iSCAPE
Living Labs

D4.7

Citizen Science Communities Report

May 2019

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Main Authors	Katinka Schaaf (FCC)	
Partner in Charge	Future Cities Catapult (FCC)	
Contributing Partners	University of Bologna (UNIBO), Technical University of Dortmund (TUDO), University of Surrey (UoS), Hasselt University (UH), Finnish Meteorological Institute (FMI), University College Dublin (UCD)	
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Short Description	This report outlines the citizen science activities (dissemination, engagement, research and collaboration) undertaken by the six Living Labs (LL) with a variety of stakeholders. The activities started in September 2018 and aimed to create awareness of, and educate the wider public about air pollution. The goal was to develop a citizen science community and utilize/test the Smart Citizen Kit (low-cost air quality sensors) with the public. This report has been produced as part of the WP4 and forms the deliverable D4.7.		
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0.3	24 May 2019	Katinka Schaaf (FCC)	Final version for acceptance and submission

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List of Abbreviations

ARPAE:	Agenzia Regionale Per La Prevenzione, L'ambientee L'energia Dell'emilia-Romagna (Regional Agency for Prevention, Environment and Energy of Emilia-Romagna)
CS:	Citizen Science
ENoLL:	European Network of Living Labs
EU:	European Union
FCC:	Future Cities Catapult (since 1st April 2019 Connected Places Catapult)
FMI:	Finnish Meteorological Institute
GA:	Grant Agreement
iSCAPE:	Improving the Smart Control of Air Pollution in European cities
IAAC:	Institute for Advanced Architecture of Catalonia
LBW:	Low Boundary Wall
LL:	Living Lab
SCK:	Smart Citizen Kit
TCD:	Trinity College Dublin
T:	Task
TUDO:	Technical University Dortmund
UCD:	University College Dublin
UH:	Universiteit Hasselt
UNIBO:	University of Bologna
UoS:	University of Surrey
VLL:	Virtual Living Lab
WP:	Work Package

Executive Summary

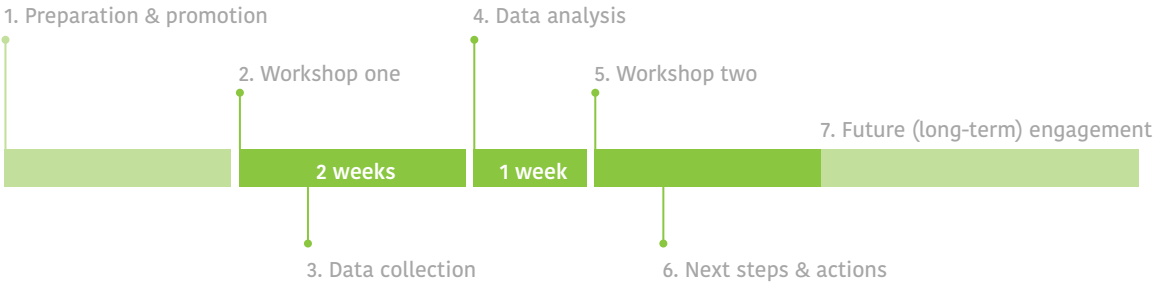
This report outlines the Citizen Science (CS) activities undertaken by the six iSCAPE Living Labs (LLs) with a variety of local stakeholders. The LLs followed a CS Framework that was developed by the managing partner, Future Cities Catapult (FCC), and resulted in two CS workshops in each city with 'citizen scientists'. We had total of 143 registrations and approximately 93 participants across the six LL cities. The goal of the workshops was to engage with the public as well as to establish a CS community.

Interactive training, delivered by FCC, was provided for the LLs during the Hasselt Summer School as well as at the Bottrop iSCAPE consortium meeting in September 2018. FCC provided further support to the LLs by holding weekly catch-up calls during the CS delivery phase. This approach enabled the LLs to share learnings, constructive feedback and get support when needed.

The short-term goal was to educate the LLs and the general public about CS, to use and test the Smart Citizen Kits (SCK) – low-costs air quality sensors – and build an air quality monitoring community motivated to influence and change local policies around air pollution. The long-term objective is to have citizen scientists actively working and collaborating with the LLs, from working on their self-initiated projects to assisting the LL.

This report is built around the seven steps that made up the iSCAPE CS framework:
1. Preparation and promotion of the CS workshops, 2. Delivering the first workshop, followed by 3. Citizen scientists collecting data and 4. iSCAPE data scientists analyse and visualise data sets. After that 5. Delivering of the second workshop where the teams analysed their data and developed engaging stories, subsequently 6. Discussing and planning next steps for the CS community and finally 7. Long-term future engagement with the community.

Figure 1: High-level outline of the iSCAPE CS framework: two workshops with data collection and visualisation in between.



Close collaboration with the technical partner IAAC (Institute for Advanced Architecture of Catalonia) allowed a smooth process of analysing the data and creating relevant data visualisations for the citizen scientists.

FCC supported each LL in the process of delivering the workshops and documenting the process undertaken by the citizen scientists. LLs completed CS reflection templates a well as collecting participant feedback after each workshop. An iterative approach allowed the LLs and FCC to adjust and improve the framework along the way. A revised version of the methods and workshop structure will be made available to the public via the iSCAPE website, at public events and conferences. This report (D4.7) summarises all the work around CS (see full iSCAPE CS Pack in appendix). All of which should provide valuable guidance and starting point for LLs who intend to use CS in their citizen engagement and/or research approach.

1. Introduction to the Report

Work package and task reference: WP4 - Location-based framework and deployment of behavioural solutions – the report shares detailed findings from the CS (citizen science) workshops that could influence policy change (GA). Task 4.4 (T4.4) - Engaging local stakeholders through workshops and developing local citizen science communities.

1.1 What is citizen science?

There is no universally accepted definition of CS. Two of the most often quoted definitions are presented below:

Both definitions clearly emphasise the importance of the involvement of non-scientists drawn from the general public. The iSCAPE CS workshop, specially created for T4.4, is a tool by which the LLs can engage the local community (the non-scientists) and so build an iSCAPE LL community around the issue of air quality.[1, 2]

In 2004, Bruce Lewenstein of Cornell University outlined a three-part definition of CS :

"1. The participation of non-scientists in the process of gathering data according to specific scientific protocols and in the process of using and interpreting that data;

2. The engagement of non-scientists in true decision-making about policy issues that have technical or scientific components; and

3. The engagement of research scientists in the democratic and policy process."

In 2013, the Green Paper on CS (citizen science) suggested that:

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

1.2 Why it's relevant for iSCAPE

The aim of CS is to undertake research and discovery which involves active and thoughtful contributions from non-scientists. Their contribution is often realised during crowd-sourcing, data analysis and data collection. They can contribute because the research tasks are broken down into digestible components that anyone can perform. The participation of the public in these projects demonstrate that 'everyday' people want and can make a contribution to science.

1: CitizenScienceCenter: http://www.citizensciencecenter.com/about-citizen-science/
2: The Conversation Blog: https://theconversation.com/explainer-what-is-citizen-science-16487

1.3 What are the iSCAPE Smart Citizen Kits

The iSCAPE Smart Citizen Kit (SCK) is a low-cost urban air-quality sensor, the first version of which was crowd-funded by a Kickstarter campaign[3] lead by the Barcelona Fab Lab/IAAC in 2013. SCK 2.0 was made available to citizens and the LLs for the iSCAPE project in 2018. Its use during the iSCAPE project has directly contributed to SCK 2.1, which is now commercially available. The importance of the iSCAPE project to the development will be highlighted on the SCK website[4].

The SCK is described in iSCAPE (GA) as follows:

> **"The key hardware development will be a low-cost urban air quality sensor kit based on the previous work and experience acquired on the design of the SCK. SCK will include the following sensors: NO2, CO, O3, PM2.5 and PM10, Noise, Temperature, Humidity, Light, WiFi density."**

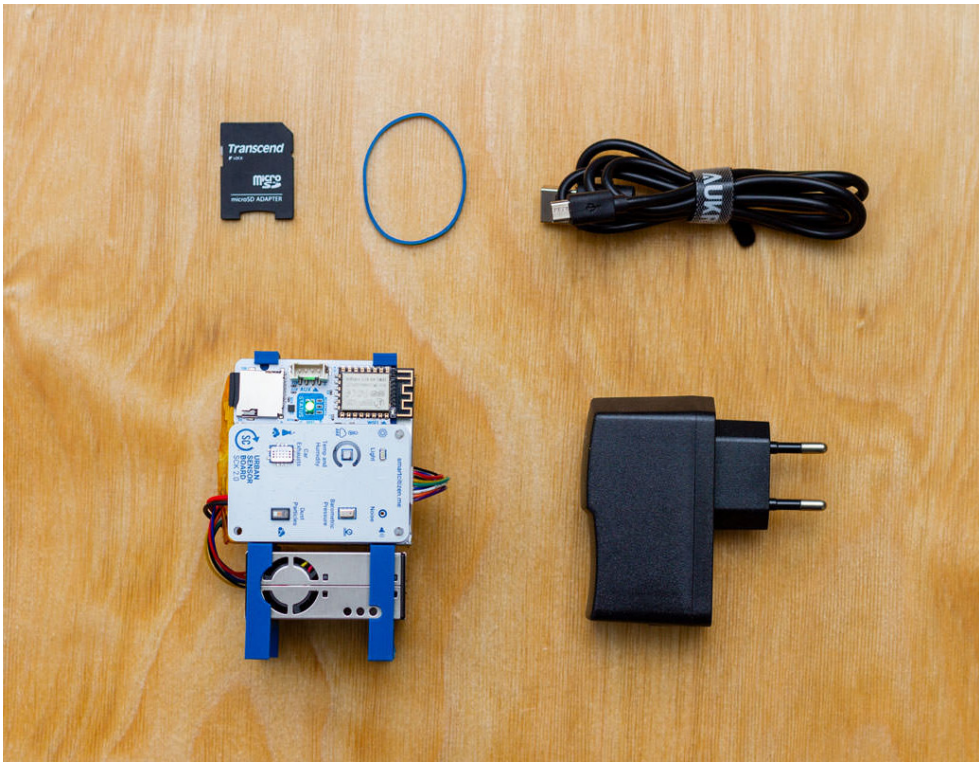


Figure 2: Smart Citizen Kit 2.0 with particle sensor and battery with two mounting brackets, MicroSD card and microSD adapter to SD, USB cable and a USB charger to charge the battery.

3: https://www.kickstarter.com/projects/acrobotic/the-smart-citizen-kit-crowdsourced-environmental-m
4. https://smartcitizen.me/

1.5 Aims and objectives

This report (D4.7), details the work for WP4/T4.4 which focuses on behavioural solutions and policy change in relation to CS and the establishing of CS communities in each of the Living Labs (LLs). Below is a description of the aims for T4.4.

Aims (T4.4)

1. Engage local citizens, businesses, authorities and researchers in exploring policy options and measures analysed in previous tasks.
2. Follow the 'teaching and showing' approach that creates awareness and enhances behaviours change amongst city stakeholders.
3. CS workshop (two in each LL city) findings will inform technical interface design of the sensing kits and recommend how to influence policy changes.
4. Two summer schools were held in Hasselt, were consortium members shared their learnings and presented their work to a diverse audience.

1.6 The aims of T4.4/D4.7 were achieved through the following:

Creating the iSCAPE CS Framework

The first step in delivering a total of 12 workshops (two CS workshops in each of the LL cities), was to create an iSCAPE specific CS framework (detailed in chapter 2), that ensured consistency across the cities and was easily configurable by non-experts/aspiring facilitators. The framework included the very comprehensive 'iSCAPE CS Pack' (see appendix), fully designed worksheets for both sessions, pre-designed PowerPoint slides and agendas.

Training and dry run prior to the workshops

Before the CS workshop phase, FCC organised a dry-run in the form of a mini CS session at the Hasselt summer school on 17-18 September 2018, the participants of which comprised of students, iSCAPE partners and citizens (some with a background in CS and/or air quality). Further, at the iSCAPE consortium meeting Bottrop on 19-21 September 2018, an introduction and run through of the essential steps followed by a Q&A session was held for the LL leads.

Engaging with the public

Prior to the CS workshops, FCC, T6 and each of the LLs disseminated/communicated information about the iSCAPE CS workshop on the iSCAPE social network channels, as well as on local online and offline communication channels. The LLs reached out to suitable audiences such as cycling groups, urban garden societies etc., and encouraged them to join the workshops.

LL management through weekly/bi-weekly catch-up calls

Together with IAAC and T6, FCC supported the LLs during their CS journey. Through regular phone calls the LL teams were trained on every stage in the preparation of the CS workshops. During the catch-up calls we discussed recruitment, planning of the two CS workshops, explaining the stages and the rationale behind them, and holding Q&A sessions about sensor usage with the technical support from IAAC team. These catch-ups were a useful, positive time for the LLs to share doubts and successes.

Data analysis and data visualisations

In between the two CS workshops in each city, two important activities took place; data collection by the citizen scientists (who were well supported by the LLs) and the creation of data visualisations for the second workshop. Data scientists from IAAC and FCC analysed and collaboratively developed a set of visualisations (see page 24) which were then shared with the LLs (focus on utilising low-cost sensor data to encourage behaviour change and influence policies).

Outcome documentation and CS reflection templates

As the FCC team did not directly participate in the CS workshops, it was decided that the best way to capture learnings was through a reflection sheet, where the LLs reported learnings, successes and areas for improving the CS approach. A reflection document was filled out by every LL after the completion of each workshop. Additionally each LL reported / documented the following:

- T6 socio and economic impact assessment (see appendix)
- Feedback about the sensors and the SCK platform - constantly improving their services and products (part of T6 questionnaire)
- Photographs from both CS workshops and scanning (digitising) of worksheets and outcomes

Technical aspects, the low-cost sensors – Smart Citizen Kits

The CS process informed the technical partner (IAAC) on how to improve their online communication/guidance, hardware components and potential interface design (see smart citizen FAQ and platform[5]).

5: https://docs.smartcitizen.me/_FAQ/

2. Methodologies - The iSCAPE CS Framework

This chapter gives a detailed overview of the iSCAPE CS Framework, its structure and methods used by the iSCAPE LLs.

Each LL had to deliver a minimum of two CS workshops in their city. Given this specific requirement, limited CS experience and the yet-to-be-established CS communities for each of the six LLs, we had to start from the very beginning.

2.1 The iSCAPE CS Pack

As there was the need to start at the beginning that FCC created the Citizen Science Pack (see figure 3 and appendix) for the LLs. The CS Pack was seen as the best way to prepare the LLs as thoroughly as possible for the upcoming CS engagement (including the two CS workshops). The CS Pack, embodied the iSCAPE CS framework and supported the LLs with co-creation/facilitation and technical support throughout the engagement period e.g. the pack explained 'how to deliver a successful workshop' and highlighted 'how to motivate participants to stay engaged throughout'.

The iSCAPE CS workshops were structured into two sessions: 'Sensing your City – CS Workshop 1.' 'Understand Your Data – CS Workshop 2.'

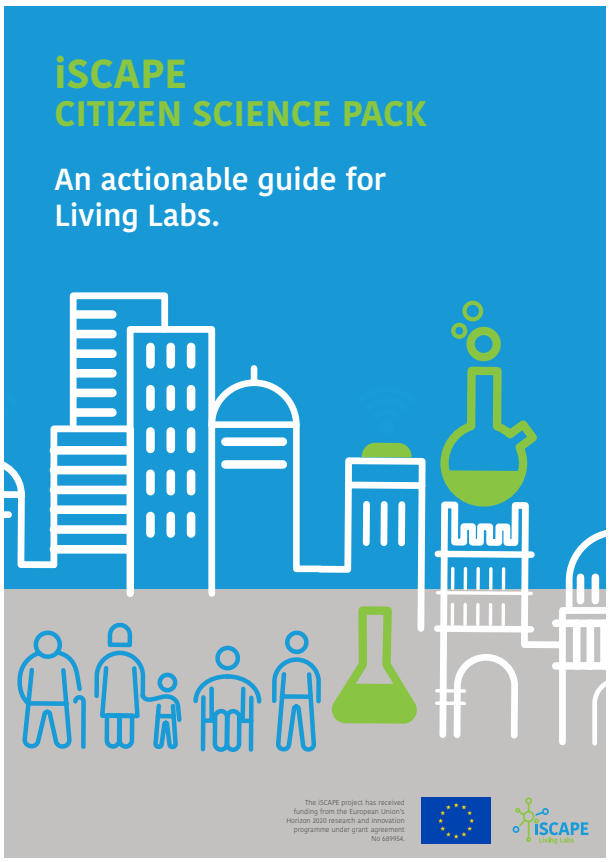
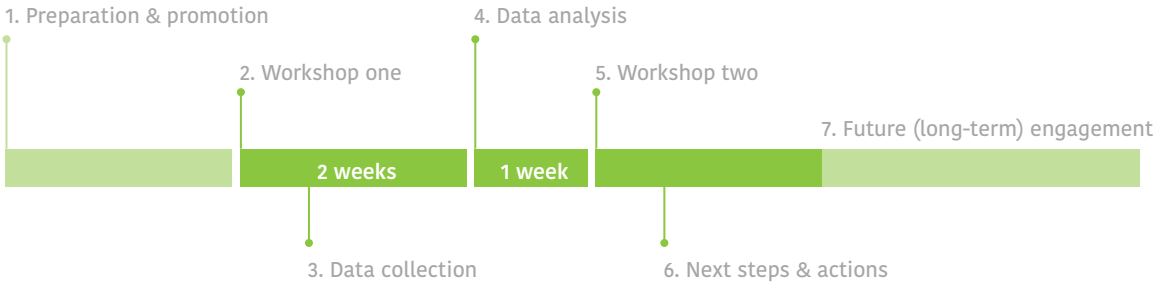


Figure 3: shows the cover of the iSCAPE CS Pack that was solely developed for the 12 CS iSCAPE workshops that took place between November 2018 and February 2019.

Seven steps of the iSCAPE CS framework

Overall, the iSCAPE framework is made up of seven steps and can be delivered with a timeframe of 2-3 months (see figure 1.2). The CS approach can easily extend beyond the two CS workshops undertaken by each LL, as the process can be repeated and iterated based on learnings and engagement of the citizens taking part.

Figure 1.2: High-level outline of the iSCAPE CS framework: two workshops with data collection and visualisation in between.



The steps of the framework are as follows:

1. Preparation and promotion of the CS workshops
2. Delivering the first workshop – On-boarding | Planning | Sensing part 1
3. Data collection (support of the teams during the data collection)
4. Data analysis and visualisation
5. Delivering the second workshop – Sensing part 2 | Awareness | Action | Reflection
6. Discussing and planning next steps for the CS community and LL
7. Future engagement and facilitation of potential CS activities

Figure 4: Showing the citizen scientists setting up the sensors during the first CS workshop in Hasselt.

2.2 Step 1. Preparation and promotion of the CS workshops

Delivering the two CS workshops in a short timeframe and with limited resources, was a major source of pressure for the LLs. The crucial question that the LLs needed to answer was: how to reach and recruit a suitable audience that is both interested and motivated to engage with the LL for a minimum of one months (two workshops)?

The three golden workshop rules

Within the CS pack, the managing partner, FCC, provided various guides, tips and recommendations for the LLs. Below are the three golden workshop rules (taken directly from the CS Pack):

1. **Easy to attend** – Everyone is busy all the time, having the workshop at a place that is easy to reach and at a time that is suitable will increase the number and variety of participants.
2. **Fun and entertaining** – The participants are probably studying or working full time, the workshop should show them something they didn't know or teach them a new skill.
3. **Memorable so people come back** – If the events stay in people's mind, they will talk about it to others which promotes iSCAPE and the individual LL! This also means they will return to the second or even third round of the CS workshops.

CS Workshop in Dublin

When and where should the workshop take place?

The LLs were also provided with more practical guidance with respect to workshops (see below, taken directly from the CS Pack):

The time and participants

It is recommended that workshops run in the evening between 5pm and 8pm. This is likely to offer greater flexibility for a broader range of citizens to attend. However, this time should also reflect local customs. LLs are encouraged to have a good balance and variety of participants that draws from businesses, local authorities, researchers as well as citizens.

The space

An inspection of the venue ahead of the workshop is also recommended – it's important to create an inviting space that is warm, bright enough and not too noisy to do this work. The chosen venue should also offer enough seating, tables, and materials to do the work – it's always better to have more than is needed than not enough. Accessibility is another essential consideration – is the venue a challenge to reach for those travelling without a car? Especially if the workshop is considering a topic like air pollution, it would make sense (wherever possible) to find a venue with a nearby train station or bus stop so participants can be actively encouraged to not use their cars. Collaboration with a local theatre, library or school with available space is frequently a good option.

2.3 Promotion and social media

T6 and FCC supported the LLs with the recruitment and communication before, during and after the CS workshops, this happened via Eventbrite and Twitter (see figures 5-8).

Figure 5: Screenshot of the Vantaa Living Lab lead, Antti Makela, shares the CS workshop Eventbrite link. The iSCAPE Twitter account re-tweeted the post and it contributed to one of the highest impressions over a 91 day period.

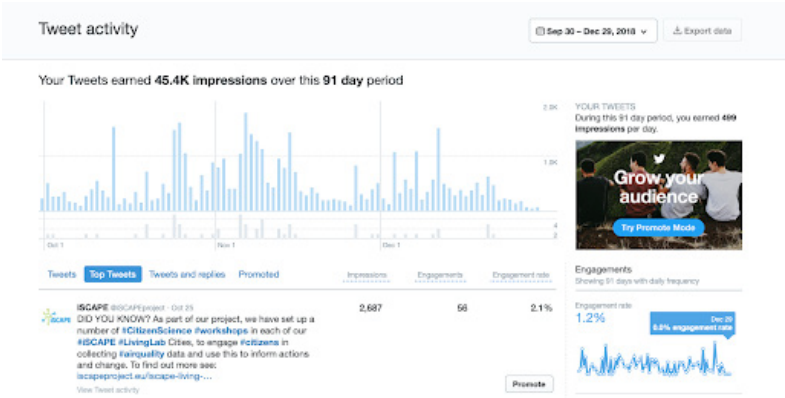
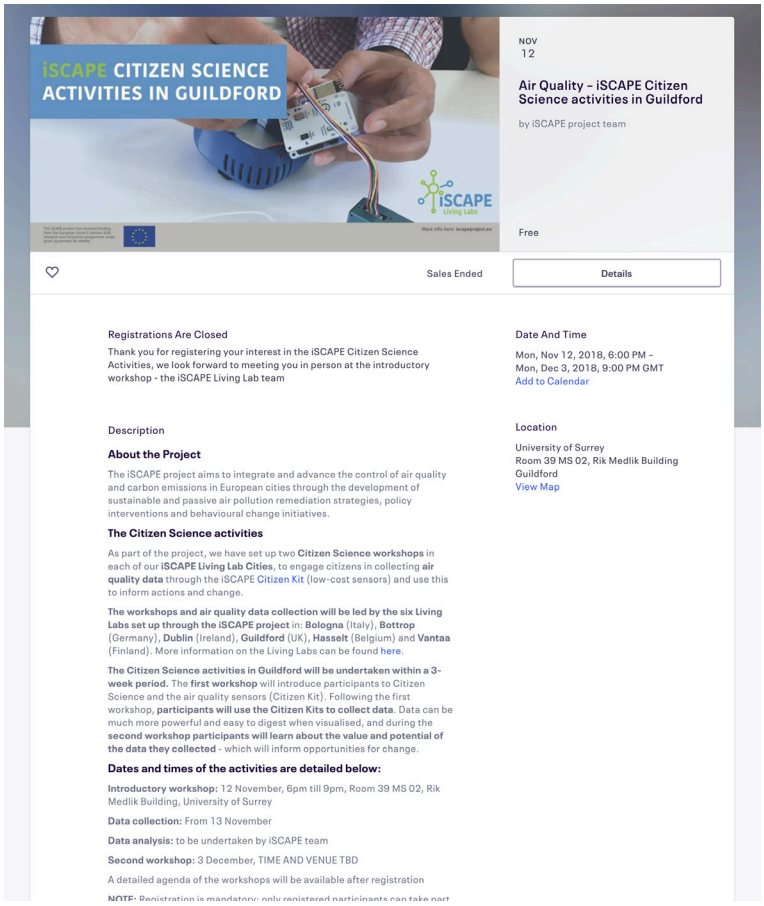


Figure 6: Twitter analytics shows the most active and highest impressions during the CS workshop period.

