

Citizen Science: a collaborative approach to air pollution control

Contents

Page 1

Key Take-Aways

The potential of Citizen Science for air pollution monitoring and how it can be used to gather data for future policies.

Page 2

Project Evidence

Key Citizen Science approaches from the six European iSCAPE Living Labs.

Page 3

Implementation Tips

Recommendations for successful replication, scaling and iterations of the iSCAPE Citizen Science approach.

Page 9

Read More

A brief overview of the Horizon 2020 iSCAPE project and the sources of information included in this Policy Brief.

Key Take-Aways

Through Citizen Science activities, conducted in six European cities, citizens were able to 'sense' pollutants impacting their environment, increasing the general awareness of science, low-cost technologies and local air quality related policies.

The Citizen Science activities, run in the six iSCAPE Living Labs (Bologna-IT, Bottrop-DE, Dublin-IE, Guildford-UK, Hasselt-BE and Vantaa-FI) demonstrated that citizen engagement in research and innovation activities can encourage environmentally-friendly action and empower citizens to play an active role in driving policy change. Through the use of low-cost technologies and inclusive approaches, citizens can contribute in solving complex urban challenges such as air pollution and climate change mitigation, ultimately leading to democratic decision-making

processes and improved policy design.

Based on the iSCAPE project experience, **Citizen Science has the potential to drive policy change and engage the public in an engaging and inclusive way.** By sharing insights and educating participants with a practical approach, **Citizen Science has the ability to encourage behavioural change and actions towards change.** Having a Citizen Science community has the capability to source large amounts of data that is often too difficult to reach, feeding into important studies and innovation projects.

Besides having a positive effect on projects, the Citizen Science approach has also a great impact on the life of citizens. **Citizen Science is increasing the general awareness of science,** low-cost technologies and air quality related policies. iSCAPE promoted alternative – more hands-on methods – on how to learn about environmental issues and contribute to potential solutions. By including citizens in data collection

and conversations about local policies, **the Living Labs facilitated inclusive decision-making processes which ultimately empowered citizens.**

Project Evidence

Low-cost technology used for Citizen Science

In recent years, technological advances have made data collection more accessible and have provided citizens with new tools for data visualisation and analysis. This has opened up alternative ways for collaborative data crowdsourcing and active citizen engagement. Low-cost technologies such as the Smart Citizen Kit developed during the iSCAPE project (for more information on the low-cost sensor technology, have a look at **Policy Brief No. 7 “Air quality sensing and real time reporting in cities”**) hold great potential to engage local communities and empower citizens to become involved in decision-making and exposed to science. Given that this solution is integrated with an online platform (www.smartcitizen.me), near real-time data collected by citizens is available online. The transparency and collection of open data enables citizen scientists to share findings, learn from each other and develop a community of like-minded people around the issues and effects of air pollution.

The Smart Citizen Kit (see components in Figure 1) was used by the iSCAPE project during an extensive Citizen Science campaign (2018-2019) designed to build Citizen Science communities across six European cities (Bologna-IT, Bottrop-DE, Dublin-IE, Guildford-UK, Hasselt-BE and Vantaa-FI). The Smart Citizen Kit measures NO₂, CO, O₃, PM_{2.5} and PM₁₀, noise, temperature, humidity and light.

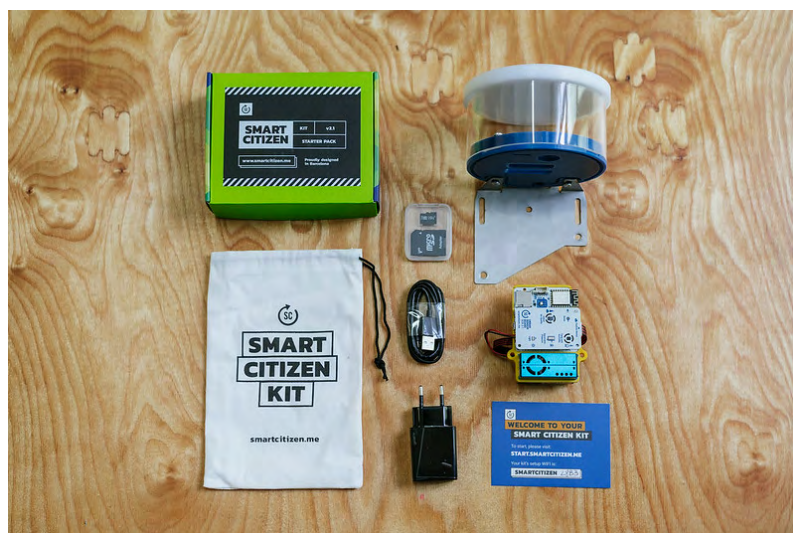


Figure 1: Smart Citizen Kit - components.

