COMPAIR

DELIVERABLE

D8.6 Final Exploitation Plan

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0.5	30.10.24	Pavel Kogut	21C	Addressing review remarks
1.0	31.10.24	Pavel Kogut	21C	Final version

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Abbreviations

API	Application programming interface
AR	Augmented Reality
bcMeter	A DIY sensor for measuring black carbon
CD4E	Communication and dissemination for exploitation
CO2 Calculator	Household emissions calculator and simulation dashboard
CS	Citizen science
DEVA	Dynamic Exposure Visualisation App
DEV-D	Dynamic Exposure Visualisation Dashboard
DEVX	A combination of DEVA and DEV-D
DIY	Do it yourself
HRP	Horizon Results Platform
IPR	Intellectual property rights
KVP	Knowledge Valorisation Platform
LDR	Learn-do-reflect
MOOC	COMPAIR's online course (massive open online course)
NO2	Nitrogen dioxide
OLC	Open Learn Create
PM	Particulate matter
PMD	Policy Monitoring Dashboard
STEM	Science, technology, engineering, maths

COMPAIR project partners

Digitaal Vlaanderen (DV)	Project coordinator
Flanders Environment Agency (VMM)	Lead of the Flemish pilot
DAEM	Lead of the Greek pilot
inter3	Lead of the Berlin pilot
Energy Agency Plovdiv (EAP)	Lead of the Plovdiv pilot
Sofia Development Association (SDA)	Lead of the Sofia pilot
Telraam	Manufacturer of the Telraam sensor
Imec OnePlanet Research Center	NitroSense owner and calibration provider
Athens Technology Center (ATC)	Tech lead and developer of PMD & DEVD
Fraunhofer HHI	Owner and developer of DEVA
University of the Aegean (UAEG)	Owner and developer of CO2 Calculator
European Citizen Science Association (ECSA)	Pilot support and CS network expansion
IS-Practice (ISP)	Project management support
21c Consultancy (21C)	Communications lead
SODAQ/QADOS	Manufacturer of SODAQ AIR

Executive summary

In November 2024, COMPAIR will cease to exist as a consortium of 15 partners, and the new journey will begin. What will follow promises to be an exciting period, in which results will be used in settings old and new, by those who share the project's ambition to mobilise communities to act on climate change and air pollution, two major challenges that are closely related.

Digital tools

The apps will be maintained and further refined to support the monitoring of policy-induced changes in traffic and air quality in places like the East Flanders province (Policy Monitoring Dashboard), to promote STEM education,[1] and environmental awareness among school children and university students in Bulgaria and Belgium (CO2 Calculator, Dynamic Exposure Visualisation Dashboard), and to test new AR visualisation techniques for emergency planning and facilities management (Dynamic Exposure Visualisation App) in pilot cities and beyond. Given the technical nature of these results, the respective developers have defined appropriate arrangements as regards ownership and licensing, so that exploitation opportunities can be maximised without jeopardising partners' intellectual property.

Sensors, data & calibration

Sensor devices which were used and improved (in terms of accuracy and usability) during the project will continue collecting data in places of original deployment (pilot cities). Data from Telraam will be incorporated into Traffic-Scout, a traffic model developed by Transport and Mobility Leuven, to enhance the accuracy of mobility simulations. Data from bcMeter will be integrated with data from SODAQ/QADOS[2] to reinforce the measurement of particulate matter, of which black carbon is a variant. VMM plans to test the bcMeter-SODAQ combo in Antwerp. As regards NitroSense devices, Flanders Environment Agency and imec[3] will use their data to finetune calibration algorithms to improve the accuracy of the NO2 sensor for measuring nitrogen dioxide. New parties looking to use imec's calibration method can do so by purchasing a licence, investing in service improvement, or working with the research centre as partners on a research project.

Communities & policies

The apps, sensors, data and calibrations would not have achieved their impact and exploitation potential without all the volunteers who contributed to COMPAIR in more ways than one, as problem setters, data collectors, solution co-creators, ambassadors and champions. Each pilot community is a result in its own right that is worth maintaining, not least to keep COMPAIR alive in the hearts and minds of people who made the project happen.

[1] Science, technology, engineering, maths
[2] The SODAQ company changed its name to QADOS in 2024. The name of the sensor SODAQ Air remains the same
[3] When the name imec is used, it always refers to imec OnePlanet research centre in the Netherlands

In Athens, cooperation will continue with Friendship Clubs from which most volunteers came and where NitroSense devices are still measuring air quality. Two other main stakeholders, the Hellenic Passive House Institute and the Natural Environment and Climate Change Agency, will work with DAEM to promote the use of CO2 Calculator in reaching Athens' Climate Adaptation Plan.

The Berlin pilot leader inter3 secured consent from volunteers who wish to stay informed about future citizen science activities. Many of those who took part in the cycling campaign would like to continue using DEVX (a combination of DEVA and DEV-D) for monitoring dynamic exposure. The release of the iOS version for DEVA helped to attract new users (of Apple devices). The results of the Graefekiez campaign, for its part, caught the attention of the Berlin Senate's Mobility Department. The authority is keen to reuse the methodology and PMD in other Kiezblocks.[4]

The community in Flanders is set to grow once VMM completes the integration of PMD into its toolkit for regional municipalities. This would significantly expand the current network of three cities (Herzele, Sint-Niklaas, Ghent) to potentially several dozen of them. Even without this growth, COMPAIR sustainability will be ensured in existing locations. A school in Herzele, for example, wants to incorporate the learn-do-reflect approach into the curriculum after seeing its impact on students' mobility habits.

In Bulgaria, schools are keen to let citizen science play a bigger role in education, as well. Plovdiv schools have kept all monitoring devices used during the project and are developing, with the support of Energy Agency Plovdiv, task-based activities around sensor assembly and data analysis using PMD and CO2 Calculator, all in an effort to boost STEM skills.

Schools in Sofia are also keeping their sensors, albeit for a slightly different reason. Inspired by the Flemish success, the city wants to introduce the first ever school street. Having PM and traffic (Telraam) sensors will come in handy when the time comes to start measuring the impact of a temporary road block. If the school street is a prospective measure, a school bus is something that has been running for two consecutive rounds (academic years). What started as a year-long trial was extended for another term thanks to Sofia Development Association's work on multi-stakeholder engagement involving schools, teachers, parents and policy makers. If new survey results turn out to be as good as the previous ones, it certainly is possible the school bus service may be prolonged.

Communication and dissemination for exploitation

In addition to the pathways described above, exploitation will be stimulated by making results easy to find by potential adopters, and soliciting their use in a controlled environment. Steps to achieve that are undertaken at project-level by the communications lead (21C). They include a) publishing results on third-party platforms like Horizon Results Booster and Knowledge Valorisation Platform, b) setting up a CS Lab on the project's website as described in D8.5, and c) releasing an online course on Open Learn Create after testing.

[4] Neighbourhoods with traffic-calming measures in place

Introduction

The final exploitation plan explains what will happen to project results after COMPAIR comes to an end in October 2024. Even though COMPAIR will no longer be around as a consortium of 15 partners after this date, its legacy will continue to drive the climate and health agenda in the five pilot locations, plus there is high potential for replicability in other contexts, too. Following the framework outlined in previous plans, D8.6 presents pathways to sustainability based on how results will be used to achieve social, policy-related, technical or scientific objectives.

Before discussing exploitation pathways, some clarity is needed as to what will be exploited i.e. which results? COMPAIR is a multidimensional project with a rich portfolio of results that span:

Digital tools: Four custom-built apps for analysing the impact of urban mobility policies (Policy Monitoring Dashboard), measuring carbon footprint and simulating abatement strategies (CO2 Calculator), visualising air pollution in Augmented Reality (Dynamic Exposure Visualisation App), understanding air pollution along the route (Dynamic Exposure Visualisation Dashboard)

Sensors and data: A variety of air quality and traffic sensors used in COMPAIR to collect air quality and traffic data. The main focus here is on Telraam, bcMeter and NitroSense because these three devices benefitted the most in terms of technical improvement from their deployment in the project

Calibration: A method to check air quality devices for accuracy and improve the latter using distant- or auto-calibration techniques

Communities & policies: Networks of citizen scientists and other stakeholders (public authorities, NGOs, schools, projects) that contributed to and were influenced by local policies (as well as by COMPAIR in terms of improved knowledge, skills, motivation, social network, lifestyle changes)

Project knowledge base: Deliverables, publications, and training content (in the form of a MOOC) produced by the consortium that others can use to reproduce COMPAIR in whole or in part, in the same or different settings and cities

For each set of results, D8.6 proposes a range of exploitation pathways, supported by a commitment from all partners and additional communication and dissemination measures (CD4E), to stimulate reuse and achieve long-term sustainability (Figure 1).

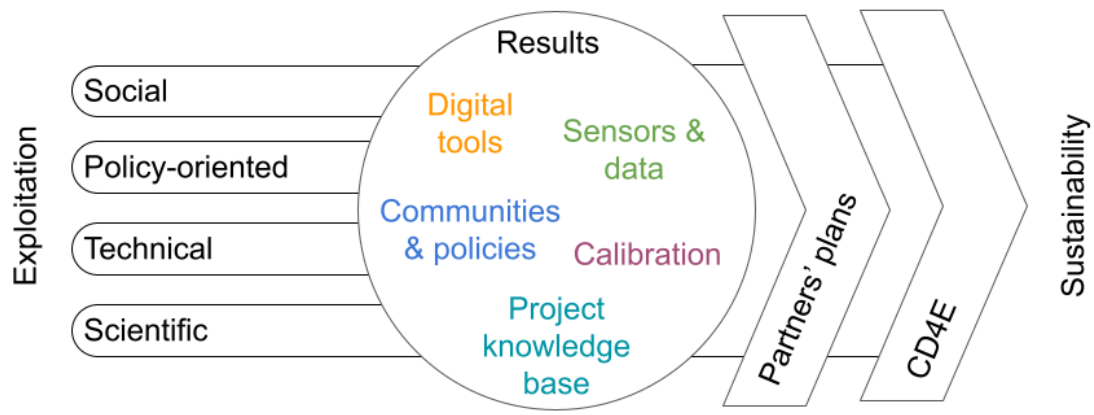

Figure 1. Exploitation concept

Digital tools

The four apps are some of the most recognisable COMPAIR results with proven ability to support several exploitation tracks. They can be used by citizens of all ages to raise their environmental awareness, by public authorities to evaluate policies, by innovators to create new digital solutions, and by scientists to analyse empirical findings and/or create new educational content.

However, the apps' technical nature - specifically, shared ownership and use of proprietary licences and technology in some of the tools - has implications for exploitation. A simple example is proprietary licence. If applied to the source code, others may not be able to easily build new products with it, so the technical exploitation can suffer.[5] Partners can have perfectly legitimate reasons, commercial or otherwise, for applying such restrictions on foreground Intellectual Property (project results) whenever proprietary technologies are involved (background IP). The fact that third party developers may not be able to reuse the source code is not necessarily a bad thing, as long as the result in question continues to provide exploitation opportunities in other tracks. COMPAIR acknowledges that trade-offs are sometimes inevitable, and it's the reason why we opted for a resilient framework that allows for multiple exploitation scenarios per result.