Figure 7: After each workshop iSCAPE tweeted and re-tweeted about the CS workshops.

Figure 8: Four out of six LL had their own Eventbrite page[6] which allowed the organisers to track the number of sign-ups, share location and time and easily communicate updates.



6: https://www.eventbrite.co.uk/e/air-quality-iscape-citizen-science-activities-in-guildford-tickets-51397566505

2.4 Step 2. Delivering the first workshop

The first workshop was the foundation on which the CS engagement was based and involved a lot of information being passed onto the participants. The LLs had to introduce the iSCAPE project, their LL and its work, the use of CS in relation to air quality and the Smart Citizen Kit. It was also imperative that the workshop prepared the citizen scientists with a solid plan and structure for their 2 weeks of data collection on which the second workshop would be based.

To help the LLs, FCC provided a workshop structure (in the CS Pack) that eased the citizen scientists into CS and the subject area, introduced the low-cost sensor and encouraged a mindset for thinking about air pollution in their city. The structure for the first CS workshop was as follows:

Workshop title: Sensing your City – CS Workshop 1

Time:	Approx. 3 hours
Approach / methods:	On-Boarding | Planning | Sensing part 1
Number of participants:	minimum 13 - maximum of 20 participants
Recommended time:	17:00 - 20:00

Agenda - Workshop 1

Arrival and networking	Should start 30 Min before the actual event
Warm-up exercise	Draw your air quality superhero (5 - 10 Min)
Presentation	Introduction to CS (15 Min)
Empathy mapping	Effects of air pollution (30 Min)
Get to know your Citizen Kit	Introduction to the sensor kit (20 Min)
Sensing checklist	Plan your data collection! (30 Min)
Data advice	Plan your data collection! (30 Min)
Closing of the Session	Final recommedndation (10 Min)
	Questions and what's next (15 Min)
Gather feedback	Online and offline (20 Min)

CS Workshop in Guildford.

2.5 Warm-up exercise – Draw your Air Quality Superhero

This exercise helped to put the participants into an appropriate, open mindset and made them think differently about 'how to control or tackle air polluted areas within their city'.

The LLs made clear that drawing did not need to look 'professional' – it's purpose was purely to activate creative thinking in readiness for the subject area. As well as improved creativity, drawing helps facilitate improved memory, communication skills and, most importantly, problem solving skills. It is also a fun way to engage participants, and helps communicate the idea that their motivation to initiate change and take part in the iSCAPE CS workshop makes them all 'air quality superheroes'.

AIR QUALITY SUPERHEROES

1. Everyone has a skill-based superpower, how could you use this to control air pollution? (The facilitators will give you some examples about their superpower).
2. Think about your skills and abilities.
3. Draw your superpower. (5 min)
4. Stick your drawing on the wall. Use the wall for networking and meet people with interesting skills.

Workshop 1

Your alter ego

Draw your air quality superpower

What is your superhero alter ego? (Write it on the top of your sheet)

What air pollution challenge do you want to solve?

Real name: .....

The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

Figure 9: Air Quality Superheroes exercise.

2.6 Team-building exercise – Empathy Mapping

To gain a better understanding of cities and citizens affected by air pollution, the exercise encouraged the citizen scientists to consider different types of participants:

- Those aware of the issue of air pollution and already active in tackling the issue.
- Those aware of the issue, but lacking direct experience of the issue as air quality in their city is very good.

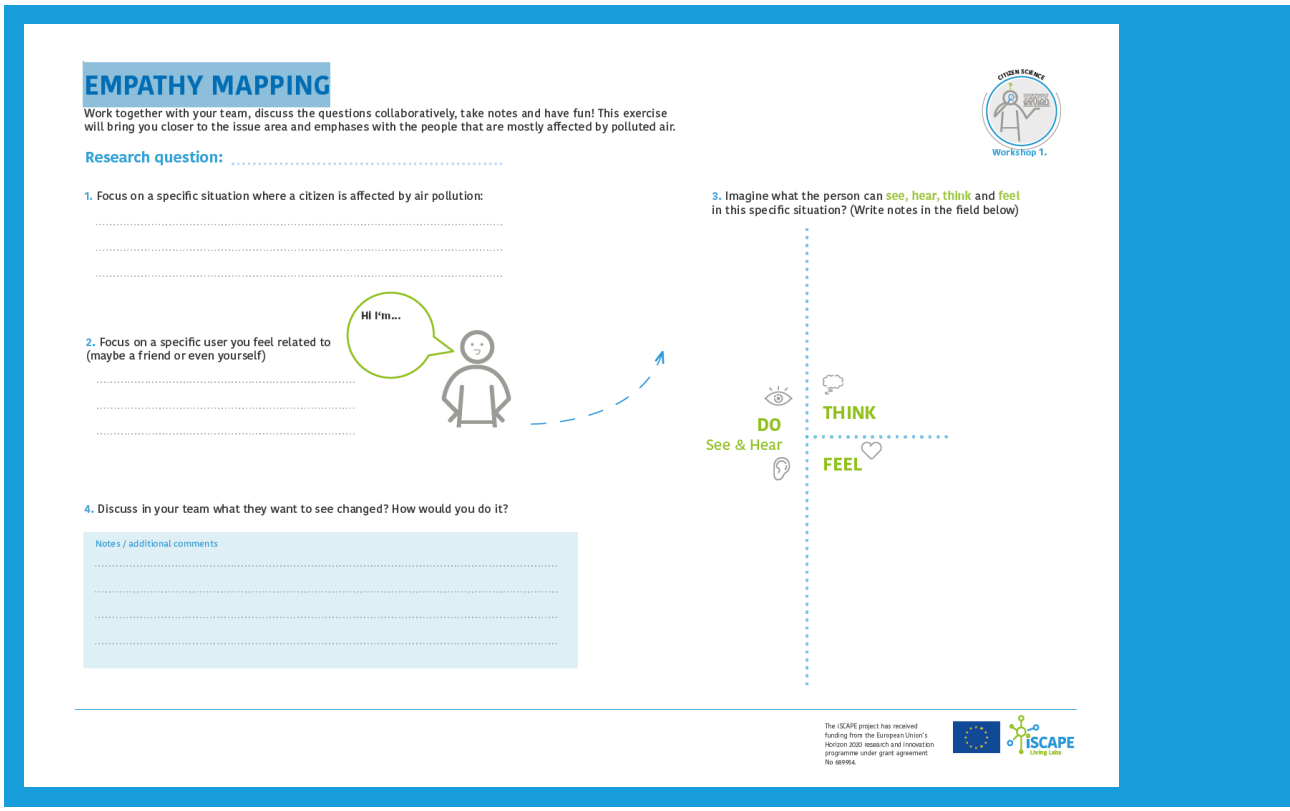
For CS workshops to work best, it was important that participants were engaged in the subject area, with some personal experience of air quality issues or awareness of specific examples/relevant research studies.

Empathy mapping helped participants understand different situations and helped them empathise with those most affected by city air pollution, such as young children, older people, people with asthma and other lung related illnesses that impact breathing.

The Empathy Map (see figure 8) and Sensing Checklist (see figure 9) presented two research questions (only two questions were posed to the citizen scientists during the CS engagement period):

- **Should the location of a bus stop take into account nearby traffic light systems?**
- **Where are the air pollution hot-spots in your city? Where are citizens mostly exposed?**

Figure 10: Empathy Map worksheet

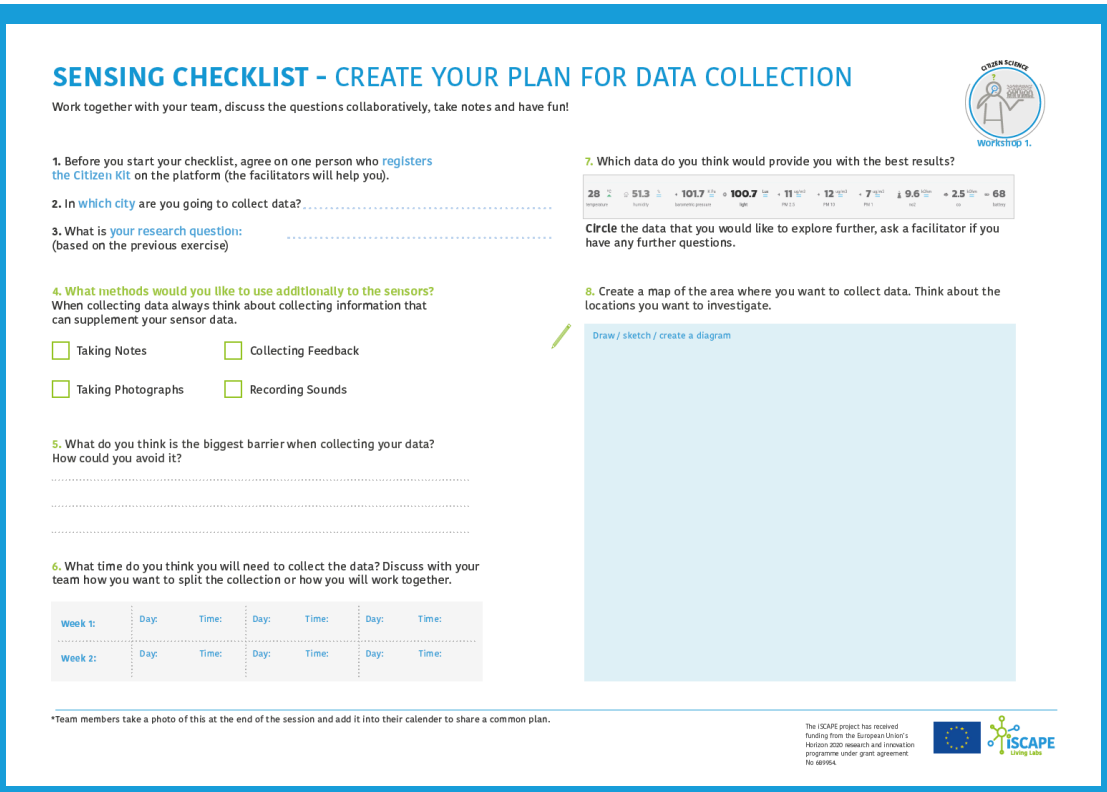


2.7 Sensing Checklist – Planning data collection

The Empathy Mapping exercise helped participants to gain a better understanding of specific situations, areas and times when air quality impacts citizens. The chosen research question, and an understanding of the subject area, determined what kind of data collection (beside the sensors) the participants chose and what tools or methods to apply.

Whilst participants filled out the 'Sensing Checklist' (see figure 9) – planning their data collection, it was important that facilitators reminded them to work collaboratively and plan their sensing phase around their usual daily responsibilities (e.g. work, university, family). At the end of the workshop, the teams presented their 'Sensing Checklist' to each other. The facilitators shared tips about collecting information that can supplement the sensor data e.g. taking notes, collecting feedback, recording sounds or taking photographs.

Figure 11: Sensing Checklist worskheet



SENSING CHECKLIST - CREATE YOUR PLAN FOR DATA COLLECTION

Work together with your team, discuss the questions collaboratively, take notes and have fun!

Workshop 1.

1. Before you start your checklist, agree on one person who registers the Citizen Kit on the platform (the facilitators will help you).

2. In which city are you going to collect data? .....

3. What is your research question: .....
(based on the previous exercise)

4. What methods would you like to use additionally to the sensors?
When collecting data always think about collecting information that can supplement your sensor data.

- [ ] Taking Notes
- [ ] Collecting Feedback
- [ ] Taking Photographs
- [ ] Recording Sounds

5. What do you think is the biggest barrier when collecting your data? How could you avoid it?

.....

.....

.....

6. What time do you think you will need to collect the data? Discuss with your team how you want to split the collection or how you will work together.

Week 1:	Day:	Time:	Day:	Time:	Day:	Time:
Week 2:	Day:	Time:	Day:	Time:	Day:	Time:

7. Which data do you think would provide you with the best results?

28	51.3	101.7	100.7	11	12	7	9.6	2.5	68
temperature	humidity	barometric pressure	light	PM 2.5	PM 10	PM 1	NO2	CO	battery

Circle the data that you would like to explore further, ask a facilitator if you have any further questions.

8. Create a map of the area where you want to collect data. Think about the locations you want to investigate.

Draw / sketch / create a diagram

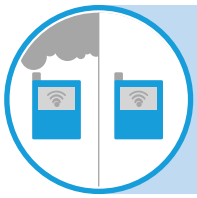
*Team members take a photo of this at the end of the session and add it into their calender to share a common plan.

The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689984.

CS Workshop in Hasselt

2.8 Best practice for successful data collection

Practical tips for successful data collection were presented (see below, taken directly from the CS Pack):



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.

2.9 Step 3. Data collection – providing support during the data collection phase

After the first workshop, the teams or individual citizen scientists started collecting data. As well as collecting air pollution data (NO2, CO, O3, PM2.5 and PM10, Noise, Temperature, Humidity, Light), the citizen scientists were encouraged to take pictures, write notes and talk to people in the area.

Each LL started on a different day, which allowed for increased learning, iteration and problem solving between the LLs during weekly group catch-up calls. Most LLs experienced minor issues with the sensors, which were solved through individual catch-up calls with IAAC. Many participants also had minor difficulties during data collection, providing each LL a further touchpoint with their CS participants, during which the LL could provide support uploading data, checking the suitability of the data and answering upcoming/open questions.

2.10 Step 4. Data analysis and visualisation

Prior to the secomd round of CS workshops, the LL managing partner FCC and data scientists from FCC and IAAC had weekly calls to discuss how to best analyse the data and create suitable visualisations that can be easily understood and used for the storytelling exercise in the second workshop, 'Understanding your Data' (see figure 10 and 11).
The Data Scientists used Python to analyse the air quality data and created two types of visuals using two types of data sets: noise (dBA) and PM 25 for every LL city (see figure 12, 13 and 14).

Data visualisations were created this way:

During the CS workshop phase it was essential to work with a multidisciplinary team, for this reason we collaborated with a data scientist who was able to analyse and visualise the data. Below are some key methodological and technical insights, provided by the FCC data scientist, about setting up and developing the visualisations:

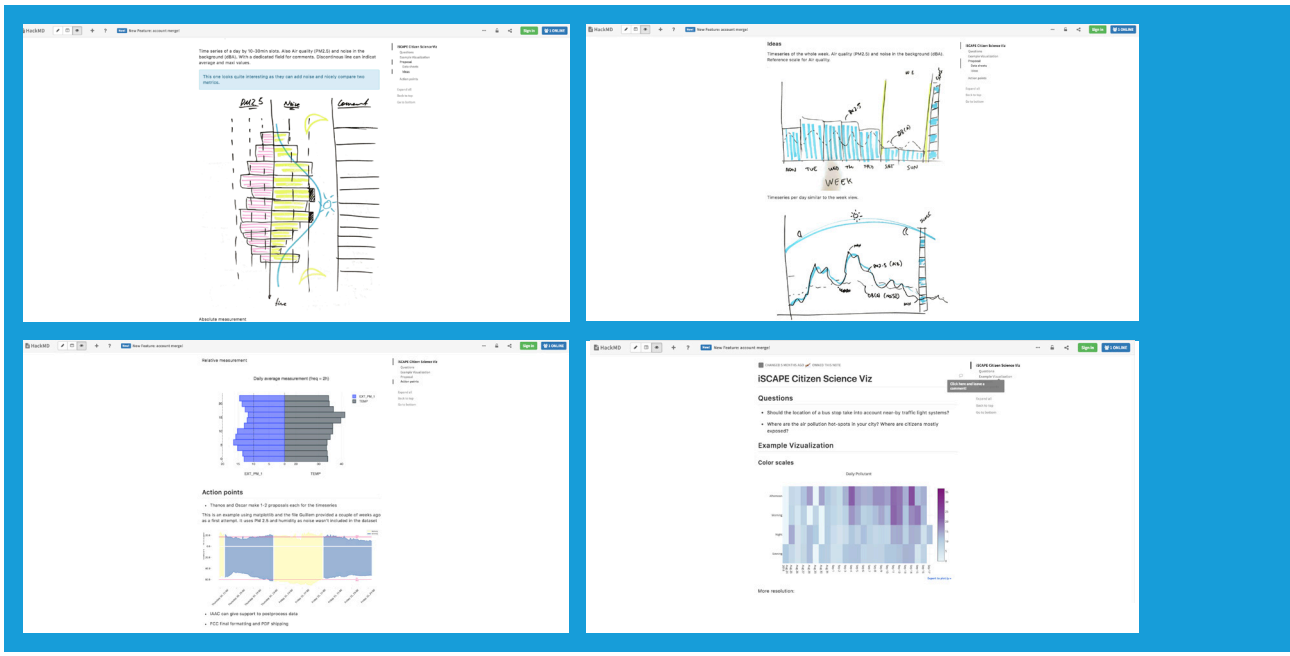


Figure 12: Screenshot of HackMD.io, a platform where IAAC and FCC shared and discussed ideas.

Technical set-up for data visualisations

- **Software** – All data visualisations were created in Python, the codebase for which can be found on GitHub[7].
- **Expertise** – Replicating and running the workflow requires quite a detailed understanding of how the software is coded and deployed. This supporting expertise is available from FCC/IAAC.
- **Open source** – Running the analysis via this open source/GitHub platform is integral to the sensor analysis Frameworks[8] iterative evolution and development. Participants are encouraged to contribute to fablabbcn/smartcitizen-iscape-data development by creating an account on GitHub.
- **Data/sensor management** – A direct correlation was observed between data accuracy and how well sensors were set up and managed. For example, when defining sensor specifications, a robust outlier filtering/data harmonisation process greatly increases the reliability of the data sets captured.

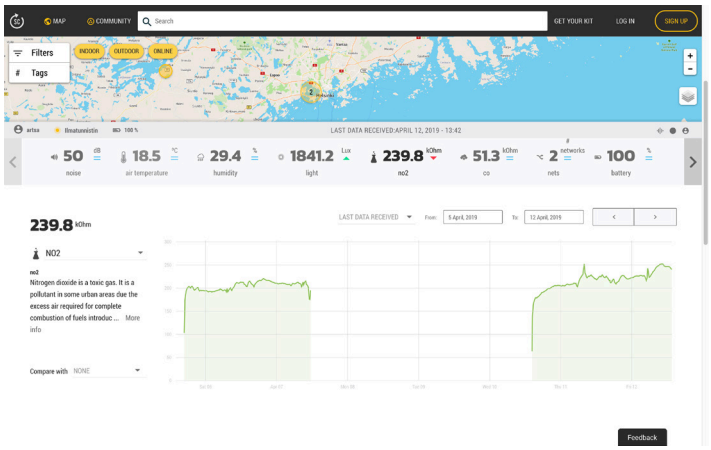


Figure 13: smartcitizen.me platform, the citizen scientists are able to upload and analyse their collected data.

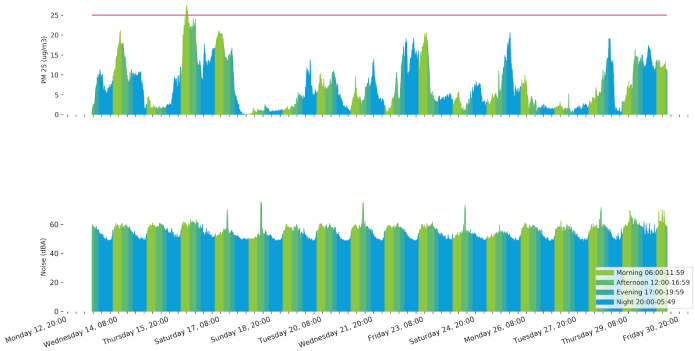


Figure 14: Creating a timescale visualisation using noise (dBA) and PM 25.

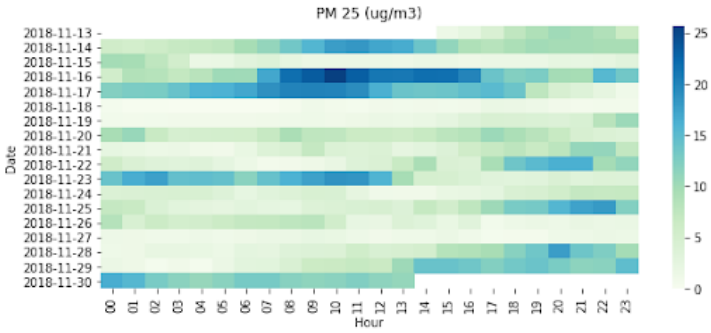


Figure 15: Creating a heatmap using noise (dBA) and PM 25.

7: https://github.com/fablabbcn/smartcitizen-iscape-data/blob/Data_Visualisation_FCC/notebooks/FCC%20Time-series%20Visualisation.ipynb
8: https://github.com/fablabbcn/smartcitizen-iscape-data

Methodological set-up for data visualisation

- **Collaboration** – Data accuracy and texture is always greatly enhanced by increased granular accuracy, and iteration by shared learning and collaboration. One example of where this was particularly impactful in this instance was in project members using Notebook to collaborate in implementing the outlier data smoothing algorithm[9].
- **Reverse engineering** – Before moving ahead, it's always good to look back: does the combination of qualitative findings and data that highlighted gaps in the current understanding of air quality issues? Does it pinpoint data gaps - where data is missing to capture the full scale of the problem? What can we see now that we couldn't see then, and how can we capture that data more accurately?

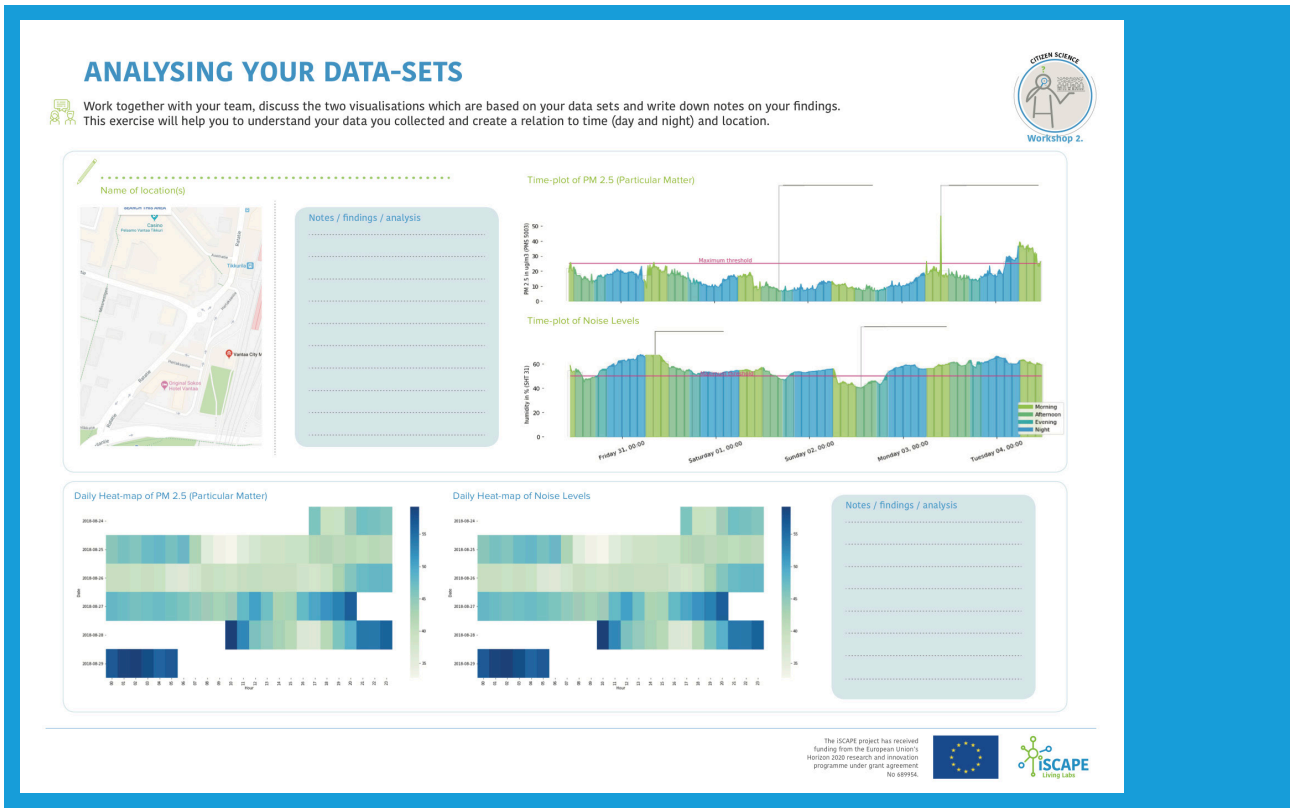


Figure 16: Final data visualisation worksheet.

