DELIVERABLE

D5.5 Co-Innovation Report 1

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List of Abbreviations

Abbreviation	Definition
AQ	Air Quality
CO2 Calculator	Carbon Footprint Simulation Dashboard
CS	Citizen Science
DAEM	Dimos Athinaion Epicheirisi Michanografis
DEV-D	Dynamic Exposure Visualisation Dashboard
DEVA	Dynamic Exposure Visualisation Application
DIY	Do It Yourself
EAP	Energy Agency Plovdiv
EU	European Union
H2020	Horizon 2020
INT3	Institute for Resource Management
KERs	Key Exploitable Results
KPIs	Key Performance Indicators
LSES	Lower Socio-Economic Status
PM	Particulate Matter
PMD	Policy Monitoring Dashboard
SDA	Sofia Development Association
VMM	Flanders Environment Agency
WP	Work Package
WS	Workshop

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Executive Summary

This report aims to give a comprehensive overview of the collaborative innovation efforts within the COMPAIR project. It outlines the common approach of co-innovation activities like citizen engagement and involvement, collaborative partnerships in creating innovative technologies and using sensors, community empowerment and constant feedback loops undertaken by each of the COMPAIR pilots - Athens, Berlin, Flanders, Plovdiv and Sofia. It also provides an explanation on the building blocks of co-innovation as understood by the COMPAIR consortium in its effort to promote citizen science as an effective tool for policy creation, implementation and analysis. If there was no open communication and collaboration, shared vision, goals, resources but also shared risk and rewards it could have been difficult to achieve a co-innovation development process, as there lies the fundament of co–innovation.

And as we wanted to continue build up we needed to lean on the 5 pillars that we implemented in all the levels of communication and implementation of the COMPAIR project:

Collaboration is the interdisciplinary approach used by the COMPAIR team - a team that consists of multinational partners which share ideas, knowledge, resources and which communicate with different stakeholders in order to achieve the set goals. As explained in D1.1 Project Vision, the multi-stakeholder collaboration exhibits high levels of trust and inclusivity, with grassroot communities, researchers, industry experts and policy actors working side by side to make the vision of zero pollution a reality. The already conducted workshops and focused discussions proved their essential role as co-creation tools in COMPAIR at this stage as they gave initial start and fostered collaboration process, knowledge exchange and co-innovation among project participants. All the project development relies on the basics of feedback from the stakeholders.

Coordination is a key factor for the COMPAIR project in order to achieve effective collaboration. As it involves international partners, coordination is set first on a high level as a consortium and then on WP level and pilot level. Common values, vision and pre-set goals of COMPAIR helps all partners to have a similar perspective and to refract their activities through the same prism - using the co-innovation and co-creation resource of citizen science to help solving the air pollution problem in cities. Planning is a key here and COMPAIR proved that the team can be strict to the planned timeline and meet deadlines. Here also comes the importance of adaptive planning and matching again the schedules between partners, as always can emerge some delays in one partner e.g. due to supply issues and that causes the need of reconfiguration and new alignment with the goals.

Convergence in the COMPAIR project means integrating diverse elements and combining all aspects of a problem-solving, with the goal of achieving a unified outcome. This is possible to happen with the help of integrating multidisciplinary expertise of the consortium partners and also the already mentioned interdisciplinary and cross-section collaboration. In D1.1 Project Vision it is stated that COMPAIR brings together members of the quadruple helix community to co-create effective place-based solutions to mitigate air pollution and other related urban challenges.

Complementarity is putting focus on how different elements, each of them having its own characteristics, weaknesses and strengths, can work in a harmonious way, each contributing with its own uniqueness to enhance the overall effectiveness and synergy of the project. In the COMPAIR project this can be seen in the integration of different tools and technologies in

order to create novel solutions. The innovative approach of combining the newest technical means and to put them in the hands of citizens could be and happened to be the missing part in dialogue with the policy makers and the starting point for creating urban policy making by empowered citizens.
Co-creation is the last but not least pillar of the co-innovation that implements in itself the understanding of inclusive stakeholders' involvement and participatory decision making. COMPAIR uses a human-centric design and agile approach with constant iterative feedback loops that can provide alignment with user needs and requirements. This can be seen best during the workshops that were held and based on their outcomes the whole technical requirements instrumentarium was built that helped develop the innovative tools of COMPAIR - PMD, DEVA, DEV-D, CO2 Calculator.

As we can see co-innovation is seen as an integral part of the COMPAIR project implementation since its very start as constant feedback and evaluation of progress is sought on both internal and external level. It provides an explanation on the approach used to boost creativity, complementarity and co-creation in the development of the COMPAIR products that aim at allowing citizens across Europe to become active participants in policy making on a local level.

One of the focuses of the report is to trace how pilots are using these co-innovation principles and how they built the process of organising the workshops and using their outcomes in the next steps of co-creation, co-development and co-innovation of the technical tools of COMPAIR. The next step is to see how this will help flourishing civil society and will help their voice to be heard by the local authorities.

That's why the report also looks at the future plans of each of the pilots on how co-innovation will be used in the last year of the project in order to scale up the results and seek acceptance and roll-out of COMPAIR developments among the larger community.

It seems that all pilots plan again to rely on the co-innovation concept as actively seeking collaboration and constant feedback on both internal and external level is seen as a useful approach by the pilots during the first two years of the project. The use of the conceptual framework of the five "co's" of the co-innovation - collaboration, coordination, convergence, complementarity and co-creation helped the pilot teams to structure their activities in a way that allowed to accept different perspectives and accommodate ideas in the early stages of the project but also identify and mitigate risks.

The results and conclusions made in this report will navigate the COMPAIR pilot teams when planning co-innovation activities in the upcoming public testing round in order to engage more citizens and generate citizen science data that will be used in the evaluation of policy measures implemented in each of the five pilots and will promote the implementation of co-innovation approach in policy-making on local level.

1. Introduction

Innovation and inclusion of innovative practices in the public policy domain has received growing popularity in recent years. Including the citizens in the process of policy creation and transformation of public services has become a major pillar for local and national authorities in their efforts to promote transparency, good governance and increase trust, as Hilgers and Ihl (2010) mention in their article "Citizensourcing: Applying the concept of Open Innovation to the Public Sector"[1]. By involving citizens in activities related to creation and implementation of public policies, a better understanding of the issues a city or country is facing is achieved and also it is easier to accept rather unpopular measures as the citizens have actually participated in the process of their development. Thus, citizen engagement has been one of the main priorities of the COMPAIR project so far, allowing volunteers and future users of the products that are being developed to actively participate in the development and testing of the latter and have their voice heard in the further development.

This report outlines the methodology and the understanding of the COMPAIR consortium on the application of co-innovation in the project activities. We start by describing the co-innovation approach, explaining how it is used, how it supports different aspects of the project activities, then presenting how co-innovation is actually implemented by each of the 5 pilots of the COMPAIR project, later providing an overview of the similarities and differences encountered, followed by an outlook of the future plans related to usage of co-innovation practices in the upcoming public testing round, where pilots will be targeting larger groups of citizens and scaling up pilot use cases towards the general public.

The aim of the D5.5 Co-innovation report 1 is to provide an overview of co-innovation activities undertaken by the COMPAIR pilots so far and also set the scene and provide justification on best co-innovation practices and engagement approaches to be used during the public testing round that would eventually promote behavioural change of the citizens from the 5 pilot locations. Moreover, the long-term aim is to up-scale co-innovation activities in the last year of the project and set an example and guidelines for future citizen scientists and local champions on the co-innovation approaches that have proven most effective in terms of engagement and willingness for behavioural change throughout the project. The latter will be presented in more detail in the up-coming D5.7 Co-innovation Report 2, which is due in August 2024.

1.1. What is co-innovation and its role in the COMPAIR project

As one of the many existing definitions suggests, co-innovation or open innovation is a strategic approach usually defined as a process where common knowledge, expertise and ideas are sought to find solutions to specific problems and issues that a company or public authority would like to tackle[2]. Collaborative innovation can occur between different groups of

[1] D. Hilgers and C. Ihl, "Citizensourcing: Applying the Concept of Open Innovation to the Public Sector," *International Journal of Public Participation*, 4/1 (January 2010): 67-88.
[2] https://ideascale.com/blog/what-is-open-innovation/

stakeholders such as companies, NGO's, research institutions, or even individuals. The goal is to combine different perspectives, expertise, and resources and generate innovative solutions or products that might not be that easy to accomplish if not working in a diverse environment where different ideas and opinions are widely discussed and assessed. This definition falls very well within the COMPAIR project framework, as the one of the main goals of the project is to provide support to citizens across different European cities and regions to use different tools and sensors for collecting and analysing data on traffic and air quality and co-create climate friendly behaviours and policies that leverage sustainability on both local and European level. Moreover, the diverse consortium of 15 partners from 6 European countries provides the opportunity to co-innovate at project level as well.

In the process of co-innovation the different points of view and perspectives are used to shape the outcomes and the products' development within a project in order to ensure its usability and sustainability in the long term. In a co-innovation partnership, each party brings its unique strengths to the table, fostering a synergistic relationship. It also helps to find as many pieces of the puzzle as possible and to look from a holistic point of view. This collaborative approach can lead to breakthroughs and advancements by leveraging the collective knowledge and capabilities of the involved parties.

