COMPAIR

DELIVERABLE

D5.7 Co-Innovation Report 2

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1.0	13.09.2024	Desislava Todorova	SDA	Final version

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List of Abbreviations

Abbreviation	Definition
WP	Work Package
KPIs	Key Performance Indicators
DIY	Do It Yourself
CS	Citizen Science
EU	European Union
H2020	Horizon 2020
LSES	Lower Socio-Economic Status
PM	Particulate Matter
PMD	Policy Monitoring Dashboard
CO2 Calculator	Carbon Footprint Calculator
DEVA	Dynamic Exposure Visualisation Application
DEV-D	Dynamic Exposure Visualisation Dashboard
AQ	Air Quality

Executive Summary

This report continues the presentation and scaling up of the co-innovation activities undertaken by each COMPAIR pilot - Athens, Berlin, Flanders, Plovdiv and Sofia throughout the public testing round. It focuses on the methodology used in the planning, organisation and implementation of co-innovation activities. It reminds of the building blocks initially presented in D5.5 Co-innovation Report 1 as understood by the COMPAIR consortium in its effort to promote citizen science as an effective tool for policy creation, implementation and analysis. As mentioned in D5.5, Co-innovation has been 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 levels. The constant agile loops made by every pilot and in every phase of the pilot projects and the technical partners was a key approach for the success of the products developed by the COMPAIR consortium.

The report focuses on outlining the development and especially the final phases of these pilot projects and co-innovation initiatives like citizen engagement and involvement in citizen science, co-design activities for creating innovative technologies, measurement campaigns aiming to collect data using the COMPAIR-provided sensors, community building for creating innovative municipal services. It also summarises the types of concrete initiatives and workshops, ideations and measurements used as tools for policy creation, implementation and analysis.

All of the pilots outline again their driving force - the partnership approach involving the entire urban value chain in tackling air pollution, monitoring and analysing gathered data for solving identified local problems. It was possible to build upon what we had already achieved during the Open round quadruple helix community. Now, our focus was to continue and upgrade to the next strategic level to help local authorities progress in building carbon-neutral cities.

All the time, pilots were led by the project vision and common approaches woven into the whole communication and implementation of the COMPAIR activities. Starting with the ***collaboration*** as consortium partners - sharing knowledge resources already set goals. The fruits of this collaboration are the COMPAIR-developed digital tools, apps and services that will remain for the benefit of society. However, without the successful ***coordination*** of all the stakeholders involved, including all the aspects of collaboration and integration, it could have been difficult to achieve collaboration and co-innovation development goals. As the project progressed, this coordination became increasingly complex and more difficult, but it was also as important. Sometimes, when unexpected issues of any nature occur, it's easy to lose focus, and here comes the coordination with the consortium partners, the alignment with the common vision and pre-set goals, and finding another solution to meet the requirements.

The next level of achievement of the consortium, without which the innovation process would not have been possible, was the ***convergence*** in the COMPAIR project. The quadruple helix community of citizen scientists, experts and policymakers working together to co-create effective place-based solutions to reduce air pollution and to solve related urban challenges bore fruit in the form of:

- a municipal service of school buses and school street as implemented policy measures for lowering the traffic and air pollution around schools;

- activating senior citizens, students and cyclists in numerous mobile and static measurements conducted in various pilots to fill the data gaps in the official measuring stations;
- helping also in developing a local climate resilience plan;
- creating space for citizens to take part in innovations, STEM education in practice and ideations.

As a consortium, we were a mix of different partners that were working with different elements, tools and approaches, having different skills, weaknesses and strengths but looking at one vision to achieve synergy and ***complementarity*** in the project for the sake of the common goals. This synergy was achieved mainly at the end of the project initiatives and everything came to its place, and all the partners saw their ideas and the ideas of all the stakeholders coming into reality. Every small step gives more and more density and matter to all the ideas and recommendations given from the very beginning of the stakeholders' engagement process. They were all conducted in ***co-creation,*** and thus no one can be absolutely sure in what direction all these ideas will develop. But when we lead all the activities and approaches on a stable foundation of human-centric principles and sustainability, this synergy leads to, among other things, innovative digital solutions meeting almost all the pre-set technical requirements - PMD, DEVA, DEV-D, CO2 Calculator and Carbon Footprint Simulation Dashboard as well as a pilot school bus project in one of the pilot locations and a pilot school street in another.

In the following sections of this report, we will mention all the achievements of the technical and pilot location partners in the field of co-creation and co-innovation. The report will trace chronologically the initiatives following the Open round testing and will outline the upgrade in the approaches and types of events and activities performed. Every pilot will explain in detail what has been achieved using the pillars of co-innovation and co-creation. In the last section of this report, we would come into some insights and lessons learned in the final stage of the project.

1. Introduction

As we mentioned co-innovation is an integral part of the COMPAIR project. This deliverable is a natural continuation of the D5.5 Co-innovation Report 1 (written after the Open round in November 2023). Up to now, the project has explored many valuable directions, and we will focus on the co-innovation aspects of the partnerships that flourished during the public round.

Now, as the whole COMPAIR project is coming to an end, we can see with the distance of the three years the project lasted what was the driving mechanism of all the achievements. It has to summarise the activities performed, results and lessons learned during the final phase of T5.5 (ideathons, workshops, citizen science measurements). One of the aspects of this report is to investigate how the use of the conceptual framework of the five “co’s” of the co-innovation - collaboration, coordination, convergence, complementarity and co-creation, set in the D5.5 Co-innovation Report 1, was extended and put into practice during the Public round testing.

Based on the quadruple helix approach, the COMPAIR project aimed to include a multi-stakeholder model and to achieve the set goals, it should build on a stable foundation of common principles and a common vision.

Co-creation is a natural process when it comes to a group of people who have a cause and want to implement any change for the sake of their city and well-being. Community-driven initiatives and bottom-up approaches are crucial in this process. Change cannot be top-down. Societal change should be inclusive, putting people first. By involving citizens and all other key stakeholders directly in a coordinated and co-design process - everyone takes their responsibility and what should be their tribute and contribution. Thus, you create a deeper understanding of the problems as you look from different angles and a stronger commitment to such widely defined sustainable practices as reducing air pollution and turning cities into carbon-neutral areas.

And as we stressed in the D5.5 Co-innovation Report 1, “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.” In the age of technological innovation, this seems easier, but it can be questioned if it really is.

In any case, the co-created effective place-based solutions are the key to bottom-up innovation and this was the direction COMPAIR decided to choose. In this report, we will outline the further application of co-innovation in the project activities starting from November 2023 since the Public Round is running.

Starting with the types of co-innovation approaches, explaining how they are used by the consortium partners, how they support different aspects of the project activities, and later providing a comparative analysis of the co-innovation approaches used and recommendations for future steps and need for solutions.

1.1. Types of co-innovation approaches used

As we already defined in the D5.5 Co-Innovation Report 1, COMPAIR's understanding of co-innovation or open innovation is a collaborative process where different types of stakeholders work together to create new products (platforms) or services that offer mutual benefits to society and solve local problems. This process relies on common knowledge, expertise of the consortium partners (especially the technical ones) and the ideas gathered by citizen science means that are sought to find solutions to specific issues that public authority would like to tackle. That's exactly what we were aiming for and managed to complete developing the COMPAIR platforms like PMD, DEVA and DEV-D apps or the Carbon Footprint Simulation Dashboard.

So, first, a collaboration and co-innovation approach was used to ***develop these digital tools***. Second, the citizen science approach was also helpful in the process of further ***developing and improving the features of the sensors*** provided by consortium partners and other external partners. During the Public round testing, all of the COMPAIR-provided devices were tested and thanks to the feedback from the citizen scientists, most of them were further developed and improved in their performance and accuracy of measuring. This was a benefit from the co-innovation methodology for partners like SODAQ, Telraam and IMEC, and for the bcMeter devices, the benefit was an entirely new prototype and a new 3D housing. That was a very satisfying outcome of the project activities in collaboration with citizens. Thus, they feel pleased and proud to see the product improvements and the integration with the digital dashboards provided by COMPAIR was better implemented.

The **COMPAIR digital platforms** themselves were a tool for co-creation and collaboration between citizens and policymakers. For example the Carbon Footprint Simulation Dashboard or the PMD and the mobile apps can be used to help policymakers and city officials to make more informed policy decisions using the data gathered.

Third, collaborative innovation was performed ***on a municipal level***. It was used, for example, in the development of a pilot school bus service in Sofia and a pilot school street in Flanders, and also in building the first wood-burning incidence map for the municipality in Flanders. Combining different perspectives, expertise and resources, pilots generated innovative solutions and recommendations for the local authorities. At least they performed citizen science experiments & co-innovation activities and trained and supported officials in building their strategies and data collection used in policy making.

1.2. Co-innovation in COMPAIR - types of events and activities performed

As part of T5.5 Co-Innovation for Capacity Building & New Service Creation, there were several co-innovation approaches and activities aiming at including citizens in the pilot locations in policymaking activities by using the COMPAIR sensors and digital tools. Below a short explanation is provided of the different formats used by different pilots to boost co-innovation and promote citizen science and participation in policymaking.

The main types of events and activities were related to citizens' engagement using the tools where participants can gather to explore a social issue, to analyse and interpret data, to gain insights, or solve specific problems.

Co-creation workshops with stakeholders, experts, citizen scientists, etc., working collaboratively on defining the scope of an experiment, creating or analysing datasets to extract useful outcomes and insights, continued to be a reliable tool for innovative action during the Public round, as well as during the Open round testing. They were used by all the pilots in COMPAIR.

Other tools used by Flanders, Berlin and Athens pilots were in the form of **static and mobile measurement campaigns** to collect data for analysis. They were crucial for citizen science starting working as they were responsible for integrating real-time quantitative data in the COMPAIR-developed digital tools - Policy Monitoring Dashboard (PMD), DEVA and DEV-D apps.

Forms of **Data Cafes** and **Hackathons** centred around data analysis and its interpretation, were also fruitful for co-innovation and co-creation activities for Flanders and Athens. They were used to foster interactive engagement and to create innovation space, inviting participants to discuss the provided data, drive understanding and smart solutions.

Using again the power of citizens, other pilots like Sofia and Plovdiv implemented **ideathons** - a collaborative brainstorming event where participants come together to generate innovative ideas to solve specific problems or address particular challenges. It's a time-bound event or collaborative session focused on ideation rather than implementation.

The **awareness-raising campaigns** were a final phase of the co-creation process in Sofia, Plovdiv and Athens as they were means used to present the digital tools of COMPAIR to the public and the local authorities. They were tools for involving a broader audience in citizen science activities.

1.3. Co-innovation as a building block of COMPAIR and its relation to other project activities

As stated in D5.5 Co-innovation Report 1, the co-innovation process implemented by COMPAIR continued to ensure acceptance and build trust among project partners and external stakeholders also during the Public round.

2. Co-innovation as performed by pilots

Following the structure used already in the D5.5 Co-innovation Report 1, this chapter will be dedicated to presenting in detail the co-innovation approaches and activities of all the five pilot locations (Athens, Berlin, Flanders, Plovdiv and Sofia).

Involving stakeholders at an early stage and involving them in the process of design thinking gave the project partners an idea of their specific needs and expectations that, at a later stage, were implemented in the COMPAIR-developed products and services aiming to tackle the air quality issues and climate change mitigation. Working in an agile and adaptive way with constant feedback loops and iterations involving stakeholders in the next co-creation phases throughout the whole project was the core process of COMPAIR. The established citizen science labs of communities with active citizens make it possible to make it happen.

Every pilot used different tools for recruitment and then for involving the citizens in the process as most of the pilot cases were different despite some of the working fields being similar.

In the Public round pilots were more focused on the implementation of the co-innovated already products and processes, their testing and improvement. This process again included various workshops, feedback iterations conducted using surveys, and more direct forms of feedback to make sure that every point of view was taken into consideration.

The overall assessment provided in the D5.6_Public Round Report is that the COMPAIR pilots managed to organise around 25 workshops as well as local recruitment campaigns, school lessons, ideathons and other engagement events. Through these efforts, we managed to reach about 600 citizens directly, with at least an additional 3,000 through indirect forms of engagement. Based on available statistics and proxies, we estimate the share of participants with a lower socio-economic status to be around 20% in total; the proportion varies greatly between the five pilots, from 5% to around 95%.

In the following five subsections, each pilot is presenting its co-innovation activities that took place during the Public round testing of the COMPAIR project.