9: https://github.com/fablabbcn/smartcitizen-iscape-data/blob/master/notebooks/signal_utils.py

2.11 Step 5. Delivering the second workshop

Outline

For the second workshop, LLs welcomed citizen scientists back to view data visualisation worksheets (which had been individually developed for each team of citizen scientists - 99 data worksheets in total).

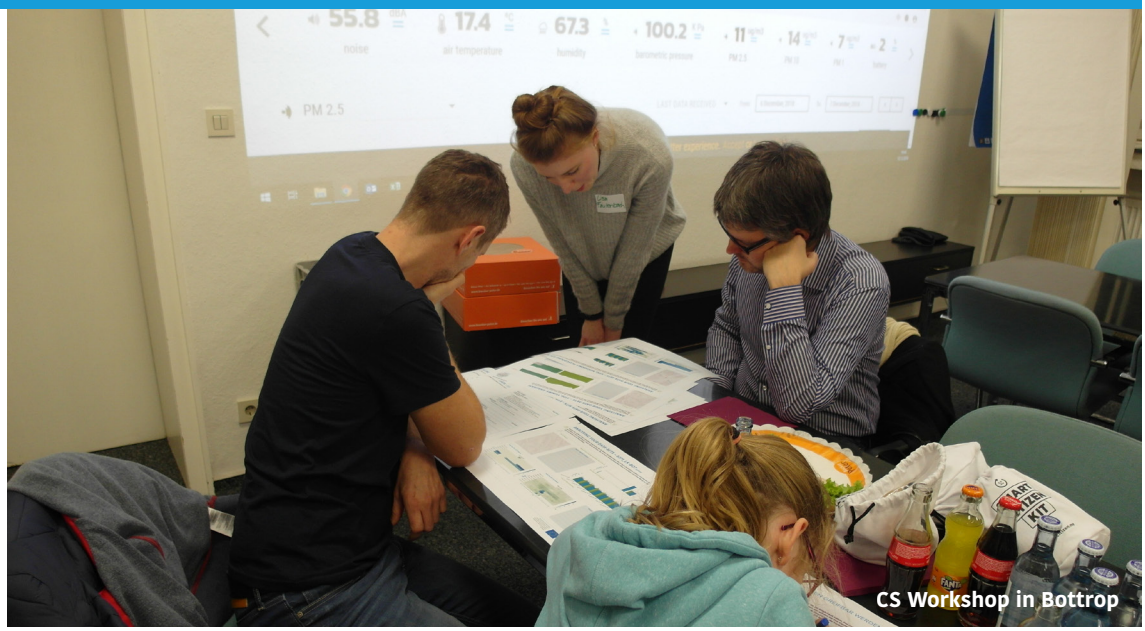
This second LL workshop opened with a summary of how the data scientists had processed the citizen scientist data and why the specific visualisations had been created. The aim of the workshop was to demonstrate the meaning, value and potential of the data the citizen scientists had collected. The workshop followed the structure below (taken directly from the CS Pack):

Workshop title: Understand Your Data – CS Workshop 2

Time:	Approx. 2-3 hours
Approach/ methods:	Sensing part 2 | Awareness | Action | Reflection
Number of participants:	Minimum 13 - maximum 20 participants

Agenda - Workshop 2

Recommended start	17:00 - 20:00
Arrival and networking	Should start 30 Min before the actual event
Introduction	Welcome back and short updates from the data collection (20 Min)
From raw to tangible data	Data awareness and analysing data-sets (30 - 45 Min)
Storytelling through data	Developing a story and presenting (30 - 45 Min)
Closing of the session	Closing and next steps (10 Min)
Gather feedback	Online and offline (20 Min)

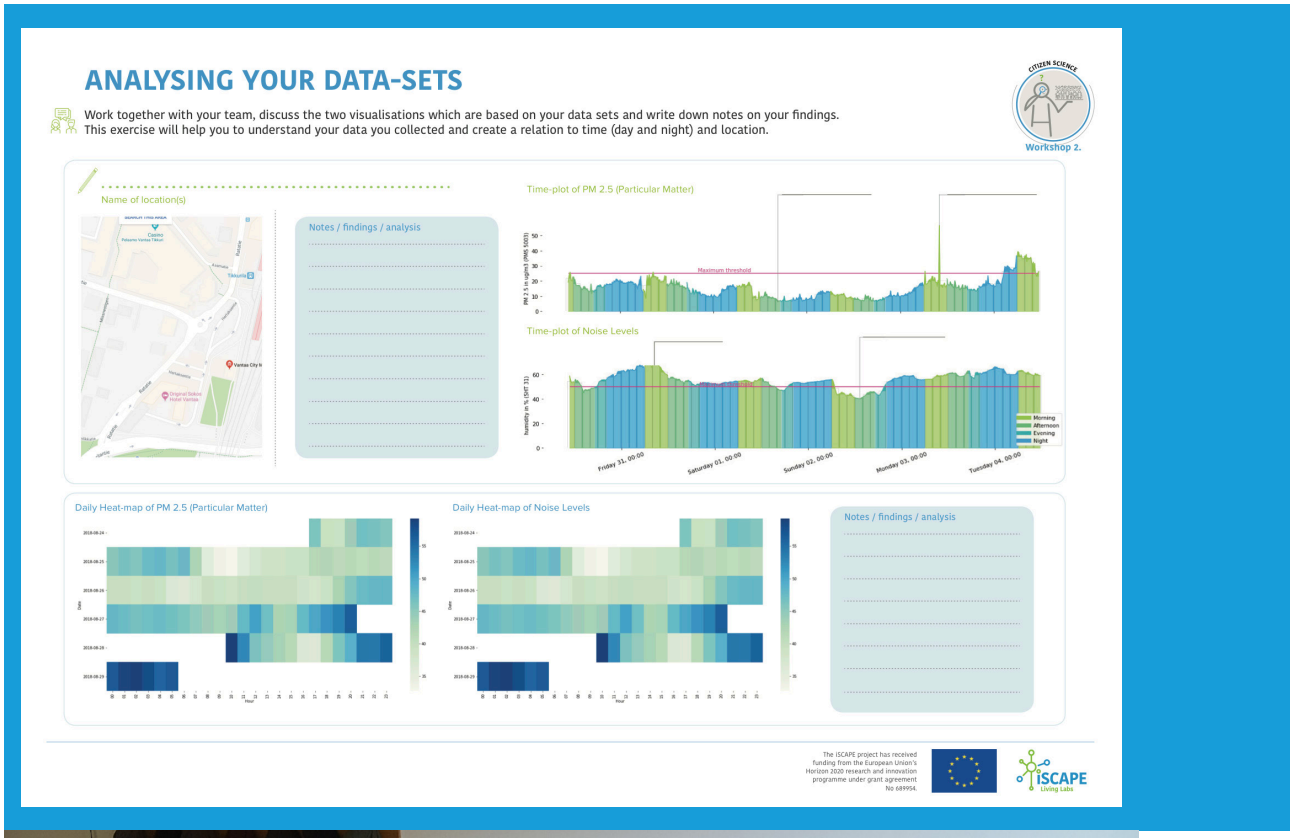


CS Workshop in Bottrop

2.12 Data visualisation worksheet – Analysing Your Data-Sets

In collaboration with IAAC and FCC we cleaned and analysed the data sets for each LL and created visualisations (see page 24 & 25) for more details) this happened 1-2 weeks before the second CS workshop took place. In the second workshop the CS teams analysed their data and compared the times and graphs with their notes and Sensing Checklist.

Figure 17: Analysing your Data-Sets worksheet.




CS Workshop in Bologna

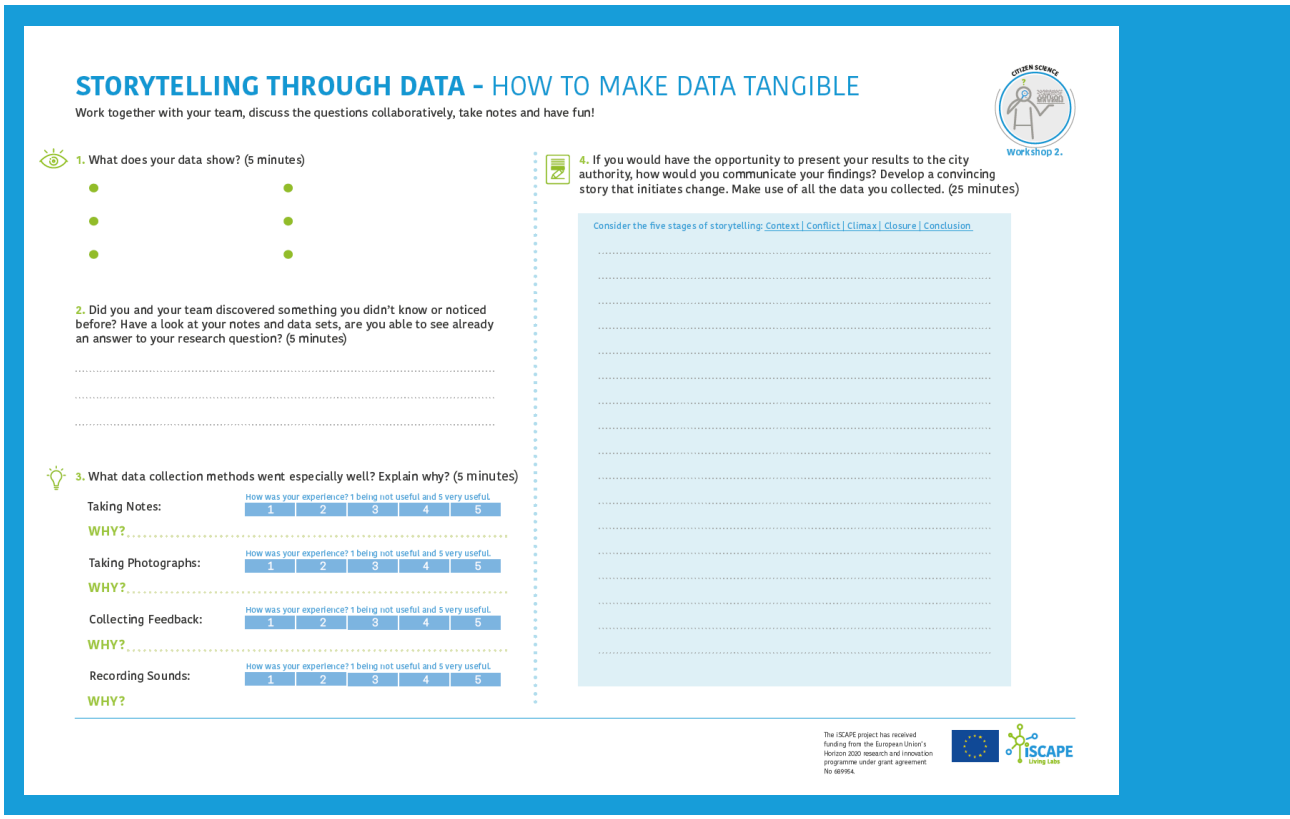
2.13 Proposing potential solutions worksheet – Storytelling Through Data

After the citizen scientists analysed their data visualisation, they started with their final exercise 'Storytelling through Data - How to Make Your Data Tangible', were they had to create a short story of their research activities by using their data visualisations (as well as images and notes they took during the data collection phase). The worksheet asked the following question:

> **"If you would have the opportunity to present your results to the city authority, how would you communicate your findings? Develop a convincing story that initiates change. Make use of all the data you collected."**

At the end of the workshop, the teams presented their stories and action plans. The LL facilitators were encouraged to take notes and prompt the audience for questions after each presentation.

Figure 18: shows the final worksheet Storytelling Through Data.



STORYTELLING THROUGH DATA - HOW TO MAKE DATA TANGIBLE

Work together with your team, discuss the questions collaboratively, take notes and have fun!

workshop 2.

1. What does your data show? (5 minutes)

2. Did you and your team discovered something you didn't know or noticed before? Have a look at your notes and data sets, are you able to see already an answer to your research question? (5 minutes)

3. What data collection methods went especially well? Explain why? (5 minutes)

Taking Notes: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5
WHY?

Taking Photographs: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5
WHY?

Collecting Feedback: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5
WHY?

Recording Sounds: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5
WHY?

4. If you would have the opportunity to present your results to the city authority, how would you communicate your findings? Develop a convincing story that initiates change. Make use of all the data you collected. (25 minutes)

Consider the five stages of storytelling: Context | Conflict | Climax | Closure | Conclusion

The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

3. Outcome and Examples

All of the CS workshops in the six LL cities were successful and ran smoothly due to the comprehensive plan and framework structure. This chapter aims to summarise the outcomes from each workshop stage (note that the LLs documented and archived the workshop outcomes).

3.1 Overview

The majority of LLs reported that the citizen scientists were very engaged in the workshops and excited about the air quality monitoring activities (they often had prior knowledge of monitoring and air quality issues). Some citizen scientists came with clear goals, knowing what they wanted to get out of the iSCAPE CS activities. One common issue reported across the six LL cities was that the less reliable Citizen Kits created data collection issues, especially for in-experienced citizen scientists and facilitators.

For more details about these issues see chapter 5. on learnings. The LLs supported the citizen scientists as much as possible during the data collection phase (including uploading the data sets on the smartcitizen.me[10] platform) and resolved problems.

3.2 Delivering the first workshop

On-Boarding | Planning | Sensing part 1

A detailed outline of iSCAPE CS methods and tools can be found in the methodologies chapter.

Air Quality Superheroes

This warm-up exercise seemed a natural fit for people with a creative background and/or younger generations. The outcomes are fun and the tool proved successful in encouraging conversations between citizen scientists. The results of this exercise do not directly influence the main CS workshop as its focus was to help everyone relax and feel at ease.

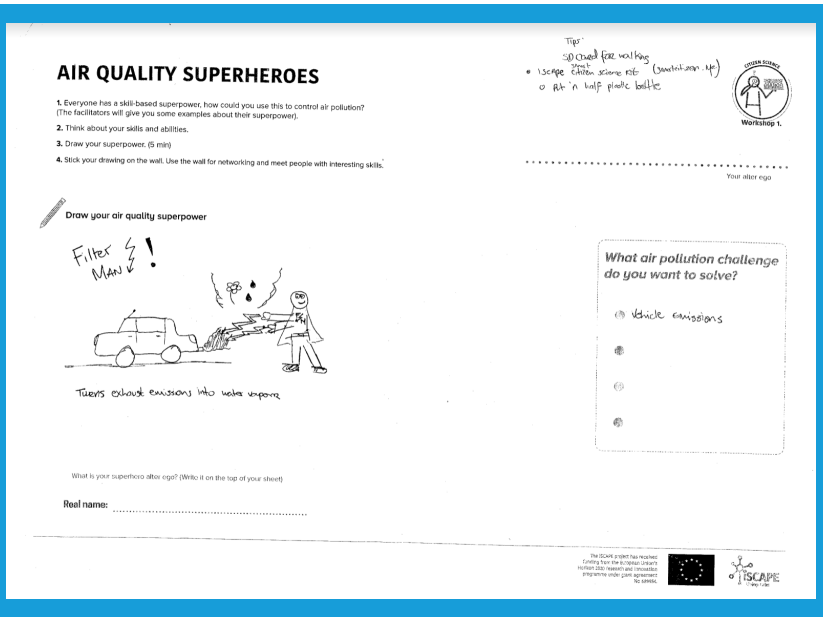


Figure 19: Shows a air quality superhero drawing from a citizen scientists in Dublin LL.

10: https://smartcitizen.me/

Empathy Mapping

Empathy mapping was the first team exercise, citizen scientists often focusing on vulnerable people such as children, the elderly and those with asthma. Commonly imagined situations included a cyclist cycling to work close to the road, a bus stop next to a very noisy and polluted busy road, parents with a toddler in a pushchair, and pedestrians walking along a road.

Exploring what could change to improve air quality, citizen scientist teams came up with options to avoid or minimise the production of air pollutants such as smart traffic lights, better traffic schemes, more public transport options and more affordable electric vehicles. This exercise lead in to the planning of their data collection.

Sensing Checklist – Create your Plan for Data Collection!

A majority of citizen scientists developed very tangible hand drawn maps (see figure 20 - 22) which are helpful when discussing the process of monitoring air quality and future collaboration. Some teams chose the already prepared questions, other came up with their own ones see 3.3 for more details.

The actual data collection that happened between workshop one and two influenced the choice of research questions, the research focus shifted for some groups. The Sensing Checklist helped the teams to frame their interest and allowed them to get an overview of the potential pollutants they could monitor (most used pollutant which was also recommended due to its accuracy was PM2.5).

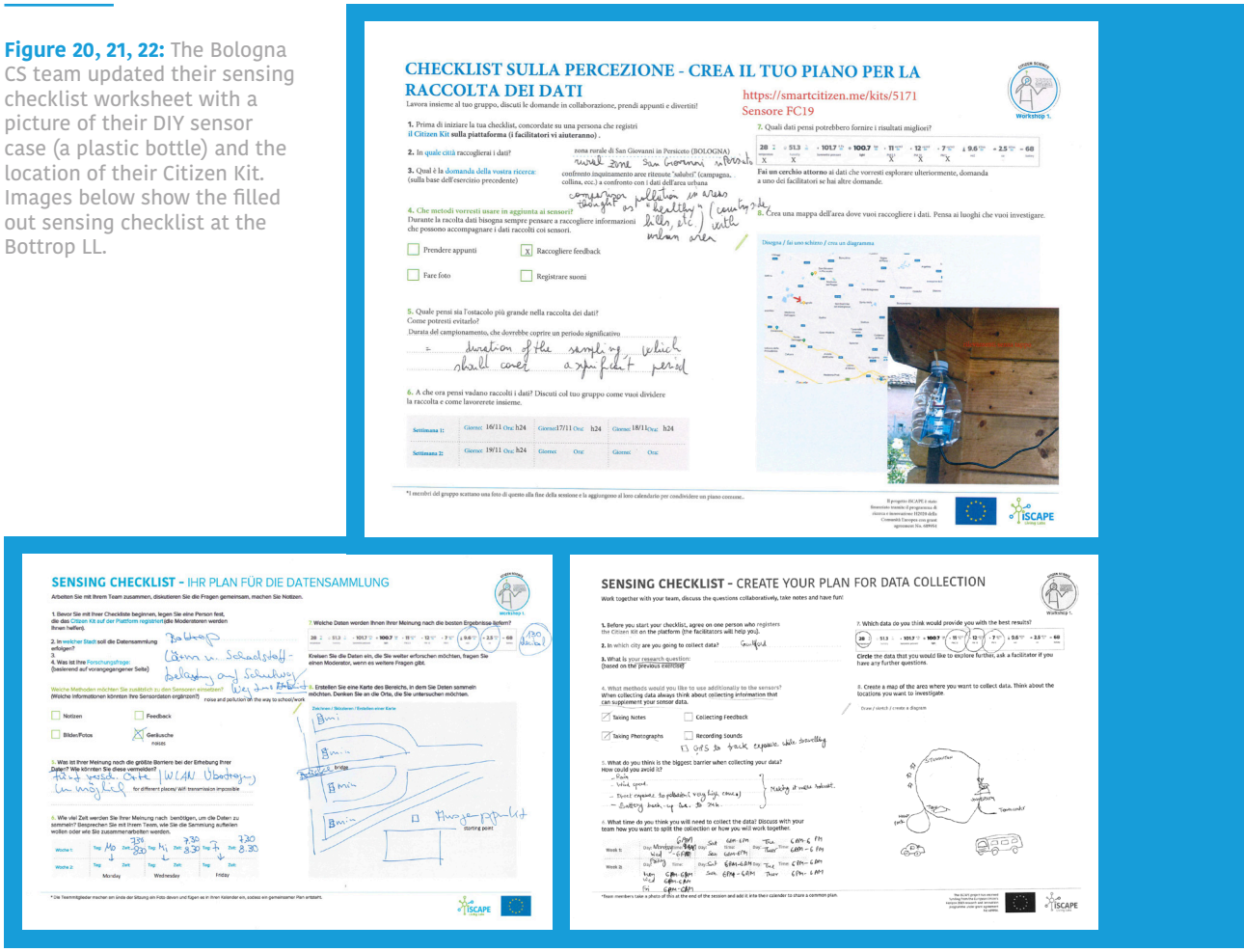


Figure 20, 21, 22: The Bologna CS team updated their sensing checklist worksheet with a picture of their DIY sensor case (a plastic bottle) and the location of their Citizen Kit. Images below show the filled out sensing checklist at the Bottrop LL.

3.3 Delivering the second workshop

Sensing part 2 | Awareness | Action | Reflection

Storytelling Exercise – Analysing your Data Sets

As outlined in chapter 2 Methodologies, two research questions were provided to choose from. Many citizen scientist came up with their own ideas and locations they wanted to investigate further. Upon analysing the responses/stories four research areas were identified that the citizen scientists were most enthusiastic about. As well as the two questions supplied, participants explored "indoor air quality vs. outdoor air quality" or just "indoor air quality", and "the balcony – examining the effect of smoking (smoking neighbours on the balcony)". They also compared the effect of roads and wood burning on air quality. One team highlighted in their story that their "data is based on real measurements monitored by a non-commercial authority". This was mentioned due to habitual mistrust of figures due to data often being exaggerated in the press "for a good story".

Question 1. Hot-spots – Where are the air pollution hot-spots in your city? Where are citizens most exposed to pollution?

The citizen scientists observed pedestrian and bicycle ways, and compared city locations with rural areas, peak hours on busy and less busy roads. They also monitored parking areas and roads close to schools. Their findings showed that the air quality fluctuates during rush hour, but that pollution is often too high (PM2.5) causing road workers breathing problems. The air quality in rural areas overall is also strongly affected by roads and/or a nearby city centre.

Solutions and recommendations for local authorities as suggested by the citizen scientists

- Reduction of traffic in favour of public transport and if possible set up bicycle and pedestrian lanes and (in one specific area) a bicycle and pedestrian bridge crossing rail lanes.
- Geographical study on pollutants, with a focus on rural areas in relation to urban areas.
- Creation of fixed monitoring stations showing real-time data in the city centre and in a more rural location, giving a better understanding of the real situation on the ground, rather than relying on 'sensationalised' media reports.
- Monitoring of pollution at local schools with a view to reducing pollution in the school playground.
- Repairing/development of green buffers.
- Better distribution of traffic flow - including public transport, with a carefully considered plan for location of associated parking spots.
- Direct all trucks to the outer ring and deploy smart traffic lights leading to less stops and starts during peak hours.
- More subsidies for sustainable traffic.
- No (or reduced) parking areas in the city centre.
- Ban all motorised vehicles from the inner ring area inwards.
- Encourage the city authority to develop a sensitisation campaign whereby drivers stop their engines (especially school buses) when waiting for or picking up children.

> **"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 LL)

Question 2. Bus stop – Should the location of a bus stop take into account nearby traffic light systems?

Citizen scientists compared different bus stops, monitored larger road crossings with traffic light systems and bus stops close to parking spaces. Only a small number examined local bus stops in relation to traffic lights. However, one of the teams emphasized the importance of a sheltered bus stop, arguing that as people using public transport are already championing environmentally/sustainable modes of transport they shouldn't be exposed to more pollution as a result. Measurements show that, especially during peak hours, bus stops have high noise levels and alarming levels of PM 2.5.

Solutions and recommendations to the local authority (citizen scientists response):

- Reserve a lane for trams and/or buses (electric) and increase the number of routes.
- Supply an efficient public transport in terms of quality and price, which would motivate people to leave cars behind.
- Run awareness-raising campaigns.
- Offer prizes/ offers /incentives for cyclists, pedestrians and users of public transport.
- Whilst it was recommended not to place bus stops immediately next to traffic flow, and to provide more space with room for a green buffer, it was recognised that bus traffic itself was a complicated issue. Switching to electric buses would be an improvement, whilst smaller buses at quieter times would improve things further, as would a larger bus station next to the parking lot (rather than many small bus stops).
- The threshold for those less mobile can be met by using (small, electric) call buses.