Co-innovation is often seen in various industries, including technology, healthcare, and manufacturing, where complex challenges require diverse skill sets and resources. It's a way to pool resources, share risks, and accelerate the pace of innovation. The resulting innovations can range from new technologies and products to improved processes, products or services. But co-innovation can be successfully used in policy making and implementation as a powerful tool to build trust, acceptance and convergence between policy makers, experts and the civil society.

Thus, it can be proposed that the key to successfully implementing a co-innovation approach lies in effective communication, mutual trust, and a shared vision among the collaborators. It's a dynamic and evolving concept that reflects the changing landscape of how innovation occurs in our interconnected world.

Since the start of the COMPAIR project, partners have been trying to implement different co-innovative approaches, build trust among the partners, ensure all points of view are taken into consideration, and provide an opportunity to collaborate in the name of the shared common goal that was set in the project proposal phase. When thinking about the most important features that were incorporated in the project activities so far to make sure that made it possible for the COMPAIR consortium as a whole and for the pilot partners in particular to shape the concrete vision and identify their approaches for pilot activities, five important things were identified. Without those all co-innovation efforts of the COMPAIR would probably not be able to bring the positive change within the targeted communities by the pilots. Below, those main founding blocks of the collaborative innovation efforts as seen within the frame of the COMPAIR project are briefly explained, and all of these have been used by pilot partners when shaping the pilot use cases:

- Open communication and collaboration: effective communication is believed to be the cornerstone of co-innovation. Open channels of communication enable the exchange of ideas, insights, and feedback between collaborators. According to the type of communication it's essential to choose the right type of channel communication so that

the target audience or the participants can feel comfortable. The culture of open communication fosters a collaborative environment where participants can freely share their expertise and perspectives. This point emphasises the importance of breaking down silos and promoting cross-functional and open minded dialogue based on trust between all participants/partners.

- Shared vision and goals: co-innovation works best when all parties involved share a common vision and goals. This ensures alignment and a unified direction for the collaborative effort. The shared vision serves as the guiding principle, outlining the desired outcome and the overarching purpose of the collaboration. Clear goals help keep the collaborators focused and motivated throughout the innovation process.
- Resource Sharing and Interdependence: co-innovation involves the pooling of resources, whether they be financial, technological, or intellectual. The collaborators depend on each other's strengths to achieve a collective impact. This point emphasises the idea that each participant contributes unique resources and capabilities. The success of the collaboration hinges on the interdependence of these resources, creating a synergy that amplifies the overall innovation potential.
- Risk and Reward Sharing: in co-innovation, there are inherent risks, and the potential rewards are typically shared among the collaborators. This includes both the benefits and challenges that arise during the innovation process. Collaborators acknowledge and accept shared responsibility for the risks involved. The framework promotes a fair distribution of rewards, fostering a sense of mutual commitment and ensuring that all parties have a stake in the success of the innovation.
- Agile and Adaptive Processes: the idea behind using co-innovation or open innovation in the public domain is to move from the waterfall project and policy implementation towards a more agile and user-friendly methodology for project implementation. Co-innovation often requires flexibility and adaptability. That's why agile processes is a more suitable approach because it allows collaborators to respond to changing circumstances, market dynamics, and evolving needs set by the stakeholders during the whole process of iterations. This point emphasises the importance of iterative and flexible approaches to innovation. Collaborators need to be agile in adjusting their strategies, incorporating feedback, and making course corrections as needed to stay responsive to the dynamic nature of the innovation landscape.

And as the building blocks give the fundament on which one can build on, you need a structure upwards that can keep the building strong and able to withstand the difficulties. Here comes the pillars that we recognized as continuation of these basis. These pillars can be set as explained in an article from 2018, where Saragih and Tan[3] discuss in more detail the five pillars of co-innovation, setting the conceptual framework of the term from another perspective. Those differ in terms of labels from the founding blocks listed above but in their essence cover conceptually in most part the features identified by the COMPAIR project team. Even though the article uses examples mainly from the business world, those five pillars seem to be quite relevant to the work and processes used within the COMPAIR project as mentioned above

[3] Saragih, H.S. and Tan, J.D. (2018) 'Co-innovation: a review and conceptual framework', Int. J. Business Innovation and Research, Vol. 17, No. 3, pp.361–377. https://www.researchgate.net/profile/Jacob-Tan/publication/328211215_Co-innovation_a_review_and_conceptual_framework/links/5c57c5b7458515a4c756b204/Co-innovation-a-review-and-conceptual-framework.pdf

and conceptually follow within the consortium's understanding of how co-innovation works. The so-called five "co's" of co-innovation are listed to be the following:

- Collaboration;
- Coordination;
- Convergence;
- Complementarity and
- Co-creation.

In this report we are taking those into consideration when explaining what we have achieved during the COMPAIR project up to now and how it reflects the activities we have implemented so far.

1.2. How the co-innovation approach is used in the COMPAIR project

Since the beginning of the COMPAIR project co-innovation, founding blocks and pillars have been used in all project-related activities and have been an integral part of its implementation. First, collaboration and open communication was happening both between project partners but also with an external expert panel, providing guidance and support on project deliverables and activities. Moreover, COMPAIR partners have been participating in a number of outside events and workshops where the project was presented and feedback has been sought.

Second, coordination, together with the shared vision and goals of the project is performed on consortium level, work package (WP), technical and pilot levels with regular meetings to keep everyone in the consortium up to date on the progress and upcoming tasks. These regular meetings and status updates are an essential part of planning the activities and have proven very effective in terms of providing solutions in the very early stages of occurrence of problems ensuring risk tackling and prevention. Moreover, in terms of constant feedback loop on technical and sensor status and development, the pilots provide regular sensor updates to the technical team to keep them aware of the state of art and take immediate action if needed. The consortium is using various communication channels and means of collaborative work that support the smooth flow of the work process.

As a result of the integration of the latter two pillars, convergence and in a sense risk and reward sharing was achieved by alignment of the perspectives of project partners and achieving mutual understanding of the goals and objectives to be achieved within the project by also sharing the burdens and looking for solutions together when problems were arising. Apart from that, complementarity, resource sharing and interdependence was incorporated in a way that technical and non-technical partners were working together to set up the framework for the needed outputs and achievements of the project.

Last but not least, co-creation workshops with external stakeholders and among the project partners are regularly organised to check project direction and provide invaluable feedback to pave the way further. Involving stakeholders at an early stage gave the project partners an idea of their specific needs and expectations. Moreover, working in an agile and adaptive way allows project partners to easily implement changes if such are requested from potential users.

The consortium is actively looking for collaboration also with other projects, presenting the COMPAIR use cases in various conferences, workshops and events in order to receive feedback and exchange some lessons learned with people facing the same challenges and working on common issues.

The five founding blocks and pillars of co-innovation are principles and approaches that are continuously used since the start of the project and the aim is to use this methodology in all remaining project activities.

1.3. How the co-innovation process supports other project activities

The co-innovation process implemented by COMPAIR supports project development activities in a number of ways. First, it ensures acceptance and builds trust among project partners and external stakeholders. Moreover, it allows the opportunity to receive constant feedback and map activities and developments in such a way that prevents major changes in the development and testing phases, helps the risk mitigation activities and supports smooth implementation of the project activities aiming to produce innovative results that best suit the needs of the users. The agile project management approach that has been followed provides partners with the opportunity to adapt changes if needed without causing major delays or draw-backs. Co-creation activities that have been happening since the very start of the project mapped the technical development and plans and alignment on four-week sprints was introduced in order to receive constant feedback and alerts if issues are identified.

A number of deliverables submitted as part of the COMPAIR project have used the results from co-innovation activities. The D1.1 Project Vision[4] was the lighthouse during the whole process of co-innovation and co-development. In the drafting phase of the D2.1 Value Network Canvas[5] partners worked together in a co-creative and co-thinking setting to identify and map main stakeholders and organised co-creation workshops that helped the identification of user stories that have afterwards been turned into user requirements (and then transformed into epics). Another example of co-innovation was the exploitation workshop held during the project meeting in Samos in July 2022. Partners participated in a ranking exercise where they had to vote for the key exploitable results (KERs), which formed the basis of D8.3 Draft exploitation plan[6]. Later, D2.4 Pilot Operations Plan[7] used the outputs of the co-creation workshops organised by the pilot teams in the four participating pilot countries to draft the upcoming activities and set the key performance indicators (KPIs) that pilots need to achieve within the timeframe of the project. As this deliverable is written, the D5.4 Open Round Report[8]

[4] D1.1 Project Vision - https://www.wecompair.eu/_files/ugd/68109f_6650c078b0cf4d71844d3b6fe480dcaf.pdf
[5] D2.1 Value Netwoek Canvas - https://www.wecompair.eu/_files/ugd/68109f_cb57a372cebd4ceb9020d55dfa765aca.pdf
[6] D8.3 Draft Exploitation Plan - https://www.wecompair.eu/_files/ugd/725ca8_9687b06bc0ed4d0092cf5cc042d9599b.pdf
[7] D2.4 Pilot Operations Plan - https://www.wecompair.eu/_files/ugd/725ca8_ee8af111bc8f4ea486395c8bb6780809.pdf
[8] D5.4 Open Round Report - will be published after this report is submitted.

is also under development and uses the results from co-innovation activities performed by pilot teams during the open testing round.