2.1. Athens

2.1.1. Co-creation

The Athens pilot activities are based on co-creation and co-design methodology.
Regarding the activities, including the sensor distribution to volunteers during the Public round, a co-creation approach was followed. Initially, meetings and discussions were held with city officials due to new mayorship and the administrative personnel of Friendship Clubs of the second selected area, that of Kipseli. In collaboration with them, volunteers were identified that tackled the criteria for participation in the pilot and receipt of sensors. Also, the process for the engagement of senior citizens was decided. The process in brief includes the path as follows:

- Meetings with a group of citizens to be informed on the objectives of the pilot implementation and their role and contribution. Benefits for the citizens are also provided
- Recruitment process

- Distribution of sensors
- Training sessions on sensors' functionalities and operation
- Follow-up visits and face-to-face meetings for engagement and any troubleshooting

Figure 1: Preparation of the workshop in Friendship Club Kipseli

By the end of this Round, final workshops are scheduled with the members of the Friendship Clubs of the two areas and their administration to present the outcomes of sensor measurements. These outcomes could be used by the city authorities to enhance environmental strategies, develop concrete future policies on climate mitigation and empower citizens' active engagement. These strategies under development are reported in more detail in the sections below.

Figure 2: End-users from the Friendship Club Kipseli assembling the SODAQ sensors

The general feedback is very positive since the interest of the seniors and volunteers in learning more is high, and they are motivated to contribute to measuring pollution. Although the targeted group for the Athens pilot is senior citizens (people over 65 years old), their interest in activities that involve more technical tasks and innovative solutions is indeed very remarkable. Elderly people are a citizen community eager to learn day by day and sensitive to environmental issues.

Figure 3: Installation of SODAQ sensor and NO2 sensors in the Friendship Club Neos Kosmos

For the CO2 dashboard, the methodology followed is that of an online campaign. In the first place, the communication was launched through MailChimp campaigns in a database of contacts that are all employees of the Municipality of Athens including more than 5000 individuals and a percentage of which are also residents of Athens. Of course, a diffusion campaign for the use of a tool resides in the volunteer intention of each contact, hence contacts are invited to sign in with their email accounts in the PMD and are directed to use the CO2 calculator.

Moreover, a series of online campaigns were organised focusing on a diverse set of target groups for the calculation of households' CO2 footprint in Athens and followed the quadruple helix:

- Citizens, NGOs, active groups
- Industry, companies, private sector
- academia and research
- public authorities.

This process is still ongoing, and it is also planned to organise a public campaign in online media and newspapers that will be active during September 2024. The campaign is planned to include a presence in 3 major news media of Greece as a banner that will redirect citizens of Athens to the PMD and CO2 calculator. Also, presence on the municipal radio Athens 9.84 is foreseen.

2.1.2. Synergies

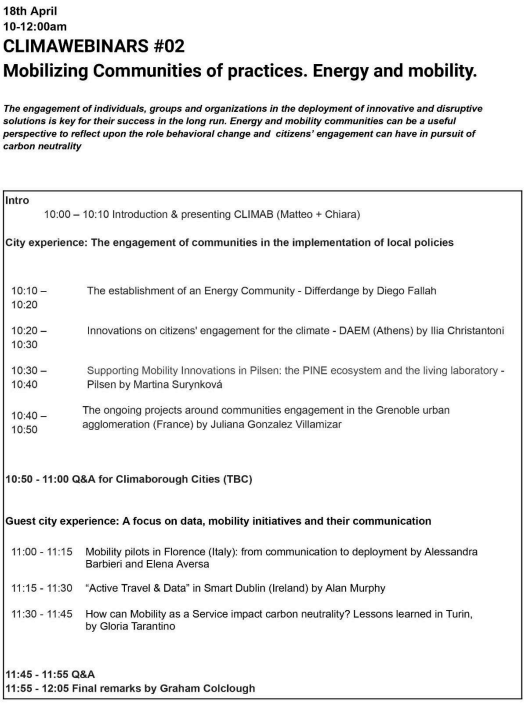
The Athens pilot in COMPAIR coincides with initiatives and projects launched by DAEM and Athens on the topic of the environment. More specifically, DAEM participates in CLIMABOROUGH project[1] focusing on bridging the gap between the design and implementation of urban innovations, particularly in the face of climatic change and its consequential needs for adaptation and mitigation. Athens has identified the environmental challenges and focused the recent years on the creation of a greener city enhancing the indicator of quality of life as a crucial urban target since the need for a cultural change to understand, support, and promote its green environment is primordial. Under this synergy, DAEM participated in a common event with CLIMABOROUGH.

[1] https://climaborough.eu/the-project/

Figure 4: Common event of COMPAIR, CLIMABOROUGH and CODE project in Innovathens

In this context, DAEM participated in the webinar “Mobilizing Communities of Practises” on 18 April 2024 which was in a series of webinars organised by CLIMABOROUGH under the thematic “Fostering the collaboration between cities and citizens”[2]. COMPAIR project was presented highlighting that the active engagement of citizens to tackle environmental challenges is crucial. The objectives of the Athens pilot were presented, mainly the important contribution of citizens on the improvement of climate in their city and consequently in the Quality of everyday life.

[2] https://climaborough.eu/climawebinars/



18th April
10-12:00am
CLIMAWEBINARS #02
Mobilizing Communities of practices. Energy and mobility.

The engagement of individuals, groups and organizations in the deployment of innovative and disruptive solutions is key for their success in the long run. Energy and mobility communities can be a useful perspective to reflect upon the role behavioral change and citizens' engagement can have in pursuit of carbon neutrality

Intro
10:00 – 10:10 Introduction & presenting CLIMAB (Matteo + Chiara)

City experience: The engagement of communities in the implementation of local policies

10:10 – 10:20	The establishment of an Energy Community - Differdange by Diego Fallah
10:20 – 10:30	Innovations on citizens' engagement for the climate - DAEM (Athens) by Ilia Christantoni
10:30 – 10:40	Supporting Mobility Innovations in Pilsen: the PINE ecosystem and the living laboratory - Pilsen by Martina Surynková
10:40 – 10:50	The ongoing projects around communities engagement in the Grenoble urban agglomeration (France) by Juliana Gonzalez Villamizar

10:50 - 11:00 Q&A for Climaborough Cities (TBC)

Guest city experience: A focus on data, mobility initiatives and their communication

11:00 - 11:15	Mobility pilots in Florence (Italy): from communication to deployment by Alessandra Barbieri and Elena Aversa
11:15 - 11:30	"Active Travel & Data" in Smart Dublin (Ireland) by Alan Murphy
11:30 - 11:45	How can Mobility as a Service impact carbon neutrality? Lessons learned in Turin, by Gloria Tarantino

11:45 - 11:55 Q&A
11:55 - 12:05 Final remarks by Graham Colclough

Figure 5: CLIMABOROUGH webinar agenda.

2.1.3. Hackathons

The first Hackathon "Apps4Athens" focusing on the digital transformation of Athens was organised on 30 & 31 March 2024 by DAEM and the Municipality of Athens with the participation of citizens. This initiative was a dynamic meeting and innovation space, inviting participants to create smart solutions that will contribute to the development of cities and the necessary skills to face challenges through technology. In the 2-days event the data gathered by citizens through COMPAIR - among other initiatives of the city - were shared as an inspiration to develop Apps and services. The participants had the opportunity to develop and present proposals and applications that will strengthen the digital presence of Athens, solving problems and improving the quality of life of citizens with innovative solutions. For the groups awarded, a monetary prize was provided, as well as possibilities for the development of the applications in cooperation with the Municipality of Athens and other municipal bodies. Moreover, for all the participants, even if not awarded, opportunities for cooperation both with the Municipality and with other bodies and agencies are foreseen.

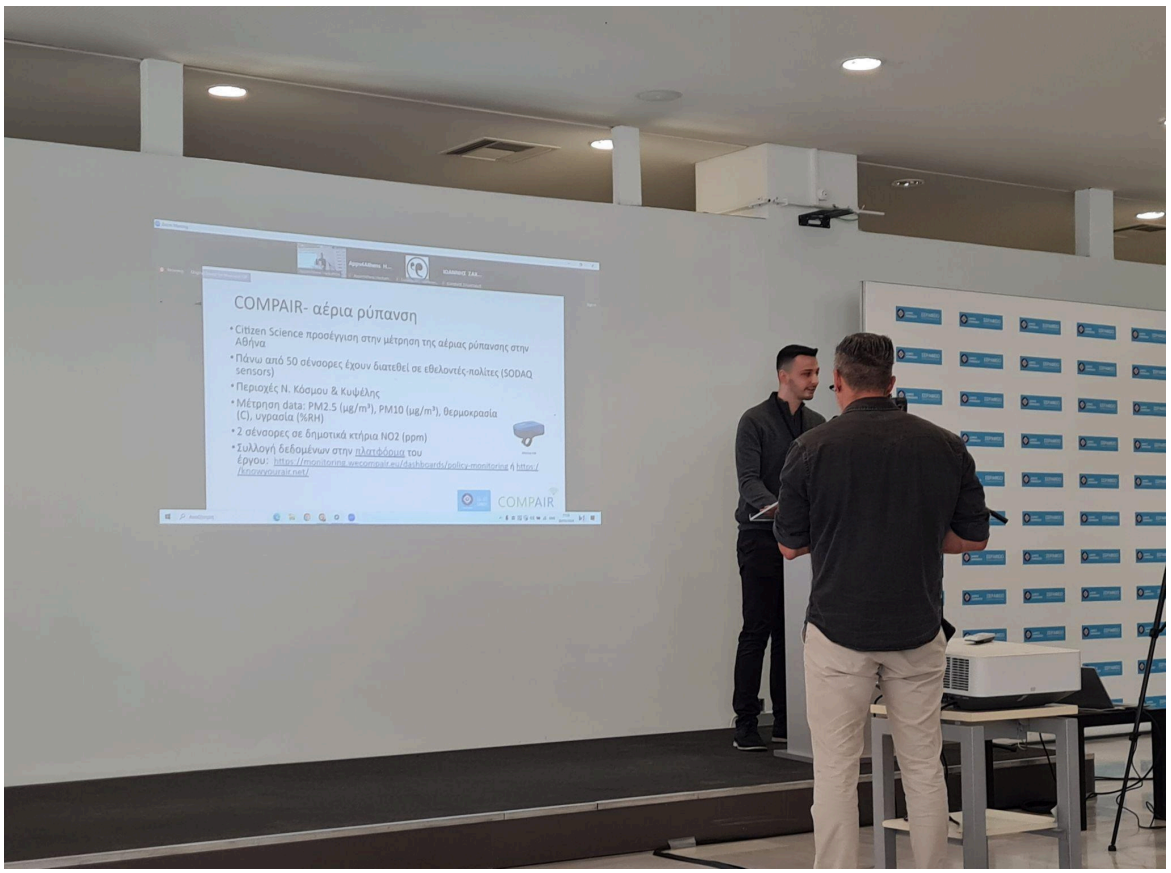


Figure 6: COMPAIR project in Apps4Athens Hackathon

Figure 7: Winners of the Apps4Athens Hackathon

2.1.4. C40 network

Following up on the activities of the project, DAEM has established a liaison with the project C40 "Global Green New Deal - Europe" which aims to support European cities to exchange practices, network and take up activities to tackle the energy crisis. For that purpose, DAEM collaborated with the initiative of the C40 for Athens that is executed by the Hellenic Passive House Institute. The latter is exploiting the experience in citizen science and the fieldwork of DAEM in the COMPAIR project in the Friendship Clubs with elderly citizens, to build up on their activities that aim to raise awareness and perform a methodology for energy efficient buildings and nearly zero emission buildings that will contribute at minimum levels to air pollution.

2.1.5. Climate neutrality

In terms of policymaking in the field of air quality, the city is currently structuring the Neutral Zero Cities plan where air pollution is one of the major challenges to be addressed. According to the data for the emissions in the city, the measures that are designed refer mainly to the transport infrastructures, the shift to non-motorized transport and the replacement of transport vehicles with electric. A long-term benefit is identified: the reduction of air pollution and the improvement of public health.

Also, structural changes are designed for the general accessibility and mobility in the city for pedestrians and bikers. The targets are initially to expand the network of cycle roads and enlargement of pavements and pedestrian routes.

In parallel focus on green infrastructure is planned for Athens in terms of trees and green spaces. More specifically it is planned to increase the number of trees and to establish a more efficient management of green spaces. This aims to reduce summer temperatures, enhance shady areas in Athens and improve air quality.

2.1.6. Climate adaptation

Also, the city’s climate adaptation plan is expanded to include more objectives for example: the reduction of high temperatures in the city and the urban heat island effect, protection of public health and support to vulnerable populations, improvement of air quality, data-based decision making and policies, informing, educating and raising citizens' awareness of climate change, etc.

2.1.7. Energy Poverty Alleviation Office

The city of Athens has recently launched the "Energy Poverty Alleviation Office" as a support centre for the energy-vulnerable residents of the city. The Office aims to contribute to the identification of energy-vulnerable households, evaluate the households’ energy consumption and provide appropriate advice, interventions and funding tools. DAEM is closely collaborating with the Office under the knowledge gained by COMPAIR to support the citizens of the municipality in changing energy behaviour, identify energy-vulnerable

households and propose interventions to the houses' footprint and increase participation of citizens.