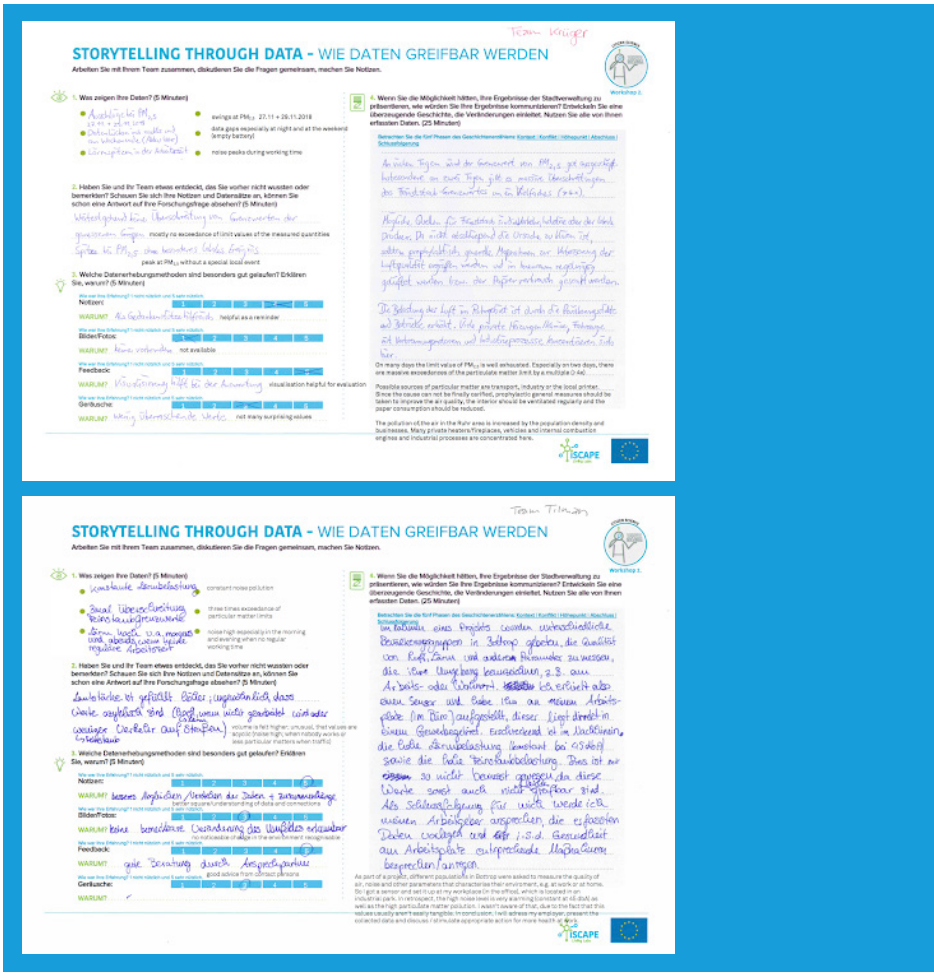


Figure 23: Shows the story from a Bottrop CS team exploring indoor air quality in their office space.

Question 3. Indoor air quality vs. outdoor air quality

CS Teams initiated their own research focusing on indoor air quality. Most participants were very surprised at how 'toxic' the air they breathe is on a daily basis – often worse than the air outside. They monitored different rooms– kitchen (whilst cooking), bedrooms and the living areas – and compared indoor and outdoor measurements. They also monitored their work location (inside an office) focusing on both air and noise pollution. The team that analysed workplace air quality identified PM levels more than fours times the average. Possible sources of PM were local road/ trains, industrial location and/ or the local printer (see figure 23).

Solutions and recommendations to the local authority (citizen scientists response):

- Encourage active search for solutions in purifying PM indoors.
- Provide education on ventilating indoors for healthier air.
- Where a single definitive cause cannot be identified, recommend preventative measures to improve air quality, especially recommending that the interior be ventilated regularly and paper consumption be reduced.
- Air pollution in the Ruhr area is magnified by population density and businesses/industry. Many private heaters/fireplaces, vehicles and internal combustion engines and industrial processes are concentrated here. There need to be better regulations in place.
- Kitchens should have proper ventilation.
- Bedrooms should have air exchange systems providing clean air
- Address employers to present collected data and discuss/stimulate appropriate action for improved health at work.

"I had no idea indoor air is polluted to this extent"
(Citizen Scientist, Bologna LL)

"Sometimes the air quality is much worse than the outside"
(Citizen Scientist, Dublin LL)

"There are many particle sources inside apartments such as from cleaning, cooking, burning candles, etc."
(Citizen Scientist, Vantaa LL)

Question 4. Balcony location – exploring the effect of smoking and close-by traffic

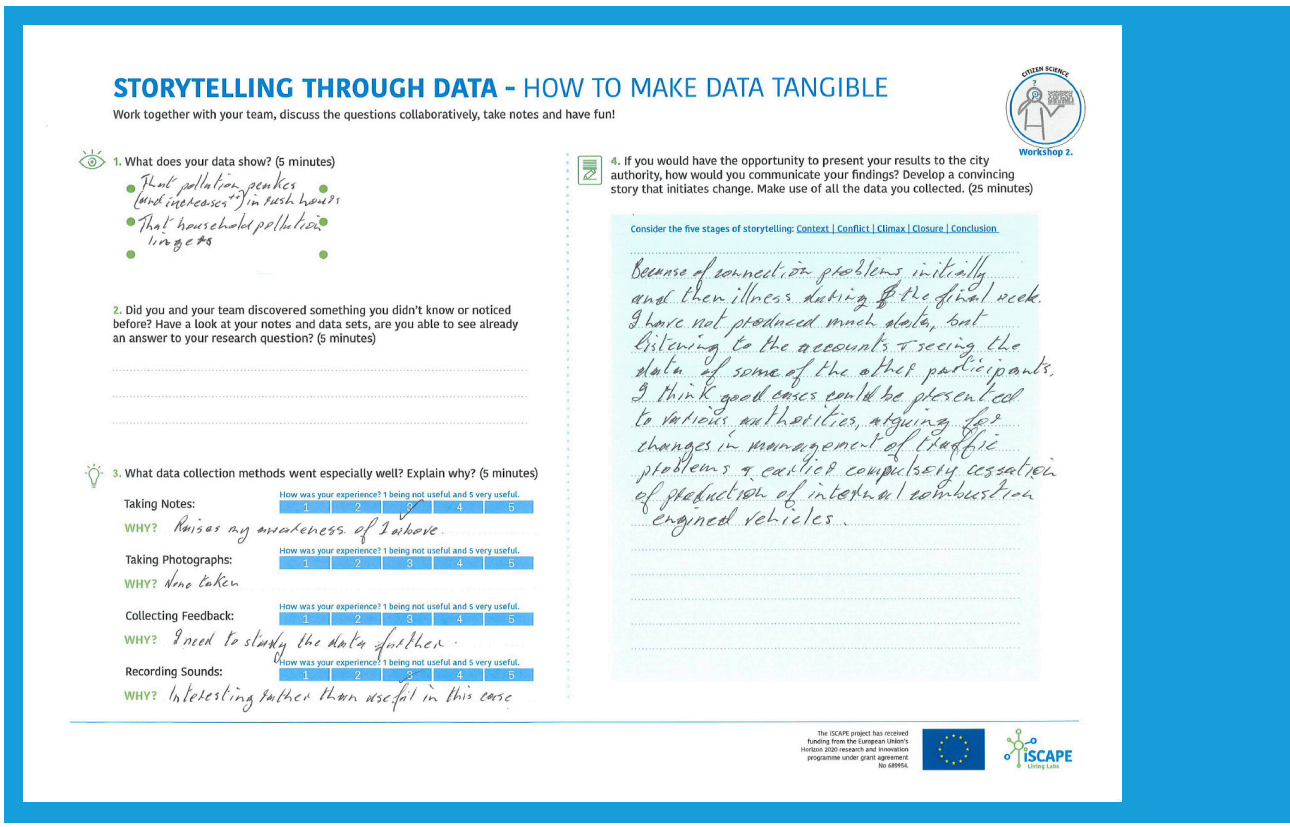
CS Teams also initiated research focusing on factors that contribute to pollution on their balcony as well as living room. They monitored local traffic time from peak hours to weekend, and measured air quality when neighbours were smoking on the next door balcony, as well as comparing times and PM levels when people start heating their homes or, in Finland, use the sauna.

Solutions and recommendations to the local authority (citizen scientists response):

- Demand lower speed limit at the nearby roads – down from 50 km/h to 40 km/h – which, evidence suggested, would help reduce noise levels and particle emissions.
- A significant source of particles is cigarette smoke, which is hard to escape if ones neighbour smokes on their balcony. It would benefit everyone's health to move it somewhere else - e.g. a dedicated smoking area. This problem is especially bad in summer when people keep windows open, or might even sleep outside.

> **"Particle emissions seem not to correlate with particle counts, there are worse emissions at times when fireplaces are normally heated, that is after 6 pm and during weekends"** (Citizen Scientist, Vantaa LL)

> **"Our neighbour is smoking a lot, it would be interesting to find out how much. Also might be interesting discussion for the housing company to assess what amount of smoking would count as too much?"** (Citizen Scientist, Vantaa LL)



STORYTELLING THROUGH DATA - HOW TO MAKE DATA TANGIBLE

Work together with your team, discuss the questions collaboratively, take notes and have fun!

Workshop 2.

1. What does your data show? (5 minutes)

- That pollution peaks (and increases) in rush hours
- That household pollution lingers

2. Did you and your team discovered something you didn't know or noticed before? Have a look at your notes and data sets, are you able to see already an answer to your research question? (5 minutes)

3. What data collection methods went especially well? Explain why? (5 minutes)

Taking Notes: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5

WHY? Raises my awareness of 1 above.

Taking Photographs: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5

WHY? None taken

Collecting Feedback: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5

WHY? I need to study the data further.

Recording Sounds: How was your experience? 1 being not useful and 5 very useful. 1 2 3 4 5

WHY? Interesting rather than useful in this case

4. If you would have the opportunity to present your results to the city authority, how would you communicate your findings? Develop a convincing story that initiates change. Make use of all the data you collected. (25 minutes)

Consider the five stages of storytelling: Context | Conflict | Climax | Closure | Conclusion

Because of connection problems initially and then illness during the final week I have not produced much data, but listening to the accounts & seeing the data of some of the other participants, I think good cases could be presented to various authorities, arguing for changes in management of traffic problems & earlier compulsory cessation of production of internal combustion engined vehicles.

The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

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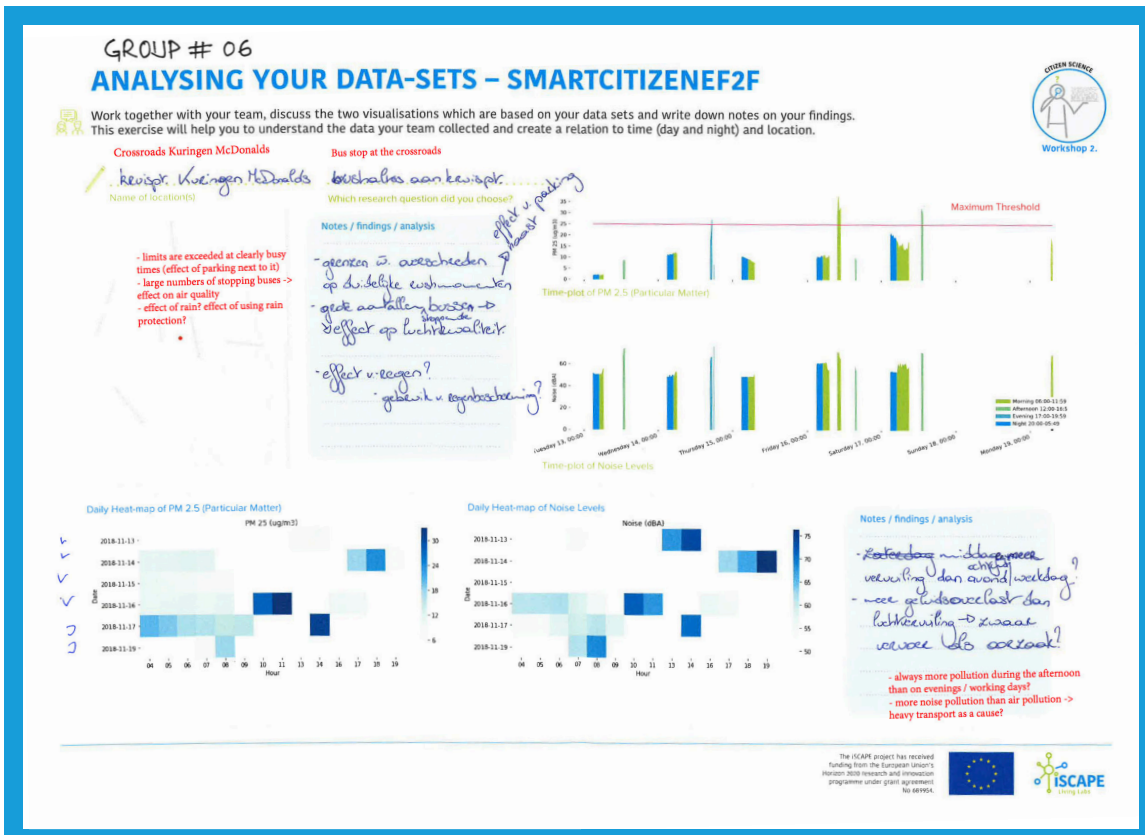
Figure 24: The same exercise from one of the Dublin CS team.

Figure 25, 26: Hows worksheets in Hasselt #06 and #07 are great examples for the final exercise, they used their data visualisations and findings to develop an engaging story with proposed solutions.



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.

Workshop 2.

Crossroads Kuringen McDonalds — Name of location(s)

Bus stop at the crossroads — Which research question did you choose?

Notes / findings / analysis

- limits are exceeded at clearly busy times (effect of parking next to it)
- large numbers of stopping buses -> effect on air quality
- effect of rain? effect of using rain protection?

Maximum Threshold

Time-plot of PM 2.5 (Particular Matter)

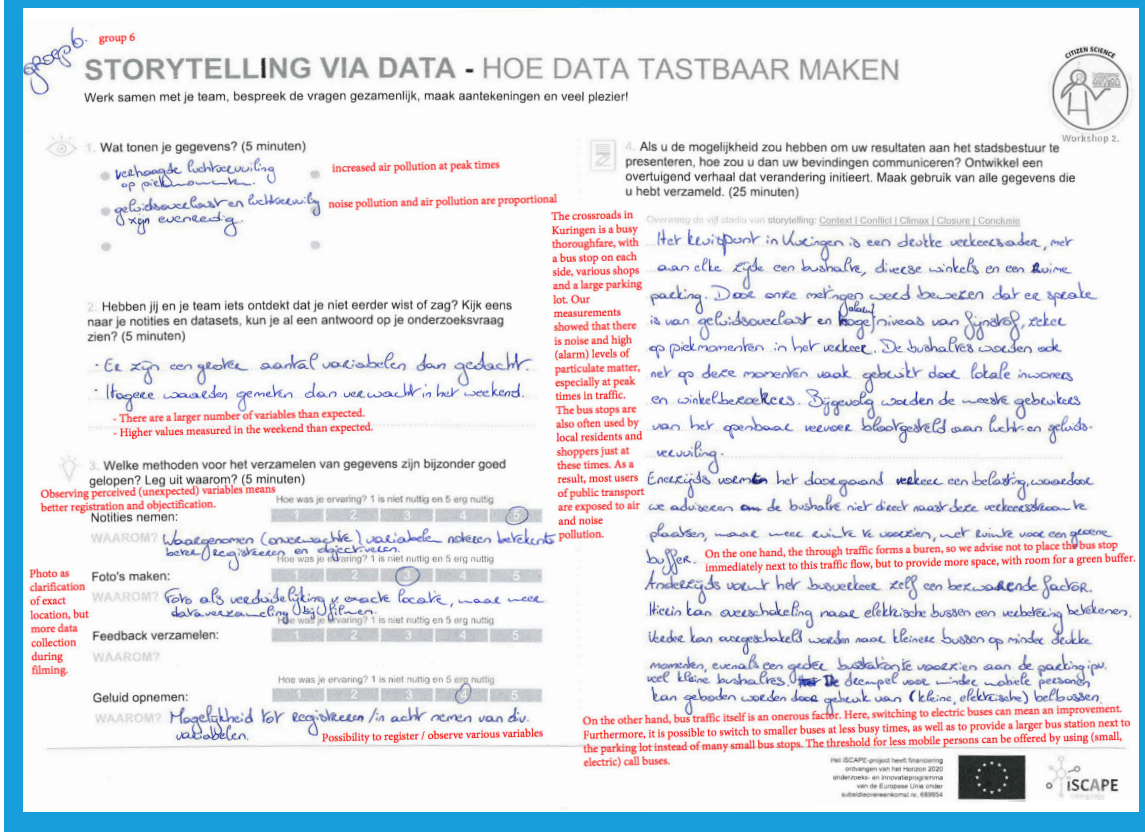
Time-plot of Noise Levels

Daily Heat-map of PM 2.5 (Particular Matter)

Daily Heat-map of Noise Levels

Notes / findings / analysis

- always more pollution during the afternoon than on evenings / working days?
- more noise pollution than air pollution -> heavy transport as a cause?



group 6

STORYTELLING VIA DATA - HOE DATA TASTBAAR MAKEN

Werk samen met je team, bespreek de vragen gezamenlijk, maak aantekeningen en veel plezier!

Workshop 2.

1. Wat tonen je gegevens? (5 minuten)

increased air pollution at peak times

noise pollution and air pollution are proportional

2. Hebben jij en je team iets ontdekt dat je niet eerder wist of zag? Kijk eens naar je notities en datasets, kun je al een antwoord op je onderzoeksvraag zien? (5 minuten)

- There are a larger number of variables than expected.
- Higher values measured in the weekend than expected.

3. Welke methoden voor het verzamelen van gegevens zijn bijzonder goed gelopen? Leg uit waarom? (5 minuten)

Observing perceived (unexpected) variables means better registration and objectification.

Notities nemen:

Foto's maken:

Photo as clarification of exact location, but more data collection during filming.

Feedback verzamelen:

Geluid opnemen:

Possibility to register / observe various variables

4. Als u de mogelijkheid zou hebben om uw resultaten aan het stadsbestuur te presenteren, hoe zou u dan uw bevindingen communiceren? Ontwikkel een overtuigend verhaal dat verandering initieert. Maak gebruik van alle gegevens die u hebt verzameld. (25 minuten)

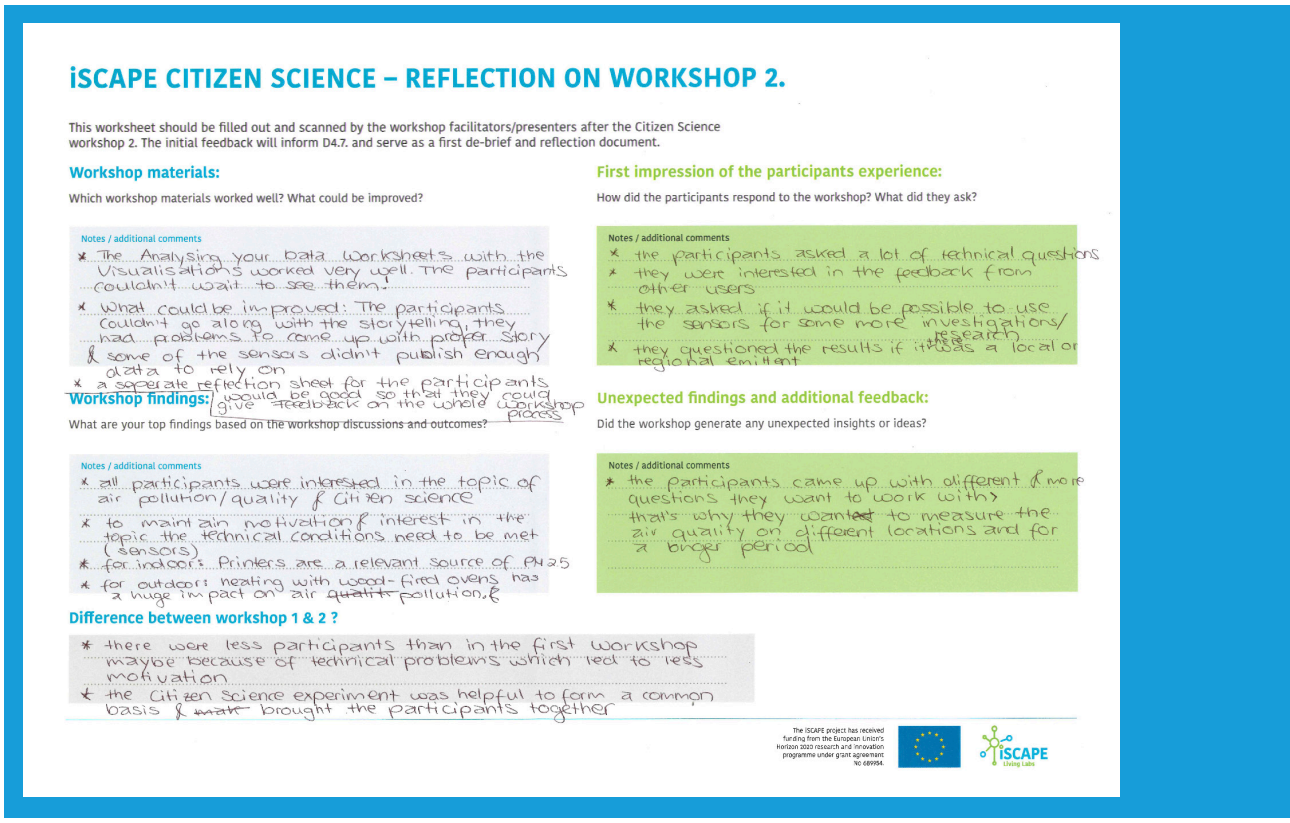
The crossroads in Kuringen is a busy thoroughfare, with a bus stop on each side, various shops and a large parking lot. Our measurements showed that there is noise and high (alarm) levels of particulate matter, especially at peak times in traffic. The bus stops are also often used by local residents and shoppers just at these times. As a result, most users of public transport are exposed to air and noise pollution.

On the other hand, bus traffic itself is an onerous factor. Here, switching to electric buses can mean an improvement. Furthermore, it is possible to switch to smaller buses at less busy times, as well as to provide a larger bus station next to the parking lot instead of many small bus stops. The threshold for less mobile persons can be offered by using (small, electric) call buses.

4. CS Workshop Findings and Reflections

The findings from the CS workshops were extracted from the reflection sheets (see figure 27) and the participant feedback method – two stars and a wish (see 4.3). Reflections on the CS workshops and the outcomes were collated during the weekly catch-up calls between FCC and the LLs.

The next page shows recommendations for an iterated CS iSCAPE framework and overall workshop learnings based on the data mentioned above.



iSCAPE CITIZEN SCIENCE – REFLECTION ON WORKSHOP 2.

This worksheet should be filled out and scanned by the workshop facilitators/presenters after the Citizen Science workshop 2. The initial feedback will inform D4.7. and serve as a first de-brief and reflection document.

Workshop materials:

Which workshop materials worked well? What could be improved?

Notes / additional comments

* The Analysing your data Worksheets with the Visualisations worked very well. The participants couldn't wait to see them.
* What could be improved: The participants couldn't go along with the storytelling, they had problems to come up with proper story & some of the sensors didn't publish enough data to rely on
* a seperate reflection sheet for the participants would be good so that they could give feedback on the whole workshop process

First impression of the participants experience:

How did the participants respond to the workshop? What did they ask?

Notes / additional comments

* the participants asked a lot of technical questions
* they were interested in the feedback from other users
* they asked if it would be possible to use the sensors for some more investigations/ research
* they questioned the results if it was a local or regional emittent

Workshop findings:

What are your top findings based on the workshop discussions and outcomes?