Another aspect that influences app's exploitation is maintenance costs. Cloud infrastructure, data storage, and technical support all cost money. A time-limited 'grace period' is foreseen

[5] The licensor might license the code for others to use under certain conditions/payment. The point is that, compared to open source, with proprietary license it may be more difficult and burdensome for others to build on the source code provided. In addition, there are many different forms of non-open license, some of which allow non-commercial use, and with varying definitions of what constitutes commercial use. In European projects, where joint foreground is often co-owned by consortium partners, non-commercial exploitation is typically allowed free of charge for those who contributed to its creation, not for third parties, however

whereby access to the tools remains free for a while after the project. It's important that interested parties know how long the period will last and which conditions will kick in afterwards so they can plan exploitation accordingly. The ownership structure, grace period, source code, considerations pertaining to the revenue model, and a range of planned exploitation scenarios, are presented for all four tools in the coming sections.

PMD & DEV-D

Ownership

Athens Technology Center (ATC) developed both tools (Figure 2) based on designs provided by Digitaal Vlaanderen (DV). Given this collaboration, a joint ownership arrangement may be appropriate.

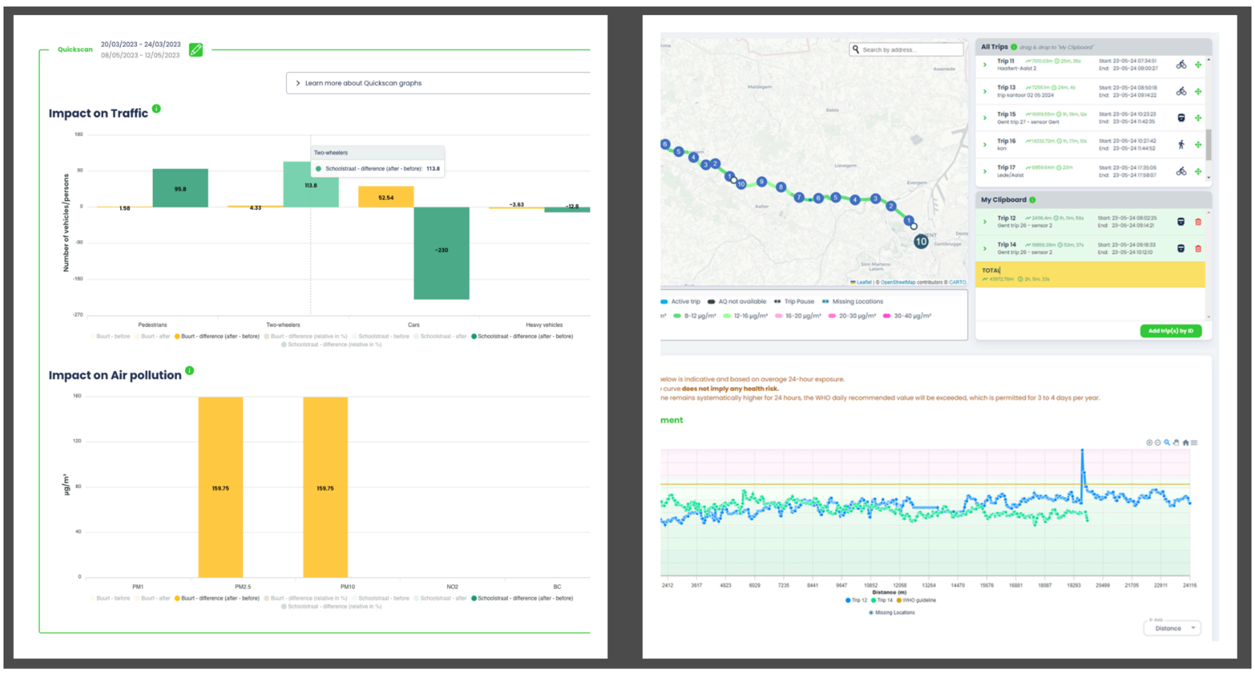

Figure 2. Visualisations showing analytical outputs by PMD (left) and DEV-D (right)

Grace period and maintenance

For a period of one year after the project completion, ATC will maintain the tools in their current form (as-is). Any additional requests or customisations during this time will be reviewed and addressed individually, based on the nature and scope of each request.

The main ongoing expenses include:

- Cloud infrastructure costs for servers, virtual machines, and bandwidth (covered by DV)

- Data storage for PMD, DEV-D, and Data Manager,[6] especially when handling large datasets or doing integration with external sources. Let's say someone in Latvia or any other EU country is interested in connecting their sensor data to PMD. Such integration would need to be done through ATC. It's not difficult but will require technical support of ATC
- Technical support for addressing system bugs, crashes, and other unexpected issues
- Ongoing monitoring, server maintenance, and software optimisation to ensure the tools and Data Manager perform smoothly. Additional resources may be needed if usage scales up to maintain optimal performance

Source code and revenue model

Both apps are licensed under GNU General Public License v3.0.[7] This means that if people know how, they can recreate PMD and DEV-D from the code provided. GNU GPL3 is an open source licence that allows others to use it privately, even for commercial purposes. If interested parties aren't able to build the dashboards themselves, they can ask owners for help. In this case, the latter can derive commercial benefit by building custom PMD- and DEVD-style apps upon request, in line with the GNU GPL3 licence. A SaaS (software as a service) model would involve

- ***Consultation and development:*** Understanding client needs and building custom dashboards or data management systems tailored to their project or organisation
- ***Data integration:*** Offering services for data migration, cleaning, and structuring to ensure smooth implementation
- ***Support and maintenance:*** Provide ongoing technical support, troubleshooting, system updates, performance monitoring, and other maintenance services
- ***Training:*** Provide training and documentation for teams to efficiently use the dashboard or Data Manager

This option may be tested already within the first year post-project as Flemish partners have plans to scale the dashboards, especially PMD, across the region.

PMD exploitation

PMD in East Flanders: The province of East Flanders bought several dozen Telraam S2 traffic sensors and gave them to citizens to measure the effects of the recently opened Vijfstraten bicycle bridge in Sint-Niklaas. Data from sensors is displayed on PMD. The monitoring will continue for several months after which time data will be stored in Data Manager.

PMD in the VMM's toolkit: VMM is running a programme aimed at supporting local governments throughout their policy cycle. As part of this programme, a toolkit is being developed to aid i) the identification of pollution hotspots and ii) the evaluation of measures

[6] Data Manager collects, aggregates, stores and shares data with PMD, DEV-D, and DEVA
[7] https://choosealicense.com/licenses/gpl-3.0/

undertaken to reduce them. VMM wants to add PMD to this toolkit to stimulate data-driven environmental decision making in cities like Antwerp, Bruges, and Ghent.

Before PMD can be offered as a viable decision support tool, though, additional testing and finetuning needs to happen. VMM plans to do this as part of the LIFE CityTRAQ project it's coordinating right now.[8] A decision is expected by mid-2025 on whether further modifications are needed or PMD is good enough to join the toolkit.

PMD in MOOC: A task-based PMD activity is included in the COMPAIR online course (lesson 4.1). Users need to perform several actions on the schoolstreet dashboard to be able to answer two questions.

DEV-D exploitation

DEV-D in the College of Geel and KU Leuven: Discussions are underway with the two academic institutions to introduce the dashboard to students to raise their awareness about air pollution. Students will need to use air quality sensors and the DEVA trip recorder to be able to measure dynamic exposure and visualise it in DEV-D. Through its capacity to convert any static device into a mobile one by linking it with the smartphone GPS tracking, the DEVX combo provides a powerful means for individuals to make sense of air quality when they are on the move. Comprehensive user manuals have been developed for various configurations and use cases, enabling future adoption of the DEVX solutions in different settings, including education.

DEV-D testing results inform QADOS sensor improvements: DEV-D testing was conducted in the closed and open rounds that took place in Flanders and Berlin.[9] The first iteration produced 750 km worth of trips made on foot and by bike. In the second iteration, 970 recorded trips were reported by cycling enthusiasts, school children, teachers, citizen scientists, local champions, attendees of the Velo-City conference, civil servants. Feedback and data collected during testing were shared with QADOS and the COMPAIR tech team working on DEVX, to inform further product optimisations. This feedback encompassed the usability and technical characteristics of the mobile air quality sensors mounted on bikes using a holder that can also be attached to backpacks with silicone sleeves and clips.

DEV-D in MOOC: Enrolled students need to find and analyse several trips on DEV-D before they can answer five questions.

[8] https://www.life-citytraq.eu/en/
[9] Examples of testing included classes in Herzele on the use of DEVX, and hands-on training at a data café in Sint-Niklaas, where attendees could borrow sensors for their own experiments

DEVA

Ownership

The app is owned by Fraunhofer HHI and Digital Flanders (DV), however it relies on DV for the API key for the BreezoMeter Google web service to get air quality model data. DEVA does not store any data displayed through its interface, rather it ingests data from

- ATC's Data Manager (real-time sensor data collected by COMPAIR)
- sensor.community (open data)
- BreezoMeter (Google's air quality index data)

The integration with third-parties makes DEVA more resilient as it reduces dependence on a single data source. Should something happen with the Data Manager, DEVA's sustainability data-wise will be ensured by two other information sources.

Grace period and maintenance

There is no grace period as such. The app is already available on Google Play[10] and will soon be released on Apple's App Store. Maintenance and updates of both versions are the responsibility of Fraunhofer HHI. There are no limitations on how long or how much people can use the app.

DEVA will continue displaying data as long as it's available in Data Manager. Requests for air quality model data are sent via API using the key provided by DV. A single API request fetches the value of air quality for a given location (latitude-longitude). Every time a user starts the app, new actual sensor data is requested from the source. Once the free limit is reached (50,000), additional requests will need to be paid for by the account holder (DV).

If someone owns a sensor and would like to display their data in DEVA (Figure 3), such an option is possible but they would need to either connect it to the Data Manager or publish on the sensor.community platform first.

[10] https://play.google.com/store/apps/details?id=de.fraunhofer.hhi.DEVA&hl=en

Figure 3. Interface and visuals of the Dynamic Exposure Visualisation App

Source code and revenue model

DEVA's code is implemented in Unity3D using a special AR framework developed by Fraunhofer HHI. Both the code and the framework are proprietary. The app itself, however, is available for free without any costs. The AR framework for Unity3D is organised hierarchically, incorporating different assets, scripts and templates. The structure can be easily adapted, modified and extended to create a custom DEVA-style app for interested customers on a SaaS basis.

DEVA exploitation

DEVA for emergency response and facilities management: Fraunhofer HHI will test DEVA as a base tool for visualising any spatially distributed real-time data with or without the geo-localisation component (GPS) in future projects. One interesting use case involving spatially referenced data relates to climate change. The idea is to visualise forecasts of extreme weather events and natural disasters (e.g. flooding, wildfire) to plan an emergency response. Another scenario under consideration without GPS concerns digital twins of a building. With DEVA, indoor space can be scanned (e.g. using a QR code) to understand what is hidden behind a wall, such as electric cables or water pipes.

DEVA on the move in Berlin: The app's trip recorder function with a subsequent visualisation in DEV-D received a lot of interest from participants of the cycling campaign. Citizen scientists liked the latest improvements to the app that made it more user friendly, with many expressing interest in continued use post-campaign.

DEVX exploitation

Multiple tests and refinements conducted during the project benefitted each app individually, while also improving complementarities between the two (Figure 4).

