EPA Network Interest group on Citizen Science:
Paper on Citizen Science and Zero Pollution

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Citizen Science and the zero pollution ambition

This paper highlights the value and potential of citizen science initiatives in contributing to the zero-pollution ambition and the Zero Pollution Action Plan, expected early 2021. The Action Plan will need to build *inter alia* upon a substantial knowledge base, technological developments, social innovation, further digitalisation and the promotion of sustainable production and consumption patterns in our society, all of which call for innovative approaches and societal engagement, such as citizen science. Following the increased policy attention and the recent recognition of citizen science by the European Commission ("Best Practices in Citizen Science for Environmental Monitoring"[1]), **this paper demonstrates national and pan-European examples of successful citizen science activities related to the zero pollution ambition**, in particular **air and water pollution**. Other areas are also briefly discussed.

The power (and limits) of citizen science

Citizen science enables **crowdsourced data collection, analysis and dissemination** of results, and thus expands the frontier of what is possible in research in terms of **places, scales and paces**. Citizen science can play an important role by filling in **data gaps** where conventional data sources may not be sufficient, such as litter or air pollution. Furthermore, citizen science provides complementary temporal and spatial data that **supports official monitoring** systems and helps to validate and fine-tune national level monitoring and forecast systems. Citizen science is also a channel to **raise awareness** about pollution issues, engage and empower citizens and promote sustainable behaviour changes. Citizen science initiatives are gaining momentum as low-cost sensors, smartphones and data infrastructures become more widely available. At the same time, there are **challenges** preventing a wider adoption, such as data quality concerns, data heterogeneity, accessibility, policy barriers or sustained resourcing, which is necessary to ensure continuity and a lasting impact.

Measuring together to understand air pollution better

Despite stringent EU regulations for the measurement of ambient air quality using standardised reference methods, the variability of air pollution across time and space calls for more localised monitoring and measuring in order to provide useful insights for local interventions. The development of easy-to-use technology and an increased availability of low-cost devices, such as passive samplers and sensors, is enabling a more frequent monitoring of air pollution at the local level, although the quality of such measurements still calls for careful interpretation and cautious use of the results. Citizen science approaches provide both unique as well as complementary air pollution data to official air quality monitoring.

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[1] SWD (2020) 149 final:
https://ec.europa.eu/environment/legal/reporting/pdf/best_practices_citizen_science_environmental_monitoring.pdf

A well-known example in this domain is *CurieuzeNeuzen Vlaanderen[2]*. The initiative involved 20,000 people across Flanders who, using passive nitrogen dioxide samplers, measured the air quality near their homes in May 2018. This initiative built on a similar exercise carried out in Antwerp back in 2016. The large-scale dataset, calibrated with measurements at reference stations, helped validating the atmospheric chemical transport models used by the Flemish Environmental Agency (VMM) to estimate air-quality levels. The initiative has had societal, scientific and policy impacts in Flanders and beyond, contributing to our understanding of the high variability of traffic-related air pollution and raising awareness about its actual impact on rural areas.

> **Box 1. Citizen science and radon**
> Citizen science can also give more visibility to less visible issues such as health risks arising from **radon**. In collaboration with the Wexford Library Service, the Irish EPA carried out a citizen science project targeting householders that have measured elevated radon levels in their homes, but not taken action to reduce their exposure. Wexford Library members were offered the opportunity to borrow a digital monitor from their local library, being quickly and easily able to confirm that the concentrations of radon in their homes remained elevated, leading the householder to carry out work on their home to reduce exposure. One of the interesting learnings from this project was the importance of community networks, participants lent monitors to family members and neighbours, resulting in further homes being remediated to reduce radon exposure.

CurieuzeNeuzen Vlaanderen has also served as inspiration for the EPA Network led initiative **CleanAir@School**, coordinated by the European Environment Agency (EEA). In this initiative, pupils, teachers and parents measured nitrogen dioxide levels around schools in eight countries in 2019 and 2020. For example, only in Italy 69 schools and 5000 students and families were involved, with more than 200 passive samplers installed. Besides the scientific outcomes from the indicative measurements at the schools, the initiative has demonstrated the potential for these approaches to increase the awareness of environmental issues and sustainable mobility, including changing commuting behaviours to and from schools. The final results, summarised in **CleanAir@MySchool** stories, will be published in early February 2021[3].