Notes / additional comments

* all participants were interested in the topic of air pollution/quality & citizen science
* to maintain motivation & interest in the topic the technical conditions need to be met (sensors)
* for indoor: Printers are a relevant source of PM 2.5
* for outdoor: heating with wood-fired ovens has a huge impact on air ~~quality~~ pollution.&

Unexpected findings and additional feedback:

Did the workshop generate any unexpected insights or ideas?

Notes / additional comments

* the participants came up with different & more questions they want to work with> that's why they wanted to measure the air quality on different locations and for a bigger period

Difference between workshop 1 & 2 ?

* there were less participants than in the first workshop maybe because of technical problems which led to less motivation
* the citizen science experiment was helpful to form a common basis & ~~mak~~ brought the participants together

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Figure 27: Reflections and feedback after the workshop.

4.1 Overall reflections and findings – Sensing Your City Workshop 1.

Reflection

Whilst the two research questions created a focus for the citizens, they also allowed the LLs and managing partner to observe patterns across the 6 European cities.

Some LLs struggled to engage citizen scientists in the Air Quality Superhero and Empathy Mapping tasks. Reasons for this are unclear, it could have been due to time pressure, a lack of explanation or potentially a lack of enthusiasm. Facilitators have to ensure the exercise and workshop structure is clear to minimise confusion.

> **“The Empathy Mapping exercise was very useful – it allowed people to discuss their issues and become familiar with the topic”** (LL, Dublin)

Facilitators noticed participants were very eager to start the hands-on part of the workshop, but the most LL spent longer on theory work than practice – a better balance should be found. Citizen scientist were very proactive and eager to improve the process and sharing knowledge. Citizen scientists had a keen interest to know exactly what air pollution is and what it isn’t, and how to measure pollutants and reduce their impact e.g. link to low-boundary walls D4.6 (due to July 2019).

> **“Interest related to research questions: strong participation with plenty of suggestions and questions about what and where to find hotspots, and what is the best way to detect them”** (LL, Bologna)

Figure 28: Shows the plastic bottle DIY sensor case. IAAC shared the instruction of the case with the LL a few week before the CS workshop took place.

Findings

- Participants were eager to develop their own research questions and often discussed research questions or locations where they could measure air pollution.
- Across the six cities participants asked many technical questions to which the LLs did not have immediate answers. Many health related questions were also raised, which should be touched on future workshops.
- The SCK is quite small and has delicate parts – difficult to handle for older participants
- Both the facilitators and the participants needed more time to familiarise themselves with the sensors, how they work and their most important features – LLs suggested a live demo would work best.
- The low-cost sensors had no 'environment protection' case (due to errors in the manufacturing process) – some LLs mentioned that participants hoping to use the sensors outside worried about data quality when using a low-fi DIY bottle case (see figure 28).
- Only some citizen scientists had prior technical knowledge or experience (e.g. those at Fab Lab Bottrop, Germany, and Vaisala Inc. and the Environmental Service (air quality focus) Vantaa, Finland). Despite a lack of technical expertise, participants across the six cities were eager to learn more and use the citizen kits.

4.2 Overall reflections and findings – Understand Your Data Workshop 2.

Reflection

Very positive feedback from all participants and facilitators about the data visualisation worksheet – it generated active and meaningful discussions and the citizen scientists were excited to see their research/data visualised. Keen interest was observed in all cities with respect to understanding the peaks and anomalies in the graph/visuals.

"Indoor measurements created a great disappointment in the teams, due to the surprisingly bad air quality results" (LL, Bologna).

"The 'Analysing your Data' worksheet with the visualisation worked very well. The participants couldn't wait to see them" (LL, Dublin)

LLs shared fantastic stories developed in the second workshop. However, some LLs mentioned some participants struggled with the storytelling (unable to find ideas for the story or the right words) whilst others felt that they didn't have sufficient data to tell a story.

As with the first workshop, participants asked a lot of technical questions. Encouragingly, in some LLs, participants were very interested in the feedback from other citizen scientists.

"The difference in the second workshop was that the workshop results changed views about vehicles, domestic indoor pollution and emissions." (LL, Guildford)

Findings

- Some LLs reported participants are planning to use iSCAPE CS results for their own initiatives – e.g. in Vantaa, a citizen scientist wants to use their results to make a case to stop neighbours (in their apartment building) from smoking on balconies.
- A few LLs highlighted that smokers (and the issue of smoking) came up a few times due to the visible impact of smokers on the data visualisations.
- Data analysis in Bologna shown high pollution in rural areas.
- The workshops showed pollutant levels were often above average (even when monitored with low-cost sensors).
- Following the second workshop, a few motivated citizen scientists (in most of the LL cities) asked to use the low-cost sensors, outside of the CS workshops, for specific purposes or research projects so that they could monitor for longer and or in different locations. They were also interested in the price and whether the sensors were available for purchase.

4.3 Feedback from participants – two stars and a wish method

FCC recommended to use a simple way of collecting participants feedback in the end of each CS workshop, some LLs followed this process. Below we grouped the responses – STARS (what went well) and WISHES (what could be improved) – into four categories: location, delivery of the workshop, framework/content and technical. The citizen scientists were very positive about the way they experienced the iSCAPE workshops and its facilitation. There was a clear preference for having more user friendly and more reliable sensors.

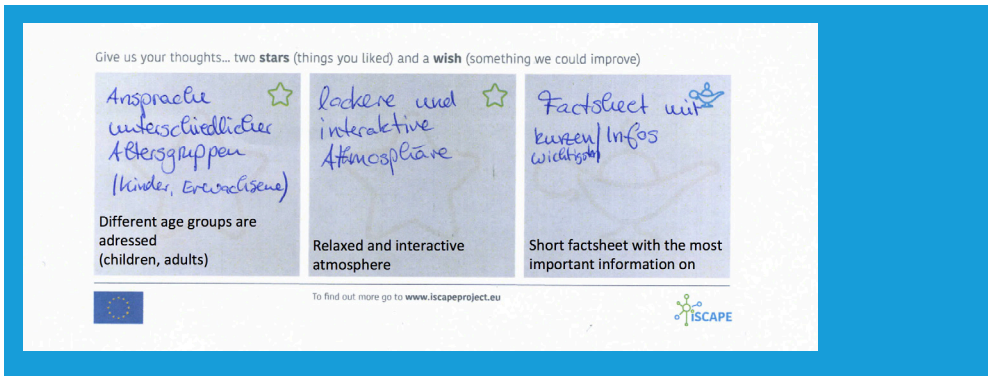

Figure 29: Example of the feedback tool: Two stars and a wish filled out by a citizen scientist in Bottrop LL.

Stars

Location
- Familiar atmosphere

Delivery of the workshop
- Relaxed and interactive atmosphere
- Workshop character with individual support
- Different age groups are addressed
- Easy explanation
- Short
- Enthusiasm of Francesco and Salem
- Clear
- Enthusiasm of facilitators
- Good explanation about the project and objectives
- Moderation

Technical
- Noise measurements
- That you can take picture
- Practical part of the workshop
- Access to data
- Printed evaluation of individual measurements results with visualisations
- Partially good results despite the technical difficulties

Framework/content
- Interesting research questions
- Hands-on workshop
- Step-by-step
- Interactive
- Good content
- Workshop was good
- Excited to take part in CS process, see results + hopefully expand to a wider audience
- Good potential to inform the public about air quality issues
- Freedom to record anywhere anytime
- Length of the workshop
- Clear process and good explanation
- Looking at and reviewing the collected data (visuals)
- Hearing about the stories

Wishes

Location
- Better lighting in the space

Delivery of the workshop
- Less Anglicisms
- More time to test the sensors
- Listen to participants and less commenting
- More storytelling

Framework/content
- Short fact sheet with the most important information on
- Clearer more engaging examples: video?

Technical
- To get a fully functional sensor
- Make the device more user friendly
- Improved cover and software for easier understanding
- NO_x measuring
- Able to attach sensor to bike - real-time data
- ‘Housing’ for equipment - would love to monitor when cycling
- Clarity and ease of use of sensors
- Set up the sensor and start it (including making the case)

5. Learnings we can take on from the CS workshops

Below, we share technical improvements for the iSCAPE SCK and overall general iterations to improve the iSCAPE CS framework and methods.

5.1 Technical improvements and lessons learned

We spoke to Guillem Camprodon, Lead Interaction Designer, at Fab Lab, IAAC, our technical partner in Barcelona, and he shared these practical insights learned over the course of the project:

The value of real-life testing:

The CS workshop enabled us to road-test the Citizen Kit under real, practical conditions. That of course meant actual deployment and testing of all the individual components of the proposed end-to-end solution – from the sensors hardware, the on-boarding website and the data visualisation platform.

Whilst some of the elements – for example the data platform – have been tested before, this more wide-ranging and testing deployment meant that they could be improved iteratively over the course of the iSCAPE project.

It was particularly useful in validating and improving the software that ran on the sensor devices. The opportunity to run the software under different practical deployment conditions – e.g. users with more or less technical skills, variable wifi connections etc. – helped inform corrections and precision.

All of which helped inform the creation of Citizen Kit 2.0, and its iteration towards a commercial version of the product which, six months after reiteration of the iSCAPE Citizen Kit, is now a commercial product available (sensor board) on SEEED[11] Studio as the 'Smart Citizen Kit 2.1'.

Examples of practical improvements, adjustments and changes:

The set-up – Heading in to the workshop we had issues with the enclosure we had designed for the sensors as it was occluding their field of sensitivity. This in fact provided an iterative participatory opportunity: to include design of the final enclosure as a DIY participant exercise that guided by the kit, with participants cutting plastic water bottles to fit the sensor.

The methodology – Rather than pursuing the traditional process of seeking support from local experts to help participants navigate the data, we felt it was critical to user-engagement that we make the data more accessible to all. The report sheets generated by IAAC and FCC met this need, escalating user-engagement and participation.

The hardware – The CS pilot helped make clear the sense of removing the NO_x electrochemical sensors from the hardware for the commercial version. Instabilities affecting its characterisation meant it overcomplicated the sensor's ability to gather meaningful data.

Next steps for the Citizen Kit (changes informed by this work)

Sensor mobility – Originally conceived to work in one location over a long period of time (one month at least), the CS experiments demonstrated a need for greater flexibility and mobility.

11: https://www.seeedstudio.com/Smart-Citizen-Kit-p-2864.html

For example, it was often necessary to be able to compare measurements in different locations within as short (i.e. as close to immediate) a timeframe as possible – fixed sensors were not workable in this scenario.

Online/offline connectivity – Introducing greater mobility into the mix meant the sensors' WiFi connectivity could be variable – and indeed sometimes non-existent. The solution was to integrate SD-card logging functionality to the Citizen Kit so data files could be uploaded to the platform by participants manually. This enabled real-time interpretation and analysis of what the sensors were measuring and the collected data, regardless of internet access. Both issues will be addressed in future iterations of the Smart Citizen software and hardware platform.

5.2 Iterating the iSCAPE Framework

Based on section '4. Workshop Findings and Reflections', the iSCAPE framework can be improved by including, elaborating, or making some aspects of the workshops 'optional' as detailed below:

Workshop 1.

Include

Technical expertise – many technical questions requiring expert guidance were raised during the CS workshops (especially during the introduction and during sensor set-up). A technical expert (present in person or remotely by phone or video conference) would be beneficial.

Feedback sheet – a feedback or reflection sheet for the workshop participants to document their experience would provide valuable insight. However, a balance with other written requirements of participants (e.g. the socio-economic assessment) needs to be struck so as not to overload them with paperwork.

Set up a meeting point for the citizen scientist and the facilitators (LL) so they can get support with the data uploading and fixing of small technical issues.

Elaborate

Research questions/interests – As well as providing two research questions, space should be made for self-initiated research questions/interests. The research questions allowed for similarities in the data sets to be highlighted, and sped up the decision-making process during the workshop, the space made for broader self-initiated inquiry should however be carefully considered to ensure the validity of any further comparisons.

Create scope for evolution – Some citizen scientists wanted to design their own air quality monitoring experiments (indoor and outdoor), which could be included in the research question and 'Sensing Checklist' structure. A follow-on workshop (with worksheets and research questions) focusing on indoor pollution would meet the significant interest expressed in indoor air quality monitoring.

Optional

The Air Quality Superhero – this warm-up exercise (see page 20), which should happen before the actual workshop, was left out by some LLs due to time constraints. The method can be challenging for citizens unused to workshop activities and who might feel intimidated by the idea of drawing. Facilitators need to decide whether this particular exercise is a good fit for their audience. If not, another activity should be found to encourage conversation between citizens who have never met before.

Theory – The CS should be weighted more towards practice than studying the theory. Reduce the number of introduction slides and make the technical explanation more practical (live demonstration of the citizen kits etc.). Citizen scientists tend to want to start hands-on activities as soon as possible.

Impact assessments – The socio-economic impact assessment proved arduous for participants and could disincentive them from taking part in future LL events (as highlighted by most LLs). Separating it from the hands-on workshop by providing participants with a link to complete in their own time might be a solution, although completion rates might fall.

Workshop 2.

Include

Pollution table/visualisation – A table/visual showing air pollutant levels (e.g. impact on citizen wellbeing when pollutants exceed average levels). This would create a link to health and air pollution in the minds of participants.

Hotspot data – Provide more detail of hotspots in each city (this information should be owned and prepared by LL partners).

'How-to' guidelines – create some 'rules' (e.g. 'what to do'/'what to avoid' to ensure maximum data accuracy) on setting up citizen kits securely, so data is not impacted by external factors such as weather conditions etc.

Ease of analysis – consider what you intend to measure, and whether you can simplify the exercise (and thereby increase engagement) for participants here – for example, pollutant PM2.5 to PM10 is easier to analyse and therefore perhaps a better starting point for newcomers.

Elaborate

Sensor instructions – Provide participants with a more detailed sensor explanation, including a run-through of quick fixes.

Storytelling examples – Providing participants with story examples in their local language gives them inspiration to start. Facilitators should motivate participants to use visual elements such as pictures or sketches. Simplifying the research question would help citizens unfamiliar to writing a short story or analysing data.

Optional

Having an external audience joining the citizen scientists for the last workshop, inviting city stakeholders is optional.

5.3 Reflections beyond the iSCAPE Framework

Further reflections from the LL, particpants and managing partner (FCC) whose scope goes beyond the iSCAPE framework include:

Manage expectations

The low-cost sensors are not as easy to use as some citizen scientists thought they would be. The overall feedback showed that the sensors still have many technical issues, and non-experts do not find a quick solution without technical support.

The facilitators need to communicate clearly from the very start that the Citizen Kits are still in a testing phase, and can have some bugs from time to time. Additionally some pollutants, such as NO2, can't be monitored due to accuracy problems.

Understand your audience

LLs need to get to know their audience, this will help them to cater and utilise the citizen's needs, expertise and interests. Recently, the LLs made the first steps towards creating a CS community, future CS activities and interaction with the public will refine the skill.

Such expertise will influence how to interact with different groups of citizen scientists, for example some like to be guided whilst others like to create their own projects and prefer a check-in from time to time. The LLs need to find their way of collaborating or facilitating with citizens on air quality monitoring activities. Being aware of the diversity of people (e.g. different age groups, disabilities or citizens with different backgrounds etc.) and how their needs differ, can only be found out when delivering a larger number of CS workshops with a diverse audiences.

Motivation and engagement

Throughout the LL activities keeping momentum and motivating the public to engage in for example CS activities is a lot of hard work and a long process.

> **"Technical conditions need to be met to maintain [citizen scientist] motivation and interest in the topic area"** (LL, Bottrop)

The 'right' methods for engagement need to be developed over time, as more is known about the audience (links to 'understanding your audience'). The iSCAPE CS framework is an example how CS can work, but each LL needs to find their own way to continue the air quality monitoring activities e.g. through workshops, one-to-ones or in small groups.

Self-initiated work

A CS community can only flourish when people put in time, effort and eventually initiate their own projects. During the two CS workshops, the LLs reported the following self-initiated works from especially eager and motivated citizen scientists:

- Creating their own research questions
- Coming up with their own sensor enclosure designs
- Developing project ideas
- Sharing tips and advice to make data collection easier

Results and outcome

- Have a back-up
- Show examples
- Use a language that everyone understands
- Motivate the citizen scientist and the actual scientist to share learnings and utilise / compare other results

Team effort

> **"Each team developed an outstanding team effort, particularly concerning the measurement planning and came up with the best possible research activities regarding pollution events – hot spots, particular urban configurations and the countryside"** (LL, Bologna)

6. Next steps for the Living Labs

This chapter summarises work in process and next steps after the CS workshops. Each LL has different goals and objectives on how they can utilise the low-cost sensors and new learned skills in the best way. Some LL decided to continue with some CS work, stayed in touch with eager citizen scientists or linked their CS research to other projects.

6.1 Establishing a CS community and next steps

Bologna

Bologna has on-going contact with some CS workshop participants who have ideas on future research and have a willingness to perform additional sampling, even though future CS community engagement planning is currently limited by time and staff availability. The LL felt that the workshops helped engage interested citizens in the topic of air pollution but the narrow scope of the framework and research topics proved challenging for some citizen scientists. Whilst the audience was large, time and venue constraints limited the significance of the outputs. More broadly speaking, the team in Bologna felt the workshop created a great starting point, but that it would need more time to create a CS community – perhaps through collaboration with already existing local networks. They are currently exploring options for publication of their findings, with a focus on re-testing the iSCAPE CS kits and co-locating them with reference instrumentation.

Citizen scientists workshop 2, Bologna

How can the CS work be taken forward and influence policy change in your city? – LL response

- Make technical result clearer to non-technical stakeholders and citizens.

Bottrop

Bottrop enjoys ongoing contact with CS workshop participants, and are similarly planning future CS community engagement. However, time and staff limitations are a challenge here as well. They hope to collect additional data, and undertake sensor function testing and installation at different locations. Strong attendance, especially at the first workshop, demonstrated pre-existing community interest in the issues and curiosity about the sensors. During the workshop, participants communicated a wide range of research interests and ideas on how to use the citizen kits. So much so in fact, that it proved challenging to hold participant focus on predefined avenues of inquiry. Participants nonetheless provided invaluable feedback on how sensors might be optimised. The Bottrop LL feel that the workshops were a good 'first step', but that further engagement and leadership, perhaps from a citizen 'expert', is what might be needed to make the initiative self-sustaining. Whilst keen to contribute to a common iSCAPE paper, no other publishing activities are currently planned in Bottrop.

Citizen scientists workshop 1, Bottrop

How can the CS work be taken forward and influence policy change in your city? – LL response

- CS activities increases awareness and demands action from the public (citizens etc.) this then generates pressure on the politicians and local decision makers.
- Politicians are influenced by voters voices, the CS results and approaches can be included in political strategies.

Dublin

CS initiatives using the Citizen Kits in Dublin are planned, including on-going collaboration with the Globe initiative[12], and the Ringsend community through provision of citizen kits and using the CS framework on their own CS projects and initiatives. CS activities are also planned with another district, Tallagh, in South Dublin County Council, who made contact via the FutureScope event.

As the CS pack provided a clear structure and instructions for citizen engagement, and the workshops illuminated pre-existing citizen concerns about local air pollution, it came as no surprise that the iSCAPE CS workshops influenced further local activity, soon to be realised in a series of student projects using the low-cost sensors.

Dublin also gained valuable insight from participants on how sensors might be optimised. As with Bottrop, Dublin feel that the CS initiatives are a good start, but not yet enough to create a CS community, and so are already planning further activities. More excitingly, Dublin's CS activities have attracted the interest of other communities and national bodies, including the Irish Environmental Protection Agency. Work on a publication, in collaboration with IAAC team, is underway, with experimental work still to be concluded.

Citizen scientists workshop 2, Dublin

How can the CS work be taken forward and influence policy change in your city? – LL response

- Any critical results should be examined against current environmental policies in the city.
- Then the examination results should be communicated to the policy makers through a special event.

12: https://www.globe.gov/

Guildford

Guildford has plans in place to deploy SCKs for future engagement with the wider Guildford community, with Burpham and Merrow communities already keen to use the sensors. As with many other iSCAPE LLs, Guildford also found that the CS pack provided a clear structure and instructions for citizen engagement. The workshops really helped citizens to participate in and provide useful input, not to mention powerfully illustrating how the CS approach could tackle serious problems and give something back to the community. Whilst it was felt that the CS workshops did help establish strong community partnerships in a very short period of time, more time might have made a more in-depth experience possible: for example, training participants on how to use low-cost sensors. As with other LLs, it was also felt that a longer-term approach would be needed to make the CS initiative self-sustaining. Since the workshop, a publication titled "A CS Approach for Enhancing Public Understanding of Air Pollution" – covering the overall CS approach followed by Guildford LL as well as further interesting case studies – has been submitted and is under review.

Citizen scientists workshop 1, Guildford

How can the CS work be taken forward and influence policy change in your city? – LL response

- Look for policy that needs to be changed.
- Use the LL results as evidences to convince the policy makers.

Hasselt

In Hasselt, whilst immediate enthusiasm to continue at this stage seems low amongst the city scientists, the city still plans to follow up with all those that took part. More encouragingly, however, work is currently underway to integrate citizen kits into the studies of Master students. Enthusiasm during the workshops was in fact high – participants found it easy to get involved and provide useful input, although they did on occasion question the accuracy of the measurements. There was a measure of disappointment that there wasn't the built-in flexibility to allow participants to introduce their own research questions. As was noted in Guildford, the workshops worked very well to establish an inquiry group, but fell short when it came to the opportunity to provide training. As with Bottrop, the Hasselt LL is looking forward to contribute to a joint publication, but have no other publications planned at the current time.

Citizen scientists workshop 1, Hasselt

How can the CS work be taken forward and influence policy change in your city? – LL response

- Strengthen the cities policy assessment results with reliability/uncertainty analysis.
- Start the policy assessment work in close coordination with stakeholders.

Vantaa

As well as ongoing contact with those workshop participants keen to follow up on the work, the Vantaa LL are continuing their cooperation with ForumVirium and HSY (Helsinki Region Environmental Services) exploring where the SCKs could be deployed (e.g. citizen campaigns). They are also looking into loaning sensors to a university student (SC workshops) for a credit-scoring research project. What's more, the "Living Lab" and "Citizen Science" ethos is now being used in other projects: for example, ongoing H2020 OPERANDUM-project[13] OpenAirLaboratory uses LL interactions with citizens and stakeholders. Uniquely amongst the iSCAPE project, Vantaa did not start a new CS community, but instead worked collaboratively with a pre-existing one (e.g. ForumVirium), working together towards a more ambitious "capital Finland" LL. The Vantaa LL are confident that a conference paper will be published this year (2019) and, as with other locations are looking forward to co-authoring a paper with their iSCAPE LL partners.

How can the CS work be taken forward and influence policy change in your city? – LL response

- Organise seminars presenting the highlights of the CS workshops, for the city decision makers/planners and for citizens and the general public.

13: https://www.operandum-project.eu/

7. Potential Impact of CS

Each LL highlighted the advantages and positive effects CS can have for a city, research project, policy design and the citizen scientists themselves. The reasons below were communicated during the CS catch-up calls and reflection exercises.

7.1 Engaging the public

During the workshops we reached a large audience on the iSCAPE Twitter channel as well as all the partners social media channels and platforms. The iSCAPE team achieved a total of 143 registrations and approximately 93 participants across the six LL cities.

Figure 30: Analytics for Tweets sent for the duration of the programme.

7.2 Empowering citizen & behaviour change

Combining a campaign approach with community-centric access to research technology and guidance (low cost sensors and CS activities) allowed citizens to get involved and encourage first steps towards change. The green shoots of the longer-term goal of establishing a self-sustaining CS community were observed in a number of instances. The behavioural changes also encourage citizens to reduce their own contribution to pollution.

Guildford – Plans in place to deploy CS kits for future engagement with Guildford community, with Burpham and Merrow communities already keen to use the sensors.

Bottrop – Workshops marked a good 'first step' that, with further engagement and leadership (perhaps from a citizen 'expert') could make the initiative self-sustaining.

7.3 Driving real change and influencing policy

As well as the behavioural changes outlined above encouraging citizens to demand informed changes from their local and national government in terms of environmental policy and action, the project also facilitates further collaboration with the local authorities, municipalities, community groups, relevant organisations and other universities/academic institutions. Changing policies is a long-term process which needs strong collaborative relationships with the city and solid evidence. The iSCAPE LLs are working with the cities to make such an impact and this will continue after the iSCAPE project. In D4.6 'Report on Local Stakeholder Engagement' will go into more detail how this will realise itself.