Figure 4. DEVX deployment in real-life

DEVA trip recorder and data manager

- ***Trip geometry refinement:*** The geometry of recorded trips was fine-tuned to manage outliers, thereby improving data granularity and accuracy
- ***Recording frequency adjustments:*** The recording frequency was adapted to suit different modes of travel (such as faster-moving vehicles), taking into account sensor limitations
- ***Sensor identification:*** The functionality for sensor ID scanning was enhanced
- ***Battery and bandwidth optimisation:*** Efficiency was improved through better management of power consumption and data bandwidth. Features like server connection optimisation, bundled data upload, and post-trip data transmission (e.g. via Wi-Fi) were introduced
- ***Network connectivity:*** Connectivity issues were investigated and optimised where possible
- ***Alert system:*** New alert messages and icons were introduced for real-time feedback
- ***Model integration:*** An analysis was conducted on how Google's Breezometer model maps onto the recorded trip geometries, which provided insights into air quality exposure along the routes

DEVA trip recorder and DEV-D integration

- ***Data filtering and WHO guidelines:*** Data filtering functionalities were improved, incorporating references to WHO air quality guidelines
- ***User Interface (UI) and User Experience (UX):*** Usability testing led to improvements in the UI/UX, making the platform more user-friendly
- ***Graphical data visualisation:*** Visual representations of exposure data were enhanced, allowing for comparative analyses based on trip duration, distance, and absolute time
- ***Multinational testing:*** Field tests were conducted across various countries (UK, Austria, Spain, France, Germany, Italy, The Netherlands, Bulgaria, and Belgium)
- ***Environmental condition testing:*** The system was evaluated under a wide range of environmental conditions, including urban and rural areas, indoor/outdoor settings, weather variations, and different times of day
- ***Interactive inhaled dose graphs:*** Exposure metrics in DEV-D were expanded to include interactive inhaled dose visualisations, allowing users to input their gender, age, and activity level for more personalised results
- ***Black Carbon sensor testing:*** A limited set of tests incorporated Black Carbon sensors without internal GPS functionalities toward the end of the COMPAIR project

Sensor-less monitoring with DEVX: When used in combination, DEVA and DEV-D provide a comprehensive, mature solution for monitoring individual exposure to air pollution, even without sensors. The integration with BreezoMeter's means that air quality monitoring can be done using just the DEV-D trip recorder, without the need for additional hardware/sensors. The use of modelled data eliminates the need for people to own and carry sensors, which makes air quality monitoring even more accessible to individuals.

CO2 Calculator

Ownership

University of the Aegean (UAEG) is the sole owner of the dashboard, which comprises two apps, one for calculating CO2 emissions, another for simulating abatement strategies for reducing them (Figure 5).

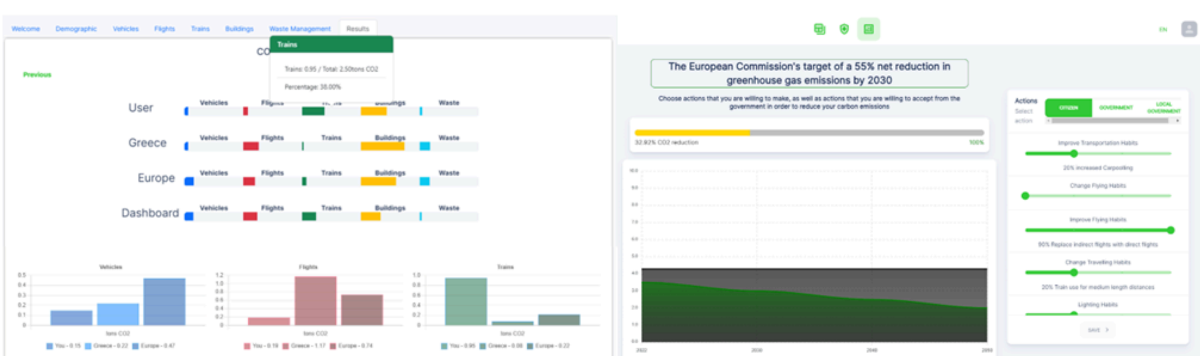

Figure 5. Results of the CO2 calculator (left) and simulation dashboard (right)

Grace period and maintenance
CO2 Calculator will be freely available for 3 years starting November 2024. UAEG will take care of maintenance and updates during this time. One likely update will involve adding new countries to the dashboard. Currently, CO2 Calculator is only relevant for people interested in Belgium, Bulgaria, Germany, or Greece. The original focus on COMPAIR pilot countries limits the sustainability potential. More countries need to be added if the tool is to appeal to the wider user base. To this end, UAEG will add a form for requesting new countries. Technically, this work is not difficult to implement. New countries and languages can be added with relative ease as existing structures and processes allow for an efficient integration. The most challenging and labour intensive task would be finding the right emissions data.

Source code and revenue model
The dashboard is built using proprietary technology, so the code is not available for reuse. The use of the platform itself, however, is more liberal, governed by the open-source CC-BY licence, which means people must attribute UAEG whenever CO2 Calculator results are used in blogs, coursework, social media, printed materials, reports, videos, and so on. UAEG can build a custom SaaS dashboard for another city or even organisation if the latter wants to raise environmental awareness of its workforce.

CO2 Calculator exploitation

CO2 Calculator in higher education: UAEG will update its educational materials by including CO2 Calculator activities that students would need to complete as part of their coursework. Another plan is to include the dashboard in workshops carried out as part of the Samos Summer Schools, an annual conference on open government organised by UAEG.

CO2 Calculator in Athens: The dashboard aligns well with the Climate Action Plan 2030[11] which calls, among other things, for Athens to "transition toward becoming a green and digital city." The tool is on the municipality's radar thanks to the project partner DAEM. And as a result of recent promotion on national media (Athina 98.4, News 24/7, Kathimerini), a lot of residents are familiar with it, too. Usage metrics show that a lot of new accounts have been created in recent months by people who label themselves as policy makers and citizens, to measure, compare and learn how to reduce carbon footprint.

CO2 Calculator in Sofia: The dashboard supports Sofia's Green City Action Plan,[12] specifically its clean-energy strategic objective (SO2) related to improvement of air quality and emissions reduction in the capital. The project partner Sofia Development Association will use the tool to propose measures for reaching SO2, and to mobilise more people, especially youth, to act on climate challenges. One promising route is to offer the CO2 Calculator to participants of future hackathons organised by the association, as a basis for co-creating new challenges and solutions.

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[11] https://www.thisisathens.org/acvb/press-releases-climate-action-plan-approved-Athens-city-council
[12] https://ebrdgreencities.com/assets/Uploads/PDF/Sofia-GCAP_ENG.pdf

CO2 Calculator in Plovdiv: The dashboard received a lot of interest from all three schools engaged by COMPAIR: Dimitar Talev, Knyaz Alexander I, and Vasil Levski. The plan is to create an extracurricular activity centred around the CO2 Calculator to make young people more aware about environmental problems and solutions, from a young age.

CO2 Calculator in MOOC: Students enrolled in the online course need to play with the dashboard in order to answer a question about citizen action required to reach the 55% reduction of CO2 emissions by 2030, as foreseen by the European Green Deal.

Sensors and data

COMPAIR used five different sensors in its citizen science experiments: 1) Telraam for counting traffic, 2) SODAQ AIR for measuring dynamic exposure to particulate matter (PM), 3) bcMeter for measuring black carbon, a pollutant found in PM2.5 concentrations, 4) a solar-powered NitroSense sensor for measuring nitrogen dioxide (NO2), and 5) the sensor.community kit for measuring PM2.5 from a fixed location. In this exploitation plan, we focus only on three of these devices: Telraam, bcMeter, and NitroSense. This is because a) SODAQ left COMPAIR before the end of the project due to its bankruptcy[13] and did not respond to the invitation to answer the exploitation survey, and b) the sensor.community kit, unlike other used devices, had no noticeable improvements to either software, hardware or firmware components that could be attributed to COMPAIR.

In relation to Telraam, bcMeter and NitroSense, the exploitation plan explains how these sensors will be used after the project and how enhancements attributable to COMPAIR enable them to achieve wider impact. We shall start with the second point first.

Sensor improvements during COMPAIR

Telraam

Telraam comes in two versions. Launched in 2018, Telraam V1 was Telraam's first concept sensor. It used computer vision to detect objects - though only during the day - and a WiFi connection to transfer data. The second version (S2) was released in 2023. S2 is a lot 'smarter' than its predecessor. It can detect more object types thanks to built-in AI, it can count traffic day and night (24/7), and it uses cellular LTE-M and NB-IoT frameworks to connect to the cloud without the need for WiFi. Overall, S2 is more robust, accurate, and easier to use than V1,[14] a significant improvement that came only at a moderate increase in cost. COMPAIR was

[13] SODAQ technology assets (i.e. the sensors, software and related server infrastructure) was taken over by a newly-established company QADOS in 2024

[14] Assuming that the country where measurements are taking place has a telecoms infrastructure supportive of LTE-M and NB-IoT connectivity

instrumental in getting S2 to its current stage (commercial-grade). Not only were many of these improvements, including the shift from V1 to S2, introduced thanks to COMPAIR, the project also provided a safe testing ground through the school street campaign in Herzele (Figure 6) for getting S2 ready for commercialisation.[15]

Figure 6. A citizen in Herzele attaching a Telraam sensor (S2) to the inner window

NitroSense

Prior to COMPAIR, the NO2 NitroSense sensor was only used in the Netherlands for research purposes. Participation in the project meant that imec had to upgrade its device to meet new requirements, namely ensuring that the sensor works in new locations and is able to support new policy-oriented use cases (Figure 7).[16] To this end, NitroSense's firmware was updated and expanded to enable connection to either the LTE-M or NB-IoT network, an update which broadened the sensor's geographical coverage. In addition, NitroSense was updated to work with the Open Geospatial Consortium SensorThings API data model.[17] This made it easier to integrate collected NO2 data into geospatial systems like PMD and expanded data re-usability as the data is accompanied by metadata relevant for interpretation (e.g. sensor type).

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[15] Almost 2500 sensors across the entire Telraam network are up and running now.
[16] In COMPAIR, NitroSense has been deployed in Antwerp, Athens, Ghent, Herzele, and St. Niklaas
[17] A standard by the Open Geospatial Consortium that provides an open, unified frameworking for IoT data, applications, and services.

Figure 7. NitroSense devices in two seniors clubs in Athens

bcMeter
Unlike NitroSense and Telraam, bcMeter is a third-party product that found its way into COMPAIR through a spontaneous recommendation by German partners. What started as a one-off interaction has quickly grown into a full-blown cooperation, driven by the need to obtain a well-rounded view of air pollution in COMPAIR pilots. After the initial deployment in Berlin (Figure 8), other citizen science labs (Athens, Flanders, Plovdiv) followed suit and incorporated their device in the measurement campaign.

Figure 8. bcMeters ready for deployment in Berlin

COMPAIR's contribution to bcMeter was twofold. COMPAIR contributed to the technical design and supported data transfer through WiFi protocols. Secondly, COMPAIR contributed by bringing in new users. Before COMPAIR, the use of bcMeter was the preserve of skilled technicians. However, once it became part of citizen science campaigns, the device's user base expanded to include ordinary citizens with basic IT skills. The ensuing deployment, testing and feedback led to improvements in accuracy and usability, which made bcMeter a more potent and versatile monitoring device than was previously the case. bcMeter's manual now includes a reference to COMPAIR settings, including how to ensure data is correctly displayed on PMD.