2.2. Berlin

2.2.1 Co-creation

The pilot activities in Berlin are based on a co-creation process. Over the last three years, several workshops have been held during the various participation phases to evaluate the COMPAIR tools in a co-creative manner together with the Citizen scientists as well as experts. The workshops aimed to look over the dashboards, Apps and measurement devices of SODAQ, Telraam and BCmeter, evaluate them, check their functionality and give feedback on where there is still room for improvement. The participants were mainly the selected Citizen Scientists, with some developers also taking part. This helped to answer the citizen scientists' questions directly and to bring the feedback directly to the developers. One example is the DEV-D app, which recorded participants' commuting routes by bike. Initially, the first version consumed so much battery that many of the participants' mobile phones were unable to record their routes. It was also not very user-friendly and the menu navigation was complicated and involved many clicks. The participants gave the two developers helpful feedback on the first version of the app, which was quickly incorporated. The new version worked much more smoothly and could be used by more participants. This is a great example of how a collaborative process between citizens and scientists can work with technical devices.

2.2.2 Start of engagement and awareness-raising

The engagement to this point relates to the closed, open and public testing rounds. The findings on the co-creative process from the closed and open rounds can be found in the Co-Innovation Report 5.5. Recalling this, in the closed round the Berlin COMPAIR team tested the first sensors (Telraam, SODAQ and the static fine dust sensor) themselves together with acquaintances. In the open round, we tested the devices together with Citizens in a static (Graefekiez) and mobile (on bikes) measurement campaign, following a classical Citizen Science approach. In both phases, we were able to co-creatively gather constructive and helpful insights into the measuring devices and further technical tools. These also served as an important basis for the public round.

We started the public round with the learning experiences from the two previous phases on research design, how best to mobilise participants and how to communicate with them. As in the open round, we also wanted to carry out a static and mobile measurement campaign in the public round.

This time, in the **static measurement campaign**, we wanted to compare a neighbourhood that had already been traffic-calmed by five diagonal barriers - a so-called "Kiezblock" - in the north of Berlin (Bellermannkiez) with two infrastructurally similar neighbourhoods in the south of Berlin (Donau/Flughafenkiez), but without traffic calming. The aim was to identify

the effects of traffic calming measures on air quality and traffic flow. As in the open round, the recruitment of participants was again difficult. Through intensive flyering in both neighbourhoods, presenting the project at a neighbourhood event and in the local newspaper, sending newsletters and through direct conversations in the neighbourhood, we managed to recruit 19 participants in total (12 from Bellermannkiez and 7 from Donau/Flughafenkiez). These 19 participants were split between Telraam, particulate matter, and black carbon sensors; some participants even had multiple sensors. In an introductory workshop (February 12), we explained the sensors and raised awareness about air quality and traffic in Berlin. As some participants dropped out during the measurement campaign, particularly in the southern Donau/Flughafenkiez neighbourhoods, and the number and positioning of the measuring devices in the comparison neighbourhoods were too different, we ultimately decided not to compare the data obtained from the two neighbourhoods with each other, but rather to place it in relation to the surrounding official measuring stations. This change in objective and evaluation disappointed some participants and we tried to motivate them by talking about the added value of Citizen Science in general. In an intermediate workshop (April 22) about the first results - together with the participants of the mobile campaign - a lively, interesting and motivating atmosphere was created, in which the participants in both measurement campaigns were able to learn a lot from each other. The final measurement results of the static and mobile measurement campaign (e.g. the correlation between traffic and particulate matter, exposure profiles) were also presented and discussed at a large closing event (June 10) with a panel discussion and a reflection section on how the participation process went. In preparation for the interim workshop and the final event, the participants helped us to interpret the results by sharing their experiences, following a co-innovation approach: Only with the help of the participants were we able to interpret certain peaks, e.g. due to a BBQ in the garden or by passing by with the bike, which would not have been possible without the practical expertise. The participants also tested the measuring devices intensively and were able to give us constructive feedback on how the measuring devices and the apps and websites to be used could be improved. In the spirit of a co-innovation and creation participation process, suggestions for changes to the ongoing survey could still be implemented.

Figure 8: Introductory workshop for the static measurement campaign

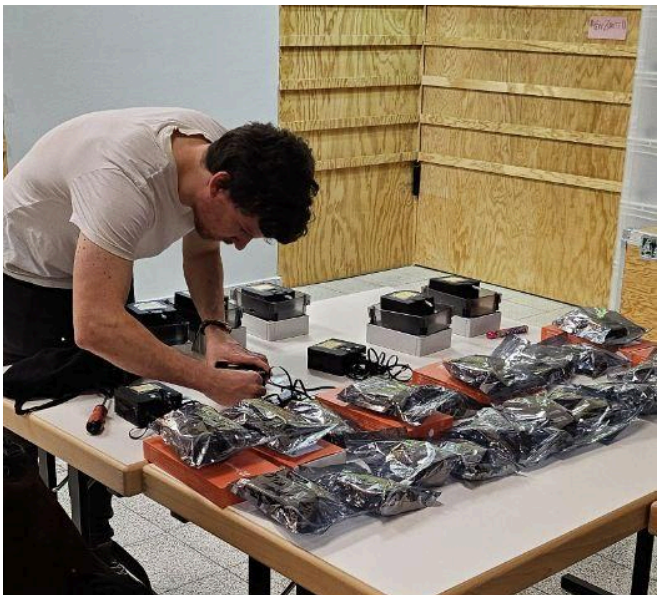


Figure 9: Distribution of the measurement devices at the introductory workshop for the static measurement campaign.

As already done in the open round, for the **mobile measurement campaign** we and cyclists worked together to gain insights into fine dust pollution. The goal for the cyclists was to measure their daily commutes and find out how congested their routes were. As our project team has good contacts with mobility and cycling initiatives in Berlin, the mobilisation went very well. With the help of flyers, Instagram tiles and a newsletter of these initiatives, we were able to submit a request to these actors to participate in the mobile measurements. The response was enormous. Within a week, over 90 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 is politically and socially relevant and therefore generates a lot of resonance. Some of the participants have already taken part in the open round. Out of 56 people, 45 stayed until the end of the measurement campaign which was a great success. As with the static measurements, the introductory workshop (February 1) was about raising awareness of the topic of traffic and air quality, introducing the topic in a playful way by testing the sensors and also providing information about the citizen science approach.

For more information about the interim and final events, please see the section of the static measurement campaign above.

Figure 10: Final event of the static and mobile measurement campaign

Figure 11: Panel discussion of the final event of both campaigns with representatives from administration and civil society from the areas of mobility and citizen science

2.2.3 Networking and synergies

As described in Co-Innovation Report 5.5 of the open round and in section 2.2.2 of this report, we worked with numerous actors from the fields of mobility, citizen science and neighbourhoods to recruit participants. For the static measurement campaign, this means that we again contacted local residents and neighbourhood initiatives in the neighbourhoods. We also visited a neighbourhood plenum in the Bellermannkiez to present our project, network and engage in dialogue. In the mobile measurement campaign, we once again cooperated with mobility initiatives, in particular the Changing Cities initiative. The cooperation had intensified since the open round so the PR officer from the association also spoke as a panelist at our closing event. We also presented the project results with a focus on neighbourhood blocks to a nationwide network of Changing Cities and have become part of an advisory group on neighbourhood block standards. Other collaborations from the Graefekiez established in the open round were also continued. Beyond our measurement period in the Graefekiez (open round), meetings continue to take place with the initiatives that were active there. This resulted in the opportunity to present our project results at a large follow-up event at one of the cooperation partners. As a group, we also organised a workshop on transformative and participatory research, which will result in a paper, as well as the presentation of the project results at a conference.

These collaborations enable a) a constructive learning space for our measurement results and the citizen science approach from COMPAIR, because we exchange ideas with many other experts and b) the project results from COMPAIR are more strongly integrated into the broader public.

List of actors we have cooperated with:

- Changing Cities
- Allgemeiner Deutscher Fahrrad-Club (ADFC, eng. German National Cyclists' Association) Berlin
- Wissenschaftszentrum Berlin für Sozialforschung (WZB, eng. Berlin Social Science Center)
- Deutsches Zentrum für Luft- und Raumfahrt (DLR, eng. German Aerospace Center)
- Forschungsinstitut für Nachhaltigkeit Helmholtz-Zentrum Potsdam (RIFS, eng. Research Institute for Sustainability Helmholtz Centre Potsdam)

2.3. Flanders

This chapter describes activities in Flanders that contributed to co-creation, co-design and co-innovation during the Public round of the COMPAIR project. Please note that activities before the Public Round have been reported in D5.5 Co-Innovation Report 1 and are only summarised briefly in this chapter to provide some context.

D5.5 Co-Innovation Report 1 mentioned 3 distinct stages named co-creation, co-design and co-innovation. During the Public Round of the COMPAIR project, most activities took place as part of the co-innovation phase which focused on involving external parties (e.g. citizens, municipalities, schools, etc.).

2.3.1. Co-innovation in schools

As mentioned in the D5.5 Co-Innovation Report 1, we conducted experiments in both a primary and secondary school in Flanders. Apart from co-innovation, the experiment in the secondary school also covers co-design aspects.

Figure 12: Classroom session on data analysis in primary school - what could be the cause of the differences in concentrations on the slide?

The approach in the secondary school consisted of several lessons as part of a class called “project work” which allows students to design and execute experiments incorporating STEM skills they learned across other classes. A weekly one-hour session is organised at school and one hour of off-school work is presumed as well. During an 8-week period, the following steps were followed:

- Lesson on air quality prepared by their teacher using COMPAIR’s D5.1 and Q&A with a COMPAIR air quality expert

- COMPAIR presented various types of projects that can be performed on air quality and explained the tools and sensors provided. The types of projects proposed to the students were:
    - Build your own air quality sensor - focused on the technical aspects of air quality measurements, benchmarking devices, etc.
    - Source apportionment - evaluation of potential PM sources, typical source characteristics, etc.
    - Pollution mapping - mapping the occurrence of a specific source throughout an area of choice
    - Clean air routes - investigating pollution levels along popular routes e.g. cyclists
- Students used the next 5 weeks to design and execute the experiment of the type chosen by their group. Weekly Q&A with COMPAIR experts was foreseen to troubleshoot and a follow-up
- In the final week, students presented their experiments and insights to the class and COMPAIR experts.

The students were able to co-design experiments to test COMPAIR's tools and sensors and provide suggestions and feedback to co-innovate and improve our offering further. The Public Round Report contains more details on the experimentation.

Figure 12: Students installing the DEVA app on their smartphone during the introductory lesson

In the primary school, a more straightforward approach was applied as the participants were obviously younger. A project month on air quality was organised in 5th grade following the LEARN-DO-REFLECT approach in which the first week worked on knowledge building, followed by two weeks of educational experiments and a final week reflecting on what was learned. Teachers used a ready-made educational package to familiarise students with the

topic and what aspects of daily routine and habits are relevant in this context. During the experimentation phase teachers and students checked air quality results using COMPAIR tools every morning and filled a logbook of observations. COMPAIR experts also hosted a walk through the city with the students highlighting several sources and discussing observations with students. Finally, students created poster presentations outlining their learnings from the previous weeks to further cement their awareness.

Figure 14: City excursion with mobile PM sensors

Both co-innovation tracks in schools confirmed:

- The usability and desirability of the educational material, sensors and tools, both schools applied for follow-up projects after COMPAIR
- Experimentation is a great way to get a discussion going and embedding the learn-do-reflect approach aligns well with typical classroom ways of working
- This kind of awareness-raising can lead to behavioural change (secondary school)

Both co-innovation tracks helped improve DEVA/DEV-D applications.

2.3.2. Co-creation and co-innovation with citizen scientists

During the Public Round, our main co-innovation activities with individual citizen scientists centred on the further development of bcMeter with volunteers in Herzele. This interaction also covers aspects of the co-creation phase where a new case for the bcMeter was developed by local technical champions.

Participants already worked with the bcMeter device during the Open Round of COMPAIR. Based on their findings a list of key improvements was defined at the beginning of the Public Round entailing the following aspects:

- User-friendliness
    - Display and/or status-LEDs
    - E-mail notifications
    - Actual buttons/switches
    - Toolless filter replacement (although the current version should allow for 4-6 weeks)
- Technique
    - Temperature correction
    - Airflow and humidity sensor
- Reliability
    - Fixing components
    - Waterproof housing solution
    - Proper data backup, handling network loss and communication to data manager (incl. onboarding)
- Applicability
    - GPS
    - Battery and/or solar panel

Figure 15: Participant workshop in bcMeter results in Herzele

VMM contracted bcMeter development and the new prototype was presented to the participants in March 2024. Participants were pleased to see their findings resulted in

product improvements. During a brief workshop, the participants chose their preferred experimental setup for testing the improved bcMeters in the ensuing months. The experiments surfaced new opportunities for product improvement and explicitly asking participants to experiment resulted in one participant 3D printing a new housing for the bcMeter alleviating issues with overheating and solar irradiation.

COMPAIR experts are now benchmarking all devices again to improve aspects indicated as troublesome during this co-innovation phase and further improve the product status over the summer.