Dublin – CS activities planned with another district, Tallagh, in South Dublin County Council, who made contact via the FutureScope event. A series of student projects is also scheduled.

Hasselt – Work is currently underway to integrate citizen kits into the studies of Masters students.

Vantaa – Looking into loaning sensors to a university student (SC WS's) for a credit-scoring research project.

7.4 Influencing global change

The project is a great demonstration of the 'Think global, act local' maxim put into practice. Whilst the issues and concerns are affecting the whole world, the motivation for change is driven through citizen engagement and empowerment of communities at a local level.

Dublin – CS activities have attracted the interest of other communities and national bodies, including the Irish Environmental Protection Agency.

Vantaa – "LivingLab" and "Citizen Science" ethos is now being used in other projects: for example, ongoing H2020 OPERANDUM[14]-project OpenAirLaboratory uses Living Lab interactions with citizens and stakeholders.

Projects such as iSCAPE and the Making Sense[15] project clearly demonstrate how participatory citizen engagement project foster awareness. By giving participants the capacity to 'sense' the pollutants impacting their environment, they are empowered to get involved in a practical, hands-on approach. In this important way, they are shown to adopt a concern and ownership of the issues.

14: https://site.unibo.it/operandum/en
15: http://making-sense.eu/

8. Conclusion

A lot has been accomplished by the LLs and their newly established CS communities in a very short period of time, and this despite uncertainties about how possible it might be to deploy low-cost air quality sensors effectively. Their results have demonstrated very clearly just how possible it is.

Even though the citizen scientists had some difficulties with the low-cost sensors, they learnt to make the best out of the situation and worked with what they had. Over time, they also learnt how to use the sensors more effectively and came up with solutions for common bugs. The results show the clear value of involving and supporting motivated 'citizen scientists'.

The process of experimentation and testing has also contributed directly to the next iteration of the SCK and scheduling of a number of follow-up projects.

The citizen-centric skills developed during the co-creation and citizen engagement work in WP2 (Task 2.3) strongly influence the quality of the subsequent CS workshops (e.g. mind-set and facilitation).

There are still, however, a number of improvements that can be made:

- LLs need to improve their knowledge of the technical capabilities of the low-cost sensors and become more confident in their use.
- CS activities that are relevant to the LL simulations, campaigns and internal research should self-initiate.
- Timetabling needs better management. For example, if LLs had received their sensors earlier they could have started the CS work with local citizens and created more confidence in the process.
- Greater direct involvement in active sensor-testing would have accelerated bug-fixing, for example through independent experiments prior to the scheduled CS workshops.
- More time should be spent ensuring greater relevance of CS activities to their audience e.g. local issues and policies.

We are very confident that the iSCAPE CS framework can be utilised as part of WP7 – exploitation, as it can be shared with other LLs, introduce them to CS methodologies and help them establish a CS community around their subject area.

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15 http://making-sense.eu/

APPENDIX –

THE ISCAPE CITIZEN SCIENCE PACK, AUGUST 2018

(no adjustments have been made based on D4.7 yet)

iSCAPE
CITIZEN SCIENCE PACK

An actionable guide for Living Labs.

The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

iSCAPE Living Labs

Document title:	iSCAPE Citizen Science Pack
Main authors:	Katinka Schaaf
Partner in charge:	FCC
Contributing part:ners:	IAAC, T6

CONTENT PAGE

Introduction

CITIZEN SCIENCE

Citizen Science Pack for the iSCAPE Living Labs T4.4

Dear Living Labs,

This document provides you with a comprehensive step-by-step guide for two connected Citizen Science workshops. Every Living Lab (LL) is required to follow the iSCAPE Citizen Science framework to ensure consistency across the experiment (data sets, feedback collection and documentation of the workshop materials). You can find the workshop guidelines on the following pages. We also encourage the LL to deliver a 3rd or even 4th Citizen Science workshop that builds on, or is an extension of, the previous workshops.

The workshop results will inform potential scientific papers and inspire the LL communities to engage in future Citizen Science activities and air quality campaigns.

There are minimum requirements to deliver a successful workshop, which are outlined on pages 9 and 21 e.g. minimum numbers for both participants and sensor kits used. If those numbers are not reached we have to understand why and put combined effort in to re-scheduling the Citizen Science workshop in the following month.

WHO

Lead FCC, supported by T6, IAAC and every LL partner in charge of each city

DELIVERABLES

- D4.6 'Report on local stakeholder engagement'
- D4.7 'Citizen Science communities report'

ACTIVITIES

- Workshops on Citizen Science – 2 in each LL city
- 2 summer school events held by UH

OUTCOME (GRANT AGREEMENT)

"The findings of these workshops will inform the technological interface design of the sensing kits and recommend how to influence policy changes"

Before the Workshop

WORKSHOP PREPARATION

How to make the iSCAPE **Citizen Science** workshops a success:

THE THREE GOLDEN WORKSHOP RULES:

1. **EASY TO ATTEND –** Everyone is busy all the time, having the workshop at a place that is easy to reach and at a time that is suitable will increase the number and variety of participants.
2. **FUN AND ENTERTAINING –** The participants are probably studying or working full time, the workshop should show them something they didn't know or teach them a new skill.
3. **MEMORABLE SO PEOPLE COME BACK –** If our events stay in people's mind, they will talk about it to others which promotes iSCAPE and the individual LL! This also means they will return to the second or even third round of the Citizen Science workshops.

RECOMMENDATIONS BASED ON THE RULES ABOVE:

WHEN AND WHERE SHOULD THE WORKSHOP TAKE PLACE?
We recommend to having workshops in the evening between 5pm – 8pm, this is likely to offer flexibility for a broad range of people to attend. However, please adjust the time to your local habits. We agree that it's great to have students attend your workshop but we aim to encourage citizens outside the university to attend.
Try to have a good balance and variety of participants.

The Grant Agreement requires involvement of businesses, local authorities, researchers as well as citizens.

THE SPACE

- Try to create a comfortable atmosphere and avoid cold, dark or noisy spaces.
- If you choose the right space it will have an impact in the numbers of people attending and **returning** to the next event.
- ☆ Have enough seats, tables and workshop materials for everyone, plan always more rather than less.
- Consider people without cars especially when they are interested in air quality, a bus or train station should be nearby. You could also collaborate with a local theatre, library or school that have a space available.

Before the Workshop

HOW TO SPREAD THE WORD?

- First of all set up an event on Eventbrite, this allows you and others to share and promote the workshop and it will direct people who are actually interested in air quality and Citizen Science to our iSCAPE workshops (via the Eventbrite recommendation feature).
- Eventbrite can be easily shared on social media and the sign up numbers will give an indication how the marketing of the event worked out. Based on those figures the LL / T6 can adjust their promotions and communication strategy.
- **T6** (Giorgio) will create the **iSCAPE Eventbrite channel**, where we publish and promote the events.

THE WORKSHOP ITSELF

Snacks & beverages (not compulsory)

- Besides creating a very interesting and insightful workshop, it's important to provide participants with some nice snacks and cold beverages. Make sure snacks advertised in the Eventbrite. Having drinks and nibbles at the Living Lab workshops will increase the number of people turning up and especially returning.
- Recommended snacks and beverages: Crisps and cheese plus some healthy snacks such as carrot sticks with hummus. Red and white wine, some bottles of beer, alternatively juices and water. A small beverage will create a suitable atmosphere for getting to know the other participants and eases the warm-up phase.
- The number of people signed up gives you an indication of how many people will actually turn up, this helps with the overall workshop and shopping preparation (always prepare for a drop-out rate).
- A small buffet table (for the snacks and beverages) also enhances conversations between participants who are not placed on the same table.

☆ The materials

- For the Citizen Science workshops FCC will provide the workshop structure and some materials, **we recommend having a dry run with some external people before the final workshop** (gather feedback to improve your workshop delivery).
- Translate the worksheets if necessary, you could translate each of the number / bullets on the worksheets and have a small translation on the side.
- ☆ Print materials always one day before the actual workshop.

Before the Workshop

DOCUMENTATION & GATHERING FEEDBACK?

- Photograph the sessions – Aim to use a good camera so we can use this images on our website! **Don't forget to ask for consent when taking pictures of faces.**
- Document and collect the worksheets – photograph or scan the worksheets, organise them by folder in the iSCAPE google doc.
- Use Twitter and Instagram to share the work and document for the general public. Utilise T6's experience, get in touch with the T6 team if you want to share something or want to develop your individual LL communication strategy (micro-site).
- When gathering feedback the language will be different, please calculate the time to translate when planning your workshop time (before and after). The LL have to collect data from the participants after each Citizen Science workshops (see page 27).
- We provide you with a simple feedback cards that ensures that all LL collect feedback from the participants before they leave the workshop!
- **Update the LL activities GANTT and get T6 in the loop!**

PIGGYBACKING ON OTHER EVENT

- Use every opportunity to collaborate with other partners to reach a wider audience and get citizens excited about iSCAPE and the Citizen Science workshops.
- You could get your local stakeholders involved for the Citizen Science workshops, reach out in advance so they can plan ahead.

iSCAPE – CITIZEN SCIENCE WORKSHOP 1.

SENSING YOUR CITY

Citizen Science Workshop 1.

WHY CITIZEN SCIENCE?

What is Citizen Science and why are we using it for the iSCAPE project?

Two definitions:

In 2004, Bruce Lewenstein of Cornell University three-part definition:

1. The participation of non-scientists in the process of gathering data according to specific scientific protocols and in the process of using and interpreting that data;

2. The engagement of non-scientists in true decision-making about policy issues that have technical or scientific components; and

3. The engagement of research scientists in the democratic and policy process.

In 2013, the Green Paper on Citizen Science suggested that:
Citizen Science refers to the general public engagement in scientific research activities when citizens actively contribute to science either with their intellectual effort or surrounding knowledge or with their tools and resources.

Why it's relevant for iSCAPE

- The aim of citizen science is to undertake research and discovery.
- It is a contribution by the public to research, which is actively undertaken and requires thoughtful action.
- Citizen science projects involve non-professionals taking part in crowd-sourcing, data analysis, and data collection. The idea is to break down big tasks into understandable components that anyone can perform.
- It demonstrates that people want to make a contribution to science.

The iSCAPE Citizen Science workshop is a tool to build the iSCAPE Living Lab community, the workshop also aims to increase the engagement of the local community around air quality.

*Sourced from: citizensciencecenter, TheConverstaion blog

Citizen Science Workshop 1.

iSCAPE CITIZEN SCIENCE

Workshop 1. Structure and step-by-step guide.

We encourage the LL to utilise the Citizen Science training in Bottrop (September '18) and directly start with the workshop preparation in your LL. We are aiming to complete the 2 Citizen Science workshops in each LL before the end of December 2018.

We have created a workshop framework that helps the LL to get a better understanding of what Citizen Science is and how to deliver workshops using the citizen kits.
This is the structure and content for the first iSCAPE Citizen Science workshop.
It is required that every LL follows those guidelines to ensure consistency across the iSCAPE Citizen Science experiment (data sets, feedback collection and documentation of the workshop materials).

We also encourage the LL's to deliver a 3rd or even 4th Citizen Science workshop that builds on, or is an extension of, the previous workshops.

Workshop title: **Sensing your City – Citizen Science Workshop 1.**

Time: **Approx. 3 hours**

Approach/ methods: **On-Boarding | Planning | Sensing part 1**

Number of participants: **minimum 15 - maximum 20 participants**

AGENDA - Workshop 1.

Recommended start: 17:00 - 20:00

1. **Arrival and Networking** (should start 30min before the actual event)
2. **Warm-up Exercise –** Draw your air quality superhero (5 - 10 Min)
3. **Presentation -** Introduction to Citizen Science (15 Min)
4. **Empathy Mapping –** Getting a better understanding of cities and citizens affected by air pollution (30 Min)
5. **Get to Know Your Citizen Kit –** Introduction to the sensor kit (20 Min)
6. **Sensing Checklist –** Plan your data collection! (30 Min)
7. **Advice and Recommendations for Successful Data Collection (10 Min)**
8. **Closing of the Session** – Questions and what's next (15 Min)
9. **Gather Feedback -** online and offline (20 Min)

Citizen Science Workshop 1.

WARM-UP EXERCISE

Draw your Air Quality Control Superhero (5-10 Min)

This exercise will help put the participants into the right mindset and make them think differently about 'how to control or tackle air polluted areas within their city'.

The LL should ensure everyone that the drawing task doesn't need to look good, it's about the thinking process to kick-start their mind and get them thinking about the subject area.

☆ There are many positive benefits of drawing such as improved creativity, memory, communication skills and most important problem solving skills.

Besides that, the exercise is a fun start. It also communicates that in the end all of the participants are air quality superheroes because they are motivated to initiate change and take part in the iSCAPE Citizen Science workshop.

- See the air quality Superhero worksheet on the next slide, you can print it in A4 or A3 (we recommend A3).

AIR QUALITY SUPERHEROES

Workshop 1.

1. Everyone has a skill-based superpower, how could you use this to control air pollution? (The facilitators will give you some examples about their superpower).

2. Think about your skills and abilities.

3. Draw your superpower. (5 min)

4. Stick your drawing on the wall. Use the wall for networking and meet people with interesting skills.

Your alter ego

Draw your air quality superpower

What is your superhero alter ego? (Write it on the top of your sheet)

What air pollution challenge do you want to solve?

Real name: .....

The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

Citizen Science Workshop 1.

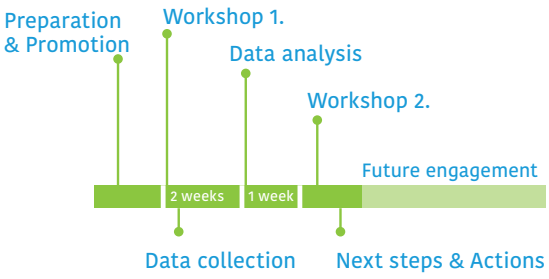
INTRODUCTION

Slide presentation + Interactive questions (15 Min)

We will prepare a short presentation template for the two Citizen Science workshops. Every Living Lab (LL) is required to follow the iSCAPE Citizen Science framework to ensure consistency across the experiment (data sets, feedback collection and documentation of the workshop materials).
Framework of the first workshop: **On-Boarding | Planning | Sensing part 1**

High-level structure:

- Welcome to everyone - introduce the facilitators
- Introduction to iSCAPE and the local Living Lab (why LL / their focus: controlling Air Quality
- Go through the Agenda, ensure that everyone is aware about the structure of the next 2-3 hours and most importantly be clear what the outcome will be in the end.
- Get to know the participants by staring a discussion:
  - *Why are you here today?*
  - *Are you passionate about air quality?*
  - *Interested in sensing air quality or something else?*
  - *What made you come tonight?*
  (Gather answers from a hand full of people - spend 5 Min on this not longer).
- Introduction to the subject area 'Citizen Science' and 'Air Quality' with a local example, this will give the participants a better understanding of the subject area, raise awareness around air quality and provide the participants with an example they can empathise with.
- Explain why Citizen Science and why it's important for LL and the community (i.e. them).
- Presenting the iSCAPE Citizen Science Kit (only a short mention - expand on it later).



FACILITATOR NOTES:

Facilitator hand out the iSCAPE Notebooks (we aim to provide stickers). Highlight the importance of documentation when collecting data, that can happen in note form, photos, sound or air quality data.

Citizen Science Workshop 1.

GET TO KNOW YOUR SENSOR KIT

Slide presentation & hands-on learning (20 Min)

We have a slide deck prepared for the LL, which includes a helpful introduction to the citizen kit.

High-level slide structure:

- Examples how to use the citizen kit, answer questions when and where
- What can the citizen kit do? Provide examples and explanations about what the pollutants do to their health e.g. Nitrogen Dioxide No2
- What data can the kit record?
- What are the limitations? Do they need wifi? Battery charging?

Introduce what we will do with the data in the next session: Introduction into data analysis, visualisation and storytelling

We advice to assemble the sensors beforehand (by LL leads), this will save time and ensures correctly working sensor kits.

Find a detailed Citizen Kit guide on page 42.

FACILITATOR NOTES:

Have post-it notes and pens ready on the tables.

Facilitators advise the teams and ask questions (always ask why?)

Citizen Science Workshop 1.

EMPATHY MAPPING

Exercise (30 Min)

In this exercise the LL is best placed to know if their local community is aware and directly
affected by air pollution or not. There could be two types of participants:

- The participants is aware of the issue around air pollution and are already active in tackling the issue.
- The participants are aware about the issue, but lack empathy as the quality in their city is very good.

It's really important that we have the participants engaged on the subject area, this works best if they have had some personal experience with air quality issues or heard about some specific examples / research studies (that show the impact of pollution).

Short discussion with their table neighbour:

1. Start the exercise with asking the participants if they can recall the latest newspaper article or social media post that focused on air pollution?
2. They should discuss this for 2 Min with their table neighbour.
3. Then ask around if someone wants to share what example they talked about.
4. For the next exercise (empathy mapping) it's **important to create empathy with the people that are most affected by air pollution in cities**, such as young children, older people, people with asthma and other lung related illnesses that affects their breathing.

   We will have a slide with the worksheet (filled out example), the facilitators will assist if needed - There will be 2 research questions that every LL is going to explore.

FACILITATOR NOTES:

For the empathy map we have 2 research questions prepared.
1. Should the location of a bus stop take into account near-by traffic light systems?
2. Where are the air pollution hot-spots in your city? Where are citizens mostly exposed?
Group the participants into teams and decide on a team leader, perhaps use the superheroes task to match the teams.

EMPATHY MAPPING

Work together with your team, discuss the questions collaboratively, take notes and have fun! This exercise will bring you closer to the issue area and emphases with the people that are mostly affected by polluted air.

CITIZEN SCIENCE
Workshop 1.

Research question: .....

1. Focus on a specific situation where a citizen is affected by air pollution:

.....

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2. Focus on a specific user you feel related to (maybe a friend or even yourself)

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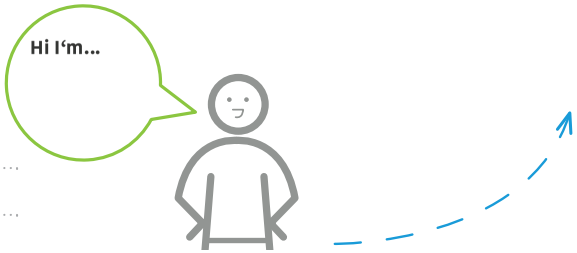

3. Imagine what the person can **see, hear, think** and **feel** in this specific situation? (Write notes in the field below)

DO
See & Hear

THINK

FEEL

4. Discuss in your team what they want to see changed? How would you do it?

Notes / additional comments

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The iSCAPE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 689954.

iSCAPE Living Labs

Citizen Science Workshop 1.

PLAN YOUR DATA COLLECTION!

Slide presentation & Exercise (30 Min)

High-level slide structure:

- Communicate that short experiments are better than long term experiments (long-term data collection is more suitable for the stations). LL share the date of the second workshop (2.5-3 weeks time), 2 weeks of data collection and 1 week of analysis is enough to gather interesting findings.
- Remind the participants to think of reliable ways to collect the type of data that will help to solve the issue or allows them to control the issue.

Plan Your Data Collection!

The previous exercise should help the participants to get a better understanding about specific situations, areas and times when air quality effects citizens. The research question and an understanding of the subject area will determine what kind of data collection (beside the sensors) the participants choose and what kind of tools or methods to apply.

- We will provide filled out worksheet examples to all LL so it's clear to everyone what to expect.

Create your plan for data collection see 'Sensing Checklist' on the following page.

1. Teams choose a **team lead** that will register the citizen kit on the platform.
2. Facilitators hand out the 'Sensing Checklist' worksheet (we recommend printing the worksheet in A3).
3. Remind the participants to work collaboratively and plan their sensing phase around their usual daily responsibilities (e.g. work, university, family).
4. At the end of the workshop the teams present /exchange their sensing checklist with each other.

FACILITATOR NOTES:

Always think about collecting information that can supplement your sensor data e.g. such as taking notes, collecting feedback, recording sounds or taking photographs.

SENSING CHECKLIST - CREATE YOUR PLAN FOR DATA COLLECTION

Work together with your team, discuss the questions collaboratively, take notes and have fun!

Workshop 1.

1. Before you start your checklist, agree on one person who registers the Citizen Kit on the platform (the facilitators will help you).

2. In which city are you going to collect data? .....

3. What is your research question: .....
(based on the previous exercise)

4. What methods would you like to use additionally to the sensors?
When collecting data always think about collecting information that can supplement your sensor data.

- ☐ Taking Notes
- ☐ Collecting Feedback
- ☐ Taking Photographs
- ☐ Recording Sounds

5. What do you think is the biggest barrier when collecting your data? How could you avoid it?

.....

.....

.....

6. What time do you think you will need to collect the data? Discuss with your team how you want to split the collection or how you will work together.

Week 1:	Day:	Time:	Day:	Time:	Day:	Time:
Week 2:	Day:	Time:	Day:	Time:	Day:	Time:

7. Which data do you think would provide you with the best results?

28 °C	51.3 %	101.7 KPa	100.7 Lux	11 ug/m3	12 ug/m3	7 ug/m3	9.6 kOhm	2.5 kOhm	68
temperature	humidity	barometric pressure	light	PM 2.5	PM 10	PM 1	no2	co	battery

Circle the data that you would like to explore further, ask a facilitator if you have any further questions.

8. Create a map of the area where you want to collect data. Think about the locations you want to investigate.

Draw / sketch / create a diagram

*Team members take a photo of this at the end of the session and add it into their calender to share a common plan.

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Citizen Science Workshop 1.

ADVICE FOR SUCCESSFUL DATA COLLECTION

Recommendations – communicate this after the checklist exercise:

- We recommend 2 locations, one most polluted and one relatively less-polluted area. This way you have two different parameters to compare.
- If you want good data keep your Citizen Kit charged!
- Work with your team, the first thing you should do is arrange the times you are available to measure together or share the work and collect data separately.
- Document your data collection as mentioned earlier; take notes about the time, the surroundings and other things that you notice. If you feel there is something different or interesting document it (e.g. smell, air colour).
- Use your sensing guide that you created with your team, keep your time, location, date to guarantee consistency.
- Check the Smart Citizen Platform to see what your data looks like and what data you are collecting. To see if the sensor is still working.
- Stick to your schedule and **don't forget to join us for our next workshop,** where we discuss the process of data analysis, visualisation and storytelling.

Closing of the workshop - should include:

- Thank you to all the participants and facilitators
- Share the google doc (Katinka will share) where participants can ask questions and get support. Alternatively you can provide an email address for the local LL.
- Communicate that they have two weeks of data collection not more.
- Have the date of the next workshop on a slide, make sure that everyone is available, highlight the importance of their attendance.
- Mention that in the next session we start with a 1 Min update of their sensing experience.

FACILITATOR NOTES:

The LL need a date ready to share, there should be only 7-10 days between the first workshop and the last day of data collection

iSCAPE – CITIZEN SCIENCE WORKSHOP NO. 2

MAKE DATA TANGIBLE

Before the Workshop 2.

BEFORE THE WORKSHOP

What your LL needs to prepare before the second workshop:

1. Recruit / get in touch with 5-7 LL 'friends' who will own the sensors for the time of the citizen science workshop period. We recommend to do that so we can be sure that the team is collecting data, that they will take care of the citizen kit and return to the second workshop session.
2. Find suitable local examples for the presentation to increase empathy and authenticity of the workshop.
3. Be in touch with Guillem, IAAC (guillem@iaac.net) and Katinka, FCC (kschaaf@futurecities.catapult.org) to coordinate the time the data sets need to be processed and prepared for the second sessions (visualised).
4. Print materials and familiarise yourself with the findings of the first workshop and the data collection (Guillem and Thanos, Data Scientist (FCC) will share the outcome with each LL).
5. Translate the worksheets if necessary, you could translate each of the number / bullets on the worksheets and have a small translation on the side.

Citizen Science Workshop 2.

iSCAPE CITIZEN SCIENCE

Workshop 2. Structure and step-by-step guide.