Use of sensors and data after COMPAIR

Telraam (technical and policy-oriented exploitation)

Telraam devices deployed by COMPAIR pilots will continue operating as normal. Data from individual devices will be visible on Telraam's public webpage (via LTE-M connection to the Telraam cloud), also on PMD (connected to the Telraam cloud via API).

Collected traffic data is owned by Telraam to ensure it can be openly shared with the public post-collection. Both the sensor and the brand name 'Telraam' are protected by copyright.

Traffic counting by the deployed devices will carry on without any additional fees. What will come at a price, however, is access to the Telraam dashboard. The dashboard is a premium service for managing projects, monitoring sensor networks and user communities in a city. The monthly fee is €25 per device. The current 'free' arrangement for pilots will expire in early 2025. Afterwards, subscription can be activated on demand, as will be the case with Sint-Niklaas in Flanders.

In addition to monitoring the impact of mobility measures like the introduction of a bicycle bridge in Sint-Niklaas, or the school street in Herzele, there is potential to use Telraam data to improve traffic models in these cities. Originally conceived by Telraam, the solution known as Traffic Scout[18] is now being developed by TM Leuven, a research institute focusing on traffic and mobility. The strength of the Traffic Scout model lies in its integration of hyperlocal traffic data collected by citizen scientists, together with other sources like OpenStreetMap, census data, and geospatial traffic indicators. TM Leuven will reuse existing data collected by COMPAIR to improve the model's accuracy and usability for new use cases, such as evaluating the effects of a new circulation plan, and estimating the impact of new measures on road safety. There is also a plan to use Telraam and Traffic Scout for the Environmental Impact Assessment Report procedure, by DV and VMM.[19]

NitroSense (technical and policy-oriented exploitation)

After the project ends, NitroSense devices and data can be used by partners for research purposes only. NO2 sensors have a lifetime of 1-2 years, so they need to be changed periodically to ensure accurate readings. Imec will absorb connectivity fees during this period, after which time new sensors have to be installed/purchased. In the event of a sensor breaking down, repair details need to be discussed bilaterally with imec. The existing maintenance arrangement is valid for three years, starting November 2024.

[18] https://traffic-scout.net/

[19] Directive 2011/92/EU as amended by 2014/52/EU

Imec (OnePlanet) will remain the owner of NO2 data collected with NitroSense. Like data from other sensors, NO2 data is stored on COMPAIR FROST server[20] (see D1.7 Data Management Plan 3 for details). In keeping with FAIR data principles, the data will be publicly available programmatically, via data platforms like PMD, or offline i.e. through a file transfer upon request, and also on Zenodo.

A promising exploitation route for the collected NitroSense data is to use it for benchmarking, or to develop new calibration algorithms. Early in the Flanders campaign, VMM evaluated how well raw and calibrated NO2 data matched that of government-owned reference stations. For some metrics, the data was found acceptable, however there was room for improvement. With additional data collected since then, it is possible to study which improvements can be introduced to the calibration algorithm to increase data quality. Going forward, imec will continue working with VMM to find new ways of improving NO2 measurements. VMM is especially keen to test the improved technique in Antwerp, where it can be used to aid with spot screening and policy evaluation as part of VMM's Sustainable and Liveable Neighbourhoods programme.

bcMeter (technical exploitation)
Deployed devices can be used indefinitely or sent back to the bcMeter team for recycling. Unlike Telraam and NitroSense, the bcMeter does not own any data; ownership lies with the respective user, who is also responsible for its upkeep. Another point of difference is the way in which the device itself can be used. Short of selling it, people can use bcMeter in any way they want. This is what VMM is planning to do. It's currently optimising bcMeter to work with different citizen science sensors, such as SODAQ, as part of an integrated data collection effort to be undertaken in Antwerp.

Calibration

In COMPAIR, data from air quality sensors was calibrated with data from reference stations to account for influencing factors (e.g. humidity, equipment depreciation) that affect low-cost sensor accuracy and precision. The calibration method was implemented by imec and is the partner's background IP. The data calibration methods developed and tested in COMPAIR (Figure 9) are very important towards the development of the European Dataspaces, especially for the dataspaces dealing with multiple ambient IoT sensors of different quality.

[20] https://sensorthings.wecompair.eu/FROST-Server/v1.1/

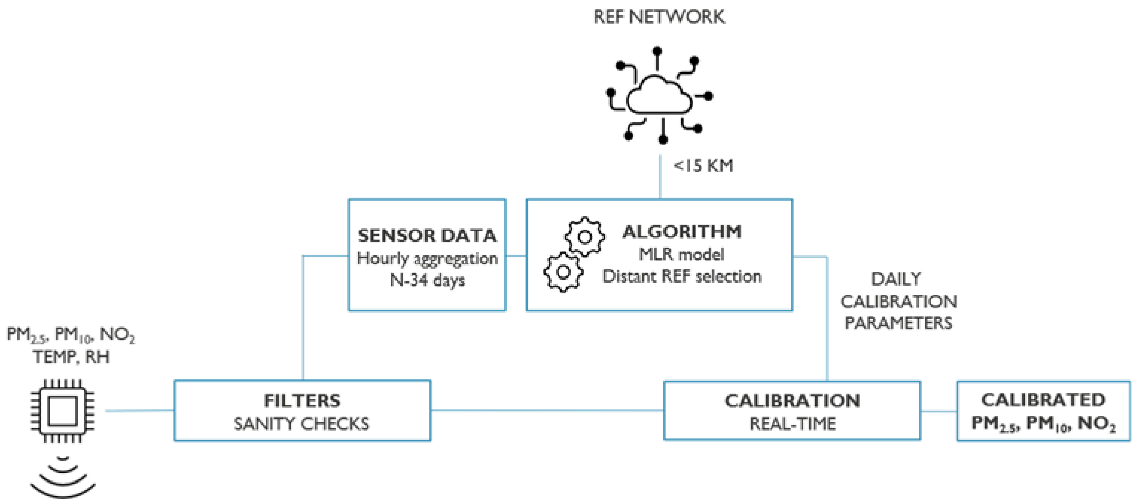

Figure 9. The cloud-based calibration framework for low-cost sensors

Calibration improvements during COMPAIR

The calibration was tested in ways not tried before the project. Imec started with the distant calibration method described above and expanded it to work in different countries and with different devices (mobile sensors). The results showed that the scalability of the original approach is limited when the density of reference stations is low and many sensors are being stored indoors.

To address these shortcomings, COMPAIR used another set of data to test a new auto-calibration algorithm. This is a different calibration approach that does not use reference data but relies on electrochemical sensor readings instead. The preliminary results obtained for NitroSense devices are promising. Preliminary tests conducted by VMM in Ghent show that a decrease in NO2 concentrations correlated with changes in a circulation plan, and that these fluctuations can be picked up when sensors are auto-calibrated. Further tests are planned in Ghent to have higher confidence in the impact of the circulation plan, namely that it is the cause of the observed NO2 concentration decrease.

Use of calibration after COMPAIR

Imec OnePlanet is a research centre that does not normally engage in commercial activities. So, the calibration service is not something that can be purchased "off the shelf", nor will the service be offered pro bono to calibrate all sensors deployed in COMPAIR after the project. The online calibration pipeline requires a lot of resources, thus it will not be maintained from November 2024 onwards. This means that data from sensors that are still in operation in

COMPAIR pilots will not be calibrated by imec. The only exception is NitroSense devices in Flanders. VMM is keeping the sensors and would like to further test them in places like Ghent. Imec can provide calibrated NO2 data to VMM on demand, as part of a three-year-long agreement.

To everyone else, there are three possibilities to obtain access to imec's calibration service:

- Enter a project with imec OnePlanet (like COMPAIR), where interested party can co-develop the solution and thus benefit from the calibration service while the initiative lasts
- Invest in imec OnePlanet research program and, while calibration is undergoing improvements, use the service and/or set it up on a platform of their choice
- Licence the IP from imec OnePlanet to integrate the calibration framework into internal systems

Communities and policies

Apps, sensors, data and calibration are important but not the only results worthy of exploitation. Local communities established in five participating cities and regions are an important outcome of the project, too. The chapter explains what will happen to these networks and which results they are going to use after the project to inform policy development and daily habits.

Athens (social and policy oriented exploitation)

The CS Lab led by DAEM worked mostly with senior citizens who generally have limited IT literacy and, because of that, low propensity to participate in innovation projects. Nevertheless, 80% of air quality data collected by the Athens pilot came from this group of citizen scientists. This success was in no small part due to the close-knit collaboration with Friendship Clubs, municipal recreational centres for the elderly.

Members of the Friendship Clubs will come to the final workshop along with other contributors, among them NGOs (e.g. Hellenic Passive House Institute) and policy makers from the Natural Environment and Climate Change Agency (NECCA).[21] There, participants will learn about the findings of the measurement campaign, with data displayed on PMD. Training on how to use the CO2 Calculator is also foreseen.

Athens will keep two NitroSense devices; there is one in each Friendship Club. Data collection and stakeholder engagement will continue after the project, with results feeding into the implementation of the city's climate resilience plan and ongoing citizen science projects like

[21] Hellenic Passive House Institute is an NGO from the C40 network. NECCA is an independent body that acts in the public interest, under the supervision of the Ministry of Environment and Energy. Representatives of both organisations were contacted and contributed to the Athens pilot and their activities are aligned with the results and tools (dashboards) on climate action

UrbanRelief[22].

Berlin (social and policy-oriented exploitation)
The CS Lab led by inter3 conducted two campaigns - one focusing on redevelopments in the Graefikiez Kiezblock, another on dynamic exposure during cycling - in which more than 100 Berliners took part.

Besides individual volunteers, the Berlin pilot benefitted from cooperation with several high-profile organisations:

- The Berlin Senate's Mobility Department expressed interest in applying PMD to evaluate redevelopments in other districts
- mit:forschen! Gemeinsam Wissen schaffen features COMPAIR in its database of German citizen science projects; plus it interviewed one of the volunteers involved in the Berlin campaign[23]
- Changing Cities and Respect Cyclists: two charities would like to work with inter3 on similar campaigns in the future; the latter is especially keen on using DEVA to assess air pollution concentration along cycling routes

Future collaboration was also the intention of the majority of volunteers, who consented to be contacted should similar opportunities arise. inter3 decided to keep all sensors (bcMeter, Telraam, SODAQ) so that, when the right moment comes, it has all the necessary devices to hand to embark on a new journey.

Flanders (social, policy-oriented and technical exploitation)
Schools - one of the core stakeholders in the Flemish CS Lab - are already asking for a repetition of the experiments. Strong interest is attributed to, inter alia, the impact of the Learn-Do-Reflect (LDR) approach on students' mobility behaviour.[24] Students at the Herzele-based Sint-Paulus Institute, who benefitted from the LDR-based programme, were surveyed before and after the trial. The results revealed a 20% decrease in car use and a 7% increase in the use of active and collective transport modes among students. Additionally, there was a 71% increase in the number of behavioural actions that students reported they could take to improve air quality. To capitalise on this inspiring outcome, VMM is talking to GoodPlanet Belgium, the national branch of the international charity, to identify opportunities for scaling LDR across the rest of Flanders.

