs are moderately to severely off track. Drastic efforts are needed to accelerate SDG implementation between now and 2030 and 'to move from ideas to action - from the abstract to the concrete -(...) to make the SDGs 'real in the lives of people everywhere'.[12]

What does localisation of the SDGs mean?

The 2030 Agenda emphasises the need for an inclusive and localised approach to the SDGs. It addresses the need to integrate all levels of governance and stakeholders in the elaboration of strategies, the use of transformative means of implementation and robust methods for monitoring and reporting. The SDGs framework was developed at a global scale and it was envisaged that local and national policies and strategies would feed into the achievement of the goals. However, as previously stated, the SDGs indicators and targets themselves are not always directly relevant at a local level.[13] The process of interpreting and translating sustainability frameworks such as the SDGs or the EU Green Deal into locally appropriate actions and impacts is a complex and ongoing process.[14,15]

The European Handbook for SDG Voluntary Local Reviews (VLRs) provides policy makers, urban practitioners and experts with a consolidated method and examples of indicators that European local and regional governments can

[11] EC Staff working document: Best Practices in Citizen Science for Environmental Monitoring 2020: https://data.consilium.europa.eu/doc/document/ST-9973-2020-INIT/en/pdf
[12] https://sdg.iisd.org/news/move-our-common-agenda-from-ideas-to-action-un-secretary-general/
[13] Expert Interview
[14] Expert Interview
[15] Expert Interview

use to monitor the achievement of the SDGs. The Handbook is updated regularly to reflect the evolution of VLRs over time.[16] It is worth noting that cities are not the only contributors or contexts for VLRs - they also take place in rural contexts too - making it even more important to allow flexibility for those undertaking VLRs to be able to tailor the monitoring process. Many local and regional governments rely on policy analysis and quantitative data to assess initiatives and regulations in several SDG-related policy fields. These assessments, known as VLRs, have become a common tool for local and regional governments to assess their contribution to the SDGs.

Box 1. City of Madrid VLR process[17]

What they did: Madrid undertook their own localisation scheme of the SDGs which was set out in their Localisation Strategy, and approved in 2021 by Madrid City Council. The strategy provided a rich agenda based on indicators and statistics that address the environmental, economic, and social challenges of Madrid. It is therefore directly connected to the Operational Government Program of the city, in which every planned action of a city department is immediately linked to the SDGs they contribute to fulfilling.

Challenges and opportunities:

a) Informing the Roadmap on Climate Neutrality: While working on its own VLR, the City of Madrid published in March 2021 its Roadmap to Climate Neutrality by 2050.[18] Carrying out the VLR enabled the City of Madrid to develop the Roadmap, which was a valuable policy document because it articulated a locally-tailored long-term strategy for decarbonisation and climate change. Madrid has a longstanding tradition of regulation on greenhouse gas emissions, climate change mitigation, and other decarbonisation measures.

b) Enabling comparison with existing VLRs: The Roadmap became a planning document on a specific sustainability issue - enabling comparisons to existing

[16] Siragusa, A., Stamos, I., Bertozzi, C. and Proietti, P., European Handbook for SDG Voluntary Local Reviews - 2022 Edition, EUR 31111 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53390-0, doi:10.2760/218321, JRC129381

[17] https://internacional.madrid.es/FWProjects/inter/contenidos/Agenda2030/SeguimientoEstrategia/VLR%20Madrid_2023_small.pdf

[18] Ciambra, A., Monitoring localised decarbonisation goals: lessons learnt from Madrid's Roadmap to 2050, Stamos, I., Bertozzi, C. and Siragusa, A. editor(s), Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-54653-5, doi:10.2760/404507, JRC130230.

VLRs from Europe and elsewhere in terms of selected indicators, collected data, and policy lines of action.

c) Defining a understanding of localised climate neutrality: Undertaking the VLR process helped to define a 'localised' concept of climate neutrality and assess whether a genuinely local approach to decarbonisation existed in Madrid, and how this might fit with the SDG targets at the global level.[19]

Lessons learnt: Madrid's SDGs agenda and VLR process is a thorough exercise of adapting global challenges to the reality and capacities of the municipality. In 2023, two annual monitoring reports of the Localisation Strategy have already been produced as new statistics become available each year. While these scheduled annual reports inform Madrid citizens about progress on the political commitment of city officials, the VLR report also demonstrates their pledge to pursue progress on the SDGs.

Support and guidance to local and regional governments on how to produce VLRs has proven to be relevant for fostering the localisation of SDGs[20]. In recent years several institutions have started to propose new guidelines on how to prepare VLRs, better tailored to the needs of local governments. Different clusters of local and regional governments across Europe preparing VLRs have also emerged in line with national strategies. This includes horizontal networks of local governments (such as in Spain) and SDG-oriented knowledge brokers leading VLR processes (such as in Germany and Italy). VLRs were considered reporting tools in their first years of publication, especially from the perspective of the frontrunner cities that published the first reviews in 2017-18. However, over time, local and regional governments have started to consider VLRs as more of a process. The 2022 edition of the European Handbook for SDG Voluntary Local Reviews analyses the different perspectives of these developments. This edition expands the definition of the VLR, starting from considering the VLR as an output and evolving to a process that is expected to produce outcomes.

According to the data collected by the JRC and updated in April 2022, the country with the most local and regional governments to have officially

[19] Ibid.

[20] Siragusa, A., Stamos, I., Bertozzi, C. and Proietti, P., European Handbook for SDG Voluntary Local Reviews - 2022 Edition, EUR 31111 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53389-4, doi:10.2760/355330, JRC129381.

published a VLR is Spain (ten), followed by Mexico (nine), Brazil, China, France, and Japan with six, Sweden and the United States with five, and Finland, Germany, Norway, the United Kingdom of Great Britain and Northern Ireland with four. Moreover, Porto, Valencia, Madrid and Seville intended to publish their VLRs at the end of 2022, increasing the number of VLRs in Spain to 13 and in Portugal to three.[21]

Figure 1. Overview of the published SDG Voluntary Local Reviews aligned to the SDGs and local SDG databases

The map was last updated in March 2021 and also shows the URBAN 2030 pilot cities.



Source: https://urban.jrc.ec.europa.eu/sdgs/?lng=en

[21] Siragusa, A., Stamos, I., Bertozzi, C. and Proietti, P., European Handbook for SDG Voluntary Local Reviews - 2022 Edition, EUR 31111 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-53389-4, doi:10.2760/355330, JRC129381.