Inclusive approach

Whilst air pollution is a global problem, the motivation for change is driven through citizen engagement and empowerment of communities at a local level. By providing low-cost technology and scientific guidance, iSCAPE not only fostered citizen awareness about air pollution and climate change but it also brought environmental research closer to the public.

Through Citizen Science activities, citizens were able to ‘sense’ pollutants impacting their environment. In addition, an iSCAPE Citizen Science framework was designed to facilitate further collaboration with local authorities, public organisations, community groups and academic institutions to drive policy change. Changing policies is a long-term process which requires strong collaborative process and evidence-based data. The proposed framework enabled the dialogue between various actors involved in the decision-making process and served as a stepping stone for taking action at both individual and governmental levels.

Based on the iSCAPE Citizen Science framework, an actionable [Citizen Science Guide](#) was developed and is publicly available at the project website www.iscapeproject.eu.

The proposed approach enables citizens to undertake research and discovery in a ‘crowdsourced’ and transparent way by actively contributing to hands on research tasks and knowledge creation. The Citizen Science Guide, including the workshop templates and proposed methodology is adaptable and can be iterated in other Citizen Science projects.

Overall, the six iSCAPE Living Labs delivered two workshops each (12 workshops in total), and engaged with more than 90 Citizen Scientists.

“Citizen Science contributes to the idea of a more innovative, inclusive, future-oriented and democratic Europe”

Carlos Moedas - European Commissioner for Research, Science and Innovation.



Figure 2: Citizen Scientists at the Bologna Living Lab analysing their data visualisation during the second workshop.

Implementation Tips

When implementing Citizen Science activities, iSCAPE followed a structured approach, which involved two public workshops, 1) **‘Sensing your City’** and 2) **‘Understand Your Data’**, with a data collection phase in-between the workshops. This following process with additional guidance was replicated in the six pilot cities:

1. **Preparation for the Citizen Science workshop**, including the workshop promotion and participant recruitment;
2. **‘Sensing your City part 1’ workshop** conducted to on-board citizens, introduce technology and collaboratively plan the citizen science activities or data collection;
3. **Data collection on the ground**, providing citizen scientists with a clear structure and research questions for the data collection with the Smart Citizen Kit. Technical support was provided throughout this process;
4. **Data analysis and visualisation** (prior to the workshop) involved cleaning up data (post-processing) and developing individual visualisations;
5. **‘Sensing your City part 2’**, shared tips on how to read and analyse visualisations, facilitating the storytelling method which explored the Citizen Science findings and potential actions that could be started based on the data collection. Teams collaboratively shared and reflected on their ideas (see Figure 2);
6. **Discussing and planning the next steps**, providing citizen scientists with local examples that show campaigns, city / citizen collaboration and policy interventions.

The workshops showed a clear willingness and interest of citizens to learn about personal exposure to air pollution, for example identifying local air pollution hot-spots in cities as well as observing transport and mobility patterns. This helped the citizen scientists to gain a better understanding and provide valuable insights on the impacts of green infrastructure, public transport and urban planning.

Through methods such as storytelling, participants were able to digest complex city concepts and discuss the actions required to make a difference in a more engaging and tangible way. Solutions and recommendations for local authorities suggested by the citizen scientists across the six pilot cities included:

- Reduction of traffic in favour of public transport and set-up of bicycle and pedestrian lanes;
- Creation of fixed monitoring stations showing real-time data to increase awareness on the ground;
- Monitoring of pollution at local schools with a view to reducing pollution in the school playground;
- Better distribution of traffic flow - including public transport, with a carefully considered plan for location of parking spots;

- More subsidies for sustainable traffic;
- City authority to develop an awareness campaign on engine idling outside of schools;
- Restriction of all motorised vehicles from the inner ring area (city centre);
- Stimulation for the city authority to develop an awareness campaign on engine idling outside of schools.