The Flemish pilot will keep all of its existing sensors for LDR and other experiments. Citizen scientists will keep their Telraam devices, though in Ghent they may be redistributed to new users to evaluate the impact of a new bridge connection in the north. To assess the measure's impact on air quality, the city will leverage COMPAIR's framework for experimental design and

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[22] https://urbanreleaf.eu/
[23] https://www.mitforschen.org/search/node?keys=compair
[24] The approach, pioneered by the Flemish pilot lead VMM, was conducted as part of a six-week-long educational track where students received information and completed practical tasks before starting to reflect on the experiment results, as well as their own behaviour.

sensor-network planning. NitroSense devices will remain active to support the screening of pollution hot spots in Antwerp and other Flemish cities as part of VMM's Sustainable and Liveable Neighbourhoods programme. The potential to improve auto-calibration is another reason why NitroSense sensors will remain in use after COMPAIR. bcMeter will not be used for data collection in the short term, as VMM wants to first enhance the sensor, taking advantage of its open-source license, to a point where it can be integrated with SODAQ AIR in the same experiment. Finally, SODAQ AIR will be part of a scale-up of the winter wood-burning walks. VMM is currently building a consortium in Flanders to ramp up, over the next three years, participation in the experiment from 20 to 1,000 volunteers. The first call for participation was launched in autumn 2024, targeting sports clubs, walking groups, nature guides, and health charities. The wood-burning experiment is partially linked to the Flemish human biomonitoring study scheduled for early 2025.

Plovdiv (social exploitation)
COMPAIR is the first project in Plovdiv where traffic intensity was measured by citizens. The CS Lab, managed by the Energy Agency Plovdiv (EAP), has worked with three schools (Dimitar Talev, Knyaz Alexander I, Vasil Levski) on several campaigns that involved traffic counting with Telraam V1 and air pollution monitoring using the mobile laboratory and a sensor.community kit.

Telraam and sensor.community devices will remain active as the schools want to keep them for extracurricular activities. And since two of COMPAIR's digital tools were also introduced to students, there is an interest in their continued use as well; PMD - to visualise and learn from collected data, and CO2 Calculator - to raise awareness about climate change.

One of the pilot stakeholders - Air for Health, a Bulgarian NGO - shared the final results within its community, which includes Plovdiv-based doctors.[25] Some are cardiologists, others are public health specialists. The expectation is that these professionals will help to amplify the findings of the Plovdiv pilot through regular interaction with patients, emphasising the risks of air pollution to human health, especially among sensitive populations like children.

Sofia (social and policy oriented exploitation)
The school bus service that the Sofia municipality introduced as a temporary measure was extended for another year thanks to COMPAIR. This was Sofia CS Lab's main outcome, achieved by bringing schools, parents, public authorities, and charities to work together in a citizen science setting. The multi-faceted engagement comprising information provision on air pollution, sensor training and assembly, data collection and analysis, surveys and ideathons raised the overall motivation to continue with a green alternative to private cars. With the school bus, 60% of students from 1-4 grade who started using the bus service were previously driven by car.

The Environmental Department and the Transport Department of Sofia Municipality continue monitoring the effects of the second school-bus iteration, to determine if the service should be extended for the second time. The need for evaluation data is the reason why the pilot lead

[25] https://air4health.eu/en/lekari/

Sofia Development Association is keeping sensor.community and Telraam V1 devices, and planning future survey rounds with parents.

Inspired by the Flemish story, the Sofia municipality is considering launching a schoolstreet pilot to test its effectiveness in creating a more healthy and safer environment around schools in the capital. The COMPAIR methodology and lessons from the Herzele case were shared with the local authority that now needs to adapt this body of knowledge to Sofia's context.

Partner exploitation plans

Complementary to the pathways described in previous chapters are exploitation tactics foreseen by all partners, not just pilots or technical product owners. These 'individual' plans provide a safety net against risks to wider exploitation should external adopters be slow or reluctant to reuse COMPAIR results. Put simply, if all partners commit to exploitation, the exploitation becomes more resilient. There is less dependence on just a few consortium members driving sustainability, plus exploitation will be stimulated independently of what third parties do, or don't. In effect, individual plans provide an additional thrust to exploitation that makes sustainability more likely.

Digitaal Vlaanderen
DV will integrate citizen science datasets into Digital Flanders' data portfolio, with a special focus on Telraam and VMM-provided datasets. The use of sensors (NitroSense, bcMeter, SODAQ AIR) in future digital twin and innovation projects is foreseen, along with the continued development and application of dashboards (PMD, DEV-D) and data management systems (Data Manager). One particular project where COMPAIR can be brought to bear is the new x-Cite project due to start (funded by Digital Europe) in December 2024.

Flanders Environment Agency
VMM has a four-fold plan focusing on 1) quality assurance in sensor tendering based on COMPAIR benchmarks and experience, to be implemented in the LIFE CityTRAQ project,[26] 2) sensor use cases for future projects, including CityTRAQ, 3) winter wood burning walks to be scaled up over the next three years, and 4) a toolkit - with PMD included - that local authorities in Flanders can use for policy evaluations.

DAEM
DAEM plans to leverage the results and lessons learned from the Athens pilot in two ongoing projects. One is UrbanReleaf, a CS project that also collects air quality measurements. Another is Climaborough,[27] which includes field activities with citizens using environmental data. In both of these projects, COMPAIR tools (PMD, CO2 Calculator) can support the analysis of newly collected data.

[26] https://www.life-citytraq.eu/en/
[27] https://climaborough.eu/

inter3
In a new Kiezblock that is going to be built in the near future, inter3 would like to do a repeat of the Berlin static campaign, to help the city compare traffic, particulate matter, and nitrogen dioxide before and after the policy measure was introduced. This would require using bcMeter, NitroSense, and SODAQ AIR, along with apps (PMD), calibration, and possibly volunteers from the established communities, in a fully-fledged project pilot. A candidate for a potential COMPAIR 2.0 is HORIZON-MISS-2024-CIT-01-01: Rethinking urban spaces towards climate neutrality. LINK (Deadline: 11/2/25).

Energy Agency Plovdiv
EAP will promote results in future meetings of Bulgarian energy agencies, including the annual meeting organised by the eponymous Association of Bulgarian Energy Agencies.[28] The aim is to develop a national framework to guide the use of citizen science in official air quality monitoring. This would cover not only low-cost sensors but also calibration tools for data analysis (PMD, DEVX).

Sofia Development Association
SDA started discussions around the planning of a school street in Sofia, the first in Bulgaria. Herzele's case study has been shared with schools and the municipality, serving not only as a source of inspiration but also a blueprint for the measure's successful implementation. If the school street receives the green light, there will be significant reuse of project results, covering both "hard" (sensors, data, apps) and "soft" aspects like the co-creation approach and human-centric methodology of working with diverse stakeholders.

Telraam
For Telraam, a key part of exploitation is reusing the improved sensor, which the company is doing already to a great extent. Other exploitation objects of interest include new engagement methods, data analysis plus scripts for citizen workshops (data cafe). In addition, the validation report done by Ghent to evaluate data quality of Telraam is a great resource the partner frequently uses to demonstrate the counting accuracy of its device.

Imec
Guides to air quality monitoring (D5.1) and calibration (D3.5) are part of imec's research knowledge. The calibration method, data model, and datasets from SODAQ AIR and NitroSense devices are already used in existing research work of the centre for benchmarking purposes.

Athens Technology Center
The primary goal is to leverage two of its dashboard to provide actionable insights for cities facing air quality challenges. ATC aims to collaborate with local governments and transportation authorities in Greece to implement the DEV-D as a critical tool in urban planning, enabling cities to monitor and reduce pollution hotspots effectively. Additionally, PMD will be positioned as a

[28] https://new.abea-bg.org/?lng=EN

key asset for data-driven decision-making in transportation policy. By integrating these tools with the Data Manager, ATC can offer a comprehensive, data-backed suite for urban planners seeking sustainable and resilient city solutions. In the longer term, ATC plans to expand its reach by marketing these tools to other cities and regions in Europe, and exploring partnerships with environmental agencies.

Fraunhofer HHI

The institute's focus will be on further developing Unity3D with the developed AR framework, incorporating all of COMPAIR's extensions. The management of geo-localised data and the rendering of sparse data with the DEVA pipeline will be tested on new use cases involving emergency modeling and facilities management.

University of the Aegean

UAEG is going to use the CO2 Calculator to improve the learning experience for its students. Its annual Samos Summer School on e-governance provides an opportunity to showcase and let others (international experts) use the dashboard.

European Citizen Science Association

Currently, ECSA is in contact with some COMPAIR partners to build a new consortium and apply together to an upcoming Horizon Europe call. ECSA aims to present some strategies built through the COMPAIR project as examples and best practices to other projects seeking guidelines in citizen science.

IS-Practice

Recently, the subset of COMPAIR partners have initiated writing of a new Horizon Europe project proposal that would build on top of the COMPAIR results. The consortium is currently being composed and project scope being defined. The following calls are considered:

- HORIZON-MISS-2024-CIT-01-04: Integrated peri-urban areas in the transition towards climate neutrality. Deadline: 11/2/25
- HORIZON-MISS-2024-CIT-01-01: Rethinking urban spaces towards climate neutrality. LINK. Deadline: 11/2/25
- HORIZON-MISS-2024-CIT-01-02: Zero-pollution cities. Deadline: 11/2/25

21c Consultancy

21C likes to organise training seminars that go beyond the traditional format of presentations followed by Q&A. Our events often feature role-based games and use of digital tools to make the experience fun and engaging for participants. COMPAIR has plenty of apps and results from which to create personas and interactive scenarios. One idea is to divide the group into citizens and policymakers, ask them to study the impact of a school street on PMD, and then arrive at a negotiated conclusion - should the measure be extended or not?

Communication and dissemination for exploitation

Exploitation in COMPAIR is not limited to these pathways only. Additional measures have been taken at project level to widen exploitation opportunities by publishing results on various platforms. Put simply, for results to be used, they first need to be discovered. That is the goal of Communication and Dissemination for Exploitation (CD4E) tactics.