Examples of downscaling SDGs to local areas

Box 2. Transformation measures and the SDGs in Porto, Portugal

SDG focus: SDG 12: Responsible Production and Consumption
Indicators: JRC experts identified 158 potential SDG local indicators relevant for Porto's analysis, 148 of which are official indicators, while 10 are experimental indicators.
What they did: Porto developed a specific template for the analysis of each SDG Goal, including the indication of trends for each indicator (when available), a specific focus on the aligned measures and projects undertaken by the city to identify local experimental indicators, and on the link between SDG indicators and specific local policies.
Challenges and opportunities:
a) Continuity in monitoring: they prioritised the municipal data sources over those proposed by the European Handbook, to ensure continuity in monitoring and consistency in the data collection methodology. The main data gaps were found in the quality of the indicators measuring poverty (SDG 1), Schooling of the population in non-superior education (SDG 4), and Gender equality (SDG 5). The existing data for poverty indicators were disaggregated at regional or at national level only, while alternative indicators were indicative of poverty in an indirect way. The data on Education of the population up to secondary level are available only for census years. Finally, on the Gender equality goal, alternatives were chosen to show the differences between men and women, namely in salaries; however, the data quality and the level of disaggregation remain unsatisfactory.
b) Finding relevant SDG indicators to express city performance: for SDG 2 (No hunger), it was difficult to find indicators to express the city's performance in 'ensuring safe and sustainable food systems' (referring to targets 2.3 and 2.4). In addition, the city of Porto has been working to create a regenerative and circular food system to stimulate local production and consumption in a sustainable way, supporting small producers (local markets) and encouraging self-production and consumption (increasing urban gardens). This is not yet reflected in the indicators for SDG 2, but might be integrated in the near future.

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c) Mapping the spatial distribution of the data collected: the geographical scale of reference for the data collected is the municipal level. However, in most cases data used for monitoring are not disaggregated to allow for an understanding of the spatial distribution within the municipality. Defining and interpreting trends also poses a challenge, because this requires the interpretation of the objectives of various municipal services, which often go beyond the global targets set out for each SDG.

d) Lack of centralised city data observatory: data from each city department are scattered, and are not stored in a unique database. The city is currently working on building data observatories, particularly in the area of social cohesion (Municipal Department of Social Cohesion) and social housing (Domus Social), which will make data collection and use easier. The creation of a centralised city data observatory would enable information and working methodologies to be shared more easily, and support a more integrated and concerted city vision, strategy and measures. The various city departments could contribute to this data observatory by providing experimental data, in addition to those from official sources, to align them with the SDGs. Experimental and official data could then be easily monitored, updated and collected. This would also help to establish a common method for collecting experimental data, as different departments currently calculate the same indicator in different ways.

Lessons learnt: Porto launched their first VLR in 2021. City departments were given the opportunity to suggest local indicators, and a special focus was given to city projects and local transformative actions. The analysis of SDG indicators and localisation assessments made by the city of Porto might be useful for other Portuguese cities for carrying out their own monitoring efforts.

Box 3. SDGs in the urban planning process in Reggio Emilia, Italy

SDG focus: SDG 11: Sustainable Cities and Communities; SDG 12: Responsible Production and Consumption; SDG 13: Climate Action; SDG 6: Clean Water and Sanitation; SDG 15: Life on Land; and SDG 7: Affordable and Clean Energy.

Indicators: 5 out of the 67 indicators proposed for measuring the SDGs in Reggio Emilia match the examples proposed in the European Handbook, while 19

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indicators have data which are fairly similar to these proposed indicators. The remaining 43 indicators proposed for Reggio Emilia are city-specific. 54 of the 67 indicators are official indicators, while 13 are experimental.

What they did: Local policy makers decided to adopt the SDG framework for the new urban spatial planning process (drafting the city's General Urban Plan). Data collection for calculating indicators was part of a spatial planning process based on a sustainable city vision, which used the 2030 Agenda and the SDGs as a reference. The city created a dedicated planning unit to identify policy interdependencies and collect data.

Challenges and opportunities:

a) Reaching a common understanding of new localised indicators: the planning process is centred on participation to reach a common understanding of local challenges and priorities among the public and local stakeholders. The identification of indicators to assess the performance of the General Urban Plan enabled the identification of new locally-defined measurements which could also be used to assess achievement of the SDGs.

b) Specific focus on spatial planning: since the localisation process focused on a spatial planning perspective, some of the SDGs were given particular attention in the development of the strategy for the General Urban Plan.

c) Sufficient data for monitoring localised SDG targets: The analysis of the data collected by the special planning unit identified certain difficulties in finding proper data or in reaching a local common understanding of the various SDG targets. The use of data for providing information about strategies and policies is still not part of the everyday activities of the administration. However, this exercise represents a step towards an evidence-based decision approach.

Lessons learnt: The adoption of the SDG framework allowed policy makers to understand and evaluate the interdependence between different policies and goals. However, the process in Reggio Emilia is still ongoing, and further findings may arise as the General Urban Plan evolves. The VLR process in Reggio Emilia is intended to not only raise awareness about the 2030 Agenda; but also to reach a common understanding of local challenges and priorities. Following the identification of the local goals, the administration itself undertook a priority mapping process to evaluate which aspects of the 17 SDGs are considered most pressing to address by the community.

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3. Why is citizen science the answer?

Citizen science involves the public in designing, doing and learning from research. Through its potential to bridge science, society and policy, citizen science is in a unique position to help governments and administrations to make sensible policies to address societal challenges that require public involvement, such as how we mitigate and adapt to the impact of climate change.[22] The main scientific benefits of citizen science include the ability to collect, analyse and produce new data, as well as to understand environmental and social challenges better, in a way that is aligned with society. There are many potential benefits for those taking part, from educational benefits, to developing new networks, or fostering critical thinking. Wider societal benefits include the potential voice citizen science can bring to communities in relation to those in government, fostering the participation of citizens in local decision making, while informing public policies and producing social innovations.[23] [24] [25] [26]

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[22] Notermans, V.I., Montanari,M. C., Janssen, A., Hölscher, K., Wittmayer, J.M., & Passani, A. (2022). Recommendations to mainstream citizen science in policy. ACTION project. DOI: 10.5281/zenodo.5772236

[23] Fritz, S., See, L., Carlson, T. *et al.* Citizen science and the United Nations Sustainable Development Goals. *Nat Sustain* 2, 922–930 (2019). https://doi.org/10.1038/s41893-019-0390-3

[24] Göbel, C., Nold, C., Berditchevskaia, A. and Haklay, M., 2019. How Does Citizen Science "Do" Governance? Reflections from the DITOs Project. *Citizen Science: Theory and Practice*, 4(1), p.31. DOI: http://doi.org/10.5334/cstp.204

[25] Turbé, A., Barba, J., Pelacho, M., Mugdal, S., Robinson, L.D., Serrano-Sanz, F., Sanz, F., Tsinaraki, C., Rubio, J.-M. and Schade, S., 2019. Understanding the Citizen Science Landscape for European Environmental Policy: An Assessment and Recommendations. *Citizen Science: Theory and Practice*, 4(1), p.34. DOI: http://doi.org/10.5334/cstp.239

[26] Vohland, K. et al. 2021 *The Science of Citizen Science* (eds. Vohland, K. et al.) 461–474 (Springer International Publishing, 2021). https://link.springer.com/book/10.1007/978-3-030-58278-4

Box 4. CurieuzeNeuzen (Curious Noses) air quality monitoring, Belgium[27]

What they did: CurieuzeNeuzen projects harness the scientific power of "massive" citizen science. Four projects have taken place, each involving between 2.000 and 20.000 participants (families, schools, companies). The first project in 2016 engaged 2.000 enthusiastic inhabitants of Antwerp (Belgium) to measure air quality across a city that struggles with high levels of air pollution. In 2018, a scaled-up version recruited over 20,000 citizens to install air quality sensors at their house across the whole region of Flanders (Belgium). In 2021, the air quality was mapped across the capital of Brussels with 3.000 citizen volunteers (including king and prime minister). In 2022, CurieuzeNeuzen went "climate meets Internet-of-Things" to document heat and drought across 5000 private gardens in Flanders. A spin-off company was created in 2022 to provide strategic advice to other citizen science projects.