This is the structure and content for the second iSCAPE citizen science workshop. It is required that every LL follows those guidelines to ensure consistency across the iSCAPE Citizen Science experiment.

Similarly to the first workshop (page 9), we recommend the use of the Citizen Science framework in the second workshop (and any subsequent workshops). This allows us to maintain consistency among data sets, collected feedback and documentation of the workshop material.

We also encourage your LL to deliver a 3rd or even 4th citizen science workshop that builds on the previous two workshop results.

Workshop title: **Understand Your Data – Citizen Science Workshop 2.**

Time: **Approx. 2-3 hours**

Approach/ methods: **Sensing part 2 | Awareness | Action | Reflection**

Number of participants: **minimum 15 - maximum 20 participants**

AGENDA - Workshop 2.

Recommended start: 17:00 - 20:00

1. **Arrival and Networking** (should start 30 Min before the actual event)
2. **Introduction -** Welcome back and short updates from the data collection (20 Min)
3. **From Raw Data to Tangible Data** – Data awareness & processing overview (30 Min)
4. **Reflection & Action -** Debate with stakeholders (20 - 30 Min)
5. **Closing of the Session** (5 Min)
6. **Gather Feedback -** Online and offline (20 Min)

Citizen Science Workshop 2.

INTRODUCTION

Slide presentation + questions to participants (20 Min)

We will prepare a short presentation template for the two Citizen Science workshops. Every Living Lab (LL) is required to follow the iSCAPE Citizen Science framework to ensure consistency across the experiment (data sets, feedback collection and documentation of the workshop materials).

High-level structure:

- Welcome back all the participants and new comers.
- Quick recap what happened during the last session.
- Go through the agenda, ensure that everyone is aware about the structure of the next 2-3 hours and most importantly be clear what the ideal outcome will be in the end.
- Distribute any new comers amongst existing teams.

Knowledge sharing:

1. Facilitators motivate every team to stand up and report very briefly (1 Min) on their sensing experience and data collection with the citizen kit.
2. Ask them if they experienced any difficulties (technical issues), what kind and why?
3. Did they gain any exciting insight they want to share?

Data Awareness

It's important to ensure that the data is not only collected and shared but understood by the participants. This session will educate the participants about the value and potential of the data they collected - which then will inform opportunities for change. The findings of these workshops will inform technological interface design of the sensing kits and recommend how to influence policy changes (GA).

FACILITATOR NOTES:

Facilitator motivate teams to stand up and provide a quick update. In case the teams are a bit shy, just start clockwise.

Citizen Science Workshop 2.

FROM RAW DATA TO TANGIBLE DATA

Exploring the power of visualisation (20 Min)

Go through the slide presentation we prepared, this presentation is interactive (ask questions to the participants). The presentation shows that data can be much more powerful and easy to digest when visualised, we aim to keep participants think differently about the data they collected?

Data processing overview

The slides include:

- **The process**
  1. Data collection | 2. Cleaning the data sets | 3.Using Software for analysis | 4. Create visualisations | 5. Storytelling
- Introduction to some open source software and step-by-step guide on how to get the data uploaded.
- Google sheets - good for partners to localise the data (communicate this to the LL's).

Data visualisation

The slides include:

- Show the process of data visualisation.
- Communicate a range of how and how not to communicate data.

– Here we simplified the process of data visualisation slightly, due to resources (time and computers and facilitators) available –

24

Citizen Science Workshop 2.

STORYTELLING THROUGH DATA

How to make data tangible (30 Min)

Ensure that your datasets from the data collection are ready and prepared the week before the workshop!
This happens in collaboration with IAAC and FCC. Together we will choose the most interesting findings (best data quality). We will clean and analyse the data collected and prepare visualisations.

Collaborative activity using the visualisation

"If you would have the opportunity to present your results to the city authority, how would you communicate your findings? Develop a convincing story that initiates change. Make use of all the data you collected."

1. The facilitators provide each team with 1-2 visualisations that are based on their area of data collection (teams with the same challenge receive the same visuals).
2. Facilitators provide each team with their worksheet **'Storytelling Through Data' (see next page).**
3. Participants discuss in their team how they can use storytelling to communicate their challenge – Facilitators support teams if they are stuck.
4. Participants are encouraged to use data they collected (such as pictures, notes or recordings) to communicate their process.
5. Facilitators ask the participants to have a look at their checklist and get their iSCAPE Citizen Science notebooks out.
6. Ensure that you have enough time for the presentation, discussion and feedback collection.

Presenting their story

- Ask the teams who would like to give a quick summary of their results (try to have all teams presenting - 3 min each)
- Facilitators take notes and open up for questions after each presentation

FACILITATOR NOTES:

Here the teams need most support from the facilitators, they should encourage the teams to include a journey and users in their story.

STORYTELLING THROUGH DATA - HOW TO MAKE DATA TANGIBLE

Work together with your team, discuss the questions collaboratively, take notes and have fun!

CITIZEN SCIENCE

Workshop 2.

1. What does your data show? (5 minutes)

-
-
-
-
-
-

2. Did you and your team discovered something you didn't know or noticed before? Have a look at your notes and data sets, are you able to see already an answer to your research question? (5 minutes)

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3. What data collection methods went especially well? Explain why? (5 minutes)

Taking Notes: How was your experience? 1 being not useful and 5 very useful.

1	2	3	4	5

WHY? .....

Taking Photographs: How was your experience? 1 being not useful and 5 very useful.

1	2	3	4	5

WHY? .....

Collecting Feedback: How was your experience? 1 being not useful and 5 very useful.

1	2	3	4	5

WHY? .....

Recording Sounds: How was your experience? 1 being not useful and 5 very useful.

1	2	3	4	5

WHY?

4. If you would have the opportunity to present your results to the city authority, how would you communicate your findings? Develop a convincing story that initiates change. Make use of all the data you collected. (25 minutes)

Consider the five stages of storytelling: Context | Conflict | Climax | Closure | Conclusion

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iSCAPE Living Labs

Citizen Science Workshop 2.

REFLECTION & ACTIONS

Debate with Stakeholders (20 - 30 Min)

In this section we want to encourage the participants to stay in touch with the Living Lab and develop their learnings from the citizen science workshops further. This could be an actions or further data collections.

Here we ask the participants for feedback and next steps that would encourage them to stay involved in the future.

Questions that stimulate a conversation (LL can personalise those questions according to their needs)

- Is there something you liked especially, what was that? (Could be on a postcard)
- Is there something you like to change or see different executed, please expand? (Could be on a postcard)
- How would you like to expand/ continue the iSCAPE Citizen Science workshop?
- Did you discover anything unexpected during the Citizen Science workshops?
- How would you use your findings to create change?
- What would you like to see in the future from the iSCAPE Living Labs?

Closing of the workshop - Goodbye

- Stay in touch and fill out the questionnaire we will email you shortly
- Mention any other events that will happen
- Share your social media channels and website on your final (as well as other) slides
- Take the chance to recruit people for the voxpopme (if the moment feels right)
- Don’t forget to collect the sensors ;)

Impact of Citizen Science (communicate this to the participants)

- Could lead to a bigger global movement!
- Campaigns
- Policy change
- Behaviour change
- Further collaborations
- Establish a citizen science community

Data Collection

DATA & FEEDBACK COLLECTION

Collecting social and economic data as well as general feedback from partcipants after both workshops.

Feedback collection via post-its and feedback cards

We encourage every LL to plan 5 minutes for a quick feedback exercise. You can decide what works best for you from a simple post-it note on a large piece of paper, to a big paper roll or the 'two stars and a wish' cards (see next page). As long as you receive simple feedback stating what was good (why) and what could be improved next time (why).

Social and economic data collection

Every LL has to plan 15 minutes **at the end of each workshop** to give the participants enough time to complete the social and economic questionnaire. T6 will provide every LL with the translated survey questions. The final questionnaire can be found in the appendix.

Tips to improve the participant experience

- Provide the participants with hot beverages, soft drinks, biscuits, savoury snacks etc. it will increase the return rate for the next workshop.
- Have pens, chairs and tables ready. The questionnaire is too long to be completed whilst standing.
- The facilitators should be close-by in case the participants don't understand the questions.
- Have a cardboard box ready so the participants are able to return their completed questionnaire anonymously.

Feedback Collection

TWO STARS AND A WISH CARDS

Give us your thoughts... two **stars** (things you liked) and a **wish** (something we could improve)

To find out more go to **www.iscapeproject.eu**

iSCAPE

Give us your thoughts... two **stars** (things you liked) and a **wish** (something we could improve)

To find out more go to **www.iscapeproject.eu**

iSCAPE

Give us your thoughts... two **stars** (things you liked) and a **wish** (something we could improve)

To find out more go to **www.iscapeproject.eu**

iSCAPE

APPENDIX

T6 – QUESTIONNAIRE 1 & 2

IAAC – CITIZEN KIT GUIDE

Questionnaire 1.

Citizen kit survey: social and economic impacts (1)

Within the iSCAPE project (www.iscapeproject.eu), a team of researchers, technicians, communicators and urban facilitators is implementing and testing smart solutions for reducing air pollution and its negative effects. These solutions aim to improve the air quality and to share knowledge about the topic. The study is carried out in six European cities, including the one where this activity is being conducted. In order to understand the impacts of these solutions, we need your help!

We kindly ask you to fill in this questionnaire. Please answer accordingly to your current mind-set. Please note that data collected during this study will be used solely for research purpose and will remain anonymous.

We recognise that you have read and signed the information sheet and the consent form for this research.

Introductory Questionnaire:

Section I: Socio-Demographic and Personal details

Age	_____(years)
Gender	Male ☐ Female ☐
Nationality	
Current Address (only Street name and Town)	
Employment Status: Are you currently…?	• Employed for wages • Self-employed • Out of work and looking for work • Out of work but not currently looking for work • A homemaker • A student • Military • Retired • Unable to work
What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.	• Less than high school degree • High school graduate, diploma or the equivalent • Trade/technical/vocational training • Associate degree • Bachelor's degree • Master's degree • Professional degree • Doctorate degree
Mother tongue language	……
What was your total household income before taxes during the past 12 months?	• Less than 10,000 Euros • 10,000 to 24,999 Euros • 25,000 to 49,999 Euros • 50,000 to 74,999 Euros • 75,000 to 99,999 Euros • 100,000 to 149,999 Euros • 150,000 to 199,999 Euros • 200,000 and up • Prefer not to answer
History of heart or lung diseases of the respondent:	Yes ☐ No ☐
History of heart or lung diseases in the family (within current family unit):	Yes ☐ No ☐

Section II: Environmental Issues, Human values and Interests

We are asking few questions regarding environmental problems and issues, along with your opinion about human values. You need to give your opinion in the form of degree to which you agree or disagree to the statements shown below:

(a) Questions in relation to Environmental issues/concern

iSCAPE

Please indicate how much you agree /disagree with the following statements. **1= Strongly disagree, 2 = Disagree, 3 = Neutral, 4= Agree, 5= Strongly Agree**
Environment pollution is a problem in my city ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Environmental pollution may affect my health ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
The environment is deteriorating, it is clearly notable and visible ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Environmental issues need to be considered properly. People who do not take this into account are escaping their responsibilities ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Humans have the right to modify the natural environment to suit their needs ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Mankind is severely abusing the environment ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
When humans interfere with nature, it often produces disastrous consequences ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
We are approaching the limit of the number of people the Earth can support ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Given the opportunity, I would like to take action that are in-line with pro-environmental behaviour ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Whether I perform pro-environmentally is entirely up to me ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Environmental pollution is a society problem, and everyone has to take part in it to resolve it ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
It is worthless for the individual consumer to do anything about pollution ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
When I buy products, I try to consider how my use of them will affect the environment and other consumers ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Since one person cannot have any effect upon pollution and natural resources problems, it doesn't make any difference what I do ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Process of designing programs/activities/events for encouraging pro-environmental behaviour should involve also citizens ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
I will be more inclined to behave pro-environmentally when *peers/people in my neighbourhood* are also engaged in that behaviour ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

(b) Questions related to Human values

Please rate to what extent these values are guiding principles in your life **-1= Opposed to my values, 0= not important, 1= Important, 2 = Very Important, 3 = Supremely Important**
Social justice (Correcting Injustice, Care for the weak) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Equity (Equal Opportunity for all) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
A world of peace (no wars, no conflict) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Protecting the environment (preserving nature) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Preventing pollution (conserving the natural resources) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Self-discipline (resistance to temptations) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Family security (Safety for loved ones) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Influential (Having an impact on people and events) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Wealth (material possessions, money) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Authority (the right to lead or command) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Curious (interested in everything, exploring) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
A varied life (filled with challenges, novelty and changes) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
An exciting life (stimulating experiences) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3

c) Questions related to ecological behaviours

Please indicate to what extent you observe the following behaviours **1= Yes Always, 2 = Yes, 3 = Very Seldom, 4= No, 5= I don't know**
I try to buy only products that can be recycled ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
When there is a choice, I always choose that product which contributes to the least amount of pollution

◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
To save energy, I drive my car as little as possible ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
I try to buy energy efficient household appliances ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
If I understand the potential damage to the environment that some products can cause, I don't purchase these products ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
I buy high efficiency light bulbs to save energy ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
I usually purchase the lowest price products, regardless of its impact on society ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
I have convinced members of my family or friends not to buy some products which are harmful to the environment ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5

Section III: The use of air-quality information

We are asking few questions related to your current level of use of air-quality related information.

Have you actively searched for air quality related information during the last calendar year?	Yes ☐ No ☐ If Yes, how well the information satisfied your needs? (1 worst, 5 best) ◯ 1 ◯ 2 ◯ 3 ◯ 4 ◯ 5
Have you received a warning of poor air quality during the last calendar year?	Yes ☐ No ☐
If there is a warning of poor air quality, which of the following options would best describe your beliefs on its impact on you:	a. It doesn't have any direct impact on me b. Inconvenience, some effects on how nice it is to conduct daily activities (commute, hobbies etc.) c. There might be some health effects e.g. related to lung or heart symptoms d. There is elevated risk of lung and heart disease symptoms, slightly elevated risk of acute diseases and death and it restricts activities I can carry on
If you receive a warning of poor air quality, would you consider changing your daily routine?	Yes ☐ No ☐ If Yes, please mark the most likely responses: • Avoiding exercise outdoors • Shutting down windows • Using air cleaning equipment in home • Use of protective masks when outdoors • Staying indoors • Changing clothes after exposure • Having a shower after coming home • Changing the schedule of planned activities (e.g. having a run at night time) • Changing the transport mode (e.g. from walking to car) • Some other? Please specify:

Consider the two most likely responses from previous question:	• Consider the first response: How much time or money it would require making the response (state both if it will cost both time and money): Time: Money: • Consider the second response: How much time or money it would require making the response (state both if it will cost both time and money): Time: Money:
Please indicate what are your main reasons to participate in the study?	• More spatially accurate air quality information • Easier access to air quality information whenever needed • To plan my activities better with the help of spatially more accurate air quality information • To help researchers to gather data about air quality • Raise my own awareness of air quality information • Interest in research or environmental topics • As a statement to bring up environmental values and health concerns • Mostly for other information that can be collected with the kit, such as temperature • Out of interest for the technical specification of the Citizen Kit • Some other? Please specify:
If not available for free, would you consider paying some annual rent for the mobile-sensor?	a. 0€ b. 0-10€ c. 10-20€ d. 20-30€ e. 30-40€ f. 40-50€ g. More than 50€ - please indicate the maximum and why it would be of such high value for you

Thank you for your time!

For information and questions about this questionnaire, you can contact:

a.passani@t-6.it

www.iscapeproject.eu

Questionnaire 2.

iSCAPE

Citizen kit survey: social and economic impacts (2)

Dear Participant,

you have had an opportunity to use a mobile sensor to measure the air quality wherever you have gone. This is a follow-up questionnaire to see how you have used the sensor during the time it has been in your use. Please answer to this questionnaire after the test-period and hand it over with the survey that you have filled before the test period.

iSCAPE

Introductory Questionnaire:

Section I: Socio- Demographic and Personal details

Age	_____(years)
Gender	Male ☐ Female ☐
Nationality	
Current Address (only Street name and Town)	
Employment Status: Are you currently…?	• Employed for wages • Self-employed • Out of work and looking for work • Out of work but not currently looking for work • A homemaker • A student • Military • Retired • Unable to work
What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.	• Less than high school degree • High school graduate, diploma or the equivalent • Trade/technical/vocational training • Associate degree • Bachelor's degree • Master's degree • Professional degree • Doctorate degree
Mother tongue language	• ……
What was your total household income before taxes during the past 12 months?	• Less than 10,000 Euros • 10,000 to 24,999 Euros • 25,000 to 49,999 Euros • 50,000 to 74,999 Euros • 75,000 to 99,999 Euros • 100,000 to 149,999 Euros • 150,000 to 199,999 Euros • 200,000 and up • Prefer not to answer
Persons living with you (your family composition)	Please provide number of persons in the household _____ Adults (above 18 years) _____ Teenagers (12 -18 years) _____ Children (6- 12 years) _____ Children (below 6 years)
History of heart or lung diseases of the respondent:	Yes ☐ No ☐
History of heart or lung diseases in the family (within current family unit):	Yes ☐ No ☐

iSCAPE

Section II: Environmental Issues, Human values and Interests

We are asking few questions regarding environmental problems and issues, along with your opinion about human values. You need to give your opinion in the form of degree to which you agree or disagree to the statements shown below:

(a) Questions in relation to Environmental issues/concern

Please indicate how much you agree /disagree with the following statements. **1= Strongly disagree, 2 = Disagree, 3 = Neutral, 4= Agree, 5= Strongly Agree**
Environment Pollution is a problem in my city ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Environmental pollution may affect my health. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
The environment is deteriorating, it is clearly notable and visible ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Environmental issues need to be considered properly. People who do not take this into account are escaping their responsibilities ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Humans have the right to modify the natural environment to suit their needs. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Mankind is severely abusing the environment. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
When humans interfere with nature, it often produces disastrous consequences. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
We are approaching the limit of the number of people the earth can support. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Given the opportunity, I would like to take action that are in-line with pro-environmental behaviour ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Whether I perform pro-environmentally is entirely up to me ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Environmental pollution is a society problem, and everyone has to take part in it to resolve it. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
It is worthless for the individual consumer to do anything about pollution. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
When I buy products, I try to consider how my use of them will affect the environment and other consumers. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Since one person cannot have any effect upon pollution and natural resources problems, it doesn't make any difference what I do ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Each consumer's behavior can have a positive effect on society by purchasing products sold by socially responsible companies ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

iSCAPE

Process of designing programs/activities/events for encouraging pro-environmental behaviour also involve citizens ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
I will be more inclined to behave pro-environmentally when *peers/people in my neighbourhood* are also engaged in that behaviour ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
There are opportunities available to change your daily routine which could lead to lesser exposure to pollution (e.g. change in activity location, flexibility in opening hours of shops) ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Public transport (buses frequency, bus stop locations) in your area is good and you are satisfied with it. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Bicycle facilities (e.g. bike share programs, bike parking availability, safe and segregated bicycle paths) in your area are good and you are satisfied with it. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
Pedestrians facilities (e.g. Footpaths, restricted traffic zones, zebra crossings, pelican signals, traffic observing priority to pedestrians) in your area are good and you are satisfied with it. ○ 1 ○ 2 ○ 3 ○ 4 ○ 5
There should be more restrictions on the use of car in your area (e.g. speed control, Car free zones, increase in parking cost, increase of taxes etc.) ○ 1 ○ 2 ○ 3 ○ 4 ○ 5

(b) Questions related to Human values

Please rate to what extent these values are guiding principles in your life **-1= Opposed to my values, 0= not important, 1= Important, 2 = Very Important, 3 = Supremely Important**
Social justice (Correcting Injustice, Care for the weak) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Equity (Equal Opportunity for all) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
A world of peace (no wars, no conflict) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Protecting the environment (preserving nature) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Preventing pollution (conserving the natural resources) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Self-discipline (resistance to temptations) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Family security (Safety for loved ones) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3
Influential (Having an impact on people and events) ○ -1 ○ 0 ○ 1 ○ 2 ○ 3

Have you actively searched for air quality related information during the test period also from **other sources?**	Yes ☐ No ☐ If Yes, please describe the situation; what information and for what purpose?
Have you received a warning **or** collected information with the sensor that showed poor air quality during the test period?	Yes ☐ No ☐ If Yes, please mark the source (or both). a. Mobile-sensor observed poor air quality b. I received a poor air quality warning from an external source
If there was a warning of poor air quality or the mobile sensor showed poor air quality, which of the following options would best describe your beliefs on its impact on you:	a. It doesn't have any direct impact on me b. Inconvenience, some effects on how nice it is to conduct daily activities (commute, hobbies etc.) c. There might be some health effects e.g. related to lung or heart symptoms d. There is elevated risk of lung and heart disease symptoms, restricted activity, slightly elevated risk of acute death.
Did the information from the mobile sensor affect your daily routine? Yes/No	Yes ☐ No ☐ If Yes, please mark the responses: • Avoiding exercise outdoors • Shutting down windows • Using air cleaning equipment in home • Use of protective masks when outdoors • Staying indoors • Changing clothes after exposure • Having a shower after coming home • Changing the schedule of planned activities (e.g. having a run at night time) • Changing the transport mode (e.g. from walking to car) • Some other? Please specify:
Consider the two most likely responses from previous question:	• Consider the first response: How much time or money it would require making the response (state both if it will cost both time and money): Time: Money: • Consider the second response: How much time or money it would require making the response (state both if it will cost both time and money): Time: Money:

If we would give you an opportunity to rent the mobile sensor for you to use on an annual basis, please indicate the maximum **rent per year** that you would be prepared to pay.	a. 0€ b. 0-10€ c. 10-20€ d. 20-30€ e. 30-40€ f. 40-50€ g. More than 50€ - please indicate the maximum and why it would be of such high value for you (open-ended)
If you stated a positive amount (>0) in the previous question, how long rent agreement would you be willing to agree?	a. 1 year b. 2 year c. 3 year d. 4-6 year e. 6-10 year f. More than 10 years
Are there some technical or practical barriers that should be solved before you would be willing to pay the rent? Please state the barriers as accurately as possible:	(Open-ended).

Thank you for your time!

For information and questions about this questionnaire, you can contact:

a.passani@t-6.it

www.iscapeproject.eu

Citizen Kit Guide

HOW TO USE THE CITIZEN KIT

Step-by-step guide to the iSCAPE Citizen Kit, you can find the same information also online docs.iscape.smartcitizen.me

The Citizen Kit

Quick links

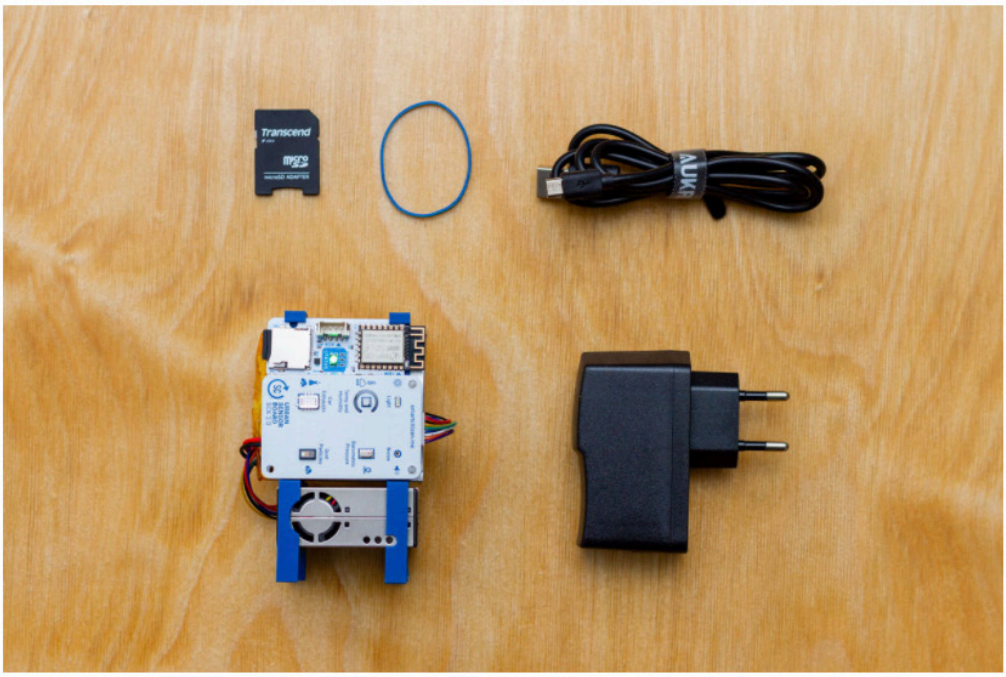
Installation: onboarding.iscape.smartcitizen.me

Platform: smartcitizen.me

Support: support@smartcitizen.me

The Kit

The iSCAPE Citizen Kit is based on the Smart Citizen Kit 2.0.