It can be assumed that co-innovation is performing a leading role in all the COMPAIR project developments and activities as the project in its essence is focused on citizen science and collaboration between policy-makers, citizens, academia and business, shared vision between project partners and external stakeholders, interdependence and sharing resources (especially knowledge and expertise) among partners and prospective users, risk and reward sharing on the results achieved and last but not least working in an agile and adaptive manner in order to allow for constant feedback and improvement. In general, COMPAIR can be described as an innovation project designed to bolster citizens' capacity to monitor, understand, and change their environmental impact, both at a behavioural and policy level. It aims at mobilising the ideas of people with different backgrounds and helping foster understanding in society about such a serious topic as air pollution which eventually will increase the chances that society and citizens themselves accept and adopt the chosen measures in an easier manner. It unlocks the power of the wider public, including citizens with lower socio-economic status (LSES), to provide broad granular data around a central theme, like the one of air quality, complementing and improving the quality of official datasets and making new information useful for research purposes, policy making and behavioural change by using co-innovation as a main tool for achieving its goals. And this is the reason that all the five pillars of the co-innovation framework are playing an integral part of the project.

2. Co-innovation into practice

In this chapter, the co-innovation approaches of each of the five pilot locations (Athens, Berlin, Flanders, Plovdiv and Sofia) in the COMPAIR project are presented. Each of the pilots used both similar and different co-innovation practices, based on and inspired by the founding blocks and pillars of co-innovation to engage local stakeholders and end-users, gather feedback and raise awareness on air quality issues and find ways to prevent air pollution by introducing and promoting behavioural changes. The section dives deeper into the different activities the COMPAIR pilots implemented in order to gather citizen science data, analyse it and raise awareness among the 5 pilot locations' citizens on air quality, traffic and climate change by using the approach described in Chapter 1 of this report.

The process consisted of three phases that were followed by COMPAIR pilots: co-creation -> co-design -> co-innovation.

- **In the co-creation phase** the pilots drafted the plan and experimental design of the use cases they would like to implement both on internal project level and together with external stakeholders by stepping on the co-innovation founding blocks.
- **In the co-design phase**, pilots developed the design of the use cases and matched it with the pipeline of the technical team, again implementing the founding blocks and were actively seeking out collaboration both on project internal and external levels.
- **In the co-innovation phase** activities corresponding to the five co-innovation pillars have been implemented in order to ensure that the planned activities will have the biggest impact on users.

All pilots have been involved in different co-innovation activities - organising workshops, Do It Yourself (DIY) Citizen Science Labs, developing surveys and using other feedback gathering tools to make sure that constant communication and feedback loop is present and ideas and suggestions are taken into account in the project planning and development activities. All these activities ensured that the agile and adaptive process is followed, communication is open, shared goals and vision are sought, risks are identified and effectively addressed and resources are shared in the best possible ways to meet the project goals.

As one of the goals the COMPAIR project has set to accomplish is raising awareness on environmental issues that will lead to behavioural change in local communities, co-innovation is seen as a tool to achieve this goal and empower local communities to lead policy changes based on the data gathered through citizen science (CS).

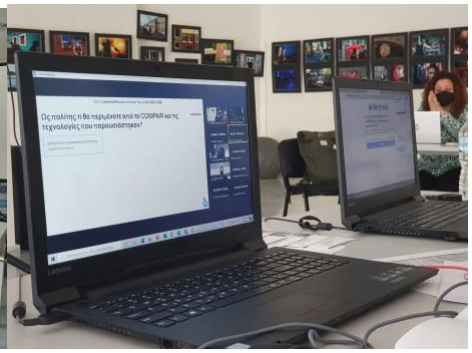
In the following five sections, the co-innovation activities the five pilots have undertaken since the beginning of the COMPAIR project are presented.

2.1. Athens

2.1.1. Co-creation

The pilot activities in Athens are based on the co-creation methodology. In the first year of COMPAIR lifetime, two workshops were organised and a co-creation approach was followed. In the 1st workshop, where the Carbon Footprint Simulation Dashboard (CO2 Calculator) has been presented, the audience stated their preferences in terms of functionalities, tools and operations to be included in the tool, while in the 2nd workshop mockups of the current development were presented following up the comments and suggestions. In addition, in these workshops, participants and stakeholders from the quadruple helix attended, namely the audience of the 1st workshop included citizens of Athens, city officials, employees of the municipality and academic partners, while the 2nd workshop exploited the IT-audience of the Samos Summit 2022 including IT students, professors and other academics. Both events included fruitful feedback collection sessions from participants in the format of structured questions (on Mentimeter) and as an open discussion.



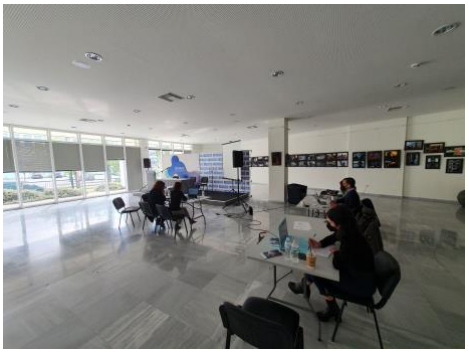


Figure 1: 1st and 2nd co-creation workshops of Athens pilot

In parallel, regarding the activities included in the open round and the sensor distribution to volunteers, co-creation approach was followed as well. Initially, meetings and discussions were held with city officials and the administrative personnel of Friendship Clubs. In collaboration with them, volunteers were identified that tackled the criteria for the participation in the pilot and receipt of sensors and also the process for the engagement of senior citizens was decided. The process in brief includes the path as follows:

- Meetings with group of citizens in order to be informed on the objectives of the pilot implementation and their role and contribution
- Recruitment and benefits for the citizens
- Distribution of sensors
- Training sessions on sensors' functionalities and operation

2.1.2. Convergence

Important feedback was received as well as lessons learnt helpful for the public round and the pilot activities. It has to be mentioned that COMPAIR's scope and objectives encourage citizens behavioural change regarding energy consumption and initiatives for limiting air pollution. It is a challenge to convince citizens to participate in a pilot project by installing sensors in households, by contributing to a dashboard and by using an application. Citizens, although nowadays are aware of climate change and air pollution emissions and participate in several initiatives to this direction, should be convinced of the added value of their contribution to air pollution diminution. However, the completion of several tasks up to now, indicates exactly the above-mentioned point, that the project's challenges are addressed and citizens, even of low SES groups are eager to participate and contribute to improvement of air quality and on environmental issues in general.

2.1.3. Synergies

The Athens pilot in COMPAIR coincides with a number of initiatives and projects launched by DAEM and the Municipality of Athens on environmental issues and more specifically on air quality. In particular, currently there are three research projects (CODE Europe, COMPAIR and UrbanReleaf) that DAEM participates in which provide convergence, collaboration and synergy among them in the field of air quality in Athens. Each project provides a different level of complementarity with COMPAIR and differentiates in terms of research and methodology.

CODE Europe[9] (Co-Deciding Europe - Working together for a green, competitive and inclusive Europe) is an EEA grants project launched in 2021 with a 4 year duration. It focuses on the methodology of participatory democracy through crowdsourcing that aims to reduce the gap among policy makers and citizens in the field of air quality. The project developed 4 participatory platforms of e-Participation that took place in 4 phases, tackled the creation of a community among policy makers, academics, private companies, NGOs and citizens on the field of air quality. As an output of the project that will be finalised in 2024, it is targeted to contribute to the EU legislation that refers to the forms of recording public opinion such as crowdsourcing and contribute to the formalisation of e-participatory methodologies. DAEM participates in CODE with 10 European cities and currently the results of the crowdsourcing activities are promoted and disseminated. The convergence with COMPAIR will mostly take place at the policies creation aspect and the outputs of CODE are taken into account by DAEM when providing policies to be elaborated, e.g. the CO2 Calculator.

The second project of DAEM that has synergies with COMPAIR in air quality and environmental topics is UrbanReleaf[10] (Citizen-powered data ecosystems for inclusive and green urban transitions). It kicked off in 2023 and is still at the early stage of co-creating and designing the pilot activities. The project aims to exploit the data produced by citizen science actions in order to correlate them with data from the scientific and academic communities. This approach is foreseen to promote civic active participation in environmental issues. Each of the 6 pilot cities of UrbanReleaf targets diverse environmental fields. In Athens DAEM will lead the pilot that aims to tackle the management of urban green spaces, the improvement of green locations in the city and the creation of a tree registry with the participation of citizens in the mapping campaigns. In parallel, this aspect will be correlated with air quality data in order to create outputs and metrics on the increase of civic green and the reduction of air pollution. To support this, air quality static devices and wearables will be distributed in a district of Athens where the mapping of trees will also be launched. The static devices will collect data such as PMs and fine particles and are managed by the National Observatory of Athens, while wearables will measure in a dynamic manner air conditions such as temperature and humidity and are managed by the Institute of Communications and Computer Systems of the National Technical University of Athens. The measurements aim to enhance the PANACEA[11] network that is managed by research and academic communities. The synergy among UrbanReleaf and COMPAIR is evident, DAEM plans to implement this citizen science activity in several districts of Athens in order to achieve complementarity of air quality data for Athens. COMPAIR participation will provide to DAEM valuable know-how for the implementation of future similar projects such as UrbanReleaf. Finally, synergies in terms of sensors, devices and hardware that are proposed by both projects are foreseen, as well as for the calibration, quality of measurements and accuracy of collected data.