Challenges and opportunities: To attract such large numbers of participants, *CurieuzeNeuzen* deployed nation-wide communication campaigns (magazines, newspapers, social media, radio, TV), in co-creation with professional media partners. To generate high-quality data, *CurieuzeNeuzen* combines simple, robust and easy to use sensor technology with state-of-the-art Internet of Things technology. This approach enabled citizens to accurately document the air quality in their street, or the heat stress in their garden.

Impact: The resulting "big data" enables researchers to generate highly detailed maps and test the latest computer models; something that would not be possible otherwise. This offers new scientific insights on how to improve air quality, and how to better prepare for urban heat islands and other impacts of climate change. In parallel, CurieuzeNeuzen empowers citizens with data-driven knowledge, raising awareness about healthy living environments and the need to urgently address climate challenges. The project resulted in both positive behavioural change in the participants while simultaneously driving political debate on air pollution and mobility measures.[28] Due to its success in delivering results that combine high levels of data quality with deep

[27] https://2016.curieuzeneuzen.be/be/

[28] Van Brussel, S. & Huyse, H. Citizen science on speed? Realising the triple objective of scientific rigour, policy influence and deep citizen engagement in a large-scale citizen science project on ambient air quality in Antwerp. J. Environ. Plann. Manag. 62, 534–551 (2019).

citizen engagement and policy influence, CurieuzeNeuzen has been up-scaled to the broader Flanders region of Belgium.[29] Through active participation, the enhanced ownership of research results and data may improve policy decision-making processes and possibly democratise research as well as public policy processes.[30] Overall, CurieuzeNeuzen demonstrates how citizen science can directly contribute to societal challenges and inform policy decisions about air quality, mobility, spatial planning and climate change.

Whilst citizen science has enormous potential to contribute to international policy agendas such as the SDGs and regional and national climate targets, such as the European Green Deal, it is a method that is currently underused. Further recognition of the practice is still needed for it to be mainstreamed and used as a continuous monitoring technique that is sustainable in the mid to long term, and for increasing trust in citizen science data to be officially adopted by public authorities. The standardisation of citizen science methodologies by national agencies can also contribute to mainstreaming citizen science and increasing trust in citizen science data. In Spain, a technical standard for citizen science was published by UNE (the Spanish standardisation body) to monitor odour pollution using citizen science.

Box 5. The technical standardisation of citizen science methodologies for monitoring odour pollution

Aims: As the first of its kind, the approach aimed to standardise at a national level the citizen science methodology validated within the D-NOSES Project to monitor odour impact in real time, from the perspective of the person actually doing the monitoring. The longer term aim was to establish new emission limits in future odour regulations to protect citizens, taking into account their own perception in the impact assessment.[31]

How they contributed to environmental policies: The Horizon 2020-funded

[29] Tipper, S. Curious noses measure air quality across Flanders. Flanders Today (30 April 2018).

[30] Hecker, S., Wicke, N., Haklay, M. and Bonn, A., 2019. How Does Policy Conceptualise Citizen Science? A Qualitative Content Analysis of International Policy Documents. *Citizen Science: Theory and Practice*, 4(1), p.32. DOI: http://doi.org/10.5334/cstp.230

[31] https://www.scienceforchange.eu/blog/primera-norma-tecnica-incluye-a-la-ciudadania-para-medir-contaminacion-por-olor

D-NOSES Project[32] (2018-2021) developed a new methodology (Arias et al., 2018)[33] to obtain real-time data about the perception of ambient odours in affected communities using citizen science. This methodology complements traditional techniques for odour monitoring by enabling real-time odour observations through the OdourCollect app[34], as well as geolocated descriptions of the type of odour perceived, its intensity and hedonic tone (if it is pleasant or unpleasant). The generated data can be then used to calculate the degree of inconvenience for citizens and to propose Odour Management Plans based on perceived impact. From 2019, a group of more than 15 odour experts, from different sectors, including the public and private sectors, odour emitting activities and citizen representatives, worked on the development of a technical standard after initiating contacts with the UNE (Asociación Española de Normalización, by its acronym in Spanish - Spanish Association for Standardization) in 2021 to build an official Spanish Standard, as a preamble to its expected future adoption at the European level. After 4 years of collaborative work, the group published the Spanish standard in May 16, 2023, entitled "PNE 77270 "Construction of collaborative odour maps through citizen science". The standard was under a public consultation period (until last 25 June), until its official publication, expected in the next month. In this way, citizen science will be officially adopted to monitor the odour impact by authorities or emitting activities.

Impact: Odours represent the second cause of environmental complaints for citizens after noise. However, this type of pollution has been repeatedly ignored in policy agendas or has been insufficiently addressed by European environmental legislation. In many European countries there is no specific regulation on odour pollution, and when it exists, the methodologies and limits are quite heterogeneous. The D-NOSES project supported the development of the first technical standard to include citizen science as the main methodology to measure odour pollution from the perspective of the affected communities. The new standard will foster the official adoption of the citizen science methodology by environmental authorities for odour emitting activities and will set the basis for new regulations to protect European citizens from an underregulated socio-environmental issue. It will also contribute to increasing

[32] https://dnoses.eu/

[33] Arias R., Capelli L., Diaz Jimenez C., 2018, A New Methodology Based on Citizen Science to Improve Environmental Odour Management, Chemical Engineering Transactions, 68, 7-12.

[34] http://www.odourcollect.eu

the recognition of citizen-generated data as valid for environmental monitoring. The standard has been developed at a Spanish national level and the next step will be to propose its adoption at European level.

The D-NOSES project validated the citizen science methodology to monitor odour pollution through 10 case studies, in Europe, Chile and Uganda, in addition to advocating to introduce this type of pollution into policy agendas. This methodology has been the cornerstone for developing this UNE standard. The final results of the project include policy documents such as the Green Paper on odour pollution[35] or the Strategic Roadmap for governance on odour pollution.[36] These documents and were also presented at an event organised at the European Parliament with representatives of the quadruple helix, the European Commission, the Joint Research Centre and the Committee of the Regions (CoR): Revisiting odour pollution in Europe.[37] As a result, the importance of monitoring odour pollution through citizen science was introduced in an Amendment[38] proposed by the CoR to the Zero Pollution Action Plan of the Green Deal. The Amendment was unanimously approved on January 27, 2022, which sets the basis for the adoption of citizen science methodologies to monitor odour pollution at European level.