“Peak period lasts for a long time, at different times of the day, and appears to be different than we thought in the beginning.”

Citizen Scientist, Hasselt Living Lab.

Practical recommendations for successful Citizen Science initiatives

Over the three years of iSCAPE, the Living Labs, partners and citizen scientists gathered many learnings and insights on how to use low-cost sensors to collect air quality data, and how to establish a Citizen Science community. Find below a set of practical recommendations based on the project learnings and experiences:

Software & Hardware

- Applying the **Smart Citizen API (Application Programming Interface)**, a platform that provides an interface allowing third party applications to access and exchange data and information via a collection of APIs. This is available at api.smartcitizen.me see Figure 3.

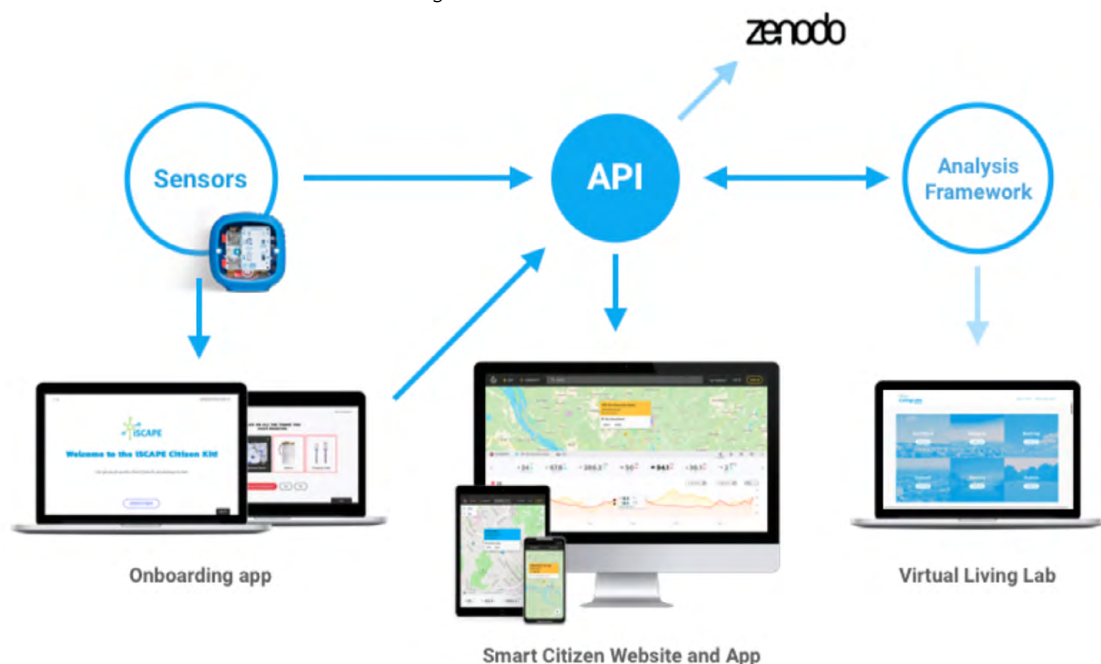


Figure 3: Smart Citizen software architecture. The sensor platform is composed of three main software components. The technical documentation is available at: <http://docs.smartcitizen.me/>.

- Using the Smart Citizen Website**, a visual and user-friendly website where the project environmental sensors can be accessed in near real-time to facilitate the exploration of data with other contextual data (maps, keywords) and processed reports. This is essential to provide transparency and create a sense of ownership of the initiative/project.
- Ensuring low-cost sensor requirements**, to make sense of raw sensor data, critical data post-processing needs to take place. This process cannot be done by citizen scientists (due to limited technical knowledge). When using data visualisation, a maximum threshold should be highlighted (see Figure 4) that helps citizens understand the research results.

ANALYSING YOUR DATA-SETS

Work together with your team, discuss the two visualisations which are based on your data sets and write down notes on your findings. This exercise will help you to understand the data your team collected and create a relation to time (day and night) and location.