1. Smart Citizen Kit 2.0 with particle and battery sensor with two mounting brackets.
2. MicroSD card and microSD adapter to SD.
3. USB cable and a USB charger to charge the battery.

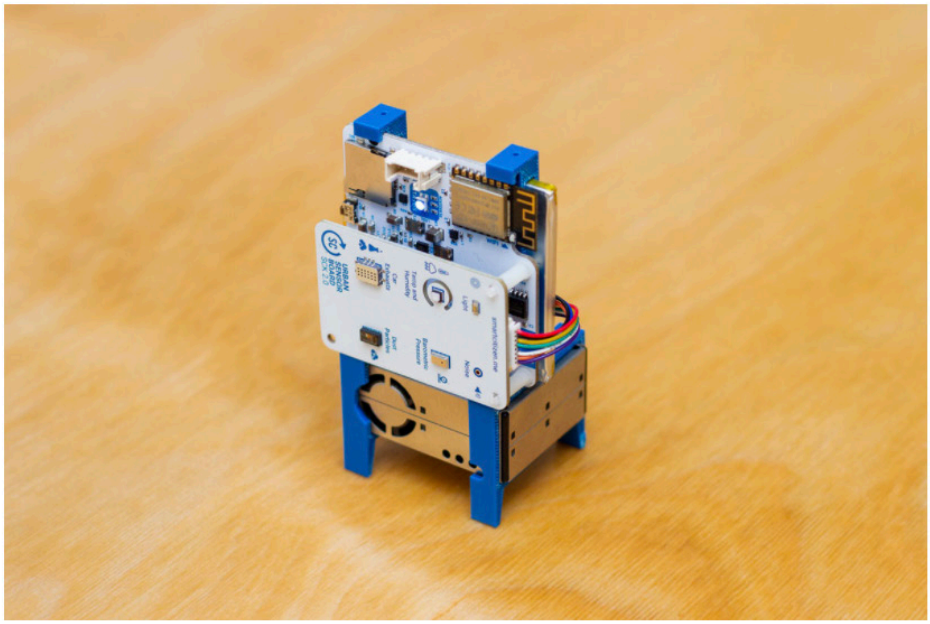
Citizen Kit Guide

Measurements

Mesura	Unitats	Sensors
Air temperature	°C	Sensirion SHT-31
Relative Humidity	% REL	Sensirion SHT-31
Noise level	dBA	Invensense ICS-434342
Ambient light	Lux	Rohm BH1721FVC
Barometric pressure	Pa	NXP MPL3115A26
Particulate Matter PM ½.5/10	µg/m3	PMS 7003

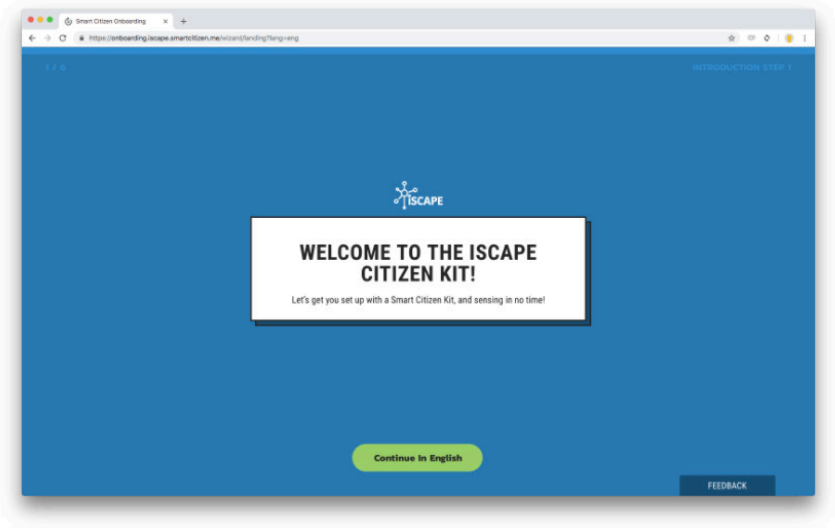
Instructions

The sensor comes mounted and almost ready to be used

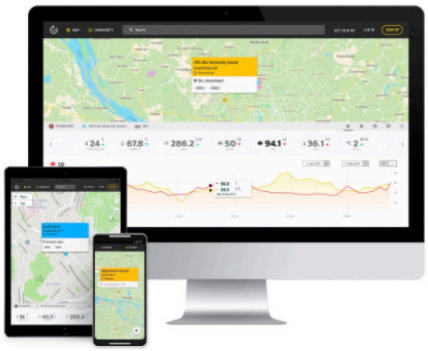


The only thing we should do is connect the battery. The kit will light in red and we will be able to configure it by following the instructions at onboarding.iscape.smartcitizen.me.

Citizen Kit Guide



After the configuration your data will be available on the SmartCitizen platform. You can explore the data there or download it using the `CSV Download` option.



Citizen Kit Guide

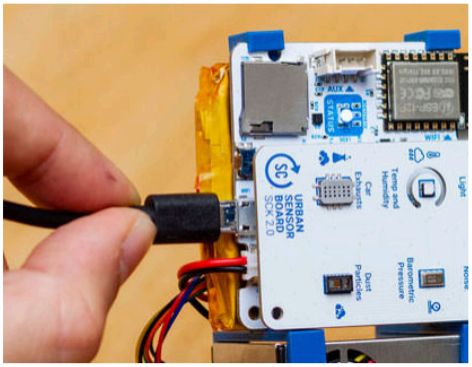
Autonomy

The kit has a battery life of 12 hours. For long exposures, we can permanently connect to the USB.

When we no longer want to publish or save more data for a few days we can turn off the kit. To do this, press the button for 5 seconds.

If the colors of the LED appear orange ● indicates that the battery must be charged.

The battery takes about 4 hours to fully charge. When the battery is fully charged, change the orange to green ●.

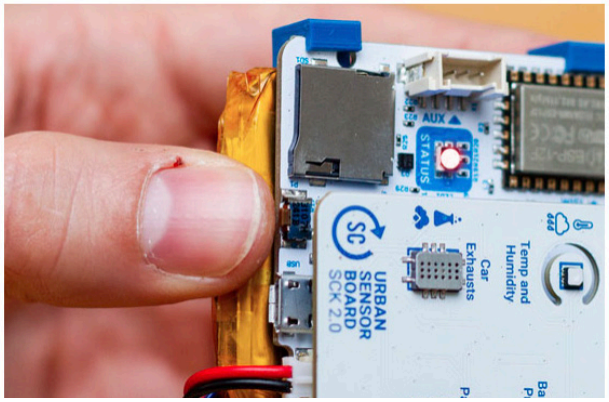


Remember that in addition to the colors you will have the state color of the kit: configuration, network and sd.

States of the Kit

The button

Funció	Acció del botó
ON	Push the button
OFF	Push the button for 5 seconds
CHANGE MODE	Push the button multiple times to choose: *Setup* ● *Wi-Fi* ● *Pink* ●
FACTORY RESET	Push the button 15 seconds for a full reset



Citizen Kit Guide

Operation modes Link

Setup mode

In this mode, the Kit is ready to be configured in **network** mode or **SD card** in **onboarding.iscape.smartcitizen.me**.

LED color	Kit status
	Ready to be setup
	Ready to be setup but battery is low, charge the Kit
	Ready to be setup, battery charging
	Ready to be setup, battery charged

Wi-Fi mode

This is the standard mode for a network that requires a Wi-Fi connection. In this way, the device will publish the data every minute on the smartcitizen.me platform. If there is an inserted micro SD card, the data will be stored in duplicate.

LED color	Kit status
	Collecting data online
	Error while collecting data
	Collecting data online but battery is low, charge the Kit
	Collecting data online, battery charging
	Collecting data online, battery charged

Warning

The kit supports Wi-Fi WEP, WPA/WPA2 and open networks that are common networks in domestic environments and small businesses.

But, it **does not** support WPA/WPA2 Enterprise networks such as EDUROAM or networks with captive portals such as those found in Airports and Hotels

SD card mode (offline)

If we do not have an internet connection we can use the SD mode. In this case the device will record the data on the micro SD card. Later we can read the card using a card reader. The data can be visually spaced in a spreadsheet but also published on the **smartcitizen.me** platform using the **UPLOAD CSV** option.

LED color	Kit status
	Collecting data offline
	Error while collecting data
	Collecting data offline but battery is low, charge the Kit
	Collecting data offline, battery charging
	Collecting data offline, battery charged

Especial status

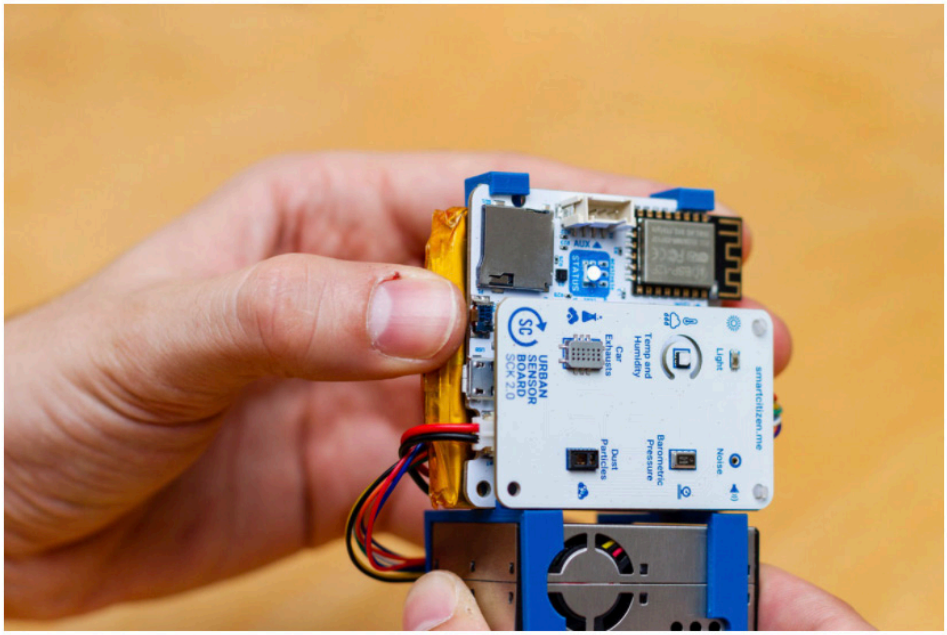
LED color	Kit status
	Busy, please wait!
	Software update going on!

Citizen Kit Guide

🧑‍🦰 Troubleshooting

Before setup

Before configuring the Kit setup make sure the LED is red. If not, press the button multiple times until the LED turns red.



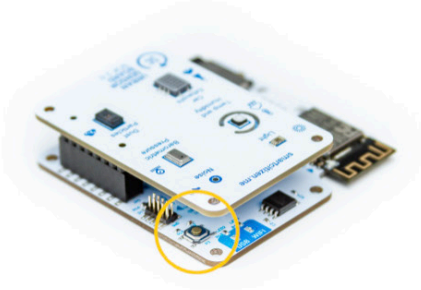
Citizen Kit Guide

The kit does not respond

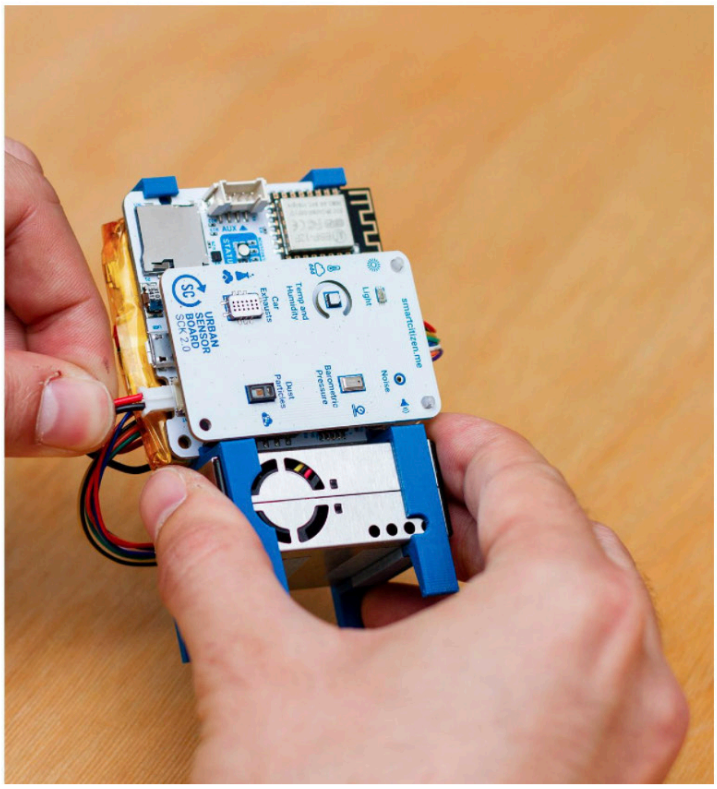
If the kit does not respond or does not work properly you can do two things:

Reboot your Kit

You can fully reboot your Kit by pressing the reset button located under the sensors board as seen on the picture. That will not delete any configuration, it will simply restart your device. Press the `RESET` button for a second. The light will go off and on and the device will start again.



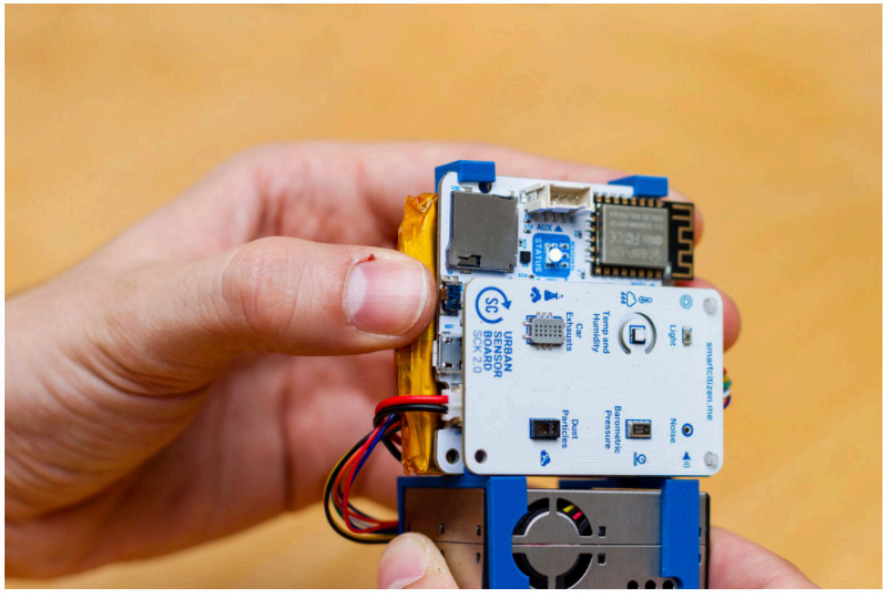
You can also perform a reboot by disconnecting the battery and the USB cable so that the kit is restarted. In this way we will not lose any data and configuration except the time in case of being in **SD mode**.



Citizen Kit Guide

Factory reset your Kit

You can fully reset the Kit to the default settings so you can register again your device. Press the main button for **15 seconds**.



After 5 seconds the light will go off and will go on again after 15 seconds. Then you can release the button and your device will be fully resetted as a brand new Kit.

The LED does not turn on and the kit does not work

First of all, push the kit button. Maybe it's simply off.

If this does not work, surely the kit has been left without battery. You will have to charge it using the USB charger. Any other mobile charger will also work.

We will know that it is charging when the LED emits orange pulses and once the battery is charged it will emit green

The kit does not store the data on the SD card.

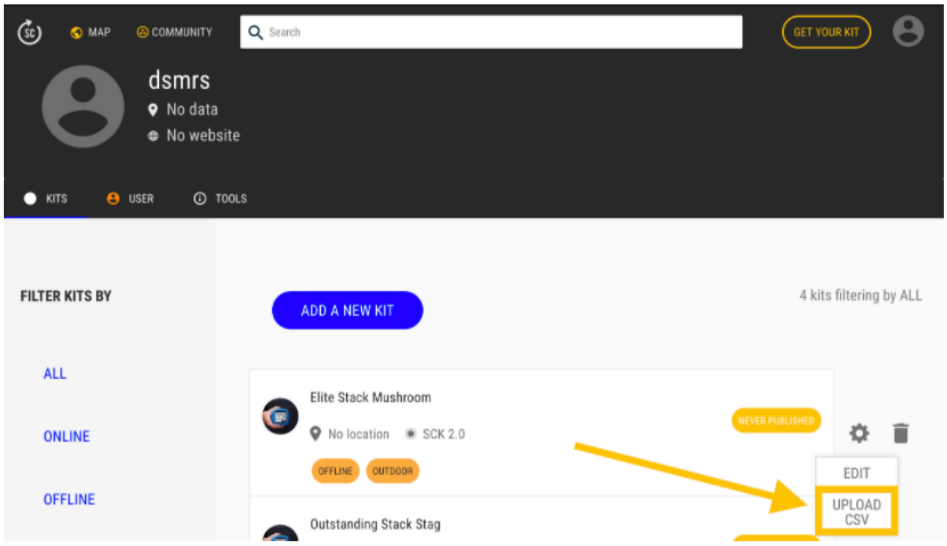
Some SD cards may have problems over time. We can try formatting it but in case it does not work any micro SD card we buy at any mobile or computer store it will work. The size is not important and any micro SD or micro SDHC 512MB card up to 32GB will work.

Citizen Kit Guide

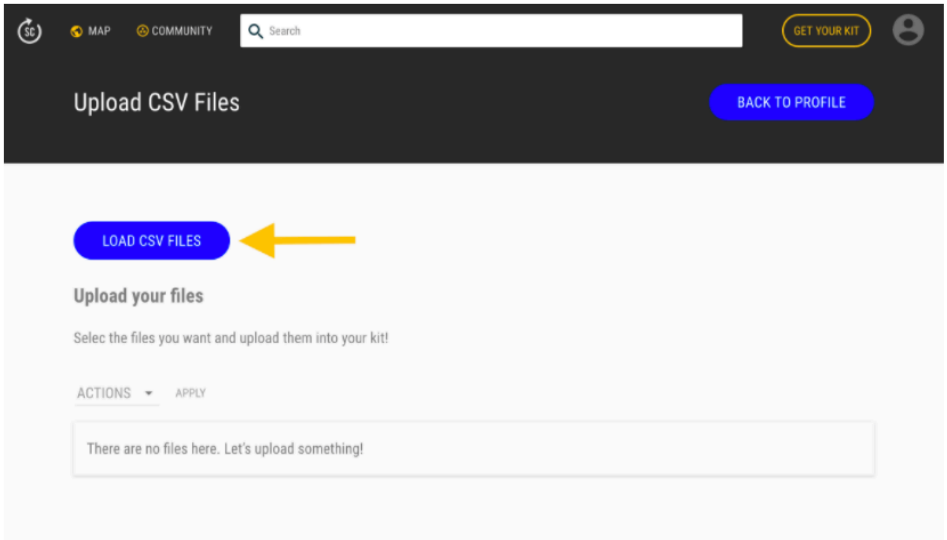
CSV Upload

Here some instructions on how to upload CSV files to Smartcitizen platform. First be sure to be logged and go to your profile.

On your kits' list, click on the wheel and then on `Upload CSV`.

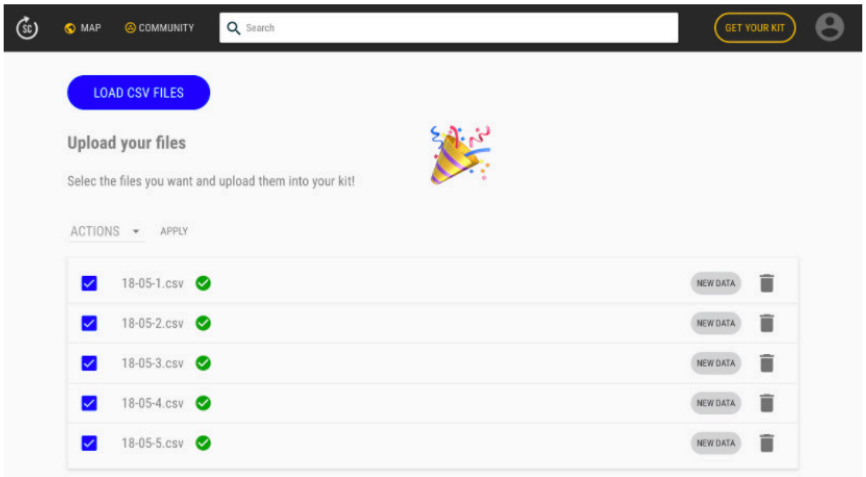


Once on the upload page, you can add some files by clicking on the `Load CSV files` button.



Citizen Kit Guide

Congrats! You just uploaded your files CSV files on the Smartcitizen platform.



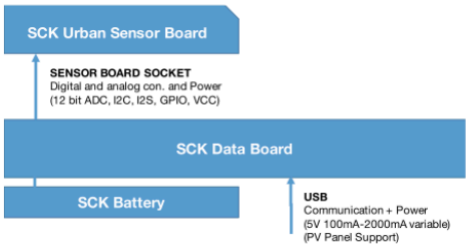
Technical specs

The Citizen Kit, formerly known as the Low-Cost Sensor, is aimed at providing a low-cost environmental sensor solution non-technical users can easily deploy. The design developed for the project is a complete reiteration of the Smart Citizen Kit, a piece of hardware for citizen sensing already tested in other projects for more than five years. On this iteration, new sensors had been added, and all the electronic design has been redone from the ground up to improve the data accuracy and reduce the manufacturing costs.

Components

The design is built around two boards the Smart Citizen Data Board and the Smart Citizen Urban Sensor Board. The first board contains the data acquisition, the power management, and the communication unit. The second contains a set of sensors aimed at the outdoor urban environment including: Air Temperature, Relative Humidity, Noise Level, Ambient Light and Barometric Pressure. The board also features a section especially focused on Air Quality including a Air Particles, a Carbon Monoxide, and a Nitrogen Dioxide detectors. This sensor while not capable of offering precise measurements can be used to understand the behavior of different urban locations especially when they are calibrated on the field using certified equipment. Both boards are later described in detail on the Sensor Components section.

Citizen Kits Components Setup



Learn more

Learn more about all the components and the software inside the kit in the Components documentation section.

Software Updates

The SCK 2.0 has two components that need periodic updates. The SCK 2.0 appears as a USB Storage device and the new firmware can be installed on your kit by simply downloading the new firmware release and then dragging and dropping into the SCK 2.0 device root folder. The Wi-Fi module firmware is updated automatically over-the-air every time the main processor firmware is updated.

Firmware updates

Update the Firmware

Dimensions

- Dimensions: 60 x 60 x 20 mm (approx.)
- Dimensions w/ enclosure: 110 x 110 x 50mm (approx.)
- Weight: 65 gr.
- Weight w/ enclosure: 160 gr.

Power Management

Battery lifetime

The SCK 2.0 comes with a 2000mAh LiPo battery. The battery is meant to be a complete power option for short-term measurements and a backup solution when the kit it is used for long periods. The battery lifetime lifetime is dependent on which sensors are enabled or disabled:

- All sensors publishing over Wi-Fi: 12 hrs.
- All sensors publishing on SD card: 13 hrs.
- Without air quality sensors over Wi-Fi: 10 days
- Without air quality sensors on SD card: 25 days

Battery charging

The SCK 2.0 has a micro USB port and can be charged like any Smartphone or Tablet using a dedicated adapter or a computer USB port. We recommend using a tablet power adaptor, instead of a computer USB port, for quicker charging. Autonomy can be extended by using a Power Bank, a 5V PV Panel, or with a through-glass induction charger (currently under development).

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