2.3.3. Co-innovation with local municipalities

In Flanders COMPAIR also co-innovated at the level of a municipality through interaction with the local environmental council. Experiments during the Open Round of COMPAIR have shown that the SODAQ AIR devices performed well in picking up elevated pollution levels caused by wood burning. An experiment was proposed to the environmental council in Hove and interaction with participants was limited to key moments: pick-up and return of devices, and final discussion of results. However, the pick-up and return moments were used to discuss practical aspects and expectations from participants. This allowed COMPAIR to further tweak our data cleaning and analysis algorithms and build the first wood-burning incidence map for this municipality.

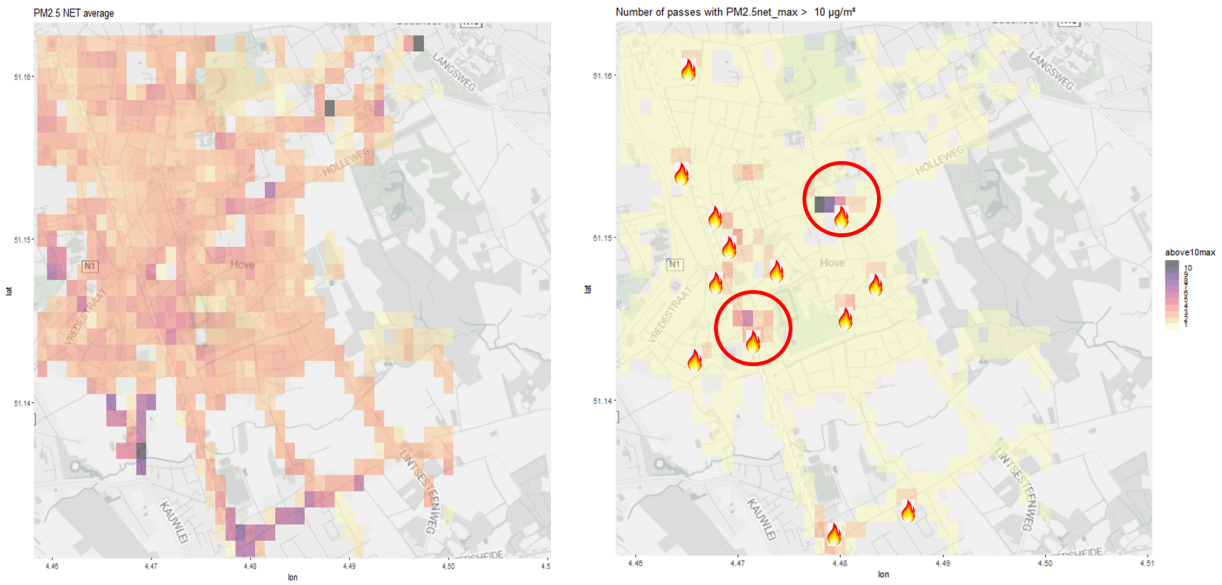


Figure 16: (left) Average net local PM2.5 contribution from mobile measurements, (right) Processed data of passes with a net contribution >10 µg/m³, independently reported wood burning odour by citizen scientists indicated with flame icon, 2 major hot spots identified in the red circle.

2.4. Plovdiv

All of the activities in the Plovdiv pilot follow the principles of co-creation and co-innovation. The EAP team followed the approach from the Open round. The main goals were to show the connection between traffic intensity and levels of PM and NO2 around the schools, to raise awareness of the impact of traffic on air pollution, and seasonal variation of PM10 and to find a way for improvements. The students and volunteers were involved in air quality and traffic measurements, workshops and ideathons.

Due to the connectivity issues, all sensor devices that were based on LTE-M / NB-IoT network technology could not be used in Plovdiv. The EAP team together with volunteers (students and citizens) conducted a lot of tests. The devices worked, but due to a lack of an LTE-M / NB-IoT network, they could not transmit data to the project dashboards. Unfortunately, a connection could not be established in any part of the city. SODAQ Air devices for PM measurement and traffic Telraam v2 sensors could not be used. For the traffic sensors, there was an alternative - to be replaced with the older version, and for this, we were provided with an additional 14 devices from version 1. The SODAQ Air devices were replaced with 10 DIY devices for PM measurement.

2.4.1. Co-creation and co-innovation with students

The EAP team conducted several meetings with teachers and school directors and decided how to include the project activities in the learning process. The mobile laboratory for AQ measurement was installed in the schoolyard.

Figure 17: Mobile AQ laboratory in the schoolyard and visit for students

About 1,000 children between the ages of 7 and 14 study in the school. For the students of the 5th grade (11-12 years old) in Environmental Sciences, when they came to the topic of air quality, we organised a workshop where we used the training materials developed under the project, we organised a visit to the mobile laboratory for AQ measurement to familiarise the children with the equipment and measurement principles.

Figure 18: Workshop with students about air quality

The students had the opportunity to assemble DIY sensors. When in Mathematics they were on the topic of tables and graphs, they were presented with the results of the measurements and an opportunity to analyse them.

Figure 19: Workshop with students for assembling DIY sensors

Older students (12-14 years old) were given personal tasks, for example, to present the CO2 calculator to their classmates, to find out what the peaks and measured concentrations of pollutants are due to, etc. Since we aimed to include as many children as possible from families with low socio-economic status, but without putting them in an uncomfortable position in front of their classmates, we turned to the school director for assistance and asked for information - families with 3 or more children, children of single parents, orphans,

with some disabilities, etc. Such children were assigned personal tasks. The children did very well, made good guesses and proved their theses. At the end of the experiment, during a workshop, several children presented the results of the measurements to their classmates. This can also be used in other schools, and a significant contribution to the analysis and interpretation of data could be made by students from vocational high schools in mathematics.

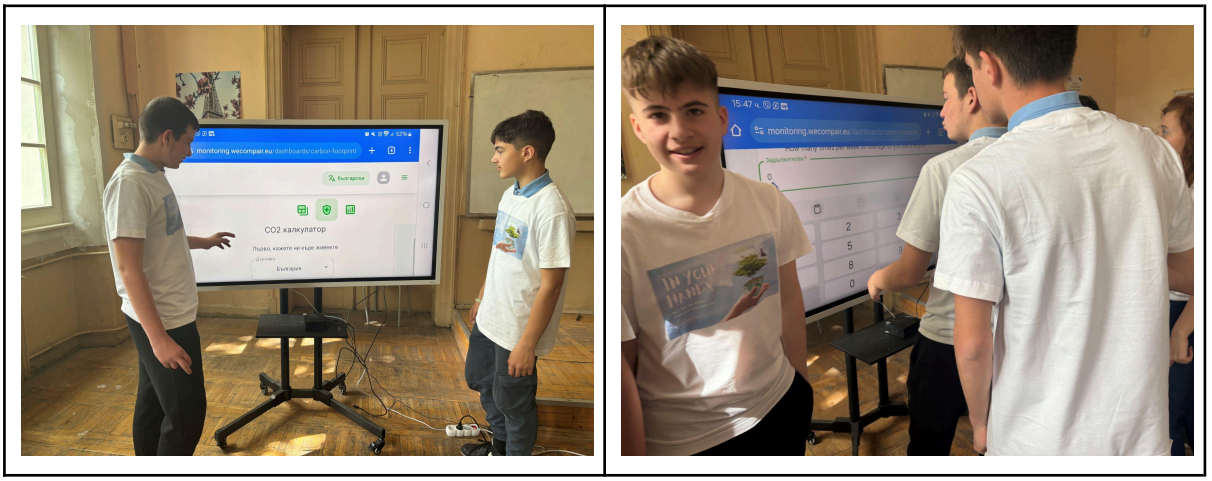


Figure 20: Students presented a CO2 calculator

2.4.2. Co-creation with citizens

Due to connection issues and a limited number of sensors, we organised an exchange campaign for PM sensors.

All volunteers measuring traffic received personal assistance from our team to install the sensors.

Figure 21: Installation of Telraam v1 traffic sensor with volunteers

Our team has focused their efforts on raising awareness. A series of workshops were organised for the stakeholders and citizens. The workshops were dedicated to the introduction of results and digital tools as a part of EAP's raising awareness campaign.

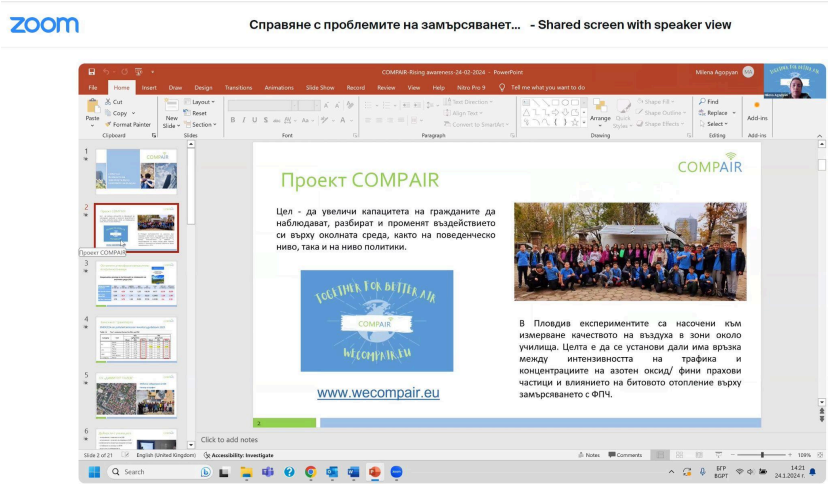


Figure 22: WS with stakeholders and citizens

After the WS for digital tools, we asked participants to try the CO2 calculator and to share with us their results.

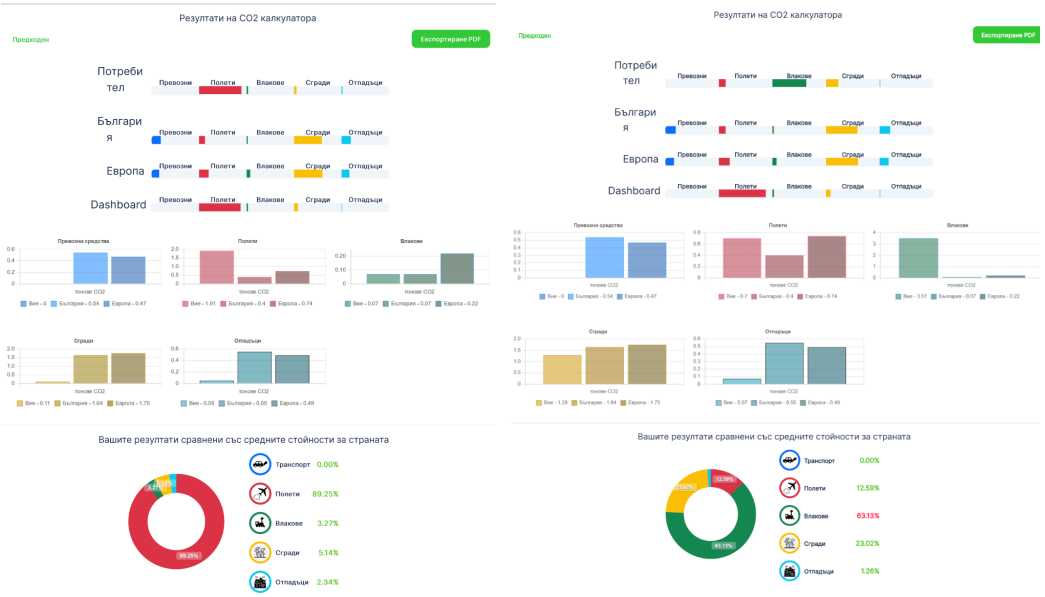


Figure 23: Shared results from using the CO2 calculator

The Plovdiv team prepared an online template of the Proposal with a list of possible measures for the reduction of traffic and improvement of air quality around schools for the municipality of Plovdiv. During the workshops, through the EAP webpage, Facebook page and direct communication the template was presented to citizens with a request to fill in their suggestions. The collected proposals were presented to the municipality.

Figure 24: The online template for the collection of AQ-improving measures

Due to the connectivity issues not all project digital tools can be used in the Plovdiv pilot. During the presentation, we were focused more on the Carbon Footprint Simulation Dashboard, and the Policy Monitoring Dashboard (PMD). The DEVA and DEV-D apps were introduced in brief.

2.4.3. Co-creation and co-innovation with local authority

At the beginning of the project, the EAP team conducted several meetings with two deputy mayors - of Ecology and of Education. They both signed invitations to participate in the COMPAIR project at two primary schools in Plovdiv.

The Plovdiv team together with the municipality co-organised the first workshop dedicated to stakeholders finding and mapping their needs. The meetings with district authorities were also organised. During the meetings the results from experiments in Plovdiv were presented, we asked for suggestions on where to install traffic sensors, and discussed the district's needs.

Figure 25: Introduction of CompAir project results with district authorities

Citizens' proposals for measures to improve air quality, together with good practices from the other pilot areas of the project, were systematised by EAP and provided to the Plovdiv municipality.