Citizen science actively involves the public in designing, doing and learning from research and presents untapped opportunities to track progress towards sustainability targets such as the SDGs and the Green Deal.[39] After a systematic review of the metadata and work plans of the 244 SDG indicators, Fraisl et al. (2020) concluded that citizen science has the potential to contribute to the monitoring of 76 indicators and was currently contributing to 5 of them.[40] However, many sustainability targets are not adapted to the regional or city level where most citizen science happens and there is a lack of clearly

[35] https://zenodo.org/record/6044964
[36] https://zenodo.org/record/6074278
[37] https://ebcd.org/events/online-event-revisiting-odour-pollution-in-europe/
[38] https://cor.europa.eu/en/our-work/Pages/OpinionTimeline.aspx?opId=CDR-3178-202
[39] Notermans, V.I., Montanari,M. C., Janssen, A., Hölscher, K., Wittmayer, J.M., & Passani, A. (2022). Recommendations to mainstream citizen science in policy. ACTION project. DOI: 10.5281/zenodo.5772236
[40] Fraisl, D., Campbell, J., See, L. et al. Mapping citizen science contributions to the UN sustainable development goals. Sustain Sci 15, 1735–1751 (2020). https://doi.org/10.1007/s11625-020-00833-7

mapped ways that citizen science projects can feed into national or international monitoring systems and decision making. There is also a disconnect between the teams implementing projects and the institutions setting policy outcomes – which can mean projects are not designed to maximise impact, or even worse, that databases drawing on data collected by citizen science projects do not match the requirements for SDG monitoring, even though the data is still relevant.

Citizen science has an integral role in VLRs. At one level citizen science can play a role in monitoring by engaging people to collect data that isn't necessarily available beforehand, and that can be analysed by national statistical offices. At another level, citizen science can play a potential role in engaging citizens in analysing the data, where citizens have a role in giving meaning to the data (not just validating it).[41] Overall, the engagement of citizens is crucial to achieving the SDGs.

We identify three main benefits in using citizen science data for monitoring the SDGs:

a. Address data gaps

Citizen science can provide timely, cost-effective and diverse data, information or knowledge, particularly in regions or areas which are otherwise not reachable by traditional approaches to data collection.[42] Citizen science offers multiple advantages for governments and National Statistical Offices (NSOs) to help fill in data gaps for indicators where traditional data collection instruments (e.g. household surveys or administrative registers) are too costly, not well suited or do not have sufficient data coverage[43]. Citizen science data can also help improve the granularity of the data and sometimes the timeliness of data, and offer an effective and cost-efficient means for NSOs to address the data needs of policy-makers in the context of limited resources.

[41] Expert interview

[42] GPSDD 2018 Advancing Sustainability Together https://www.data4sdgs.org/resources/advancing-sustainability-together-citizen-generated-data-and-sustainable-development

[43] Fritz, S., See, L., Carlson, T. et al. Citizen science and the United Nations Sustainable Development Goals. Nat Sustain 2, 922–930 (2019). https://doi.org/10.1038/s41893-019-0390-3

Box 6. Monitoring Progress: Tracking Mosquito invasions in Spain using Mosquito Alert (MA)[44]

Aims: to provide accurate early warning information about the Asian tiger mosquito (Aedes albopictus) invasion in Spain.

How it monitors progress: Obtaining field information with traditional mosquito surveillance tools is notoriously costly and time-consuming, and a major drawback of these tools is that they lack scalability. Costs can be significantly reduced by combining citizen science approaches with traditional ones for targeted surveillance[45] and using big data spatial modelling techniques to produce risk maps of vector presence and abundance, human–vector interactions, and disease transmission zones at local or regional scales. The MA app lets people collect data, such as photos of mosquito bites and breeding sites that can be submitted to be analysed and verified by a network of specialists. The user receives feedback as a form of recognition for their participation. The MA dataset includes occurrence records of adult mosquitoes collected worldwide in 2014–2020 through the MA app. The MA dataset helped to develop citizen science-based early warning systems for mosquito-borne disease risk in Spain. It can also be reused for modelling vector exposure risk, or to train machine-learning detection and classification routines on the linked images, to assist with data validation and establishing automated alert systems.

Impact: Most records are from Spain, reflecting Spanish national and regional funding, but since autumn 2020, substantial records from other European countries have been have been included in the database in the dataset, thanks to volunteer entomologists coordinated by the AIM-COST Action[4647] (2018-2023), and to technological developments to increase scalability. The AIM project sought to establish a transboundary network of partners and institutions across Europe to cost-effectively address the management of the risk of introduction and spread of Exotic Invasive Aedes Mosquito Borne Viruses.

[44] http://www.mosquitoalert.com/en/

[45] Palmer JRB, Oltra A, Collantes F et al.. Citizen science provides a reliable and scalable tool to track disease-carrying mosquitoes. Nat. Commun., 2017; 8(1): 916. doi: 10.1038/s41467-017-00914-9

[46] https://www.aedescost.eu/

[47] https://www.aedescost.eu/

b. Improve policy relevance and accuracy

Citizen science provides the opportunity to increase the societal relevance[48] and acceptance of policy measures resulting from it. The closer involvement of citizens can lead to better decision making, solutions pathways and better policy implementation[49] which is crucial for successful sustainable transitions. Why? Because more diverse solutions are more likely to be appropriate to a given context. Beyond filling data gaps, official measurements can be expanded, complemented, or cross-verified with citizen science data. This includes pattern and trend identification and the creation of baseline indicators for further research. Citizen science can help governments detect anomalies, test the accuracy of existing monitoring processes, understand contextual factors, and initiate follow-up data collection. Through active participation, enhanced ownership of research results may improve policy decision-making processes and help to democratise research as well as public policy processes.[50]

Box 7. Contributing to developing new and improved policy: Pan European Bird Monitoring Scheme[51]

Aims: to use common birds as indicators of the general state of nature using large-scale and long-term monitoring data on changes in breeding populations across Europe.

How did they contribute to developing policy: The Pan-European Common Bird Monitoring Scheme project started in January 2002 as a joint initiative of the European Bird Census Council (EBCC) and BirdLife International. They collected data on European common bird species from national monitoring schemes and calculated European common bird indices and indicators. They made European common bird indices and indicators available to the policymakers and promoted them to the public. In cooperation with scientists, they explored the forces driving changes in populations of common birds in Europe. They also

[48] https://www.nature.com/articles/d41586-018-06855-7

[49] Notermans, V.I., Montanari,M. C., Janssen, A., Hölscher, K., Wittmayer, J.M., & Passani, A. (2022). Recommendations to mainstream citizen science in policy. ACTION project. DOI: 10.5281/zenodo.5772236

[50] Hecker, S., Wicke, N., Haklay, M. and Bonn, A., 2019. How Does Policy Conceptualise Citizen Science? A Qualitative Content Analysis of International Policy Documents. *Citizen Science: Theory and Practice*, 4(1), p.32. DOI: http://doi.org/10.5334/cstp.230

[51] https://pecbms.info/

assisted national monitoring scheme coordinators with various tasks related to monitoring methods or data calculation. Lastly they developed an active network of national monitoring scheme coordinators and other experts on monitoring cooperating with the PECBMS project

Impact: The scheme has had an impact by contributing to refining European biodiversity indicators and improving policy more relevant and appropriate indicators for monitoring. The multispecies population indicators produced by PECBMS have been used for:

- Streamlining European Biodiversity Indicators (SEBI)[52]
- As part of the Indicators of Sustainable Development of the EU[53]
- the European farmland bird indicator has been accepted as biodiversity indicator for EU´s Structural Indicator[54]
- National versions of the Farmland bird indicators have also been approved as the Regulation indicators in the EU´s Rural Development Plans (Council Regulation (EC) No 1698/2005)[55]
- The indicators produced by PECBMS have been used by international such as: Organisation for Economic Co-operation and Development (OECD)[56], United Nations Environment Programme (UNEP)[57] and the European Environment Agency (EEA)[58]
- The indicators have also been included in the Living Planet Index (LPI)[59]

c. *Raise awareness and build trust*

Citizen science can also strengthen relationships and build trust. Through participating in citizen science, citizens can acquire the interest, confidence and knowledge to get involved in policy debates and develop new skills. Participation in citizen science can enable citizens to make their voices heard in policy-relevant debates and processes. Relevant policy societal dialogues

[52] http://biodiversity.europa.eu/topics/sebi-indicators
[53] http://ec.europa.eu/eurostat/web/sdi/indicators
[54] http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Structural_indicators_%28SI%29
[55] http://europa.eu/legislation_summaries/agriculture/general_framework/l60032_en.htm
[56] http://www.oecd.org/
[57] http://www.unep.org/
[58] http://www.eea.europa.eu/
[59] http://www.zsl.org/science/research-projects/lpi,1162,AR.html

can be fostered with the involvement of relevant stakeholders and decision makers to include citizens in local decision making, contributing to the compliance of Principle 10 of Rio Declaration.[60]

Box 8. Fostering policy-societal dialogues: the Distributed Network for Odour Sensing Empowerment and Sustainability (D-NOSES) project[61]

Aims: to use a co-creative citizen science methodology to address odour pollution, and to increase access to information on local odour pollution issues to encourage participation to tackle it.

What they did: the D-NOSES pilots sought to implement Principle 10 of the Rio Declaration by empowering citizens to become drivers of change. Achieving real action requires the engagement of quadruple helix stakeholders who, in this context, mean representatives from industry and business, policymakers and regulatory authorities, academics and odour experts, as well as citizens and CSOs. Given these diverse actors, and their competing interests and agendas, it was essential to establish dialogue-based communication that treated all these different stakeholders in an equal way. To address these issues, the D-NOSES pilot leaders first engaged each group of stakeholders separately. The most appropriate initial contact point was determined in each case, based on in-depth stakeholder analysis (including their interests in odour pollution, the barriers or concerns that needed to be overcome and the appropriate mitigation strategies and arguments to address them). Each stakeholder group was involved, one after the other, while making it clear that all stakeholders would be equally involved and were equally important for the project. In some cases, industry actors were approached first, to bring on board the stakeholder with the greatest expected resistance. In other cases, initial contact was with a local policymaker or regulatory authority, because they had access to their community and knew them well. And in other cases, initial contact was with citizens to build up enough pressure for hesitant policymakers and industry leaders to engage. The stakeholders were then brought together for open and moderated discussions — so-called 'policy-society scientific dialogues', as every meeting or dialogue involved policymakers or regulatory authorities, and public representatives. These dialogues provided an opportunity for finding

[60] https://www.unep.org/civil-society-engagement/partnerships/principle-10
[61] https://dnoses.eu/

common ground and establishing citizens' co-responsibility for issues and solutions related to odour pollution.

How the project raised awareness: The D-NOSES project organised 50 policy-society dialogues across nine countries, involving almost 400 citizens. The focus of these ranged from including the needs and views of citizens and policymakers in the pilot design, through understanding current procedures and regulations, to measurement training sessions to create a common knowledge base on odours. While these outreach activities do not fall within the typical boundaries of citizen science — no data on odour pollution was generated or collected — this early focus on reaching out to stakeholders lay the foundations for a deeper engagement with the issue. Without this initial focus on outreach and dialogue, further citizen science actions (e.g. data collection on odour sources, policies to address these) would have a much-reduced chance of being possible or leading to positive changes. This confirms the need for communication to happen at every stage of the research process, even before the research, in a traditional sense, has even begun.

Impact: The policy-societal dialogues of the D-NOSES project highlight the particular challenge of reaching out to, and achieving engagement from, actors who have highly contrasting — or even competing — interests and priorities. The project demonstrates how dialogue can deepen all stakeholders' understanding of the issue, and appreciate perspectives that differ from their own. It also demonstrates how citizen science, even in a project's earliest stages, can facilitate communication between disparate stakeholders around a scientific theme: by acknowledging their concerns and hesitations, responding to these in a transparent way, and providing trusted spaces within which to discuss these.[62]

[62] Wagenknecht, K., Woods, T., Nold, C., Rüfenacht, S., Voigt-Heucke, S., Caplan, A., Hecker, S. and Vohland, K. (2021). A question of dialogue? Reflections on how citizen science can enhance communication between science and society *JCOM* 20(03), A13. https://doi.org/10.22323/2.20030213

4. Practical steps for using citizen science for decision making

Citizen science data is clearly highly valuable for monitoring and also potentially achieving the SDGs, and can support decision making at all levels of local, municipal and regional policy. However, it is still underused to make progress towards sustainability targets. We need to move forward and work towards mainstreaming citizen science as an accepted methodology and source of data for SDG monitoring and reporting. Much needs to be done to create a trusted environment in which citizen science data are accepted as a credible source of inputs for statistical reporting at the national level. New efforts should be conducted to interlink national and regional citizen science projects with the relevant statistical agencies to increase the contribution of the practice to SDG monitoring. Eventually, the relevant agencies could call for new citizen science projects that contribute to filling in data gaps.

Below we outline practical actions and measures that local governments can take to make the most of citizen science for localised sustainability reporting, including:

- Reviewing the local context
- Data quality assurance
- Building partnerships and networks
- Raising awareness

The following considerations are a summary of the key learnings on localising the SDGs to neighbourhood, city and regional levels. They are a list of practical suggestions for using citizen science data in decision making, particularly for monitoring and achieving sustainability targets. For most people, the SDGs are an abstract framework that does not have an impact on their lives. Those who are responsible for reporting nationally need to come together with local NGOs, communities and other stakeholders to identify how and where they could fill the gaps.

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Review the local context

Some practical considerations can be given to reviewing the local context to establish what existing citizen science activities might currently be underway, and to establish whether a VLR has taken place already in the area. Suggested activities include:

1. **Map or identify civil society organisations, academia and local companies** with the potential to contribute citizen science data, including the data they already produce, and their ability and their interest to produce new or additional citizen science data. If there is scope, consider this becoming a yearly horizon scanning exercise to identify key data gaps for policy progress to prioritise.
2. **Review the local context to see if a Voluntary Local Review has taken place or is planned** in your city context or if there are intentions to undertake a Voluntary Local Review. Mapping existing CSIs could help with setting localisation targets.
3. **Identify and openly communicate about the data gaps looking to be filled and be proactive in linking with citizen science activities.** Clarifying policy needs will help to overcome the difficulty that citizen science project leaders face in identifying relevant policy linkages[63].