Open Learn Create

This Open University-managed platform hosts COMPAIR's online course titled "Better Together: Citizen science and digital tools to improve air quality policy".[29] The course has five modules that cover and test students' knowledge of COMPAIR results through quizzes and task-based activities. A certificate is awarded to enrolled students who meet completion requirements (Figure 10). The plan is also to feature the course on the EU-citizen.science platform.[30]

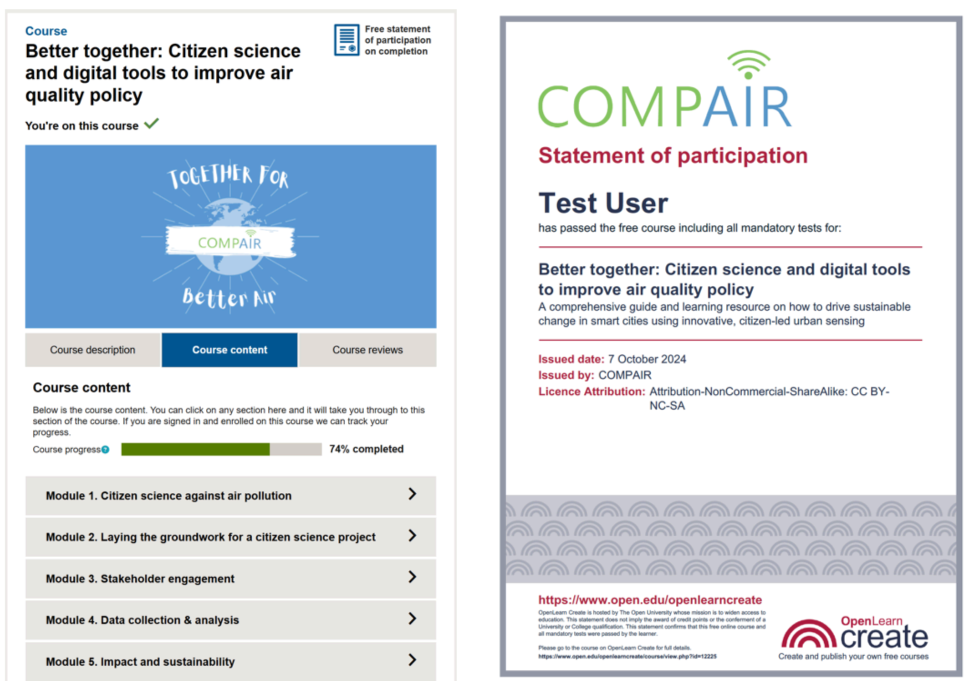

Figure 10. COMPAIR online course and sample certificate

Horizon Results Platform

The resource adds extra visibility to EU project results that aim to influence policy, seek further scientific collaboration, and need business support and/or financing to enter the market. HRP is

[29] https://www.open.edu/openlearncreate/course/view.php?id=12225
[30] https://eu-citizen.science/training_resources

meant to be used for high-impact results with a significant potential for scalability. With this in mind, we added four COMPAIR apps to HRP: PMD, CO2 Calculator, DEVA, and DEV-D (Figure 11).

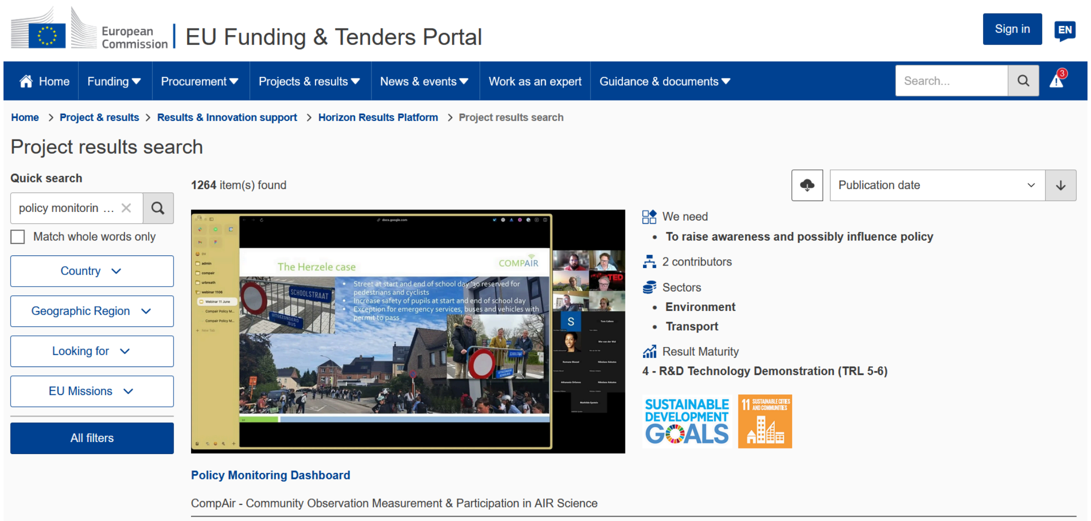

Figure 11. PMD on HRP

Knowledge Valorisation Platform

KVP is another EC-managed platform that spotlights project results, although its focus is more on "soft" outputs like best practices rather than market- or policy-oriented products. The most suitable COMPAIR results for KVP are 1) the calibration method for improving quality of data obtained from citizen science sensors, 2) the guide for air quality monitoring, and 3) the LDR approach practised in Flanders. However, these results cannot be published just yet because of the technical issue with the submission form.[31] KVP was alerted to the problem, something we hope will be resolved soon.

COMPAIR CS LAB

The fourth CD4E measure leverages an existing resource of COMPAIR - its website - to facilitate exploitation.[32] The Lab is intended to be used as a guide for running citizen science campaigns. By following COMPAIR's maturity model set out in D8.5,[33] users can learn from project results, best practices and lessons, what they need to do at different stages (exploratory, co-creative, analytical, transformative) to make their project a success (Figure 12). The Lab will provide easy access to all relevant outputs per stage, and will also include a link to the online course.

[31] https://ec.europa.eu/eusurvey/runner/BPKnowledgeValorisationNEW
[32] https://www.wecompair.eu/cs-lab
[33] https://www.wecompair.eu/deliverables

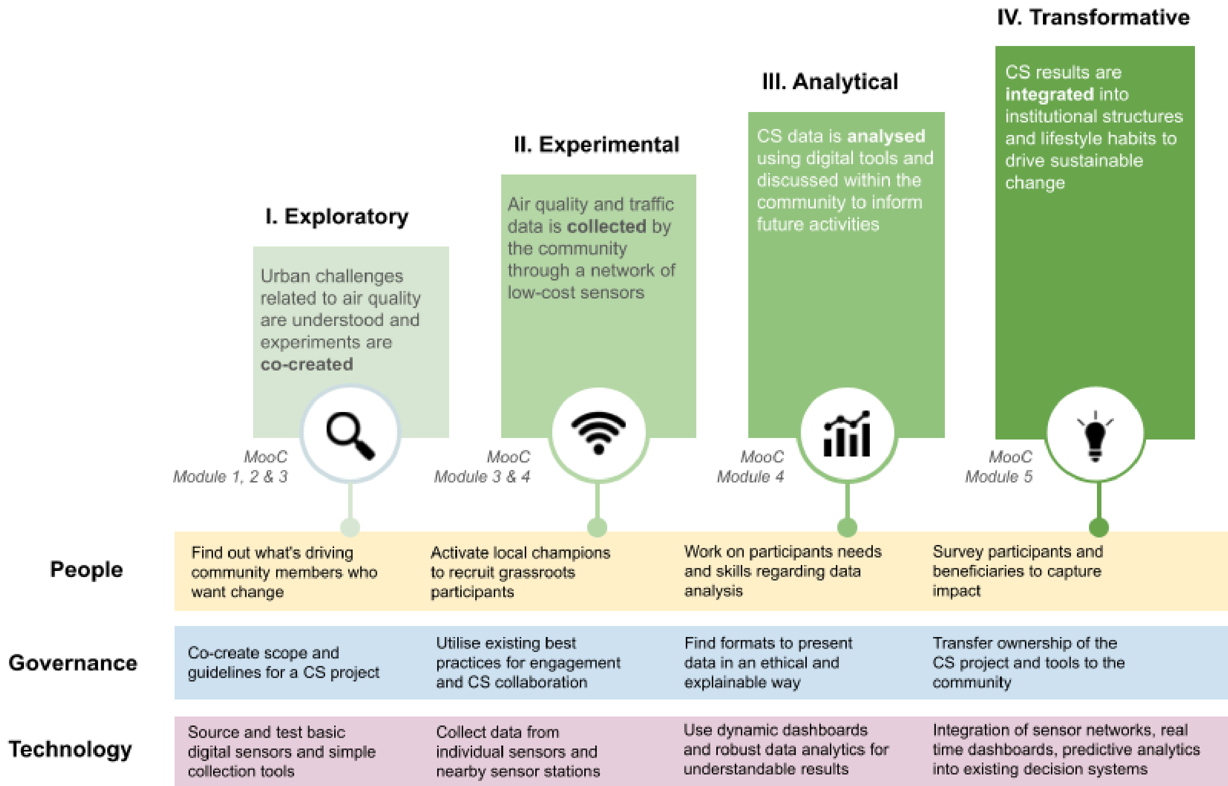

Figure 12. The COMPAIR maturity model for urban CS projects

Conclusion

This report presented a plan to stimulate exploitation of COMPAIR results by those who have something to gain from their use. More than 30 pathways have been identified to achieve long-term sustainability (Table 1). These routes are based on activities from three complementary tracks: exploitation by external adopters, by project partners, and through CD4E. The three-pronged approach maximises chances of success by not making exploitation dependent on a single strategy, which is always risky. If external stakeholders are slow to adopt results, the latter will continue to be used by partners. If partners' exploitation efforts are less impactful than anticipated, availability of results and their testing on third-party platforms like OLC is expected to produce a new loyal user-base sooner or later. Another danger is that exploitation plans will not materialise due to a lack of finance. To mitigate this risk, the consortium has started developing a proposal for COMPAIR 2.0 (HORIZON-MISS-2024-CIT-01), integrating COMPAIR results in existing and future EU projects (e.g. LIFE CityTRAQ, UrbanReleaf, Climaborough, x-Cite), and piggy-backing on initiatives funded internally or as part of a wider local or regional programme (e.g. Toolkit for municipalities and Sustainable & Liveable Neighbourhoods programme by VMM, Flanders biomonitoring study, Sofia School Bus Service). Reliance on other projects means that the associated exploitation will be as long- or short-lived as their duration: some will be running for another year, others will last until 2027. Much also depends on the grace period afforded to different tools. PMD and DEV-D will be supported for a year. CO2 Calculator for three years. DEVA has no defined period. And calibration was discontinued, except for NitroSense devices in Flanders, for which calibration can be requested on demand within an agreed three-year period between imec and VMM.

Table 1. Summary of pathways to exploitation of project results

	Social	Policy-oriented	Technical	Scientific
Digital tools	Provide DEVX to cyclists in Berlin Create hackathon challenges with CO2 Calculator in Sofia Train citizens of Athens how to use CO2 Calculator to reduce footprint	Use PMD in Sint-Niklaas to assess impact of a cycling bridge Add PMD to VMM toolkit which cities can use to monitor pollution e.g. Gent, Bruges, Antwerp Present PMD & DEV-D as good practices in x-Cite	Liaise with SODAQ/QADOS to update air sensors based on DEV-D testing results Apply DEVA to model natural disasters and support facilities management	Offer DEV-D to students at Geel College and Leuven University Incorporate CO2 Calculator into University of Aegean curriculum Enhance STEM education with CO2 Calculator in Plovdiv schools
Sensors & data	Maximise reuse of collected data through open	Use the enhanced Traffic Scout model to simulate mobility	Integrate Telraam data into the Traffic Scout	Use NitroSense data to benchmark and calibrate NO2

	licences	measures in Flanders Share Plovdiv results with other BG energy agencies	model Integrate bcMeter with SODAQ/QADOS in Flanders	readings
Calibration	Integrate calibrated NO2 data into VMM's programme on Sustainable & Liveable Neighbourhoods	Do more tests of auto calibration on mobility measures in Antwerp e.g. circulation plan	Refine auto calibration with electrochemical data Use for benchmarking in LIFE CityTRAQ	Provide access to calibration to new research partners and scientists from VMM
Communities & policies	Cooperate with GoodPlanet BE to integrate LDR in existing and new schools in Flanders Recruit 1,000+ volunteers over next 3 years for wood burning walks in Flanders, as part of human biomonitoring study	Liaise with Berlin Senate Mobility Department on a potential CS project in another Kiezblock Lobby for extension of school bus in Sofia for another year Introduce first ever school street in Sofia	Enhance extra curricular activities in Plovdiv schools with Telraam and sensor.community devices Keep NitroSense devices in two Friendship Clubs in Athens	Share the outcomes of the Plovdiv campaign with local medical professionals Share outcomes of the Athens pilot with scientists from UrbanReleaf and Climaborough
Project knowledge base	Publish good practices on KVP	Establish presence on HRP	Share know-how on CS Lab	Use MOOC to train professionals

Annex: Impact on partners

Helping others - be they citizens or policy makers - has always been COMPAIR's main goal. In doing that, the project also greatly benefitted those who worked on it as partners, those who organised citizen science activities and technical development, those who produced deliverables and presented COMPAIR to international audiences, those who were responsible for day-to-day management and strategic coordination. This annex is dedicated to them. Our ultimate goal here is to show how working on European projects can benefit participants, to encourage organisations big and small, from policy, industry, business or academia, to form interdisciplinary teams and push the boundaries of innovation, for their own benefit, that of the EU, its citizens and international partners.