2.4.4. Co-creation workshops and Ideathon

2.4.4.1. Co-creation workshops

Stakeholders were divided into 3 main groups:
- students
- citizens
- local authorities, academia and business

Different workshops were organised for the students, that were focused on:
- Introduction of air quality topic and visit to the mobile laboratory
- Assembling of DIY PM sensors
- Results presentation, CO2 calculator presentation

The citizens were trained on air quality topics, and how to assemble and install sensors. They were invited to participate in workshops where the results and digital tools were presented. Representatives of local authorities, academia and business participated in these meetings. In this way, all interested parties had the opportunity to share their needs and give suggestions and recommendations.

The local authority was invited to participate in a workshop to see the results from experiments, and to understand more about good practices in other pilot areas and digital tools. The local authority was invited to participate also in the workshop together with the citizens and academia and had the opportunity to hear the voices of citizens and their needs.

2.4.4.2. Ideathon for students

On April 22, 2024, Earth Day, Primary School Knqz AlexanderI and the Energy Agency - Plovdiv organised an IDEATHON for students in Plovdiv. More than 50 children from the 5th, 6th, and 7th grades took part in the Ideathon, who presented projects for environmental protection and air quality improvement.

Figure 26: Projects of the students

The students participated with different materials - video, computer presentations, 3D models and pictures, essays and poems, brochures, posters, posts, news, puzzles, crosswords, or games;

Especially for the Ideathon, the students prepared a school newspaper. It featured articles on air quality, ideas on how to reduce pollution, a crossword puzzle and other fun tasks related to the topic.

One of the most attractive projects was "Earth from a bird's eye view" - 7th-grade students used drones, and 7th and 6th graders wrote the date 22.04 and the words “ЗЕМЯ” ("Earth") and "AIR".

Figure 27: The "Earth from a bird's eye view" project from above

The EAP surveyed the satisfaction of students, stakeholders and citizens with their participation in the project. To the question "How satisfied are you with your participation in the project" 62% of citizens and stakeholders and 54% of the students answered "very satisfied".
To the question “Did you learn something new, were the project activities interesting to you?” around 49% of citizens and students answered “The activities were interesting to me”; around 42% of citizens and 37 % of students answered: “I learned new things and the activities were interesting for me”.

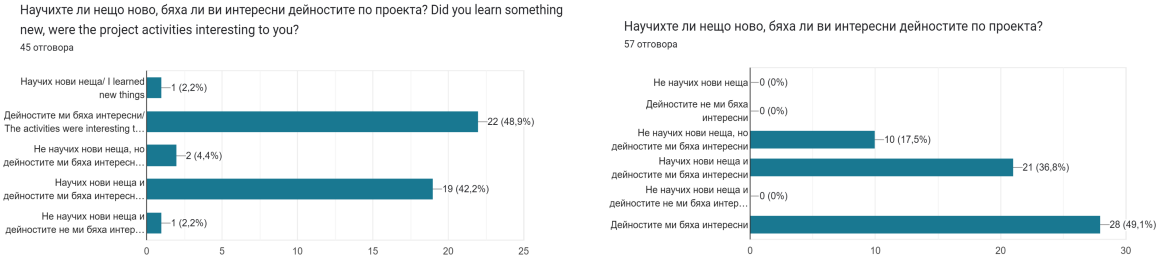


Figure 28 (1&2): Answers to the question “Did you learn something new, were the project activities interesting to you?” - on the left - citizens and stakeholders, on the right - students

This shows that the participants are interested in doing something specific, participating in the creation of something new and seeing their contribution.

2.5. Sofia

2.5.1. Co-creation and co-innovation

All the activities in Sofia pilot are based on the principles of co-creation and co-innovation. The approach the SDA team used was a human-centric agile approach to involve key stakeholders in all the phases of the processes. Following what we have achieved during the Open round, reported in D5.5 Co-Innovation report 1, we continued to rely on the quadruple

helix community of citizen scientists (who were also users), experts, policymakers, that we already developed during the previous testing rounds to continue co-create an effective and innovative local solution to reduce air pollution and related urban challenges e.g. congestions and increased safety risks around schools.

This approach was used in all the activities of the COMPAIR project but mainly in the development of a school bus service on the outskirts of the LEZ including schools in the centre of the city where the behavioural model of driving your children to school by car is most prevalent. The service itself is broadly explained in D5.6 Public Round Report 2.

Building on the outcomes of several types of research among schools and surveys among parents that defined the scope of the school bus service and then taking into consideration the outcomes from the second testing period during the Open round of COMPAIR activities, the SDA team planned the next testing round of the school bus service that was about to start in the 20023-2024 school year during the Public round.

The approach continued to be a bottom-up methodology with direct communication with the users getting their feedback about the effectiveness of the service and bringing the outcomes to the policymakers that made some rearrangements of the routes or other features of the service.

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The process in brief includes the following steps:

- Starting with a top-down approach to get the permissions to operate in schools and spreading surveys among parents and users of the service
- Continued with direct communication like phone calls and emails with parents who are more interested and want to be more engaged in the process
- Summarising all the gathered feedback in a report with user needs, expectations and recommendations and presenting the analysis to the local authorities in several private meetings and communication
- Using this bottom-up approach and helping the authorities in their decision-making process for adjustment of the service in alliance with user requirements, needs and recommendations, and also taking into consideration the resources the municipality has available
- Launching the improved service for the next iteration/testing round
- Run this loop again starting from the first step.

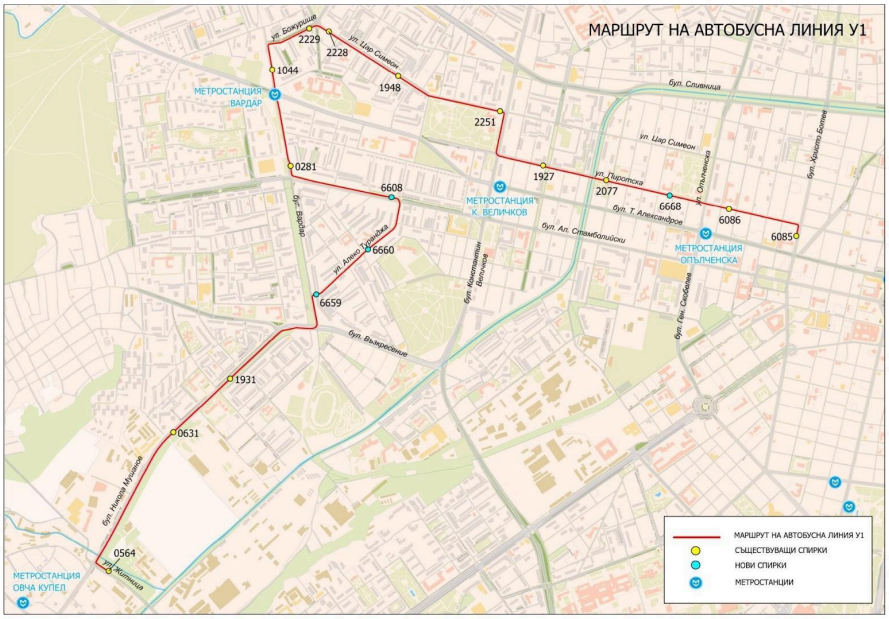
This process of co-design created a first-of-its-kind innovative public service created by the users themselves in collaboration with the local government in a pilot project of school buses in Sofia.

The main contribution of the users - students and their parents - was in the process of defining the school bus routes but also other features of the service and its scope. The routes were defined first using data from the schools with anonymous addresses of the students, which defined where the biggest concentrations of students were. Then citizen science was used as the parents of the students from 1st to 4th grade helped validate and define more precisely the routes providing their needs, bus stops they wanted to use and preferences of the service features. In the second round of testing, we even managed to change one of the routes and extend both routes due to the requirements of the users.

Parents shared all the information anonymously in a series of surveys we prepared during the different testing periods. And finally, the proposed routes and features were discussed with the experts in the Transport Department and finalised with tests on terrain with the buses. We used this final testing period for validation of the final route proposals and judging from the parents' feedback - the routes are optimal at this phase of the project. They were serving 11 neighbourhoods nearby the schools and along the main highways and were effective enough. Here on *Figure 29A* and *Figure 29B* are displayed the two school bus routes that operated during the last testing round in the 2023-2024 school year.

Figure 29 (A+B): Route maps of school bus line U1 and School bus line U2, provided by Urban Mobility Center in collaboration with the Transport Department of Sofia Municipality and SDA

A: School bus line U1 route map



B: School bus line U2 route map

The recommendations of the parents led also to extend the service also for the noon timetables of the schools as parents declared to have interest in using the service both in the mornings or at noon. This improved the municipal service by making it more comprehensive and made it clear that the project aims to provide a qualitative alternative to cars to all children no matter whether they are studying in the mornings or in the afternoons.

2.5.2. Surveys

Seven anonymous parent surveys were conducted to determine parents' needs and satisfaction, and their feedback was periodically analysed and also responded to any issues and complaints.

The surveys aimed to gather feedback on different aspects which can be conditionally divided into the following sections:

- Section on the statics on school bus routes - which route do they use, which stop do they use, school shift during the tested period
- Section for statistics of usage and satisfaction - how much do they use the bus, how satisfied are they, what do they like in the service and what don't like, assessment of the effectiveness and the service itself
- Section for the users - information about children - the name of the school, grade of the student
- Section for the parents - recommendations and additional comments on future testing rounds, sharing future interest of the project and contacts with us

We used this feedback mainly for the next iteration and one of the most important questions in all the surveys was connected first with assessing the current testing round of the school bus service and after that the section for the future iterations.

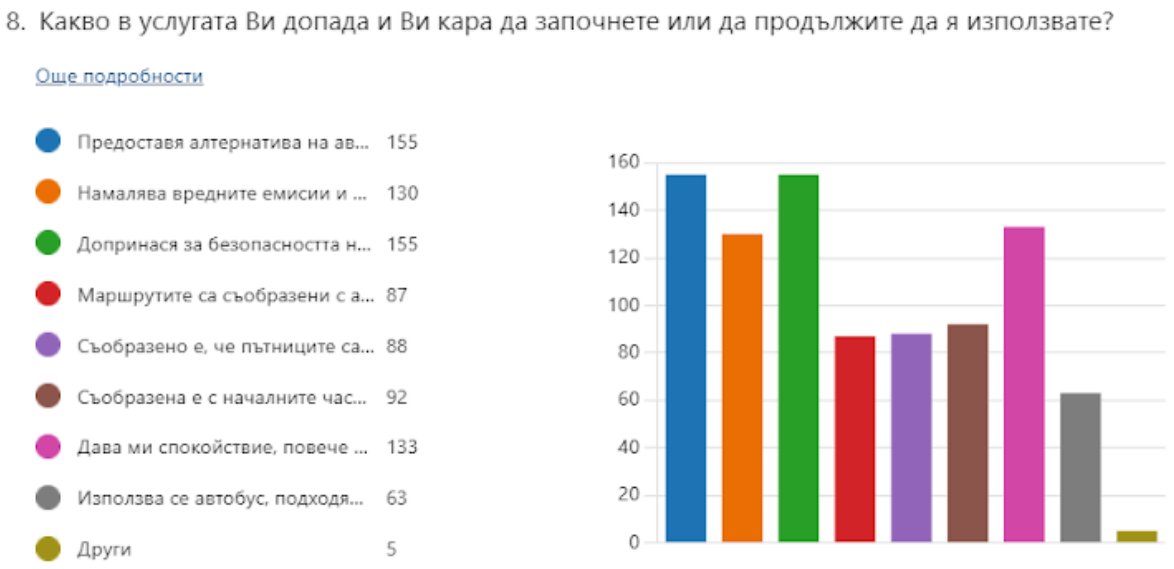
As we shared in D5.6 Public Round Report 2, the feedback from the last survey was the most comprehensive one. We got 382 answers from respondents. Thus we gathered not

only positive feedback but also managed to create an overall picture of the problem itself and to outline potential solutions as recommendations to the local authorities that they can take into account for a possible next testing round.

One of the Perceived Usefulness Questions (PU) that were used to assess the service was the following: “What appeals to you and makes you start or continue using the service?”. This question allows multiple answers.

The outcome we got is that almost 70% of the responses (155 out of 224 responses to this question) defined that the service provides an alternative to the private car.
130 of the respondents think that it reduces harmful emissions and air pollution around schools and in the city. The service contributes to the safety of children on their way to school, according to 155 of the parents (again 70% of the respondents).
87 of them define that the routes are tailored to the addresses of most of the children in the neighbourhoods adjacent to the schools and 88 parents are happy that it is considered that the passengers are children and thus the boarding is from the first door and there is an option for a companion. Parents (97 of them) also like that the service is following the starting hours of school classes in the mornings and at noon.
Safety is very important for parents judging from the answer “It gives me peace of mind, much more compared to public transport”, given by 133 respondents that the service is preferred by them compared to public transport.
63 respondents expressed that they appreciate that the bus used is child-friendly, with soft seats and comfort for children.

Figure 30: Answers to the question from the survey: “What appeals to you and makes you start or continue using the service?”