Box 9. Reviewing the local context: NSO Philippines Statistical Authority (PSA) mapping of citizen generated data[64]

Aims: to create an enabling environment for collaborating with organisations holding or producing citizen generated data in the Philippines, and to develop an inventory of data holdings and citizen-generated data produced by Civil Society Organizations (CSOs) or Non-Governmental Organisations (NGOs) to review and assess the data collected, and how they are currently processed and used, in the context of data gaps on SDGs and the Philippine Development Plan (PDP).

[63] Turbé, A., Barba, J., Pelacho, M., Mugdal, S., Robinson, L.D., Serrano-Sanz, F., Sanz, F., Tsinaraki, C., Rubio, J.-M. and Schade, S., 2019. Understanding the Citizen Science Landscape for European Environmental Policy: An Assessment and Recommendations. *Citizen Science: Theory and Practice*, 4(1), p.34. DOI: http://doi.org/10.5334/cstp.239

[64] https://paris21.org/sites/default/files/inline-files/PSA-report-FINAL.pdf

What they did: The PSA took an active role in reviewing the SDG indicators to assess whether the identified data gaps could be potentially addressed by using citizen generated data. The PSA then conducted a survey on CSO data holdings, which yielded a total of 53 completed questionnaires sent to 80 CSOs/NGOs that were identified through snowballing techniques due to time constraints. However, 14 out of the 53 CSOs/NGOs responded that they do not collect data, and so were not included in the processing. A series of consultation meetings with CSOs/NGOs were also organised, which provided an opportunity to develop relationships, build trust and establish a collaborative environment between the PSA and the CSOs/NGOs.

Role of local authorities/decision makers: The PSA established a task force to a) identify citizen generated data as a possible data source for official reporting, and b) improve the data ecosystem in collaboration with different stakeholders via a framework of data sharing, and an exchange of good practices on citizen generated data. The Task Force is composed of the PSA, CSOs and NGOs, as well as representatives from academia and international organisations. This work provided opportunities to bring together a range of stakeholders, primarily from CSOs and NGOs, across sectors and data communities to collaborate and explore data holdings that can address SDG data gaps. To sustain the partnership with the CSOs/NGOs on citizen generated data for official reporting on the SDGs, the PSA continues to play a crucial role in some initiatives such as: a) conducting further studies on citizen generated data; b) the further refinement of the Quality Assurance Framework and development of guidelines on citizen generated data; c) Utilising CSO/NGO data holdings to estimate SDG indicators d) capacity building for CSOs/NGOs e) further exploration of citizen generated data at the sub-national level f) location more funding support and investments on citizen generated data and SDG statistics.

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Data Quality Assurance

Developing clear protocols and criteria for assessing data quality can help to clarify what data and metadata CSIs need to provide. Being open about this process and where possible, co-designing protocols with the citizen science community can enhance the potential of citizen science data to fill data gaps

in sustainability monitoring. Providing relevant data infrastructure that can be used by citizen science practitioners will also help.

1. **Identify the most suitable criteria and processes for ensuring data quality**. (See Box 10 below for more details on the UK Office of National Statistics' protocol for using non-traditional data sources[65] and as an example of a type of quality assurance processes). This should be coupled with requirements from NSOs and other government agencies regarding their quality standards and protocols.
2. **Co-develop data-capturing methodologies and quality assurance/control mechanisms**. Collaborate with public authorities at the appropriate administrative level (such as Environmental Protection Agencies (EPAs) and national statistical offices) and where methodologies or quality assurance frameworks are not yet available. This process would benefit from citizen science community expertise in the relevant area (e.g. through data validation mechanisms) enhancing the future uptake of citizen science data in specific policy processes. Citizen science associations and networks and academia/research organisations could contribute to and facilitate this co-development process.
3. **Adapt or align with existing data platforms to allow integration with citizen science data.** Public authorities (EPAs. statistical offices, meteorological offices, etc.) could use these platforms to make public their own (open) datasets. This could help in the calibration, comparison and quality control of citizen science monitoring data and provide a common entry point for all relevant environmental monitoring data on specific topics, regardless of their origin. In other areas, new data portals may be needed, based on an open access approach.

Box 10. Data quality assurance: the UK Office of National Statistics' protocol on how to use non-official sources of data[66]

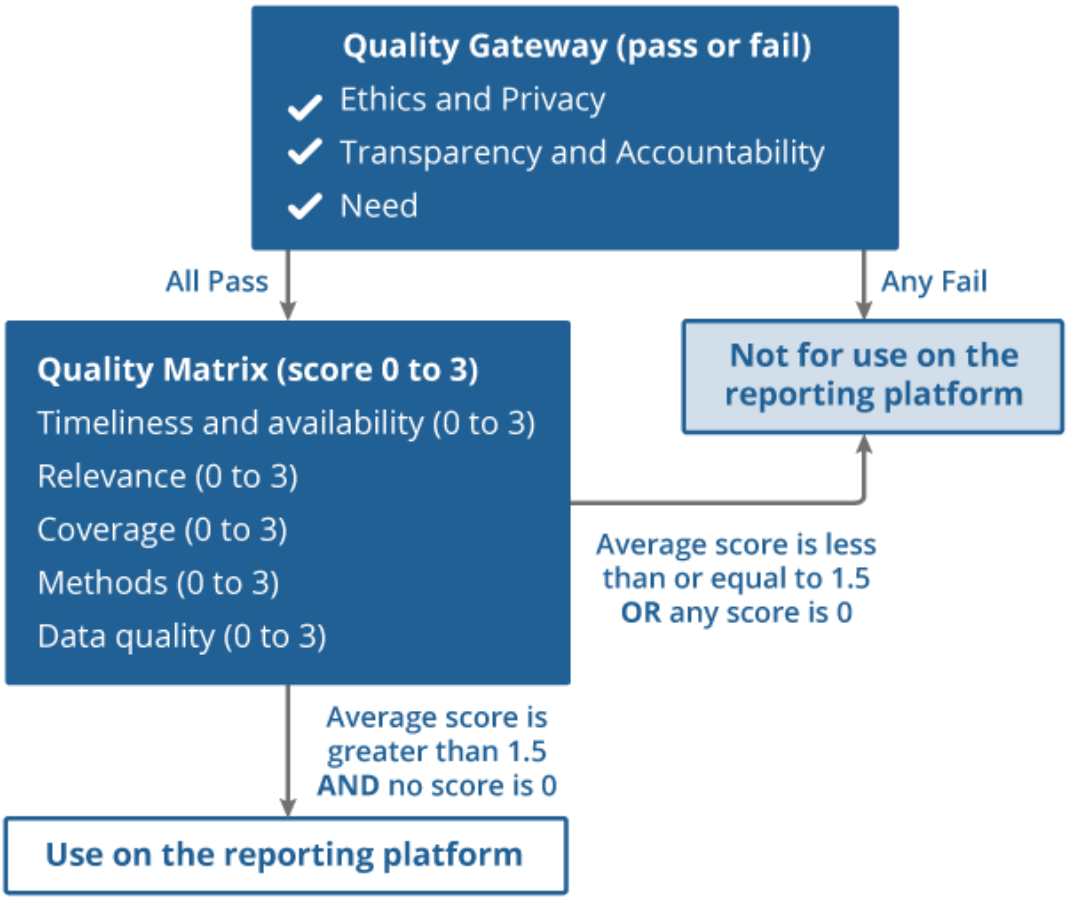
[65] https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/uksustainabledevelopmentgoalsuseofnonofficialsources

[66] https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/uksustainabledevelopmentgoalsuseofnonofficialsources

Aims: to assess the quality and suitability of non-official sources for reporting the UK's progress towards the SDGs.