GROUP # 06

ANALYSING YOUR DATA-SETS – SMARTCITIZENEF2F

Work together with your team, discuss the two visualisations which are based on your data sets and write down notes on your findings. This exercise will help you to understand the data your team collected and create a relation to time (day and night) and location.

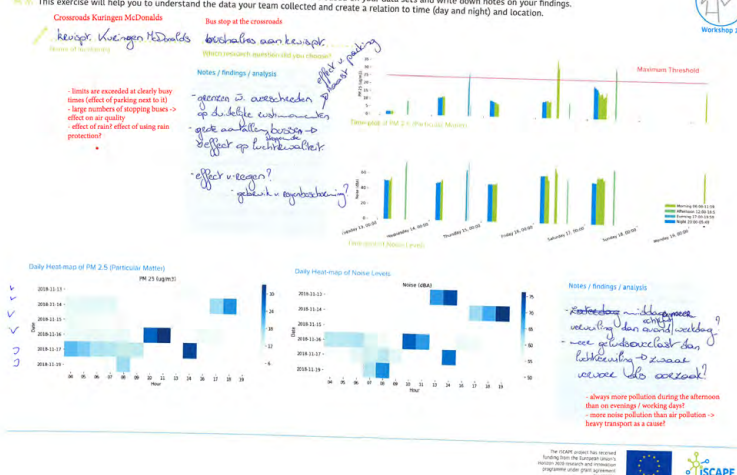


Figure 4: Data visualisation template and filled out worksheet from a Citizen Science team in Hasselt, Belgium.

Data

- **Ensuring consistency among data sets**, collected feedback and documentation of the workshop material to ensure high quality research results.
- **Validating data**, as crowd-sourcing air quality data can be challenging due to different methods, variations in locations and many other factors. Those processes are not yet synchronised and could result in faulty data. A more unified way can increase the consistency, this can be very useful when the findings should inform policies.
- **Taking care of personal data issues**, ensuring participants safety when undertaking data collection activities. Considering data protection, privacy and the relevant permissions needed.

Engagement & Communication

- **Keeping the momentum high - also in the long-run**, develop a communication strategy that reaches a diverse group of citizens and city stakeholders, ensuring the right information and updates are shared with the right audience.
- **Engaging with a diverse group of participants**, stay away from engaging solely with educated citizens. Reach out to local community groups, schools and organisations. Even though this requires increased effort, creativity and local knowledge, it will result in richer and more sustainable results.
- **Managing expectations prior to data collection**, depending on the type of data collected and tools used. Managing expectations of citizen scientists is essential to avoid disappointment. For example, the level of complexity or limitations of low-cost sensors sensing NO_x cannot be monitored due to accuracy problems.
- **Ensuring that data is not only collected and shared but understood by the participants**, to educate participants about the value and potential of the data they collected and why storytelling is a great tool to communicate findings, create empathy and share ideas.

Management & Delivery

- **Avoiding underestimating time**, when planning or starting Citizen Science activities. Better forecasting and planning can be achieved through increased knowledge exchange and sharing of best practice approaches with other Citizen Science practitioners.
- **Understanding different participant groups**, to cater for diverse citizens demographics, expertise and interests, including their desire to work independently or in groups.

- **Being aware of local and national policies**, important for Citizen Science activities, for facilitators as well as participants. By exchanging knowledge of current policies (local and national) this will help citizens to gain a better understanding of the current situation and potential opportunity areas.
- **Having a framework with process and experts in place**, to develop a structure that guides as well as solves problems before, during and after the data collection (see Figure 5).
- **Ensuring one point of contact and location to meet-up**, this will help the citizens to receive support if required. Technology can sometimes fail and expertise is necessary.
- **Setting tangible actions**, by collaboratively creating actions based on their data analysis and how to achieve those as a collective, who needs to get involved and takes ownership. Engage with the local authority to share findings and get them further involved.



Choose 2 locations, one more polluted and one less so, to provide two different parameters for comparison.



To ensure good data, keep your Citizen Kit charged!



Work as a team, either agree times to work together on measuring data, or if working separately agree means for collecting and sharing data..