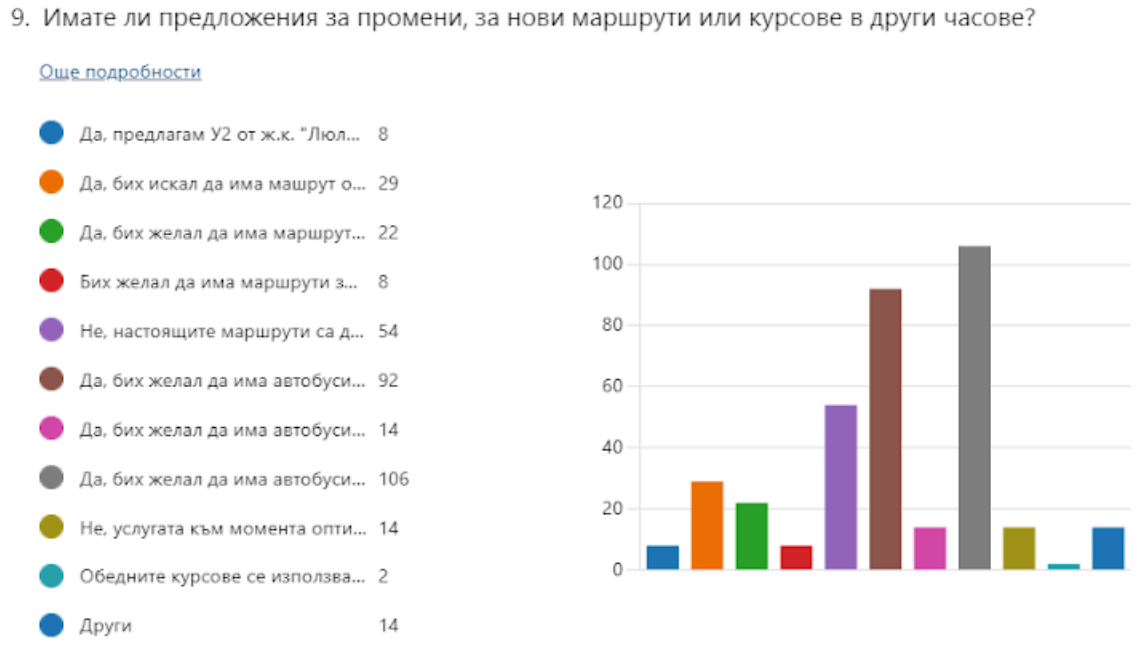


These outcomes show that the school bus service is recognized by most parents as an alternative to private cars or public transport for their children and also that it’s an effective

measure for reducing air pollution around schools and increasing safety in the vicinity of schools. They like that all the proposed measures during the previous testing rounds for a safe and child-friendly service are taken into consideration. It seems that the process of defining the routes with the help of the citizens themselves is also satisfactory as a result.

Looking ahead to a future school bus testing period we also wanted to understand whether parents have some suggestions for changes, new routes or other ideas and thus to continue the next iteration of discussions with the local authorities, presenting to them the outcomes of the survey.

Figure 31: Answers to the question from the survey: "Do you have any suggestions for changes, new routes, or other ideas?"



The largest percentage of answers (106 out of 224) was that parents would like to have school buses for children returning home as well, not only for going to school.
92 of the parents (out of 224) would appreciate it if there were school buses for students that are starting school classes at 07:30 - these are 5th-7th grades. Now we have buses only for the smaller kids (1-4th grade students) that are starting school classes at 08:20.
68 of the parents (54 + 14 out of 224) think that the current school bus routes and the service as a whole are effective enough and there are no changes needed.
Some of the respondents want the school bus routes to be extended for other neighbourhoods (29+8 answers out of 224) or other schools (22 + 8 answers) or other time schedules (14 answers). Only 2 of the parents consider that the noon time schedules of the buses are not effective and should be stopped from operation.

The overall feedback for the school bus project was positive and the engagement of the stakeholders in the process not only helped to develop the service but also made them feel like ambassadors of the cause for clean air and sustainable mobility to school.

The role of the policymakers and the stable political will for a strategic solution and building on what has been already achieved is also very important. Only with persistence in the quality and features of the service could make a lasting change in parents' habits about how they take their children to school and a change in thinking that this is really possible without having to rely on the private car. That's why we are working on making this measure stable and prolonging the school bus service as well as putting it on the next strategic level while scaling up the pilot project. Now we are in the process of private meetings with the Deputy Mayor of Transport and his team to make this happen.

2.5.3. Ideathons and co-creation workshops

Along with the surveys, some other tools and methodologies helped in the co-creation process and were pretty much effective and delivered another type of outcome - more personal feedback and an opportunity for honest discussions and solution-making.

During the Public round of COMPAIR, we conducted two ideathons and several workshops with a focus on co-creation with the different types of stakeholders on different levels.

Having the experience of the successful workshops from the Open round that was more focused on raising awareness of students and schools on air pollution as well as assembling and installing DIY sensors in and outside schools, now we focused more on workshops and ideathons dedicated to the digital tools developed under COMPAIR project and the school bus service as well as working with students.

Figure 32: Ideathon with stakeholders discussing the further development of school bus service in Sofia

The school bus surveys were supported also with an ideathon that aimed to gather in one place all points of view of the different types of key stakeholders that have an interest in this project to live a longer life. On 27 May the SDA team conducted a data cafe workshop that put next to each other representatives of the City Council, the Environmental Department, the Transport Division, the Marketing Department of the Urban Mobility Center, parents, NGOs and other stakeholders interested in taking part in the further development of the school bus service.

All the gathered data and outcomes from the surveys as a citizen science experiment conducted throughout the years of testing was a starting point for discussion between citizens and local authorities. Parents again stressed that they appreciate the impact of the school bus service on changing the mindset of offering an alternative to driving their children to school. 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. They indicated that air pollution is important to be taken into consideration and appreciate the measures for decreasing the pollution and safety risks around the school areas. Other benefits of the service they see are that thus their children develop their independence and social skills. At the end of the meeting, all the stakeholders came together around the idea that a school bus service was a sensible measure to reduce air pollution around schools and wanted to work together to prolong and further develop the service. This is an indication that we have managed to achieve one of our goals - empowering the citizens and encouraging them to think of themselves as an important part of the decision-making process and changing the environment around them with innovative solutions.

All the recommendations and ideas from the meeting were summarised in a report to the Deputy Mayor of Transport and submitted as recommendations for changes and improvements in the service. Personal meetings with experts from the Transport department are yet to come in the coming weeks to start the process of creating a strategy for a long-term and more stable municipal service of buses to schools in more areas of the city.

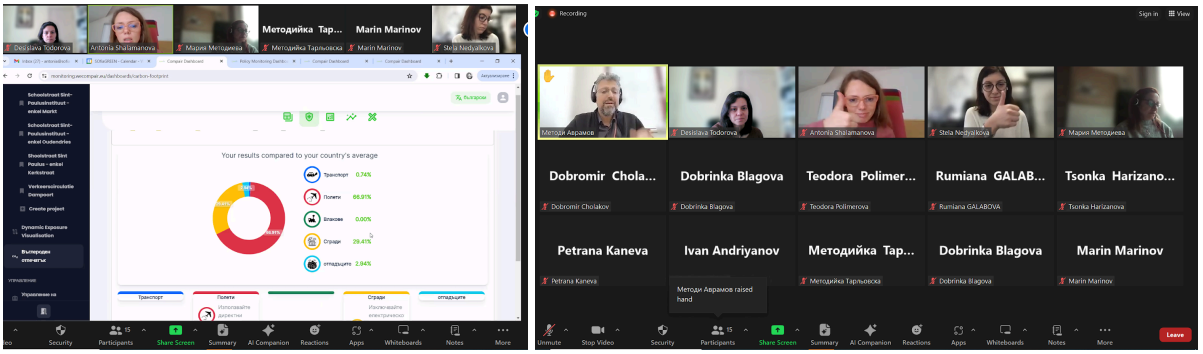


Figure 33: Online stakeholder webinar dedicated to the digital tools developed by the COMPAIR project

Two more events were conducted during the Public round - this time dedicated to the digital tools developed by the technical team of COMPAIR in collaboration with the stakeholders that had pre-set the user requirements during the Open round activities. On 2 February 2024

was the first event. The SDA team conducted a stakeholder webinar and presented to key stakeholders the status quo of the tools - more on the Carbon Footprint Simulation Dashboard, the Policy Monitoring Dashboard (PMD), and in brief - DEVA and DEV-D apps. Later we discussed with representatives of experts from Sofia Municipality, in concrete - from the Air Quality Department, Digital Department, and the Urban Mobility Center. We also had NGOs interested in this topic like Trust for Social Achievement (TSA) and MOVE.BG, that are focused on working with vulnerable groups, especially TSA that are working with Roma communities.

They were also the most active participants in the discussion and shared that any background data and resources could be very helpful to them in integrating more successfully the air quality topic into their activities in the Roma community and neighbourhoods in Sofia. As a continued partnership with them, and in response to the request, our team provided them with Air quality educational materials and training materials based on the D5.1 Guide to Air Quality Training. The SDA team translated and adapted the materials to serve TSA needs and the specifics of working with vulnerable groups. It was an important strategic step to reach out to such difficult-to-reach vulnerable groups as they are pretty much closed as a community and the best way is to work with organisations that already have established relationships with them. Our partnership with TSA was a key approach to promote awareness about air pollution's harmful effects and to motivate them to change their heating habits using alternative options for domestic heating.

According to the original plan, the SDA team was initially planning to use the Telraam traffic count sensors and SODAQ Air PM sensor that was about to be integrated into the Policy Monitoring Dashboard (PMD), DEVA, and DEV-D apps. Due to the connectivity issues all sensors like these that are based on LTE-M / NB-IoT network technology, could not be used. As we discovered via tests during the Open round and also during the Public round, the sensors were in working order but the problem was with telecoms in Bulgaria that seemed to not support LTE-M / NB-IoT networks, which means that all the collected data could not be transferred to the cloud and integrated into the digital COMPAIR tools for analysis. To overcome the issue, the SDA team decided to focus on the tools that were not using the Internet of Things like the Carbon Footprint Simulation Dashboard.

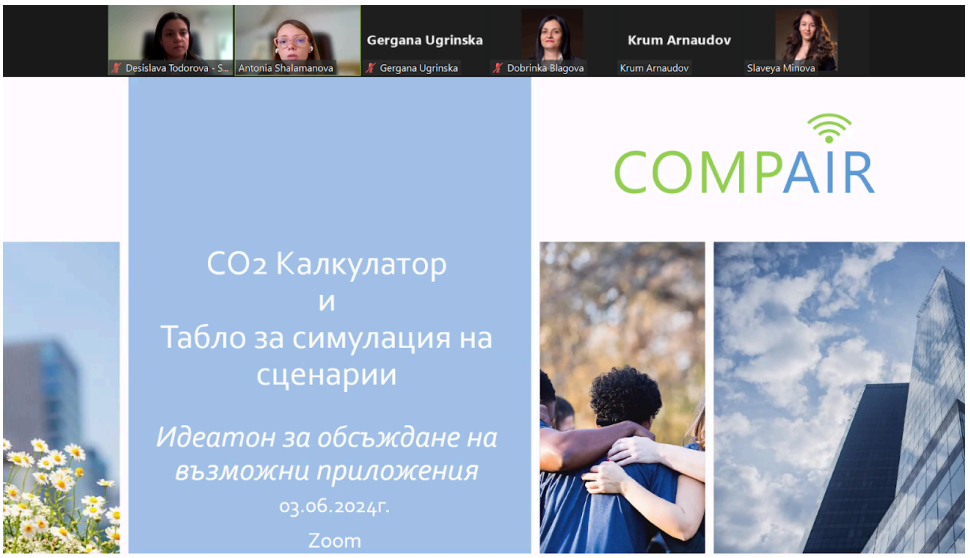


Figure 34: Online ideathon focused on the integration of the Carbon Footprint Simulation Dashboard with other digital tools of Sofia Municipality

That's why the second stakeholder workshop dedicated to the COMPAIR tools was focused on presenting the Carbon Footprint Simulation Dashboard. It was conducted on 3rd June in the form of an online ideathon and intended to involve again the same representatives from experts from Sofia Municipality and the Urban Mobility Center as the previous workshop. The ideathon was defined first to present the already full-featured tool for citizen science where users can calculate their CO2 emissions and also understand how they affect their carbon footprint through their daily activities. On the other hand, the Scenario Simulation Dashboard allows citizens to participate in policymaking while creating scenarios when choosing a set of actions they are willing to make, as well as actions they are willing to accept from the government to reduce carbon emissions. Some already gathered data from the Simulation dashboard was presented to the municipality experts to show them how it works and stakeholders were invited to reflect on how this tool can be used for municipality policymaking and how it can be integrated into some other digital tools of Sofia Municipality.