[9] https://codecidingeurope.eu/
[10] https://urbanreleaf.eu/
[11] https://panacea-ri.gr/

2.2. Berlin

2.2.1 Co-creation

The pilot activities in Berlin are based on a co-creation process. Over the last 1.5 years two workshops took place to evaluate the COMPAIR tools in a co-creative manner. The aim of the workshops was for selected participants to look over the dashboards, evaluate them, check their functionality and give feedback on where there is still room for improvement. The participants were specifically invited so that they were people who already had prior knowledge of technology and data.

2.2.2 Start of engagement and awareness-raising

The engagement to this point relates to the closed and open testing rounds. In the closed round, the Berlin COMPAIR team tested the first sensors (Telraam, SODAQ and the static fine dust sensor) themselves together with acquaintances. The aim was to test the functionality of the sensors in a low-threshold manner and to identify problems and open questions. It was also important for us as a COMPAIR team to practise exactly how these sensors work and how we can explain this to the citizens in a way that is as comprehensible as possible. This phase, which lasted several weeks, ended successfully because we collected a list of questions and hints, e.g. that the bicycle mount of the SODAQ sensor is too small for many bicycle handlebars and needs more adapters.

At this stage, we have not yet mobilised any participants because we have only measured ourselves and our circle of acquaintances. In parallel, however, we raised awareness of the texts for the COMPAIR website and of the project in general by using social media to help us mobilise for the open round.

In the open round, we then conducted a more classic Citizen Science approach for the first time. This started by thinking specifically about the research design and how to implement it. We decided that we wanted to have both a static measurement group and a mobile measurement group. During our research on static measurements, we came across a pilot project in Berlin-Kreuzberg (Project Graefekiez), where the Senate temporarily closes streets to cars, i.e. makes the area traffic-calmed. There is also greening, a lot of citizen participation and research on how these mobility measures are accepted. This pilot project and delimited neighbourhood lent itself very well to conducting our static measurements with residents there. With the pilot project already in place, we had easier access into the neighbourhood and were plugged into a larger network of mobility stakeholders. Nevertheless, recruiting citizens proved to be very difficult. Through intensive flyering, being at information booths, sending newsletters and through direct conversations in the neighbourhood, we managed to recruit eleven participants for the static measurements. These eleven participants were split between Telraam, particulate matter, and black carbon sensors; some participants even had multiple sensors. In an introductory workshop, we explained the sensors and raised awareness about air quality and traffic in Berlin. The aim of these measurements was to measure the air quality and the traffic flow before and during the measures in the Graefekiez. Unfortunately, there were construction delays and also the designated area where streets were to be unsealed and closed decreased drastically, so that unfortunately no recognizable changes were to be

expected during the measurement. This demotivated the participants relatively strongly and we tried to motivate them by talking about the added value of Citizen Science in general. In an intermediate workshop, the so-called Data Café, only two people were present. There we talked about the first results and despite the few participants a very interesting discussion arose. Furthermore, eight out of eleven participants are measuring and the final workshop is scheduled for November 16.

Figure 2: Participants of the static measurements introduction workshop

Figure 3: Participants of the static measurements introduction workshop

Figure 4: Creative construction of the soot and fine dust sensor of a participant in Graefekiez

For the mobile measurements in the open round, we and cyclists worked together to gain insights into fine dust pollution. The goal is for cyclists to measure their daily commutes and find out how congested their routes are. A survey was also conducted regarding any behavioural changes. The mobilisation went very well because one of our team members at COMPAIR has good contacts with bicycle and mobility initiatives in Berlin. With the help of flyers and Instagram tiles, we were able to submit a request to these actors to participate in the mobile measurements. The response was enormous. Within a week, over 70 people reported back, so we were able to stop our mobilisation. The fact that the response was so great was certainly due to the fact that the topic of mobility is very important in Berlin and also because the access through the initiatives was very promising. Of the 20 participants who had agreed to attend, only 14 people ended up attending the two introductory workshops. As with the static measurements, the introductory workshop was about raising awareness of the topic of traffic and air quality, introducing the topic in a playful way and also providing information about the citizen science approach. The participants are very motivated and nine people came to the online interim workshop. The 60 minute workshop was not enough to answer all the questions. Some participants have already announced that they would like to take part in the public round again.

A final workshop took place on October 25th. It consisted of two parts: one session on gathered air quality data and another session on assessing behavioural change. The first part was all about the results of PM measurements, where the Berlin team and the participants examined pollution patterns, absolute and relative concentration levels (total vs. individual exposure) as well as changes before and after the workshop on “helped” behavioural changes. A fruitful discussion arose in the second part, where citizens provided their viewpoints on whether insights into their pollution exposure (assessed during the interim workshop on September 6) affected their mobility behaviour. Although all of them remained fond of their

bicycles, the participants' views diverged slightly on the topic of individual vs political responsibility, that is, who can and should do more to improve overall air quality. The participating citizen scientists confirmed that they enjoyed being part of the campaign and expressed their interest to collect new data in the public round.

Figure 5: Photo from the final workshop

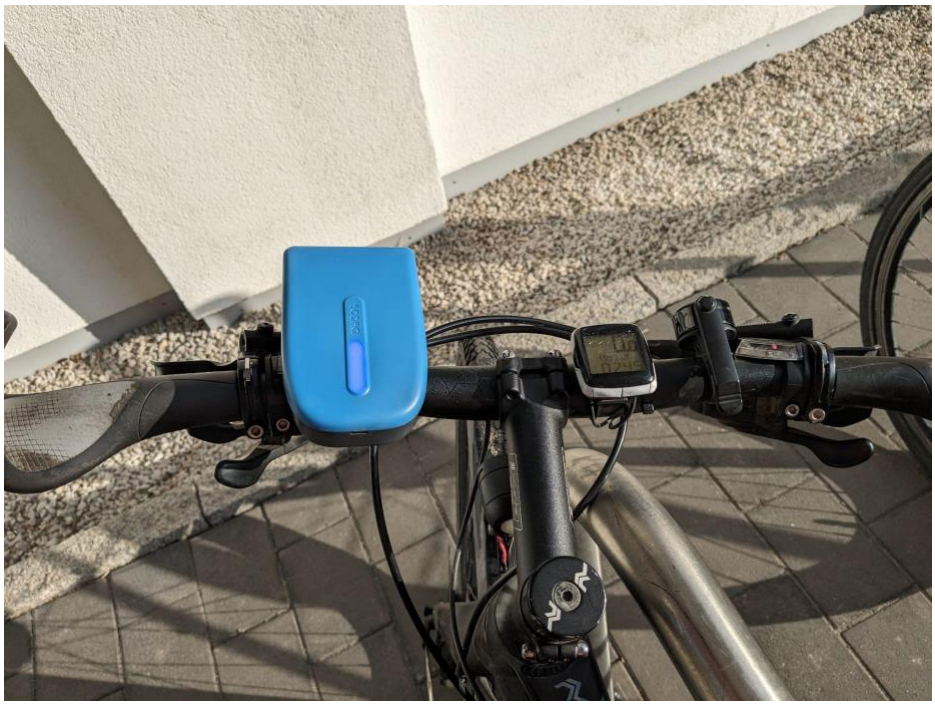


Figure 6: Photo of the SODAQ sensor on the bike of one participant

2.2.3 Networking and synergies

What was already mentioned in chapter 2.2.2 was that we worked with numerous actors in the open round to recruit participants for our citizen science project. For the static measurements, this means that in addition to our project work, we went to plenary sessions and network meetings in order to go beyond our measurements to understand what exactly is happening in the neighbourhood and to be informed. Through this cooperation, we have expanded our network for future projects. On the other hand, it is important to use synergies. We benefited greatly from the access to the neighbourhood provided by the other actors. It is

important to us to give something back by attending their events and presenting our results. In this way, synergy effects are used and their and our COMPAIR project achieve greater awareness, reach and leverage. This is exactly how it went with the mobile measurements. Thanks to the cooperation with bicycle initiatives, we have benefited from access to members and were happy to speak at events in order to report our results. This type of cooperation also allows us to provide professional feedback on our citizen science approach.
List of actors we have cooperated with:

- Changing Cities
- Allgemeiner Deutscher Fahrrad-Club (ADFC, eng. German National Cyclists' Association) Berlin
- Respect cyclists
- VCD
- Paper planes
- WZB
- Projekt Graefekiez

Figure 7: Podium discussion about the approach of Citizen Science in Berlin-Graefekiez, 31.08.2023

Since we were affiliated with the pilot project in Graefekiez for the static measurements, we organised a panel discussion to increase activities and participation in this neighbourhood. Five guests from scientific institutions and two citizen scientists from the static and mobile measurements from COMPAIR spoke on the podium on the topic of citizen science.

2.3. Flanders

2.3.1. Co-creation phase

The co-creation aspect in Flanders happened at two levels: the local Flemish cases and the integrated aspect of the experimental design of all COMPAIR pilots. In the former we focused on gathering feedback on our goals, experimental approach and recruitment strategy while we were still scoping those. The latter was a process when the goal of each pilot and the available resources had matured somewhat and focused on aligning internal stakeholders in a single integrated process resulting in a well defined experimental design for each pilot.