Benefits

Digitaal Vlaanderen

The Digital Flanders (DV) initiative successfully established and deepened numerous new collaborations with project partners and networks. Specifically, collaborations with suppliers and technical developers facilitated partnerships with a diverse group of sensor developers, significantly influencing the Smart Cities and Citizen Science domains in Flanders. Key contributors included project partners Telraam, imec OnePlanet, SODAQ/QADOS, and bcMeter, who each made impactful contributions. Notably, the project gained valuable experience with emerging technologies, such as AI-based traffic models applied in real-world settings (e.g., Traffic Scout), which is planned for ongoing collaboration alongside continued utilisation of Telraam sensors.

From a sociopolitical standpoint, partnerships with regional stakeholders—including the Flemish provinces, specifically East Flanders, and cities such as Ghent and Sint-Niklaas, along with the municipalities of Herzele and Hove—proved to be particularly impactful. Each pilot project prioritised social dimensions, such as recruiting vulnerable groups, as well as ensuring findings were effectively communicated to participants, the general population, and policymakers. Scientifically, the COMPAIR project generated new insights into the reliability of citizen science sensors and developed practices to enhance their integration with official data sources in innovative applications such as Digital Twins.

Flanders Environment Agency

COMPAIR allowed us to attract new staff with 'young potential' profiles in the field of data science enabling us to grasp the broader value they can bring to our organisation. Additionally, working on COMPAIR provided us with more knowledge on the distant calibration technique applied by OnePlanet. Working together on improving this calibration has levelled up internal expertise on this topic.

Technically we now have a better understanding of the OGC SensorThings framework and will seek to apply this in future developments with our organisation. COMPAIR also allowed us to try out new Digital Twin based tools like TML's TrafficScout in Sint-Niklaas. We have demonstrated the potential of linking mobility simulations to air quality simulations and their added value in policy preparation. VMM is working together with the Mobility department of the Flemish Government to establish an equivalent tool at the Flemish level, open to all local authorities, linked to air quality impact simulations under development in the LIFE CityTRAQ project. At the interface of technical and scientific benefits, the various sensor assessments in COMPAIR (mobile benchmark in closed round, open round benchmarks of bcMeter, Nitrosense and Telraam and continuation into the Public Round) have really changed our understanding of the performance of the devices. These experiences have allowed us to propose a standardised tender that cities can use with built-in quality assurance mechanisms that guarantee quality results from these devices. This tender is currently being tested in LIFE CityTRAQ and seems to be effective.

Furthermore the various types of experiments in COMPAIR - especially because of the broad range of scope and research questions - have pushed our insight into the additional value sensor devices can provide to our organisation. VMM already concluded in the LIFE VAQUUMS project that the way forward was through experimentation and environmental organisations should refrain from using sensor devices with replication of a reference network as the starting point.

LIFE VAQUUMS suggested that by applying sensors to specific use cases, we could step by step generate examples of their added value and proper applicability. The robust data analysis and experimentation methods applied in COMPAIR clearly illustrate the potential of these sensor devices in relation to policy implementations, source screening and awareness raising. Our organisation is now much more confident in applying sensors in various other use cases and will actively encourage other stakeholders (local authorities, our peers in other countries) to do the same, basing our guidance on COMPAIR findings.

Lastly, we are very happy with the cooperation we have had among all Flemish partners specifically as this has allowed us to find new ways to reach local authorities and to start communication on an integrated story that is about more than merely air quality. Within this approach we also developed the 'data café' concept that has presented us with a new dialogue format that easily allows in-depth discussions with citizens.

DAEM

COMPAIR is a highly beneficial project for DAEM introducing the concept of citizen science in Athens. The latter is correlated with the environmental strategies of the municipality providing added value to the topic. The know-how gained through COMPAIR can be replicated and further advanced in terms of CS implementation in a highly populated urban environment such as Athens. The benefits for Athens are focused on social aspects, technological and procedural.

inter3

The COMPAIR project has definitely led to a number of new findings from which inter3 benefits and can integrate them well into its existing work. The COMPAIR project was the trigger for further promoting Citizen Science as a subject area at the institute. We were able to gather a lot of new knowledge, particularly on citizen science, but also on sensor technology. The network in the field of citizen science and mobility has also expanded and new opportunities for cooperation have been established in Berlin and Germany.

Energy Agency Plovdiv

Through citizen science, more data on air quality and traffic around schools were collected. For the first time in Plovdiv the traffic intercity was measured by citizens. The localised, granular data collected from citizens helps create a clearer picture of air pollution and the impact of traffic on air pollution. The COMPAIR project provided innovative data collection techniques, like low-cost sensors, mobile AQ monitoring laboratory and digital tools and its expanded EAP technical expertise in environmental data management, sensor technology, and data validation. The EAP involved citizens in training and equipped them with sensors for monitoring, helping them take ownership of environmental issues that directly affect their health and well-being and created a stronger social network.

Sofia Development Association

Working on the COMPAIR project was beneficial for our team in capacity building and getting to know the newest trends and technologies in measuring air pollution and taking actions while involving and empowering citizens. It was a good starting point for essential discussions with experts and city officials. COMPAIR was put on the map of innovative projects of Sofia Municipality.

Telraam

Working on the project has been beneficial in terms of sensor development, but for sure also to raise our profile and increase brand awareness. Telraam is a small, starting company and working in a big EU project increases our credibility with potential clients.

imec

The partners that we have worked with on the projects are partners we could collaborate with in the future. VMM benchmarked OnePlanet sensors for their pilot experiments during the project, and this data is valuable as a part of our dataset to further develop calibration algorithms. Benchmarking means VMM tested the sensors. In terms of accuracy/precision VMM does not provide quality labels but they evaluated different aspects of how much the (raw and calibrated) sensor data compares to the high end reference stations and between each other. For some metrics the sensor data was found acceptable, and other metrics they conclude that the calibration can be further improved.

Athens Technology Center

By being involved in a project like COMPAIR, ATC has gained visibility among a wider range of stakeholders, such as government agencies, research institutions, and private organisations interested in air quality monitoring or data analysis. With air quality monitoring as a critical part of smart cities, ATC's experience on the project could allow it to enter the growing smart cities and Internet of Things (IoT) markets, where data analytics and real-time monitoring are essential.

Fraunhofer HHI

The work in COMPAIR was very beneficial for Fraunhofer HHI. We developed a complete framework for AR applications, which can be further reused in future projects. An important aspect is that Fraunhofer HHI is now the first Fraunhofer Institute, which offers a meaningful Augmented Reality app on both app stores, Google Play Store and Apple Store. The way to achieve this required solving several Fraunhofer internal administrational issues. Furthermore the process of publishing apps on both stores is a complex process that requires providing a lot of information on ethical and usability aspects. Internal app testing and review by the app store managers also takes time and effort to fulfil their publication requirements.

University of the Aegean

The innovation of this CO2 calculator has to do with the easier and more efficient process to be used by individuals, cities and policy makers. It strengthened our collaboration with the pilot organisations in order to pursue new applications and projects. It opened the smart city market through collaborative policy making regarding air quality and CO2 emissions measurement.

European Citizen Science Association

Through the COMPAIR project, ECSA gained several benefits. First, ECSA has expanded its network locally in Berlin and in Europe via the collaborations with the COMPAIR consortium partners. ECSA has already planned to deepen these partnerships, for example, in being part of a new consortium with some former COMPAIR partners and applying together to a Horizon Europe funding call (probably HORIZON-MISS-2024-CIT-01-01). ECSA also gained extensive knowledge in domains such as air quality monitoring, wearables sensors, citizen engagement strategies, data collection and visualization and collaboration strategies to make citizen science data valuables for policy makers. ECSA presented COMPAIR as an exemplary success project to advocate for citizen science at conferences, for example at the XIth SWS International Scientific Conferences on Social Sciences and on Arts & Humanities in August 2024.

IS-Practice

The COMPAIR project enabled ISP to significantly advance its expertise in air quality and climate neutrality domains, expanding its collaborative network through new partnerships. This expanded knowledge and network will support ISP's future efforts in forming research consortia and developing new research and innovation initiatives.

21c Consultancy

Working on the project has benefited us in many ways. We raised our research profile by publishing COMPAIR results in several papers. We honed our science communication skills by creating infographics and updating the website with interactive content on air quality monitoring. Our credentials as event and training facilitators got stronger after a series of webinars and the online course that we led to a successful completion. And last but certainly not least, personal connections established within the project forged new relationships that will be leveraged to push the state of the art of science and innovation in Europe.

Lessons learned

Digital Vlaanderen
Key learnings from this project centred around establishing cross-policy domain projects and initiatives. A significant insight was the experience gained in coordinating diverse stakeholders, each operating with unique paces, priorities, and policy objectives. Additionally, the design and implementation of multi-device projects proved more complex than single-device initiatives, with added layers in project design, deployment, communication, result interpretation, and policy application. The project highlighted the importance of citizen science devices delivering policy-relevant outputs, including adaptable measurement intervals and the provision of open and reusable data services. These aspects will be incorporated into future tender specifications.

Flanders Environment Agency
There are three main lessons. First, generating behavioural change and contributing to policy making does not require large citizen science campaigns and heavy involvement of policy and psychology experts. Applying simple principles such as a learn-do-reflect scheme, involving policy makers from the start and getting them together with citizens in an open format such as the data café can yield good results and increase local impact. Second, mobile campaigns with particulate matter sensors are a valid use case for mapping wood burning. Third, in-depth discussions with citizens, such as through the data café format, are a valuable way of obtaining insights in the local situation and involving citizens in the policy making process.

DAEM
CS implementations especially in metropolitan areas include a high amount of field work that requires specific resources in terms of working hours, personnel and face-to-face communication. This aspect was evident in COMPAIR that the campaigns were designed for Athens through the distribution of sensors and measurements to individual citizens and most importantly elderly.

inter3
Even though it was clear that participation projects are time-consuming, we once again realised where and how many resources are needed to ensure successful support for citizen scientists. It requires properly functioning sensors and technical tools that are made available to participants. If these don't work well, participants become frustrated, they may drop out and lose motivation.

Energy Agency Plovdiv
There are two main lessons: the lack of an IoT network in Bulgaria, and that students are very enthusiastic and prefer assembling the devices rather than to compare data.