> **Box 2. Hollandse Luchten**
> In collaboration with citizens, municipalities and private companies, RIVM is taking part in the large citizen science project *Hollandse Luchten* ("Dutch Skies/Air", see: https://www.samenmetenaanluchtkwaliteit.nl/projecten/hollandse-luchten) which aims to create a broad sensor network for measuring air-quality in the province of North Holland. In this province, there are multiple official air quality measurement stations, which are now being complemented by citizens to create a fine-meshed network. RIVM helps citizens with the data collection, calibration, and interpretation. The first pilot started around a steel factory (also a partner in the project) since citizens had concerns about the air quality. According to participants, the measurements provide something concrete and reliable to start a discussion about specific actions with local politicians, companies or neighbors.

One of the institutions involved in CleanAir@School, the Irish EPA, has continued this citizen science approach by launching a large-scale nitrogen dioxide monitoring project together with the National Trust for Ireland (*An Taisce*), called **Clean Air Together.** This project seeks to increase public knowledge and engagement with air quality issues and to evaluate the impact of citizen-based air quality monitoring on policy change, awareness and attitudes. A pilot has been completed in Dublin and, in autumn 2021, approximately 1,200 tubes will be placed by members of the public (including vulnerable groups, local government and schools) in measurement areas that are vulnerable to elevated nitrogen dioxide

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[2] https://curieuzeneuzen.be/
[3] https://www.eea.europa.eu/themes/air/urban-air-quality/cleanair-at-school

concentrations. The data will be input to the validation of EPA air quality forecast models for Dublin City. A follow up study will be carried out in 2022 in Cork.

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Box 3. Odour pollution
D-NOSES Horizon 2020 project (https://dnoses.eu/) is a relevant initiative to tackle odour pollution, by empowering people through tools that map and measure the problem and engaging relevant stakeholders in finding solutions. Through a series of local pilots across Europe, the project aims to provide input for future regulations in this domain.

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Another EPA Network member involved in CleanAir@School, the Dutch National Institute for Public Health and the Environment (RIVM), launched in 2016 a platform for citizen science measurements called *Samen Meten* ("measuring together")[4]. Information is shared on what environmental aspects can be measured (with an initial focus on air quality but now extended to water quality and noise) and how this can be done with different sensors. On an open data portal[5], data from various citizen science projects is displayed and shared on a continuous basis. The platform creates a possibility for dialogue and knowledge sharing between the Dutch EPA, the (local) government and citizens, promoting transparency, openness and action. The platform has had impact on several fronts: a) awareness raising and citizen empowerment; b) strengthened communication and collaboration between citizens, local authorities and environmental agencies underpinned by scientific methods; c) complementary data and information to official reference measurements providing local details; d) higher participation in decision making processes with an increased demand for accountability on pollution; and e) creation of a virtuous cycle in which new activities can be nurtured based on the available information and data infrastructure from a well-trusted party (RIVM).

Ultimately, the platform is facilitating a space where an evidence-based discussion about pollution problems can take place so they can be addressed and solved together.

Addressing water pollution with the power of the crowd

The accumulation of litter, including plastics, in seas, lakes and rivers is one of the most prominent and visible problems in the freshwater, marine and coastal environments. In recent years, multiple collaborations between environment agencies and local communities have been established to collect and monitor litter, thus providing a detailed evidence base on its accumulation and distribution.

As a way of example, the Environment Agency in England (EA) is a partner of the Interreg France (Channel Manche) England **Preventing Plastic Pollution (PPP) project[6],** a cross-channel initiative aiming to identify and target hotspots of plastic pollution within river catchments, with data collected from source to sea. The PPP project connects with active

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[4] https://www.samenmetenaanluchtkwaliteit.nl/
[5] https://samenmeten.rivm.nl/dataportaal/
[6] https://preventingplasticpollution.com/

community groups in order to co-ordinate and collect data from litter picks, river and beach clean events. Citizen science is being further introduced to a younger audience by embedding litter pick and beach clean activities, including data collection and sharing, into educational resources, helping develop positive behavioural changes and raise awareness of plastic pollution across all ages. In this context, EA has also set up an internal citizen science project, **Plastic Champion Network**, open to all government employees, to enable individuals and groups to participate in litter pick activities as well as contributing to the Big Microplastic Survey 2021[7], a citizen science project run through

> **Box 4 Nitrate pollution**
> Chemical water pollution is another extremely important, yet less visible issue, where citizen science can contribute. For example, RIVM is carrying out water quality tests in collaboration with farmers and the Wageningen University. With sensors placed in ditches on and around the farms, the electrical conductivity of the water is measured, in order to reveal possible runoff of manure/fertilizer. In order to check the presence of nitrates, the farmers received test-strips to measure nitrate concentrations. Sensors therefore serve as an easy first warning system and, if measurements show changed nitrate concentrations, farmers can evaluate what has caused this and what practices they could change to avoid this pollution.

the University of Portsmouth. Participants have welcomed the opportunity to make a positive difference to their local environment and to be part of a wider community of like-minded people. As plastics are intrinsically linked to the climate emergency, the EA plans to use potential waste avoided and the associated CO_2 saving as one indicator of the impact of their interventions. They also plan to present their impact as a reduction in marine natural capital loss and to use these metrics to support our net zero pollution ambitions.