Local level
At the local level, we organised 2 stakeholder workshops aimed at co-creating our experiments in the 3 COMPAIR rounds. An initial workshop took place on February 3rd 2022 and aimed to:

- Determine the added value that COMPAIR could realise through static measurements, dynamic measurements and visualisations
- Elucidate the expectation of participants on the Flemish pilots
- Gather lessons learned and experiences from our stakeholders on topics related to our pilots

The workshop (setup: Zoom with parallel break-out sessions) started with a short introduction (goal, set-up and course), a general presentation of the COMPAIR project, presentations of the 3 Flemish pilots (documented with examples) and a round of questions. This was followed by an interactive part on a digital whiteboard (LucidSpark) with various breakout groups. Participants provided ideas for the pilot execution, prioritised them and explored the most valuable ideas in more detail. At the end, findings were summarised and grouped for the entire group of participants. Nineteen people participated representing 16 organisations from government (both local and regional), academia (research institutes) and society (citizen science, citizen groups).

On June 22nd 2023, we hosted a second workshop to test assumptions on dynamic air quality measurements and look into recruitment and lower SES involvement. Additionally we also gathered feedback on mockups of our dashboards and apps, but that is out of scope of this report.

The workshop (setup: Zoom with parallel break-out sessions) started with a short introduction (goal, set-up and course), a general presentation of the COMPAIR project, a short presentation on mobile citizen measurements, followed by a practical example on handling and presenting mobile air quality data from the Provincial Institute for Hygiene (PIH). This was again followed by breakout sessions on a digital whiteboard. One breakout focused on recruitment, LSES involvement and privacy, the other on measuring devices and motivational aspects. In preparation for the workshop, a short questionnaire (in google forms) was already sent to the participants. The output of this was added in advance as post-its, to have a base to start from during the actual workshop. At the end, findings were summarised and grouped for the entire group of participants. Seventeen people participated with a similar composition across organisations as the first workshop.

COMPAIR level

As mentioned, the co-creation phase at the COMPAIR level focused on co-creating detailed experimental designs with internal stakeholders. The aim here was to get to a comparable level of detail across pilots and make sure technical and pilot teams were aligned on mutual expectations for the open round.

To accomplish this we developed a new stakeholder interview process for drafting an experimental design. It provides a structured and comprehensive approach and draws from established methodologies, including the LIFE VAQUUMS air quality sensor roadmap and INTERREG Zuivere Lucht's citizen science guidelines. We converted the backbone of these methodologies into a semi-structured interview guide, the results of which can be summarised in a template for experimental design that COMPAIR also drafted. A more detailed overview of this process is described in the D5.4 Open Round report which will be published after the submission of this deliverable.

The approach emphasises understanding local challenges, assessing stakeholder needs, and mapping out feasible and effective experiments. It guides pilot projects in specifying what to measure, where, when, and for how long, while ensuring data collection aligns with research questions and goals. This comprehensive process helps ensure that the experimental designs are well-suited to the unique contexts of each pilot, fostering meaningful results and informed decision-making.

We applied this interview approach to all 5 COMPAIR pilots involving the local pilot team, a technical team representative and experienced air quality researcher (VMM) as internal stakeholders. The resulting experimental designs are also described in the D5.4 Open Round report that is going to be submitted at the end of October 2023. These designs helped in aligning technical and pilot teams, supported pilot teams in planning and provided a framework to assess the impact of changes and unforeseen events.

2.3.2. Co-design phase

The co-design phase builds on the COMPAIR level aspect of the co-creation phase. The technical team was involved as a stakeholder in these structured interviews. This section will describe how we further co-designed the implementation plans based on the experimental design coming out of the co-creation phase.

Specifically, we specified time slots during monthly pilot calls in which sensor requirements (numbers, properties, mounting, etc.) were discussed across pilots and matched to the technical team’s supply and development pipelines. The experimental designs allowed the consortium to assess the impact of mismatches between pilot requirements and supply & development. Specifically given the supply issues we faced during the open round, this allowed our pilots to swiftly adapt their planning based on the outcomes of the monthly discussions and updates. Additionally we asked pilot teams to draft implementation timelines based on the experimental design indicating key delivery moments and stakeholder interactions. This resulted in a detailed, manageable and amendable implementation plan for each pilot synced with the technical team.

2.3.3. Co-innovation phase

In this section, we will map pilot activities in Flanders to the 5 co-innovation pillars. The co-creation pillar is covered in the specific co-creation phase. Activities already described in the co-design phase will only be mentioned briefly in this section.

Collaboration
We have actively sought input of several stakeholders through the workshops described in the co-creation section of this report. The Flanders pilot in COMPAIR further represents a specific case as it is a region instead of a city and the participating partners are rather far from any local implementation or network. Therefore we actively cooperated with local authorities, intercommunal agencies and schools when setting up the local implementations in Herzele and Ghent for the open round.
During implementation we emphasised our openness to cooperation with participating citizens. This led to 2 local champions standing up, one focused on traffic measurements, the other on air quality. We are now looking into deepening this approach by actively seeking out local champions through the SOCIO-BEE[12]'s (an EU project with which COMPAIR is actively partnering with since the start of the project) questionnaire on the topic.

Coordination
Project coordination and convergence are described in the co-design section and occurred through monthly pilot calls. The Flemish pilot team organised bi-monthly update calls to check up on progress and discuss alignment of the project partner plans and expectations from the partners with whom we were cooperating. Specifically for the Herzele case - which was implemented furthest in the open round - we set up a weekly coordination call with the partners and stakeholders following up on the school street and citizen science implementation.

Convergence
Project coordination and convergence are described in the co-design section and occurred through monthly pilot calls. Alignment with local partners for the implementation was sought through ad hoc meetings discussing issues and changes as they arose. These meetings were fed and triggered based on the coordination calls at the project and Flemish pilot levels (cf. coordination).

Complementarity
Complementarity with project partners was achieved through the COMPAIR-level activities of the co-creation phase and the entire co-design phase. Complementarity also has a forward looking dimension with respect to project valorisation. To this end we have been liaising with other ongoing projects, programmes and initiatives in Flanders to assess interest in uptake, replication or other forms of valorisation of our project outputs. We are currently investigating the possibilities of incorporating the black carbon measurement technology, DEVA-app and DEV-D dashboard into the human biomonitoring programme in Flanders. This program is executed by a number of (health) research institutes. During our initial tasks a clear interest has been established and sources of added value have been identified such as linking to sound measurements amongst other things. Another forward looking complementarity option

[12] https://socio-bee.eu/

we are looking into is the valorisation of the PMD dashboard as a monitoring tool for local authorities to assess (1) the impact of local policy and (2) whether a gap still remains requiring additional local action. Such a tool is foreseen in the Together for Clean Air programme run at the Flemish level by VMM, which is aimed at activating local authorities in taking more local action in light of air quality.

2.4. Plovdiv

2.4.1. Co-creation workshops

The first project year was dedicated to co-creation and two workshops were organised to identify stakeholders and gather some feedback and suggestions on their needs. The first workshop (WS) was organised together with the other Bulgarian Pilot - Sofia. The municipality of Plovdiv sent invitations to some stakeholders in the city of Plovdiv and its representatives actively participated in the meeting. This first WS supported identification of the stakeholders. The project tools were presented and participants shared what can be helpful and what needs to be added. This was very useful and gave guidelines for future development of the digital project tools.

All identified stakeholders were invited to participate in the second WS at the end of June 2023 where the project activities and achievements were presented.
In the second year of the project, the Plovdiv pilot team mainly focused on the activities for the preparation and implementation of the Open Round. The Plovdiv pilot team works mainly with students (10 to 12 years old). The deputy mayor of Ecology and deputy mayor of Education signed the invitation to schools for participating in the project activities.The goals are to raise awareness of the impact of traffic on air pollution among students and their parents and raising awareness of the impact of traffic on air pollution and seasonal variation of PM10.
During the Open round three WS were organised:

- 1st workshop focused on the introduction of the Mobile Air Quality Monitoring Laboratory, presenting the COMPAIR project and assembling of the DIY(sensor.community) devices for PM measurement.

Figure 8: Photo from 1st workshop - introduction of the mobile air quality monitoring laboratory and COMPAIR project

Figure 9: Photo from the second workshop - PMD introduction and data gathering

- 2nd WS - introduction of the PMD and data from the measurements - the topic of air quality (AQ), different types of pollutants and possibilities for AQ measurements were introduced to the students. The D5.1 Guide to air quality monitoring[13] and D5.3 DIY Citizen Science Lab[14] were used for preparing the presentations.

Figure 10: Photo from the 3rd workshop

- 3rd WS - presentation of the results from measurements and connection between number of counted vehicles and NO2 and PM10 concentrations.

The Municipality of Plovdiv intends to introduce school streets. But parents are not particularly enthusiastic about this measure. Our team hopes that, having become familiar with the impact of traffic on air quality and prompted by their children, parents can themselves propose to the Plovdiv Municipality the introduction of such a measure.

[13] D5.1 Guide to Air Quality Monitoring - https://www.wecompair.eu/_files/ugd/725ca8_3f3569e8264345b6b6b2c7c4a345c96c.pdf
[14] D5.3 DIY Citizen Science Lab - not published yet

2.4.2. Engagement and awareness-raising activities

According to the original plan, two types of sensors were to be used - Telraam traffic count sensor and SODAQ Air PM sensor. Due to the connectivity issues all sensors based on LTE-M / NB-IoT network technology could not be used. The sensors worked, but due to a lack of an LTE-M / NB-IoT network could not transmit data to the dashboards. The students and volunteers were asked by the Plovdiv pilot team to test SODAQ Air devices in order to find connections somewhere in the city area. Unfortunately, in the city connection was not established.
For the experiments and to raise awareness of the impact of traffic on air pollution, a mobile station for measurement of the air quality was situated in the schoolyard. The pilot school is “Dimitar Talev” primary school with more than 800 students and they have an opportunity to visit the mobile laboratory.