The Digital Department expressed the idea to think in collaboration with the Waste Department and also to integrate the waste management platform waste.sofia.bg with this tool or vice versa, as they are both platforms targeting active citizens and promoting eco-friendly and sustainable behaviour. Now the SDA team in collaboration with the Digital and Waste Department is working on including information about the CO2 calculator on waste.sofia.bg and to direct citizens towards the tool when they want to calculate their CO2 footprint. Last but not least both websites are also included in the integrated raising awareness campaign "It's cool that you care” run under the COMPAIR project.

The work with citizens and other stakeholders dedicated to further improvement of the features of the Carbon Footprint Simulation Dashboard was also supported with other tools like an online form for feedback that citizens could spread among users via social media posts. Direct communication with testers of the platform was also a useful method for gathering feedback and promoting the tool among stakeholders and future users.

During the organised several meetings dedicated to the development of the media strategy for the raising awareness campaign "It's cool that you care”, the SDA team was able to again get to know briefly the responsible team of the Deputy Mayor of Environment and the Deputy Mayor herself, with the features of the COMPAIR tools - PMD, DEVA, DEV-D and especially the CO2 calculator and the Carbon Footprint Simulation Dashboard. They expressed their interest to continue participating in the process of elaboration.

Figure 35: Ideathon on media strategy of the raising awareness campaign on sustainability

Our third meeting was some kind of small-scale ideathon, representatives of the PR and marketing teams of the Environmental Department and also of the Urban Mobility Centre, as well as the director of the Waste Department also got familiar with the COMPAIR tools and took part in the co-creation of the future "It's cool that you care" campaign. They shared their ideas for the information campaign and were involved in the process of validation of the messages and finalisation of the visuals that would promote the COMPAIR-provided tools, SDA pilot projects and also programs, projects and policy measures of Sofia Municipality calling for sustainable living habits among the general public and personal contribution to Sofia becoming a greener city. The whole process of developing this campaign was a synergetic approach and a collaboration between many departments and entities - something not so common when talking about citizen science projects of municipalities in Bulgaria. This coordination was crucial as the campaign should have been aligned also with the municipal plans and programs, deadlines, etc. (e.g. LEZ for domestic heating introduction, Pay as you Throw future introduction, afforestation campaigns of the Municipality, a program for changing your domestic heating system, etc.). The campaign itself went live on 1st August and will continue until the end of September as we foresee the final event probably to be during European Mobility Week when the culmination of activities is on 22 September - the Car Free Day. Thus many citizens will have the opportunity to test the CO2 Calculator and the Scenario Simulation Dashboard again.

2.5.4. Synergies and cross-collaboration with other projects

During the Public round the SDA team continued the convergence activities with other projects and stakeholders that helped the team to spread the work of COMPAIR activities and expand the community of stakeholders and citizens we can reach with our call to action.

The SDA team had the opportunity to continue the collaboration with another EU project and to present the COMPAIR activities during several mobility forum meetings happening in the frame of Future Mobility Lab we were coordinating under the Shared Green Deal project[3] financed by Horizon 2020 (H2020). The main focus of these meetings with 4th and 5th-grade students and other stakeholders was to discuss their daily commuting to school and to examine their habits, needs and obstacles to commuting sustainably on one hand and on the other hand, to search for solutions and recommendations to the local authorities. Students were impressed by the school bus services and wanted to have such an opportunity to go to school and one of our tasks was to identify possibilities for developing the service wider and including their schools in the next phases of the project.

Figure 36: Future Mobility Forum with participants in Shared Green Deal project on Sustainable Mobility in Schools - the SDA team is presenting DIY air sensors and outcomes of the COMPAIR project

These forums were used also to popularise the project activities and workshops we had with their peers under the COMPAIR project and also to showcase the installation of DIY *sensor.community* sensors and the features of the CO2 Calculator. Parents and kids participating in the project were some of the first testers of the Carbon Footprint Simulation Dashboard and the CO2 Calculator. Kids were willing to participate more actively and when asked whether they wanted to install such a sensor in their classroom, they showed their readiness but unfortunately, the School directors rejected the installation without explaining their motivation.

[3] https://sharedgreendeal.eu/

Nevertheless, we managed to raise awareness on the air quality topic and the main sources of air pollution and to build a reputation of the COMPAIR project among local communities of citizens. During the mobility forums, we discuss widely with parents, teachers and students one of the biggest reasons in Sofia for high levels of harmful particles in the air - the high motorisation rate, the old fleet of personal cars used and their use in everyday commuting to work or school around the city. Further in the discussions, we paid attention to the ideas of the youngest participants in solving these problems and changing their habits to more sustainable mobility to school, constantly seeking to achieve synergy in the measures and solutions that have borne fruit in previous experiences in the various projects in which we are involved.

2.5.5. Engagement and awareness-raising campaigns

Engagement and awareness-raising campaigns were set as an important direction of COMPAIR activities in the Sofia pilot since the Open round testings. The SDA team was focused on building community and engaging key stakeholders in all phases to foster creativity and collaboration between them, providing them a platform to pitch their ideas and challenge their mindset and everyday habits.

The process laid on the principles of collaboration, convergence and complementarity of their ideas and an open and honest dialogue between groups of stakeholders and communities that usually don't have such occasions for direct communication in a friendly and co-creative environment in Sofia.

Stakeholders were directly involved in the testing rounds explained widely in the D5.6 Public Round Report 2[4]. Schools starting with the school principal, then teachers and continuing with the students, parents and other citizens contributed equality to the outcomes of the valuable insights we shared in this report. In addition, their collaboration with the local authority and the provided environment for their voice to be heard by the decision-makers was another valuable benefit.

Users were involved in testing the COMPAIR-provided digital tools and sensors but due to the connectivity issues in Sofia, it was not possible to follow this initial plan. Thus we emphasised the engagement of citizens in activities that directly reduce air pollution like the development of the school bus service and the CO2 Calculator that also encourages the users to reduce their CO2 emissions and thus to influence the air quality too.

As the citizens' awareness can also lead to actions that impact air pollution both directly, through citizen activities and actions, and indirectly, through influencing public authorities, one of our use cases aimed to work on the realisation of an awareness-raising campaign showing positive examples of people living sustainably, in general, to call to action to behavioural change.

[4] D5.6 Public Round Report 2 is also under development and uses the results from co-innovation activities performed by pilot teams during the public testing round

After the ideathon in June with the PR teams of Sofia Municipality, we organised small focus groups to verify once again the validation of the messages and to gather useful feedback on how citizens understand and see the visuals as first impressions.

The raising awareness campaign “It's cool that you care” includes attractive visualisations on different sustainable topics. Two of the posters are dedicated to COMPAIR digital tools and calls to action to scan a QR code redirecting the user to the CO2 Calculator and the Carbon Footprint Simulation Dashboard.

Figure 37: City lights on public transportation stops in Sofia promoting the CO2 Calculator and the Carbon Footprint Simulation Dashboard: “It’s cool to care.” and “It’s cool to unplug devices when not used to save energy.”

Other posters promoted programs and environmental projects managed by the Sofia Municipality such as the municipal program that supports lower SES groups to change their heating system to be more eco-friendly. Many households use solid fuels for heating and this program targets them and allows them to install an air conditioning system for free and to use it for heating during winter as well as for cooling during summer.

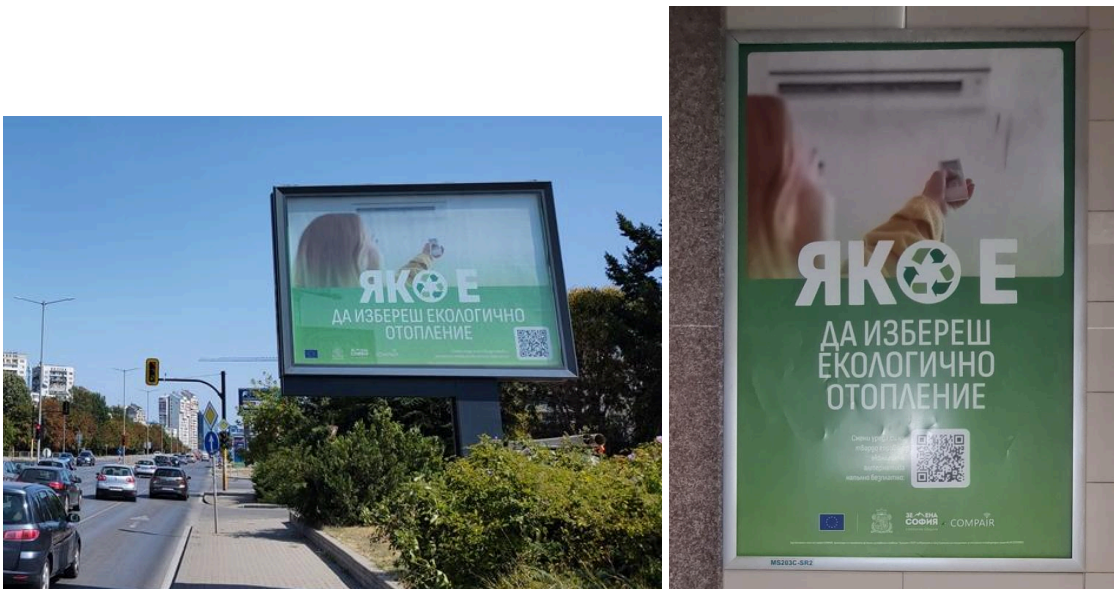


Figure 38: A billboard and posters at metro stations in Sofia promoting a municipal program for low SES groups for free switching to eco-friendly heating systems in their home: "It's cool to choose eco-friendly heating."

Visuals dedicated to shared mobility around the city and promoting cycling among parents and people going to work were the other accents in the media campaign.

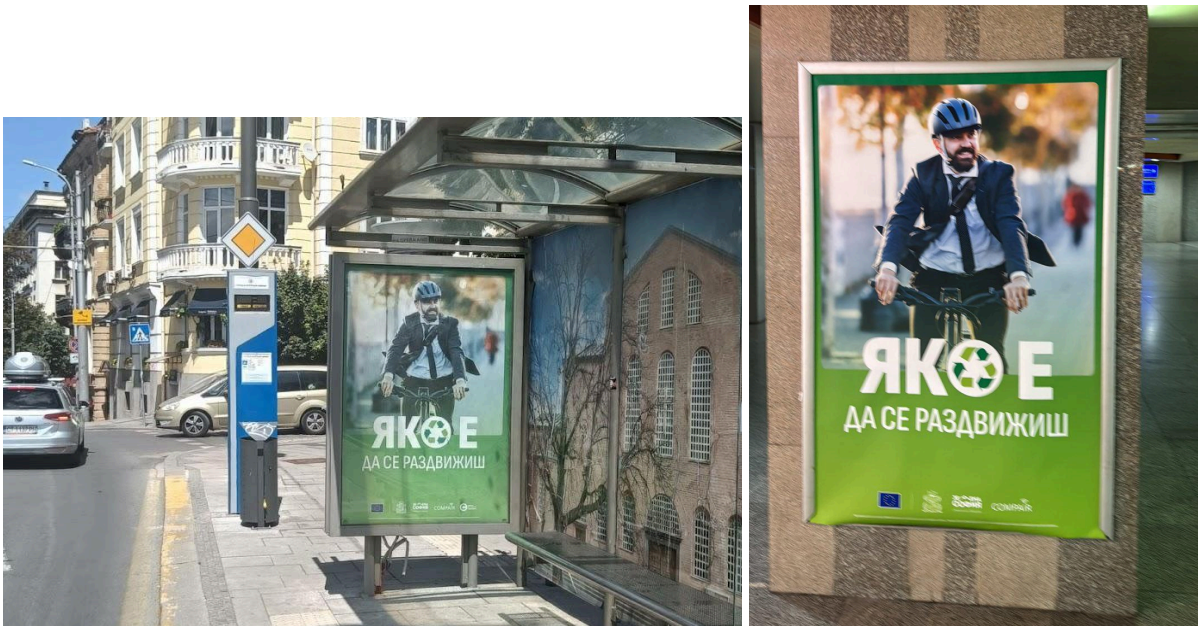


Figure 39: City lights on public transportation stops and posters at metro stations in Sofia promoting cycling to work: "It's cool to move around"

Figure 40: City lights on public transportation stops and posters at metro stations in Sofia promoting cycling with the kids: "It's cool to be on 2 not on 4 wheels"

Figure 41: Billboard in Sofia promoting carpooling: "It's cool to travel together"

Several locations were also promoting the school bus service as part of the COMPAIR activities.

Figure 42: Posters at metro stations and billboards in Sofia promoting the school bus service: "It's cool to travel with friends"

The media campaign is still ongoing and the SDA team is also planning to also start an online campaign in September involving some media partners and NGOs. The raising awareness campaign currently consists of 40 locations in total - 20 locations in the metro stations, 10 locations of city lights around the city and 10 billboards. All the locations are around big boulevards and highways and also the busiest metro stations and public transport stops mainly in the centre of the city and along the main two diameters of the city. Here is a map with the exact locations of the posters.