Document data collection as mentioned earlier; note down the time, surroundings and other notable details. Document anything different or interesting (e.g. smell, air colour etc.).



Use the sensing guide created with the team, follow the time, location, and date to ensure consistency.



Check the Smart Citizen Platform to see if the sensor is still working, what data is being collected and what it looks like.



Ensure adherence to the schedule and encourage attendance of the second part of the CS workshop, where data visualisations are shared and analysed.

Figure 5 : iSCAPE Tips for successful air quality data collection, based on the iSCAPE Citizen Science Guide.

Keywords to remember

Air pollution:

Harmful emissions of particulate matter (PM), nitrogen oxides (NO_x), carbon monoxide (CO) and other volatile organic compounds (VOCs). Air pollution is particularly harmful for children, senior citizens and people with breathing related health issues.

Citizen Science:

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

Living Lab:

A citizen-centred urban innovation ecosystem, based on systematic user engagement in real-life settings through a wide variety of methods and tools, with the participation of multiple stakeholders in the co-creation of innovations.

Low-cost sensor:

A device that detects different types of input from the physical environment, for example: light, temperature, motion, noise and air pollutants. Citizen Science developed as such through the development of low-cost sensors as well as the wifi connection. Low-cost sensors allows citizens to take part remotely in research, a large number of participants are able to undertake research.

Read More

Information from the following key iSCAPE project deliverables have been used in the preparation of the current policy brief: **D4.6** 'Report on Local Stakeholder Engagement' (May 2019), **D4.7** 'Citizen Science Communities Report' (May 2019), **D7.8** 'Sensor Monitoring Experiences and Technological Innovations' (November 2019), the [Citizen Science Guide](#) and the following publication:

Mahajan, S., Kumar, P., Pinto, J.A., Riccetti, A., Schaaf, K., Camprodon, G., Smári, V., Passani, A. and Forino, G., 2020. A citizen science approach for enhancing public understanding of air pollution. *Sustainable Cities and Society*, 52, p.101800.

All reports are available on the iSCAPE project website: www.iscapeproject.eu

Impressum

Acknowledgements and Disclaimer

Author of this Policy Brief is Ms Katinka Schaaf from Future Cities Catapult, with support of Mr Francesco Molinari.

Policy brief coordination by: Ms Ines Vaittinen ENoLL - European Network of Living Labs; final editing and design by: T6 Ecosystems S.r.l.

For further information regarding this document, please contact: francesco.pilla@ucd.ie.

The content in this leaflet reflects the author's views. The European Commission is not liable for any use that may be made of the information contained therein.

The iSCAPE project

iSCAPE aimed to reduce urban air pollution and the negative impacts of climate change by leveraging sustainable passive control systems, behavioural change initiatives and the Living Lab approach.

For more information: www.iscapeproject.eu.

iSCAPE partners:

University College Dublin



University of Bologna



University of Surrey



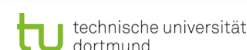
Finnish Meteorological Institute



Hasselt University



TU Dortmund University



JRC - Joint Research Centre - European Commission - Institute for Environment & Sustainability



Institute for Advanced Architecture of Catalonia - FabLab Barcelona



T6 Ecosystems S.r.l.



Nanoair Solutions S.r.l.



Future Cities Catapult Ltd.



Dublin City Council



Regional Agency for Prevention, Environment and Energy of Emilia-Romagna



European Network of Living Labs



Trinity College Dublin



Smart Control of Air Pollution - Policy Briefs

The Smart Control of Air Pollution - Policy Briefs series summarises key outcomes of the iSCAPE project with a clear policy orientation, to provide practical information to EU local decision-makers and other urban stakeholders. They cover the following topics:

- No. 1** Living Labs for air pollution control and prevention
- No. 2** iSCAPE manifesto for citizen engagement in science and policy
- No. 3** Effectiveness of travel behavioural change interventions
- No. 4** Simulating change in urban air quality and climate conditions
- No. 5** Urban strategies and interventions for planning healthier cities
- No. 6** Improving air quality and climate with green infrastructure
- No. 7** Air quality sensing and real time reporting in cities
- No. 8** Introducing infrastructural passive control systems in cities
- No. 9** Citizen Science: a collaborative approach to air pollution control