The mobile laboratory was equipped with PM10 and PM2.5 dust samplers, NO/NO2/NOX Analyzer, and meteorological station. Also in one classroom one traffic sensor and one PM DIY sensor were installed.

The classroom is specialised for learning environmental science, physics, and chemistry and is attended by over 180 students during school hours. A teacher familiarised the children with the sensors, what they measure, and where they can see the results. The school principal and 2 teachers ensured the support during the period. In mid-June (before the end of the school year), our team organised a workshop and presented the results of the measurements.

The biggest newspaper for south Bulgaria published several articles, dedicated to the activities in the school. Several local on-line media published articles about the experiments.

The team of the Energy agency of Plovdiv organised meetings and training with volunteers.

Figure 11: Photos from meetings with volunteers

The municipality of Plovdiv implements measures for improvement of the air quality. In some cases the local authority introduces some restrictions/bans. The typical reaction of citizens is resistance to this decision. The Plovdiv pilot team hopes to change this situation. First, by including the children in the experiments, they have the opportunity to learn about the topic of air quality and the origin of the main pollutants. After participating in the experiments and seeing the relationship between traffic data and pollutant levels, they can do something themselves - for example, start moving more sustainably to and from school. We are planning to organise a working meeting together with students and parents, where we will show the

results. Once parents see what the results are, they can encourage and support sustainable mobility.

2.5. Sofia

2.5.1. Co-creation workshops

In the first year of the COMPAIR project, two co-creation workshops were organised with identified stakeholders from the quadruple helix where feedback and suggestions were discussed and paved the way to planning the pilot use cases. These two workshops also helped with the identification of potential partners and volunteers to participate in the Sofia pilot activities. The results from the first workshop that was conducted in February 2022 were used to identify the user stories that were later translated into user requirements and have been used by the technical team to plan the development activities. The second workshop that took place in June 2022 focused on feedback on the mock ups prepared by the COMPAIR technical team provided by local stakeholders that was later used by project partners in order to plan development activities for the second year of the project.

Figure 12: Photo from 2nd co-creation workshop

The second year of the COMPAIR project was mostly dedicated to planning the open round testing activities, detailing the use cases and identifying potential partners. As the Sofia team believes that behavioural change and environmental sustainability should be promoted from an early age special attention has been given to children when defining experimental design of the pilot activities. Thus, one of the groups the Sofia pilot works with are children, particularly students in elementary school, and different approaches were used to engage them during project activities in order to activate their creativity and raise awareness on the topic of air quality and sustainability. During the open testing round, the pilot team organised a few co-creation workshops with students from the 4th grade in order to familiarise them with the COMPAIR project. Moreover, the workshop activities included quizzes on air pollutants and measures to tackle air pollution were organised. In order to raise awareness of the local policies on air quality pollution, students were introduced with local measures the municipality is developing such as school buses and those of them who had already used the bus shared their experience and opinion.

Besides, students were asked in advance to draw pictures or write a poem based on their understanding of air quality and care for the environment. These techniques were used as a tool to inspire creativity and critical thinking in the students towards the air quality topic and also boost innovation ideas for their own solutions. The learnings and materials from two previous COMPAIR deliverables were also used in the preparation phase of the workshop, namely D5.1 Guide to air quality monitoring and D5.3 DIY Citizen Science Lab, which provided a thorough understanding of the topic of air quality with very valuable graphics and pictures and also a step-by-step guide to sensor assembly and usage.

Figure 13: Photo from workshop with students presenting their understanding of air quality

As a cross-promotion of projects related with air quality and sustainable mobility we get students inspired by the method used in the COMPAIR project for citizen science (CS), co-innovation and empowerment of young people by hearing their voice. Students from 3 schools participating in another EU-funded project for sustainable mobility in Schools (Shared Green Deal Sustainable Mobility Stream[15]) had the chance to see and interact with mobility sensors and to see the installation of a DIY sensor in the event hall where the workshop was held. This was used as an introduction to the topic of why they and their parents need to rethink their daily commuting habits and switch to more sustainable means of transportation going to and from school. It raised awareness that we need to take care of our health - both physical and psychological well-being that are quite dependent on air quality in the city.

2.5.2. Surveys gathering feedback

A survey was developed to gather feedback from students whose parents agreed to participate by using a mobile air quality sensor on their way to/from school together with an additional survey that was evaluating the satisfaction level of the users of the school bus service. Both surveys were included in the data factsheet that was later presented to the Sofia City Council which had to vote on the prolongation of the school bus service to the next school year. In the survey, parents said that they appreciate the impact of the school bus service on the decrease of air pollution and indicate this topic as one of the main benefits of the project. They admit that one of the reasons for using the bus for their kids is the opportunity to use eco-friendly transportation that is not so polluting. This is an indication for changing the mindset and starting to think not only about the problem, but also about the possible solutions and being empowered to change the environment around you.

[15] https://sharedgreendeal.eu/hubs/sofia-bulgaria

2.5.3. Engagement and awareness-raising activities

Figure 14: Photos from events where COMPAIR sensors were introduced and tested by volunteers

Due to connectivity issues and unavailability of data to organise data jams or other activities to analyse and promote CS data gathering during the open round testing that is described in more detail in D5.4 Open Round Report, Sofia team engaged in activities aimed at both awareness-raising and engagement. As there were some spots around the city where sensors were sending data, Sofia team was trying to find some innovative or at least working solutions of the connectivity issues and to search for areas where sensors are active. Thus the pilot team reached out to cycling communities and asked them to take mobile sensors around the city to check connectivity. During the summer months, seven SODAQ Air mobile sensors were distributed to cyclists that are commuting with bikes around the city of Sofia. This activity was initiated in order to promote the project and test the available technologies. Sofia team started engaging cyclists to use the mobile sensors that were available within the project and test their connectivity, data collection and usability by providing regular feedback. By doing this a certain level of awareness raising was also performed as being in contact with cyclist communities allowed the Sofia team to build relationships and promote air quality topics among people who are commuting sustainably and moreover to provide them with the opportunity to test available technologies that they can use in the future and become active citizen scientists.

Figure 15: Photo from participation at a biking event

Apart from reaching out to dedicated cyclists, the Sofia team made efforts to engage citizens that are not so active bikers by introducing the COMPAIR project and the sensors within the European Mobility Week activities. The main event where COMPAIR was presented was the Car Free Day on 22nd September 2023, when a biking tour was organised by Sofia Municipality and SODAQ Air mobile sensors were distributed to some of the participants, as well as a Telraam device was installed to test connectivity again. Moreover, leaflets about the school bus initiative were also distributed in an attempt to raise awareness and engage citizens.

2.5.4. Cross-collaboration with other projects

In order to seek collaboration outside the COMPAIR consortium, gather feedback and engage larger communities, Sofia pilot team engaged in a number of collaboration activities with other projects where COMPAIR was showcased. Convergence activities with other projects and stakeholders helped the team build a reputation of the COMPAIR project among local communities and also eased the communication with citizens. It also allowed room for establishing further collaborations on air quality topics.

During the final conference of the INNOAIR project, COMPAIR was presented with a stand together with other projects related to air quality, climate change and sustainability. The conference took place in May 2023 and the pilot team had the opportunity to collect contacts of potential volunteers to participate in the public testing round as a result.

As mentioned in the previous section of this report, in June 2023 the Sofia pilot team presented COMPAIR project and its sensors to the students from the three schools participating in the Horizon 2020 (H2020) Shared Green Deal[16] project as part of the Sustainable Mobility Stream of pilot initiatives. During the presentation the students had the opportunity to learn more about the sensors, get an overview of the air quality domain and also provide ideas on how the school bus service can be further improved and extended to other schools in the city of Sofia. Also the coordinators and the project leads of the Mobility Steam will have the chance to participate in a guided tour to one of the schools participating in COMPAIR project and see the installed sensors, and discuss with children what their motivation for sustainable daily commuting is.

3. Next steps - Co-innovation planning for the public testing round

This section provides a general overview of the approaches each pilot plans to be using during the public testing round to engage citizens and stakeholders and promote citizen science and data gathering through co-innovation activities. During the project lifetime so far and the open testing round in particular, pilots have used co-innovation practises mainly to engage citizens and raise awareness, while in the last year of the project more efforts will be put in activating policy makers and show-casing the power of citizen science data for policy making in the environmental domain. Again, as during the open testing round, co-innovation activities in the public testing round will be designed in such a way to follow the founding blocks and co-innovation pillars explained in Chapter 1 of the report.

3.1 Co-innovation approaches comparison

As explained in the previous section, all five pilots have used co-innovation activities to engage citizens and raise awareness among the communities each pilot is targeting. Even though similar approaches have been used, each pilot had to assess the effectiveness of the co-

[16] https://sharedgreendeal.eu/

innovation activities implemented and choose the ones that have been proven most effective. After analysing the effectiveness of approaches used during the open testing round, pilots will be focusing on co-innovation activities that have proven most-effective for their particular use case during the public testing round scheduled to start in November 2023.