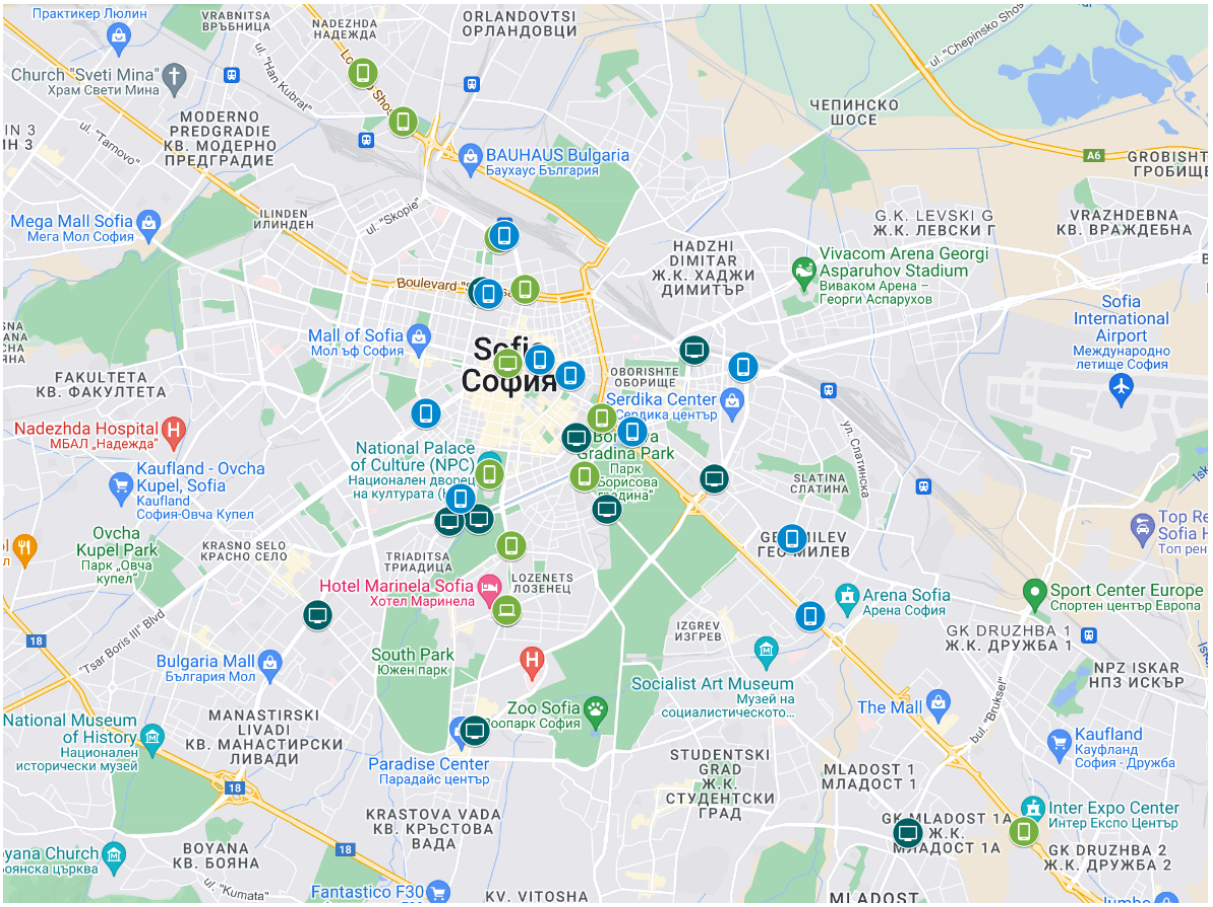


Figure 43: A map with all 40 locations of billboards, city lights and metro station advertisement posters of the awareness campaign "It's cool to care", released as part of the COMPAIR activities.

Currently, it's still difficult to evaluate the effectiveness of the campaign as it's too early and the campaign is still ongoing at least until the 22 September as it's planned to be the closing event. Nevertheless, we see an increase in the number of users of the websites the posters are promoting -the CO2 Calculator website, waste.sofia.bg and others.

3. Lessons learned - the way ahead

This section provides a general overview of the approaches each pilot plans to use during the public testing round to engage citizens and stakeholders and promote citizen science and data gathering through co-innovation activities.

The second part of the section is directed to the recommendations for future steps and needs for solutions to the pilots as an outcome of their co-innovation activities and from the COMPAIR project as a whole.

3.1 Comparative analysis of the co-innovation approaches used

During the project lifetime so far and especially during the Public round testing, pilots have used co-innovation practices mainly to engage citizens in co-creation activities and raise awareness. Activating more and more citizens at every phase as scientists and stakeholders in the decision-making process of policy creation was also recognised as an aiming outcome.

Considering the results presented in this report, we can conclude that all the pilots created a well-functioning methodology for building communities and involving volunteers and stakeholders in the process of co-creation and co-innovation. The good results of the measuring campaigns, the highly engaged participants who stayed until the end of the project, and the positive feedback in the surveys are evidence of that.

Pilots targeted different types of audiences and every pilot managed to build successful community engagement by tailoring its strategy to entirely different demographics. The motivation factor was how vulnerable the specific group was in the selected pilot area. Athens recognised elderly people as the most vulnerable, considering air pollution, heat waves and climate change. That's why they put their efforts into engaging them, understanding their needs and activating their force for solving the environmental issues. The key role for recruiting them was to use "Friendship Clubs" and to create an innovation space close to their way of living and their habits and only after that to make them believe they contribute to behavioural change. The motivation to take part in the measuring campaign was high throughout the whole project, and this once again proves that this approach was successful. Unfortunately, Sofia and Plovdiv were not able to continue actively with the measurements using LTE-M / NB-IoT devices and that was the reason for shifting the focus to other activities like using more actively the Carbon Footprint Calculator.

Flanders, Sofia and Plovdiv defined kids as an important vulnerable group and involved stakeholders like parents, teachers and students in the co-creation process. They know best what the local urban problems in their neighbourhood and around the school area are, and if their voice is heard and implemented in policy measures, they could be more effective and well adopted by society. That was the approach used in Sofia, for instance, when determining the scope and developing the school bus service. The stakeholders were invited to share their opinions and recommendations and to gauge interest in using the service via

surveys, workshops and ideathons. While in Flanders and Plovdiv, citizens were engaged in measuring and awareness-raising campaigns.

Despite the various methods used for involving the different stakeholders, the positive feedback and the continuation of the pilot measures is again a sign that this co-innovation approach works well. For instance, in Herzele, Flanders, the school street was first set up as a pilot project but then has been made permanent as a direct consequence of COMPAIR. The Sofia team is also working on the continuation of the school bus service as a stable and long-term strategic measure for Sofia Municipal to reduce air pollution and congestion around the school area and increase safety.

Pilots have stuck to the quadruple helix approach when organising the events. During the public round, stakeholder workshops were conducted, as well as hackathons and ideathons, aiming for stakeholders to be directly involved in policy-making and empowering them to come up with innovative ideas for experiments. Athens involved a whole variety of stakeholders, starting with citizens, NGOs, active groups, also industry, companies, the private sector, academia, research and public authorities. Berlin used their well-established connections with cyclist associations, institutes and research centres. Flanders, Plovdiv and Sofia created a school area community of students, citizens, teachers, parents, local authorities, academia and business.

The engagement strategy of the pilots usually consists of a top-down approach, starting with the municipal administration or the school administration to get the permissions to operate in the school area, for example. However, as behavioural change cannot be top-down, pilots continued with a bottom-up approach to ensure comprehensive and inclusive community engagement. That builds trust and predisposes to open collaboration and co-design.

The pilots' variety of well-organised and well-moderated events was a key factor in the success of co-innovation. They regularly checked if the experiments and the pilot projects were moving in the right direction, boosted with more useful ideas and provided valuable and sometimes even crucial feedback to the technical partners or the policymakers to pave the way for the testings further. With each testing round, pilots were increasing their outreach towards more citizens and every subsequent phase or event was giving the next level of details and iteration that enables it to work in adaptive and agile methodology. This ended in a package of digital tools co-designed in collaboration with the citizens, trying to meet their needs and expectations. All the COMPAIR-provided dashboards aimed to provide the city officials the opportunity to use the generated results from the citizen science activities and to integrate the results into policy measures strategies to improve not only the climate conditions in the city but also the quality of life. This collaboration between citizens and municipalities is the next level of complementarity and convergence that is an emanation of the co-innovation process.

The constant feedback coming directly from the users also helped all the technology partners (like SODAQ, Telraam, etc) to improve the features of their devices and make them easier to use and assemble by potential users. The best example of this co-innovation process was redesigning the bcMeter sensor. Testers from almost all pilots but mainly citizen scientists from Herzele, Flanders, shared their concrete recommendations with the creators of the technology and hardware developers and supported the process of product

improvement. The entire new prototype was assembled with changes in user-friendliness and the measurement technique, as well as improved viability and applicability of the devices. A new 3D printed housing (modular, rain & sun proof) for the bcMeter alleviated the issues with overheating and solar irradiation that was crucial for the safe use of the product. This interaction involved many COMPAIR partners and citizen scientists. It covered all the aspects of the five “co’s” of the co-innovation - collaboration, coordination, convergence, complementarity and co-creation, well explained in the D5.5_Co-Innovation Report 1 as pillars of the co-innovation methodology used in COMPAIR project.

The same co-design methodology was also implemented by Sofia pilots in the development of the school bus service, and it was again a successful application of the 5 “co’s.” The good results are mainly due to the coordination between the citizens and the municipality, well-established connections with key stakeholders like the school administration and teachers, converged points of view of all stakeholders, and complementary iteration at the subsequent phases of the testing rounds.

This proves that led by a clear vision and stated goals, synergy in collaboration and co-creating can be achieved at a level that develops entirely new and innovative products and services.

3.2. Recommendations for future steps and need for solutions

Working with such a variety of partners, stakeholders, technologies and methodologies wasn’t an easy process. It was a complex way of harmonisation and community building, synchronisation of plans with all types of internal and external stakeholders and their active participation during all the project phases, combined with leadership and local champions.

The most satisfying results come at the end of the project when you see all the plans and visions set from the beginning of the project come into reality. Of course, some of them are modified and transformed, but they still follow the pre-set principles to deliver benefits to society.

Now that all these achievements are in place, our recommendation to all the pilots and partners of the COMPAIR consortium is to build upon their strategies for a sustainable continuation of the activities, campaigns and or services already established.

There is a risk that these already well-developed networks will stop working if they are not nurtured with more motivating events, causes, and space for action and further co-creation. That’s why the consortium is setting up initiatives to exploit post-COMPAIR results and outcomes.

Unfortunately, air quality and climate actions, as part of the Green Deal, must continue and demand further efforts. That is why we need to harness all that we have learned and achieved through the COMPAIR project and take it to the next level — by making it part of

the way that municipalities work and co-innovate with citizens on all the issues that directly affect them.

We have already proved that this co-creation and co-innovation is a valuable and fruitful methodology that develops societies and helps citizens take their responsibility into their own hands. It empowers them to take real actions and that's the best way of behavioural change we want to nurture and it's also well explained in the deliverable D6.2_Pathways to Behavioural Change Report focussed on how CS can effect changes in attitudes and behaviour to drive sustainable decisions. As we said - social change cannot happen only top-down. It needs to be desired bottom-up. The right balance, a collaboration between top-down, then bottom-up, and vice versa in continuous loops that never end is the key to society's progress. This methodology and the accumulated knowledge can be implemented also in other future projects, taking into consideration the lessons learned in these co-design experiences with various stakeholders, challenges and working on common issues.

4. Conclusion

D5.7 Co-Innovation Report 2 is the final deliverable summarising the results of the activities performed under T5.5 Co-Innovation for Capacity Building & New Service Creation, which is also the final task of the WP5. The deliverable focuses on describing how COMPAIR pilots implemented co-innovation practices in the development of project activities until the end of the public round testing and provides an analysis of how these approaches could be used by other projects in the future to promote joint policy creation between public administrations and the citizens.

All the pilots stated their fruitful experience and the belief that by activating the stakeholders in decision-making, they showed the power of citizen science for policy-making in the environmental domain. By bringing together stakeholders with various viewpoints, you create a more robust and inclusive process that is more likely to achieve a consensus on developed policy measures. Thus, citizen science has become better accepted by policymakers as an effective partner in the creation of policies related to such specific fields as air quality and climate change, which are usually considered territory only for scientists. The co-innovation proves this can be a collaborative process, and local governments can innovate hand in hand with the citizens. The products or services created during the COMPAIR project and all the processes established are a well-recognised value and support for the development of society. It stimulated the exchange of knowledge and networking between different layers of society, including the lower SES groups. This increased awareness of the important topics of well-being like air pollution and climate change and accelerated the deployment of the most promising and innovative solutions to tackle these problems locally.

As stated in the D5.5 Co-innovation Report 1, it is reaffirmed 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 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 to mobilise the ideas of people from different backgrounds and help foster understanding in society about such a serious topic as air pollution, which will eventually increase the chances that society and citizens themselves will 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 in the project.”