Sofia Development Association
COMPAIR confirmed one more time that empowering people is the most effective way to

motivate them, to be responsible and to take actions they stand for. Here we still have an emerging civil society and such projects are paving the way for more active citizens that have the feeling that they are recognised as important and something depends on them and their opinion matters.

Telraam

At Telraam, we need to invest more in engaging citizens also after sensor installation, specifically in the in-depth data interpretation with citizens. This is an opportunity for a future project.

imec

There are three main lessons. First, sensor deployments, especially when working with small scale companies can have a large uncertainty and there is a plan B and C needed if one partner is not able to deliver sensors that are needed by other partners. Second, low bandwidth sensor networks are not always reliable and network coverage maps do not always represent the actual coverage. Third, implementation of experiments planned with the municipalities will depend on several circumstances such as political timelines and may have large uncertainties.

Athens Technology Center

Accurate, well-presented data has the power to influence public awareness, as well as policy development and urban planning decisions. The ability to provide actionable insights through the PMD dashboard has demonstrated how impactful these tools can be in shaping environmental and urban policies.

Fraunhofer HHI

In the project, we used for the first time professional software development tools such as Jira, Slack and Lucidspark. The management of Jira tasks and sprints in bi-weekly meetings was especially challenging for the HHI team. This was an interesting experience for our team and will be considered further in the future.

University of the Aegean

The higher the granularity the better the policy decisions. The higher the engagement of citizens the higher the acceptance and trust to governments.

European Citizen Science Association

In person events are powerful to build up confidence and motivation of the citizen scientists, to build up trust between the different stakeholders (citizens, local authorities, technical/research partners) and foster productive discussion for problem solving and for new policies implementation. It is crucial to involve the local authorities as early as possible in a citizen science project in order to design a scientific protocol and set of data that can be relevant to influence for policy making. In the case of Berlin, the local authority was interested in the set of data collected but the format of the data should have been changed to be used by the local authority's science department.

IS-Practice
A critical insight gained was the degree of inaccuracy associated with low-cost air quality sensors and the intricate research demands of air quality data calibration methods. Additionally, we observed a heightened importance placed on air quality by both citizens and policymakers in recent years, highlighting the relevance of this area for future research and public engagement.

21c Consultancy
We didn't know much about the different low-bandwidth communication networks and were unpleasantly surprised that, despite the rhetoric to boost connectivity in Europe - one of the explicit goals of the post-Covid recovery strategy - there are major cities where SODAQ and Telram S2 still don't work (basically, they can't send any data), because the necessary infrastructure is lacking. Despite these challenges, it was great to see how partners in Bulgaria, with consortium's support, found a workaround by switching to different sensors and adjusting use cases accordingly.

Achievements

Digitaal Vlaanderen
COMPAIR yielded numerous practical outputs, making a notable impact in the field. For instance, the project contributed to the creation of a second OEM version of TELRAAM, enhanced with improved AI capabilities for road user recognition, and revised its API to better serve policy needs. The project's outcomes also informed the development of the bcMeter, fostering a collaborative environment in which COMPAIR contributed to real-time online accessibility of bcMeter results, integrated the device in pilot projects, and supported the product's advancement. Additionally, COMPAIR validated the NitroSense sensor as a cost-effective alternative to more expensive commercial NO_2 measurement devices. Other significant achievements include the application of OGC data services and the integration of sensor data into a data manager, which supports advanced multi-sensor dashboards and a globally unique augmented reality app with considerable future potential.

Flanders Environment Agency
The outreach activities to elderly and Roma communities in Athens and Sofia have been an inspiration to pursue similar ways of working in Flanders. In a way already under implementation with our call for participation aimed at sports clubs etc. The LEARN-DO-REFLECT educational tracks that have had a proven impact on behavioural change, are highly replicable and combine STEM education, experimentation, actual scientific work, behavioural change and even policy implementation. The citizen scientist interaction, specifically in Herzele, where citizens actually contributed to prototyping and product development, and where the data café format was born. The PMD provides an interface that allows communication on policy effectiveness to a broad audience. The DEVA/DEV-D combination converts any sensor into a mobile monitoring device.

DAEM
DAEM has achieved a high number of participation in the CS with individual citizens and most

importantly elderly that have limited technological literacy and high hesitation on relevant initiatives. Despite the latter more than 80% of data collected on air-quality were sourced by seniors. Additionally, the response to the online campaigns for the CO2 calculator was high as expected and Athens has a sufficient number of registered users in the PMD, while users can also reply to the tool without registering. Finally, DAEM managed to create valuable synergies with other bodies from the ecosystem of the city e.g. the Hellenic Passive House Institute, the Natural Environment & Climate Change Agency.

inter3

We are particularly proud of the high response rate of participants in the mobile measurement campaign. Through our network we found over 80 interested persons from whom we were able to select those who were suitable for the project. We are also proud that the project received such a good response and that we were able to present the results to many initiatives and other research projects, that private individuals and institutions became aware of us, that we expanded the network and thus made a small contribution to the Citizen Science and mobility discourse.

Energy Agency Plovdiv

The deputy mayor of Education and deputy mayor of Ecology in Plovdiv signed the invitation letter for schools to participate. This facilitated the engagement of local authorities and schools. More than 50 children from the 5th, 6th and 7th grades took part in the Ideathon, who presented projects for environmental protection and air quality improvement. Especially for the ideathon, the students prepared a school newspaper. It featured articles on air quality, ideas on how to reduce pollution, a crossword puzzle and other fun tasks related to the topic. One of the most attractive projects was "Earth from a bird's eye view" - 7th grade students used drones, and 7th and 6th graders wrote the date 22.04 and the words “ЗЕМЯ” ("Earth") and "AIR". The EAP prepared an on-line template of Proposal with a list of possible measures for reduction of traffic and improvement of AQ around schools for the municipality of Plovdiv. The collected proposals were presented to the municipality. The report contains good practises from other pilots - engagement of the elderly persons, school street implementation in Flanders and school bus service in Sofia.

Sofia Development Association

The fact that the school bus service was recognised as an important strategic measure also by the newly elected local authorities and was continued for the next school year was a source of pride. We hope this project will be upgraded and developed further as a measure for reducing air pollution around schools and providing sustainable mobility to schools.

COMPAIR was a trigger to continue working on the school bus and a tool in our hands to push institutions and departments of Sofia Municipality to support us. This project would not have survived after its first testing round if it wasn't COMPAIR because it financed our work on it and as a new and innovative project COMPAIR was another starting point for discussion with the city officials and attracting supporters and partners. Thanks to the project, sensors were installed which was a reason for a very direct and more regular communication with the schools that made building the community easier. COMPAIR also contributed to popularising the service. Parents and also children were involved directly through the communication within the project and thus we managed to involve these main stakeholders who wanted the bus project to be continued. The best outcome of this was the ideathon for gathering ideas for developing the service further. We have raised parents' awareness of the harm caused by traffic and accordingly, their desire to use the service, which has turned from a pilot into a permanent one.

Also the raising-awareness campaign was recognised by all our partners, experts and citizens that have feedback to us as a very positive and meaningful campaign. It was a continuation of a previous campaign but far more comprehensive and widely spread. It managed to fulfil the preset goals and we consider it successful. It managed to involve many stakeholders and to promote significant sustainable programs and projects of Sofia Municipality and the COMPAIR project.

Telraam

First, we achieved what we aimed for, even though it was high risk and success was not at all guaranteed: a new sensor which is easy to install and more robust. The fact some project partners acquired more Telraam devices outside of the project is a testament the sensors are delivering on their promise. Secondly, even though it's just a small village, how we achieved change in Herzele with the school street, by involving a whole community in collecting data through Telraam (while they were in fact "guinea pigs" for testing the device) is really cool. At the start, people were sceptical, but at the end, they became advocates. That's a great turn-around!

imec OnePlanet

The Flanders pilot planned their experiments quite well and asked specific research questions to address mobility and air quality challenges in the pilot regions which lead to valuable insights and lessons learned. Large scale deployments of many sensor devices in several countries went relatively smoothly. We were able to mitigate the sensor delivery delays by introducing different types of sensors and work together towards a solution. The autocalibration algorithm we developed for the NitroSense NO2 devices shows decent agreement with the reference station data, and preliminary analysis by VMM shows that the decrease in car emissions related to circulation plan change in Ghent is picked up by the sensors after this calibration is applied.

Athens Technology Center

ATC has achieved a transformative impact on urban mobility and environmental quality through the development and implementation of three pivotal tools: the Policy Monitoring Dashboard (PMD), the Dynamic Exposure Visualization Dashboard (DEV-D), and the Data Manager. The PMD empowers city planners and policymakers to make informed, data-driven decisions by visualizing real-time and historical urban mobility data, leading to optimized traffic management and reduced congestion in key areas. The DEV-D, integrating real-time pollution data, allows cities to dynamically assess pollution exposure along specific routes, which has enabled the identification of pollution hotspots and adjustments to traffic patterns, reducing environmental impact and improving air quality. The Data Manager serves as a robust data hub, ensuring high-quality, accessible data across applications, which has streamlined ATC operations and enhanced analytical accuracy. Together, these tools have delivered significant insights into urban traffic dynamics and environmental quality, enabling the implementation of sustainable mobility solutions that improve the quality of life for citizens and contribute to healthier, more livable urban environments.

Fraunhofer HHI
Speaking of DEVA, it's the first relevant Fraunhofer app on app stores. We are proud of the AR pipeline in DEVA and its flexibility to integrate several AQ servers, and to visualise graphical content in AR urban environments enabling new representation and spatial techniques. The DEVA Trip Recorder developed in close cooperation with the DEV-D team to give a user the possibility to daily record trips and monitor the impacts in DEV-D, is another great success.

University of the Aegean
Two achievements are worth mentioning: a) acceptable actions from the side of citizens to achieve the EU goals, and b) adaptable to any city context and language in a small amount of time.

European Citizen Science Association
Collaboration, expertise and creativity of the different COMPAIR partners lead to the powerful strategies for co-creation, stakeholder engagement, gamification and framework design. A direct result of these strategies was that COMPAIR was successful at involving and maintaining the participation of diverse groups of stakeholders and, notably, a large number of SES groups in the pilot activities.

IS-Practice
The successful implementation of the COMPAIR project stands as a collective accomplishment, marked by substantial outcomes and strong collaborative dynamics within the consortium. Among the achievements, the Telraam 2.0 sensor and the policy monitoring dashboard represent standout contributions. Additionally, we are proud of the diverse pilot initiatives conducted in Flanders and the commitment to sustaining these efforts beyond project funding, supported by DV, VMM and imec.

21c Consultancy
There are only a handful of studies that map citizen science projects per country. The landscape review conducted in WP2 addressed the gap in literature by not just mapping but also methodically analysing 100 projects in five COMPAIR countries. On the basis of research results, 21C developed recommendations for pilots on how to set up their CS Labs. In addition, insights gained from the review led to a new conceptualisation of citizen science regimes at a national level. Another object of pride is the online course. We know from experience that these deliverables are very sustainable. In 2020, we published a course on the same platform (OLC) for a project called PoliVisu. Fast forward to 2024, people are still enrolling in it. We expect COMPAIR's course to be just as long-lasting, if not more. A lot of results are packed in this learning resource. We would be surprised if it had less than one thousand sign-ups in the first year.