From the experience gained during the open testing round, conclusions were drawn that are being used in the preparation of the experimental design for the public testing round. In Athens, for example, activities actively engaging elderly people have proven to be most effective, especially 1:1 feedback gathering, together with establishing synergies with other EU project teams working on similar topics. For Berlin, communicating with intermediary organisations, engaging in networking activities in order to get introduced to the local communities have been considered as very effective together with the distribution of leaflets and flyers at places that are of importance for the local community as a means of engagement. In Flanders, the game-changer in terms of engagement, building trust and gaining support was related with the activation of local champions who tremendously helped with the execution of co-creation and co-innovation activities implementation. For Plovdiv, what worked best was the partnership with the municipality and their support in engaging the participating schools and the opportunity to use the mobile air quality measuring station that raised the interest of the students on the air quality topic. In Sofia, the most effective co-innovation tool turned out to be the co-creation workshops with the students and using surveys to gather feedback from other stakeholders, also working with cyclists and identifying synergies and cooperation with other projects turned out to be a very successful tool for engagement and citizens' activation. Moreover, even considering the pilots similar to each other in terms of the goals set, every pilot had to adapt the co-creation and co-innovation activities towards the specific local situation and decide on which activity will have the most impact on achieving the project and pilot-specific goals.

Nevertheless, even different in their essence all the pilots have implemented the co-innovation founding blocks and leant on its pillars as those turned out to be fundamental for successful implementation of pilot activities.

3.2. Future steps and need for solutions

This section provides a brief overview of co-innovation approaches each pilot team plans to use during the public testing round in order to achieve project and pilot-specific goals. The co-innovation activities during the public testing round aim at scaling up the work from the open testing round and allow the opportunity for more people to participate in the project activities by also engaging policy makers and show-case how CS data can be used as a powerful and useful tool in policy making. Moreover, during the public testing round more sensors will be made available to pilot teams that will provide an opportunity to engage more volunteers and thus promote CS on a larger scale and generate more air quality and traffic data that will be accessible to both citizens and local authorities. Nevertheless, a major issue still remaining is the lack of IoT network connectivity in Bulgaria, but actions will be undertaken by both Plovdiv and Sofia pilots to find alternative solutions to generate air quality data and make it available on the COMPAIR dashboards.

Current planning of activities to be undertaken by pilots in an effort to boost collaborative innovation in terms of measurements, data analysis, policy-making support, promotion and usage of COMPAIR products and engagement are described below:

3.2.1. Mobile measurements

Athens

No mobile measurements have been planned for the Athens pilot and thus no co-innovation activities have been planned in this regard. Athens will be only focusing on static measurements in their pilot activities, as the main aim is to measure air pollution coming from domestic heating.

Berlin

As in the open round, we will again work with commuters on bicycles in the public round. We will increase the number of participants from currently 15 people to almost 50 people. The focus will be even stronger than in the open test round on commuter routes, which also cover outlying districts and areas in Berlin. The goal is for the modelled data on fine dust pollution to be checked by cyclists, because there are only a few sensors in Berlin and these are mainly in the city centre. So we want to cover as large an area as possible. The mobilisation will certainly work very well again because a) we have many participants in the current phase who would also like to measure in the public round and because b) we had very good responses in the first round. We are in close contact with cycling initiatives that share our call. The measurements will start in January 2024, so we will start preparing in October 2023.

Flanders

We'll start working with both primary and secondary school kids in the public round. They have been prepared during the open round by activities on traffic. We will expand this now with a project month on air quality later this year in the primary school for which we adopted the INTERREG JOAQUIN educational package[17] and added specific feedback and interaction moments in line with the approach we agreed with teachers over summer. The students will perform small experiments, do a guided tour of mobile measurements and use the SODAQ AIR devices on their bikes. At the end of the project month they will present their work in a creative poster session to build some of their related skills in line with the curriculum. The secondary school track is still under discussion with the teachers but students will co-design the experiments here, delve deeper into their school routes and other data they collect. A specific group will look into the workings of DIY devices and attempt at product improvement.

Related to that topic we will increase our co-creation efforts with our participants and aim at co-developing the bcMeter platform. This open source platform will benefit greatly from the hands-on experience of our participants, who will in turn get involved in a more international community and be able to contribute direct added value to this product. One specific goal we'll target with this platform is realising a mobile mode that allows us to use the bcMeter device in conjunction with the DEVA and DEV-D applications.

Plovdiv

[17] JOAQUIN Air Pollution Lesson Package - https://en.vmm.be/publications/joaquin-air-pollution-lesson-package

Unfortunately, there is no IoT network coverage on the territory of the city of Plovdiv. During the public testing round, we plan to distribute some SODAQ Air devices to the volunteers to try to find a connection somewhere in the city.

Sofia

Despite the lack of connectivity of the IoT networks in Bulgaria, Sofia pilot team will put efforts during the public testing round by continuously using the SODAQ Air mobile sensors to check if connectivity will appear and will be ready to roll out mobile sensors once connection is available. As in some of the areas of the city connection was present, Sofia team feels positive about gathering some data from SODAQ Air devices during the public testing round that can be used in datathons and workshops. One possible solution is also to rely on data from static PM sensors like Sensor.Community and also to exchange sensors with other pilots that they will not use - Athens will provide some sensor.community DIY sensors to Sofia and Plovdiv, while Sofia will send some SODAQ Air sensors to Athens.

3.2.2. Static measurements

Athens

The Athens pilot mainly includes static measurements and this will be continued also in the public round. The planning foresees to engage more end-users in the area covered in the open round that is Neos Kosmos by providing additional devices but also to extend the experiment in a second area of Kipseli. This approach aims to compare the PM concentrations, the air quality and generally the environmental conditions of the two areas that have different characteristics. The difference is in the smaller percentage of green areas and the urban context of Kipseli, while Neos Kosmos is an area greener and with a better socioeconomic profile of the citizens. The public round follows the approach of the open round and will be launched in the Friendship Club at the end of 2023 where the low SES group for Athens is active, that is senior citizens.

Berlin

In the public round we will work with Kiezblocks (neighbourhood blocks). We are currently in contact with the organisation Changing Cities, which coordinates this throughout Berlin. We shall work with them to discuss which neighbourhood block might be suitable for carrying out measurements with residents there. As the name suggests, a neighbourhood block is a block that is traffic-calmed and characterised by an engaged neighbourhood. Sometimes there are also green parklets or even unsealed areas. This small microsystem is very suitable for measuring what the air quality is like there. At the same time, we will look for a block in Berlin of approximately the same size in which there is no traffic calming and compare their measurements with each other.

In general, neighbourhood blocks are a very innovative form of driving forward the transport transition and are therefore very suitable for the pilot project.

Flanders

We'll continue working in Herzele, building on the base we have established there. Participants will be engaged in more activities than data collection, in particular we'll co-create a winter time experiment with the participants. This will put them in the lead to define goals, design the implementation and look into the data and draw conclusions. COMPAIR will advise them

throughout this process, provide a sounding board and add expertise at the request of participants.

Plovdiv

As a result of the promotion of the Public Round activities, another school in Plovdiv wanted to participate and activities like co-creation workshops, sensor installation and air quality training are being planned.

Sofia

In terms of engaging more citizens into gathering CS data and promoting CS activities, Sofia pilot team will be partnering with the AirBG Foundation which is the first network for sensor.community DIY sensors in Bulgaria. They are a pioneer in citizen science regarding air quality topics and have a well-developed network of volunteers and installed sensors. Most of the sensors were installed some years ago and need to be updated so partnership with COMPAIR is beneficial for both sides even in terms of cross-checking data from different versions of the sensor.community sensors. Moreover, the Sofia team is discussing the possibility to install static sensors in one of the community centres in the biggest Roma populated neighbourhood in Sofia in order to check levels of PM during winter months and educate the Roma community on the issue of air quality and pollution that comes from domestic heating. This will allow the team to involve more people from the LSES group and get a better understanding of their needs and objectives.

3.2.3. Use of COMPAIR Dashboards

Athens

The actions mentioned for the measurement of air quality through sensors will be coupled in the open round for Athens with the use of the CO2 Calculator. This tool is innovative in terms of providing a ground where city and national policies can be elaborated by citizens, analysed by policy makers and also other policies can be proposed by the citizens. So, it combines both a bottom-up approach through the citizens' suggestions but also the bottom-up through the evaluation of the proposed city solutions by the citizens and their intention to adopt them. During the evolution of the CO2 measurements of the Athens pilot, important outputs can be produced and the results could also be promoted after the end of the Athens pilot in a potential policy-dialogue event with city officials and citizens that were most active in the CO2 Calculator.

Berlin

Strong emphasis will be placed on implementing the PMD in the static measurement campaign during the public round. Its application in the open round was relatively limited (except for its use in the final workshop) because no data was available on the dashboard for long periods of time. This changes in the public round as the PMD will be presented in the first workshop with local residents to gather their feedback and make them aware of the practical use of the tool. By the same token, policymakers - especially those from the district offices - will be involved in a data jam with other citizens. The PMD will be proposed as an easy-to-use, practical tool whose functionalities can be seamlessly integrated into existing workflows of parks and recreation, street management and other similar agencies.