> **Box 5 Litter and the fishing sector**
> Citizen science is being used to empower the fishermen community through fishing for litter activities. The Italian Institute for Environmental Protection and Research (ISPRA), within the ML-REPAIR Project (2014-2020 Interreg V-A Italy-Croatia Programme), has developed the first mobile app that allows fishermen to collect data on marine litter on board. This innovative tool allows the fishermen community to contribute to data collection of marine litter (typology, quantity and distribution), in particular on waste caught accidentally during fishing operations. This initiative has contributed to increase the data availability on marine litter on the seabed with the direct participation of the fishing sector.

There are a significant number of other initiatives fighting litter pollution in water across Europe. Since 2013, EEA coordinates **Marine Litter Watch (MLW)[8],** a pan-European citizen science initiative tackling litter in Europe. Using a common mobile app, volunteers from communities across Europe are collecting beach litter data, mainly from European seas but also rivers and lakes. Applying a methodology developed in the context of the EU Marine Strategy Framework Directive (MSFD), by the end of 2019 more than two million litter items have been recorded and the collected data made available through a dedicated web portal. Quality assurance through detailed data profiling is used to remove inconsistencies and other anomalies. Recent analysis from MLW data show relevant variations in litter composition across different regions, being useful for the evaluation of the effectiveness of existing policies such as MSFD, the EU Strategy on Plastics and the Single-Use Plastics Directive.

Citizen science efforts in other zero pollution areas

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[7] https://www.port.ac.uk/research/research-projects/big-microplastic-survey
[8] https://marinelitterwatch.discomap.eea.europa.eu/

Numerous other citizen science activities are currently taking place:

- **Soil quality and soil pollution:** a number of applications have been developed in this domain, including mySoil[9] from the British Geological Survey that provides detailed soil mapping data from UK and across Europe and allows users to submit their own soil data. The initiative *Expedition Erdreich[10]*, with funding from the German Federal Ministry of Education and Research, aims to involve citizens in recording the mineralization activity of the soil as an indirect measure of soil quality by using the simple and scientifically recognised Tea Bag Index method. ISPRA in Italy has developed another application[11] for citizens to send information, updates and pictures on newly built areas, which are validated by ISPRA and integrated in its national web map on soil consumption and degradation.
- **Noise pollution:** several initiatives have been launched to involve the public in mapping noise pollution by recording sound levels to inform local authorities, although the technologies and methodologies require careful consideration. An interesting example is the Hush City app[12], piloted in Berlin, which uses a methodology to identify, assess and plan urban quiet areas, as required by the Environmental Noise Directive. European projects such as MakingSense or GroundTruth2.0 have also tested participatory approaches in addressing noise pollution in European cities, such as Barcelona[13] (Spain) and Mechelen[14] (Belgium) respectively.
- **Illegal waste disposal:** Several actions are involving citizens in mapping and reporting illegal waste disposal, in coordination with the authorities, such as the application 'See it, Say it!'[15]" from the Irish EPA, or the Zero Waste Scotland's 'dumb dumpers' project[16]. The latter, established already in 2004, is helping in the development and evaluation of better policies to address illegal waste disposal.

Recommendations to the EPA Network

Building on our findings, and on the recommendations by the European Commission's Best Practices in Citizen Science for Environmental Monitoring, the Interest Group recommends the Heads of EPAs to:

- **Take note of the results and impact of the success stories of citizen**, both in enlarging evidence base and in encouraging positive behavioural changes;
- **Support the IGCS further to explore other areas** where citizen science can contribute to the zero pollution ambition;
- **Explore supporting the creation, extension or upscaling of citizen science initiatives** that can provide further evidence needed to fulfil the goals of the zero pollution ambition, as an integral part of the EPAs institutional mandates.

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[9] https://www.bgs.ac.uk/technologies/apps/mysoil-app/
[10] https://www.expedition-erdreich.de/
[11] Soon available at: https://www.isprambiente.gov.it/en/activities/soil-and-territory
[12] http://www.opensourcesoundscapes.org/hush-city/
[13] http://making-sense.eu/making-sense-noise-pollution-placa-del-sol/
[14] https://mechelen.meetmee.be/c/english-summary/
[15] http://www.epa.ie/htmldocs/seesomething/seesomethingsaysomething.htm
[16] https://www.zerowastescotland.org.uk/DumbDumpers