What they did: The UK Office for National Statistics (ONS) leveraged the use of non-official data sources for SDG reporting on their National Reporting Platform to address gaps on some of the SDG indicators. As the UK national statistical institute, the ONS has a remit to monitor and report on the SDGs for the UK through the National Reporting Platform. The UK ONS developed a protocol with an initial Ethical Gateway on key criteria, followed by a quality assessment using a simple scoring system to assess the quality of data from non-official sources. The Ethical Gateway serves as a pass/fail mechanism with three criteria, all of which have to be met on Ethics and Privacy, Transparency and Accountability, and Need. Once this condition is met, a scoring matrix is applied to evaluate the given data set using additional criteria: Relevance, Methods, Coverage, Timeliness, and Data Quality. The average score is then calculated and 1.5 points are used as a threshold to decide on whether or not the source could be used for the SDG platform. The non-official data protocol is aligned with the UK Statistics Authority Code of Practice and its voluntary application procedure applied to non-official data sources. Data from non-official sources will be labelled as such and made available in addition to the official source data where available.

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Source: Office for National Statistics[67]

Role of local authorities/decision makers:
Local authorities, non-governmental organisations that may produce statistics relevant to SDGs, and any organisation working with SDGs data, sends the UK ONS data for review. While the protocol is tailored to SDGs reporting, the ONS welcomes others to adapt it for assessing non-official sources in other contexts.

Build partnerships and networks

Key to using citizen science data for localised sustainability monitoring and achievement is through developing relationships to undertake activities in partnerships with other relevant stakeholders, in particular national statistical

[67] https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/uksustainabledevelopmentgoalsuseofnonofficialsources

offices, as well as data producers and users. Specific recommendations include:

1. **Make contact with the appropriate National Statistics Office (NSO)** to check if the NSO has clearly defined protocols on citizen science data quality standards, quality assurance frameworks and criteria for data management.
2. **Strengthen partnerships with data producing and data user communities** such as Ministries, local authorities, municipalities, and other stakeholders. These stakeholders can help to identify those already producing data and also those who may be interested in collaborating on new projects. Assess their ability and interest to produce new or additional citizen science data.
3. **Co-design implementable local policies**. Taking time to co-create shared goals, expectations, and standards when using citizen science in policy allows for co-ownership and alignment of efforts. Not all policies are suited to co-design due to time and resource constraints but when it is possible, co-designing policies helps to build mutual understanding and trust.
4. **Establish and strengthen communities of practice inside public administration:** Previous and ongoing initiatives have proven the effectiveness of sustained mechanisms for civil servants and policymakers to incorporate citizen science into their work. Examples of mechanisms include creating networks of practitioners and champions across departments, units or agencies; developing adequate communication and capacity building tools such as roundtables, webcasts, blogs or practical training; and introducing best practices which showcase successful projects.
5. **Connect your work with key actors providing national or regional support to citizen science practice**, to maximise its potential for SDG monitoring. Recently, the European Commission launched a Mutual Learning Exercise on Citizen Science[68] to increase its national support, where 11 countries participated. The conclusions included in the final report

[68] https://ec.europa.eu/research-and-innovation/en/statistics/policy-support-facility/psf-challenge/mutual-learning-exercise-citizen-science-initiatives-policy-and-practice

provide a roadmap for implementation, which can be aligned with SDG monitoring goals.[69]

Box 11. Build partnerships and networks: the Litter intelligence project[70]

Aims: to develop a national citizen science programme in New Zealand to collect data about beach litter, and to produce data to contribute to the reporting of indicator 14.1.1 on marine litter by Stats New Zealand, as part of the 2019 Voluntary National Review.

What they did: The platform Litter Intelligence was developed and launched in 2018 in collaboration with Stats New Zealand, the Department of Conservation and with funding from the Ministry for the Environment. The platform provides open, scientifically rigorous litter data from hundreds of survey sites around the country. The monitoring methodology uses a localised adaptation of the United Nations Environment Programme/ Intergovernmental Oceanographic Commission guidelines. [71] The LItter Intelligence team trains, equips and supports citizen scientists to conduct quarterly marine litter surveys. These data can be accessed via the litter intelligence platform, and are used by regional, national and international agencies for reporting, including for the SDGs. Led by New Zealand charity Sustainable Coastlines, the programme works in close collaboration with the Ministry for the Environment, Department of Conservation and Statistics New Zealand. So far, volunteers have spent 22.2k hours on the project, 1840 surveys have been completed and 459 areas have been surveyed.

Role of decision makers: A key enabler for the success of Litter Intelligence was around the way the project built connections between citizens and the decision-making process through community engagement work. As the project worked with Statistics NZ - the official national statistics office of New Zealand, it had official buy-in for the data to be used. Litter Intelligence is a national CS programme in NZ which began by monitoring beach litter data, and has also

[69] https://op.europa.eu/en/publication-detail/-/publication/63baa6bb-d359-11ed-a05c-01aa75ed71a1/language-en/format-PDF/source-283611345

[70] https://litterintelligence.org/

[71] https://litterintelligence.org/media/nladhmse/unep-ioc-operational-guidelines.pdf

launched a new methodology for fresh water and stormwater. New Zealand now has an official national litter database delivering surveys every 3 months.

Raise Awareness

In order to promote the further take up and use of citizen science data in sustainability monitoring, there are a number of activities that can help raise awareness about the potential of citizen science.

1. **Build awareness and share experiences on the use of citizen science for sustainability monitoring and the SDGs**. It is crucial to hear from and respond to citizen science project coordinators. Matchmaker events could be organised to foster exchange and networking between decision makers and project leaders across governance levels.
2. **Be transparent about how data will be used.** People should know their rights to contribute data, their rights enabled through data, and how their data can be used within public institutions - ethical aspects need to be addressed[72], as well as in relation to General Data Protection Regulation (GDPR) compliance.[73] Fostering open government, open data and right to information policies.
3. **Give visibility and recognition to citizen science outcomes,** giving explicit credit and feedback when using citizen science contributions (e.g. using citizen science data in reports, scientific papers and policy publications, and acknowledging citizen scientists as contributors). This demonstrates the value of public contributions and encourages citizen scientists to maintain their involvement.
4. **Provide feedback to citizen science communities about policy decisions on particular environmental issues.** Channels for feedback could include institutional news feeds, contributions to citizen science newsletters, dedicated email lists and social media groups, possibly in partnership with citizen science networks and associations. This is especially effective in maintaining interest and active participation.
5. **Promote a central interface or communication channel where decision makers could advertise their data or citizen participation needs**, and where citizen scientists could also get feedback on how their data contributed to policy decisions. Make communication bidirectional, open, transparent and participatory.

[72] https://eu-citizen.science/resource/88
[73] https://gdpr.eu/

6. **Systematically analyse policy frameworks** like the SDGs and Green Deal to identify and promote the opportunities that citizen science can bring to policy implementation and monitoring.