DEVA and DEV-D will be highly used during the mobile measurement campaign, too. The open round relied heavily on SODAQ's knowyourair.net platform[18], making sophisticated data analysis difficult. Participants in the public round will be presented the DEVA and DEV-D combination during a first workshop, emphasising the importance of utilising both apps for gaining more nuanced insights into collected air quality data. As in the open round, cyclists from all over Berlin will participate, especially in those areas with no official measuring stations, in order to identify hotspots and to help create more detailed exposure profiles.

Flanders

In the open round we presented the dashboards and dashboard based conclusions in a data café in Herzele. Students in the secondary school in Herzele familiarised themselves with the dashboard environment. During the public round we'll take this a couple of steps further and challenge participants to draw up their own conclusions based on the COMPAIR dashboards for traffic and air quality. Secondary school students will be challenged to delve into the data, look for particular events and report on potential causes and solutions. This ultimately allows them to formulate policy options and present these to the local policy makers. Citizens will be guided through this policy formulation process as well as part of their expanded role in our experiments (cf. static measurements).

The DEVA & DEV-D combination will be tested extensively in both Ghent and Herzele as about 100 students will start recording trips during various periods of the public round. Specifically, we would like to investigate the impact of school routes on their total exposure to determine whether this effect is as significant as the one observed for home-work commutes in preparatory studies.

Given we can link a high resolution air quality model to DEVA, we'll do classroom experiments with DEVA in Ghent and Herzele and work with citizens in Leuven to test these applications. Finally we are trying to match up with Leuven - one of the climate active cities - to implement CO2 dashboard footprint calculations and policy simulations as part of their activities. This would allow us to work on climate related behavioural change and public support for Leuven's climate mitigation actions.

Plovdiv

The Plovdiv team plans to organise several workshops dedicated to the implementation of the PMD during the Public round. Due to the connectivity issues limited data was available on the dashboard during the Open round. The PMD will be presented to the students from pilot schools and local stakeholders (local policymakers, active citizens. etc.). During the workshops will be presented some results and analyses from the Publick round.

The usage of DEV-D and DEVA is also limited due to the lack of IoT network and phone compatibility. We will continue to promote both tools for awareness-raising and improving the digital abilities of students and citizens to read graphs, compare values, etc.

Sofia

Once air quality data is readily available on the Policy Monitoring Dashboard (PMD), Sofia team plans to organise in partnership with the Data Science Society in Bulgaria a datathon

[18] https://www.knowyourair.net/

that will be focused on data analysis and policy implementation. Results from the datathon will be then presented to the Sofia City Council in an attempt to promote CS data and its relevance for policy monitoring and analysis.

In order to promote behavioural change towards more sustainable mobility, heating and energy consumption habits of citizens, Sofia team will be using the CO2 Calculator to motivate citizens to calculate their carbon footprint and get use of the recommendations. The results from the CO2 Calculator dashboard of users will be then presented to policy makers as a tool to assess the relevance and level of acceptance of certain policy measures that will positively affect the reduction of carbon footprint on city level.

Currently, some limitations in the usage of DEV-D and DEVA are envisaged by the Sofia pilot team due to the already mentioned issues with the IoT connectivity and phone compatibility. However, the Sofia team will be making efforts to get use of the two tools and promote them among the citizens of Sofia as a tool for awareness raising and motivator for behavioural change.

3.2.4. Engagement

Athens

During the public round it is foreseen to follow different approaches for the mobilisation of seniors in order to reach more participation, so actions in the relevant municipal medical centres will take place in the two districts of Kipseli and Neos Kosmos. The City of Athens operates municipal medical centres that provide first level medical support in each of its districts, hence these points of interest will be utilised.
Another target for the public round is to sensitise not only citizens but also the internal ecosystem of the municipality on air quality matters since the transition towards better air quality must be launched not only by residents but also the city itself. Under this context it is planned to contact the whole group of the city's human resources, so all municipal employees, in order to inform them and provide the opportunity of participation in COMPAIR as volunteers.

Finally, the City of Athens supports actions from citizens groups that are active in the city as associations, NGOs or other formats of collaboration. These groups include diverse types of volunteers such as urban architects, environmental groups, green associations volunteers, etc. and are collaborating with Athens under the Synathina[19] platform. DAEM aims to promote through the platform and to publish open calls for participation also for this target group that is already active in urban issues.

Berlin

The mobile measurement campaign in Berlin will continue as it has in the open round. By primarily contacting cycling associations, and working together with participants from the open round, the campaign will attract a large number of people. The key difference in the public round will be the reaching out to community centres that work closely with more disadvantaged groups. The second use case - focusing on comparing neighbourhood areas with and without mobility measures - will take a more targeted approach. The Berlin team will concretely seek out two types of areas, namely those with mobility measures that are also part of the

[19] https://www.synathina.gr/en/

neighbourhood management zone. The latter areas are designated neighbourhoods with residents who come from disadvantaged households, often with migrant backgrounds and of a lower socioeconomic status.

Flanders

We've seen the potential of local champions in the Herzele case during the open round. In the public round we'll keep actively seeking out more champions. Though we'll add a more structured approach here as well, exchanges with the SOCIO-BEE project have pointed us towards their questionnaire that we could use to identify local champions early on. If possible we would like to incorporate this approach in our workshop methodology. Lastly, we will work on community recognition of these champions and try to add some more value for them to maintain their motivation as they are putting in more effort for an extended period of time.

Plovdiv

In order to recruit more participants in the project and spread the result, we will rely on the cooperation with the local authorities and media. To date, a partnership has been established with the largest newspaper for Southern Bulgaria "Maritsa". Our team will continue the partnership with the municipality of Plovdiv, active citizens and the network of innovative schools. We plan to organize workshops to present the results of the air quality measurements. Based on the results, citizens will be able to propose solutions to improve air quality and hopefully want to change their habits.

Sofia

In order to engage more people in the COMPAIR activities for the public testing round and promote behavioural change to the wider population of Sofia, the Sofia pilot team plans to get in touch with local heroes within certain communities that will play the role of ambassadors. These people will be serving a coordinating role between the project team and local communities, especially the Roma population of Sofia, who are generally hard to reach groups and also have a very low level of trust towards organisations they do not know. These ambassadors will help with the convergence with this group and will be playing a leading role in co-innovation activities, helping with the communication and materials preparation activities.

The Sofia team also plans to introduce a comprehensive information campaign that will be spread out at the public transport in Sofia, where local popular influencers will be spreading positive messaging related to air quality, climate change and sustainability.

4. Conclusion

Co-Innovation Report 1 is the first of the two deliverables aiming to summarise the results achieved during the initial phase of T5.5 Co-Innovation for Capacity Building & New Service Creation. The deliverable focuses on describing how COMPAIR pilots implemented co-innovation practices in development of project activities up to the end of the second year of the project life-span. As the main goal of COMPAIR is to foster citizen science to become better accepted by policy makers as an effective tool used in creation of policies related to air quality and tackling climate change, co-innovation is sought in each part of COMPAIR's implementation.

During the first two years of the COMPAIR project, pilot teams put efforts to engage citizens and establish a strong community in each of the pilot locations that can and is willing to participate in the CS Labs that were created as part of the project so far. In the last year of the project, during the public round activities, pilots will be putting more effort to spread the knowledge and support for CS activities even further and seek for local champions and/or volunteers who would be willing to continue participating in CS Lab activities after the project's end.

In the report the main co-innovation activities used by the pilots are described, together with an explanation of the co-innovation methodological approach that was followed in their implementation during the closed and open testing rounds. Moreover, an overview of the activities planned for the upcoming public testing round is provided and will be used as a building block for the D5.7 Co-Innovation Report 2 due in August 2024 which will be summarising the results and outcomes of co-innovation activities during the public testing round.

Even though some of the pilot teams have struggled with data collection during the open testing round, this did not prevent the pilots from using innovative approaches to engage citizens and stakeholders and constantly receive feedback on COMPAIR product development. The effective communication both internally at project level and externally with stakeholders, experts and potential users has been and will continue to be an important element of all co-innovation activities implemented by the project team. The agile approach used in project management and product development also boosted creativity and complementarity among partners. Shared vision and goals helped to build trust at an early stage of the project implementation and helped to have better understanding within the project team but also allowed for the introduction of the project to external parties and like-minded partners who helped in COMPAIR products evaluation and promotion. Working closely together with the technical team helped to mitigate risks and find solutions to problems in a timely manner that did not affect project implementation dramatically.

The report describes the different approaches and methods the pilots used in order to promote citizen science and behavioural change in the mobility and domestic heating domain among the involved citizens and stakeholders. These co-innovation activities took different forms and types (e.g. educational and DIY workshops, extracurricular activities, meetings, etc.) but all were aiming at spreading knowledge about air quality and awareness on the main pollutants by also providing suggestions on behavioural changes that may positively affect the latter. The

activities the five COMPAIR pilots used to promote behavioural change are also explained as an effort to evaluate which co-innovation activities have proven to be most effective in each of the pilot locations and the results will be considered when planning the public testing round.

All the efforts related to the usage of co-innovation practices within the COMPAIR project are focused on provoking critical thinking by citizens on issues related to air quality, climate change and sustainable development by empowering them to gather data and become active participants in the analysis of the policies implemented by local governments on the one hand, and on the other, to change the attitude towards technologies and citizens' stake in developing policies and evaluating their effect by local governments.