Box 12. Raising Awareness: Using Citizen Generated Data in Kenya[74]

Aims: to bridge data gaps in monitoring of the SDGs and other development frameworks by building on the common interest in data and developing collaborations between the national statistical office and civil society organisations (CSOs).

What they did: The Kenya National Bureau of Statistics (KNBS) responded to a call from CSOs in Kenya for guidance on producing quality citizen generated data that adheres to rigorous standards and draws on key concepts related to official statistics. The KNBS developed a guide by listening and learning as much as possible from CSOs and NSOs. The approach consolidates learning from:

- A multi-stakeholder peer-to-peer exchange between the Ghana Statistical Service and the KNBS in 2019. One session focused on how to integrate citizen generated data into official statistics or apply it for official purposes. Another session focussed on how civil society can produce high-quality citizen generated data.
- A session on citizen generated data at the 2019 Data Tamasha event hosted by Tanzania Data Lab. This session brought together the Tanzania National Bureau of Statistics, KNBS, the county government of Vihiga, Open Institute, Humanitarian OpenStreetMap and Twaweza to share experiences of working with citizen generated data.
- A co-creation workshop with CSOs in early 2020 to share knowledge on existing data guidelines within KNBS and among CSOs, and gather insights on priority areas to be covered in the guidelines.
- A side event at the United Nations Statistical Commission (UNSC) in 2020, which brought together NSOs and CSO representatives across the globe to discuss ways of building trust in citizen generated data.

[74] https://www.data4sdgs.org/sites/default/files/file_uploads/Citizen-Generated%20Data%20Improving%20Quality%20and%20Use%20for%20Policy%20and%20Decision-making%20in%20Kenya.pdf

- A workshop with teams from the KNBS in autumn 2020 which gathered reviews from the KNBS on the guidelines, as well as developing ways to adopt citizen generated data as an alternative source of statistics.

The guidelines catalysed conversations between KNBS and CSOs, deepening trust and cooperation between the KNBS and members of the national statistical system (NSS) and civil society actors. Both parties were able to discuss and address methodological, reputational and other concerns.

Role of local authorities/decision makers: With support from PARIS21, KNBS worked to disseminate the guidelines with CSOs. As a result, KNBS developed a quality criteria for validating citizen generated data based on guidance from PARIS21 and drawing on best practice from the UK Office for National Statistics (see Box 10) and Philippines Statistics Authority (see Box 9). KNBS was instrumental in starting the process of developing the guidance on citizen generated data. These efforts in Kenya also attracted attention from other countries and KNBS was invited to a number of peer learning forums on citizen generated data with other countries' national statistical offices (NSOs). For example, in January 2022, PARIS21, in collaboration with KNBS, Partners for Review, the Global Partnership, and UN Women East and Southern Africa, hosted a regional citizen generated data peer learning session. Participants included representatives from NSOs, government, civil society, academia, research, and media. The webinar was an opportunity for practitioners to discuss use of citizen generated data by NSOs in Ghana, Kenya, and Uganda.

5. Next steps

The examples set out in this deliverable have demonstrated the value of citizen science for the SDGs. However, we need to move towards mainstreaming citizen science as an accepted methodology and source of data for continuous SDG monitoring and reporting. This is the overall aim of the IMPETUS project, in terms of enhancing the impact of citizen science. It is also the more specific aim of WP4 of the IMPETUS project to improve the evidence base for making policy on citizen science. WP4 is dedicated to the policy aspects of citizen science, both in terms of enabling CSIs to work with policy makers, but also crucially, providing recommendations to policy makers on how they can effectively work with diverse CSIs.

One clear next step is the development of the impact pathways training for the IMPETUS accelerator pilots going through the first round of the accelerator (Task 2.4). This training and support package is being developed drawing on the research and best practice for how citizen science can contribute towards sustainability monitoring at local, municipal and regional levels.

Another next step is to validate the guidelines with policy makers at different levels to ensure that they make sense and if not, to undertake the necessary refinements to ensure they are as practical and useful as possible. An example of such an opportunity to sense check the guidelines is at the European Week of Regions and Cities[75] in October 2023.

Although citizen science data clearly has value for the SDGs, there is at least one major barrier to its use - a lack of trust surrounding the quality of the data produced by CSIs. Demonstrating a high quality of data will be a key mechanism in overcoming barriers to data use. The first IMPETUS policy brief, due at the end of October 2023, will focus specifically on data management standards and best practice in citizen science. This practical policy brief will be for local policy makers to provide clear guidance and signposting to using citizen science data for monitoring local and national sustainability targets.

[75] https://europa.eu/regions-and-cities/

6. Further information and resources

These guidelines were developed as part of the IMPETUS Coordination and Support Action (CSA)[76] work package on Impact for Policy (WP4) which aims to shape EU policy in and with CS, through horizon scanning, anticipatory policy and action research, informing policy briefs, webinars and workshops with key policy stakeholders. IMPETUS aims to support and give recognition to citizen science by enabling a wider range of citizen science initiatives (CSIs) to access innovative funding. The IMPETUS project also aims to bring citizen science closer to society and policymakers and to acknowledge its role in tackling the greatest challenges of our times. IMPETUS has a strong focus on enhancing the contributions of citizen science to the Green Deal and the UN SDGs. IMPETUS consists of an accelerator programme with three cycles of open calls, and rounds of the accelerator to provide training and support for CSIs with the overall goal of helping them to enhance their impact. It also consists of the European Union's Citizen Science Prize to support outstanding projects whose social and political impact advances the further development of a pluralistic, inclusive and sustainable society in Europe.

Other relevant and potentially useful resources on citizen science and the SDGs are the following:

Fraisl et al. 2020 Mapping citizen science contributions to the UN sustainable development goals
Fritz et al. 2019 Citizen science and the United Nations Sustainable Development Goals
Gold et al. 2022 Mutual Learning Exercise on Citizen Science Initiatives – Policy and Practice. Topic Four Discussion Paper: Enabling Environments for Supporting and Sustaining Citizen Science
GPSDD 2018 Advancing Sustainability together? Citizen-generated data and the Sustainable Development Goals
Moczek et al. 2021 A Self-Assessment of European Citizen Science Projects on Their Contribution to the UN Sustainable Development Goals (SDGs)
Notermans et al. 2022 Recommendations to mainstream citizen science in

[76] https://impetus4cs.eu/

policy. ACTION project. DOI: 10.5281/zenodo.5772236
PARIS21 report on Philippines: https://paris21.org/sites/default/files/inline-files/PSA-report-FINAL.pdf
SEI 2017 Discussion brief: How could citizen science support the Sustainable Development Goals?
Siracusa et al. 2022 European Handbook for SDG Voluntary Local Reviews
Sprinks et al. 2021 Coordinator Perceptions When Assessing the Impact of Citizen Science towards Sustainable Development Goals
Turbé et al. 2019 Understanding the Citizen Science Landscape for European Environmental Policy: An Assessment and Recommendations
UK ONS protocol on how to use non-official sources of data: https://www.ons.gov.uk/economy/environmentalaccounts/methodologies/uksustainabledevelopmentgoalsuseofnonofficialsources

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