INNOAIR

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Innovative demand responsive green public transportation for cleaner air in urban ENVIRONMENT

Final Monitoring and Evaluation Report

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European Regional Development Fund
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Abbreviations

Abbreviation	Explanation
AF	Application form
AI	Artificial intelligence
CO	Carbon oxide
EU	European Union
EUI	European Urban Initiative
GDPR	General data protection information
KPI	Key performance indicators
LEZ	Low emission zone
MaaS	Mobility as a Service
NGO	Non-governmental organization
ODPTP	On-demand public transport
PM	Particle matter
SUMC	Sofia Urban Mobility Center
TV	Target value
UIA	Urban Innovation Action
WHO	World Health Organization

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Key data

Keywords	KPI, monitoring and evaluation, transferability, project outcomes and results, evaluation aspects and findings, lessons learned

Statement of originality

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation, or both.

Abstract

INNOAIR overall objective is to improve air quality in the city of Sofia by introducing holistic set of tools and a novel paradigm of public transportation - “Green on-demand public transportation" shifting the way people travel in the cities and dramatically reducing single use vehicles, which are the major contributor to air pollution. The project aims to result in significant behavioural change and broader use of public and active transport. PM and CO2 emissions are to be reduced, contributing to the improved quality of air and citizen health.

INNOAIR developed and piloted several innovations in this respect: on-demand electric public transport in selected neighbourhoods in Sofia with respective tariff and regulatory amendments; green corridors mobile app allowing citizens to use public and shared vehicles with zero emissions; the introduction of the first Low Emission Zone in Bulgaria and in Central and Eastern Europe; and a roadmap for the introduction of Congestion Charging in Sofia. The introduction of these innovations was based on rigorous research, data collection and management, outreach and awareness building and stakeholder empowerment.

The project goes beyond traditional policies and services – it needs to be bold and innovative. Consequently, monitoring and evaluation of such a project presents its own set of challenges. Monitoring as a systematic collection of information about the programme/project activities carried out to see if they are on track, has been an ongoing process. Final project evaluation was designed to measure the success against established goals and objectives and the applicability and transferability of the piloted Sofia solutions.

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Introduction

1. Purpose, development, and structure the report

Monitoring and evaluation are essential management functions that are interactive and mutually supportive. They help INNOAIR consortium to ensure accountability in the use of resources entrusted to it; provide a clear basis for decision-making; and offer practical lessons from experience to guide future development interventions and project scaling up and scaling out.

Monitoring and evaluation have been integrated into the programming cycle to enhance the implementation and achievement of results. INNOAIR has been conducting ongoing monitoring and evaluation, and has developed three annual reports measuring project progress, improvements in the efficiency, effectiveness, performance, accountability, outcomes, and other indicators of quality (Deliverable D2.5.1).

This final monitoring and evaluation report is an overall assessment of INNOAIR project by its stakeholders, service and innovation users and project partners and is prepared towards the project completion. The final report also aims to serve as a source of initial lessons from experience and to recommend follow-up activity, when necessary, because evaluation is a crucial tool for learning.

In the period January – June 2023 a project evaluation team consisting of representatives of all project partners, listed on the front page, conducted an end-of-cycle evaluation of the project implementation, outcomes, results, and impact.

The main focus of this evaluation involves:

- Assessing whether, and to what extent, the project has realised its expected benefits.
- Gaining feedback from users and other stakeholders on how well the project innovations meet their expectations.
- Reviewing the impact of any service change on operational activities, processes, and people.
- Understanding how well the project has impacted on service activity and performance.

The report consists of several parts, outlining respectively the project innovations and planned objectives, impact, and indicators; the evaluation method, the evaluation aspects and data, the evaluation findings, including lesson learnt, allowing to take action on the findings.

The evaluation,included the following activities:

- analysis of the project's documentation;
- analysis and verification of the project's indicators;
- preparation of tools (questionnaire and interview's check list) for collecting information from the partners aimed at evaluating project management and core activities;

- preparation of a questionnaire to assess consortium consolidation;
- collection of information from partners and stakeholders regarding KPIs;
- surveys with innovation users;
- incorporation of results of the three project monitoring reports into the final evaluation report;
- preparation of an evaluation report in draft;
- finalisation of the Final evaluation report.

The evaluation process assessed the relativeness, effectiveness, efficiency, sustainability utility, coherence, completeness, complementarily, coordination and additionally of processes and outcomes.

2. INNOAIR project

INNOAIR is the first Bulgarian project financed by the Urban Innovative Actions initiative of the EU, which enables large European cities to test innovative, creative, but also risky solutions to urban challenges.

INNOAIR experimentally implements measures in the thematic area "air quality", and in particular "innovative solutions for mobility and green mobility". The project tests in a real environment new transport services and solutions for Bulgaria and Europe on a pilot basis in the neighborhoods of Manastirski livadi and Buxton, with which to give citizens alternatives for movement, reduce car traffic and improve air quality. In addition, the project targets key segments of the population to encourage cultural and behavioral change towards greener and more environmentally friendly modes of transportation.

The investment component of the project includes the purchase of 5 new electric minibuses and the construction of a charging station.

Along with this innovative for Europe service, the project introduces other innovations to achieve a holistic approach to limiting air pollution from transport in the city: Green Corridors that provide the "greenest" route from one destination to another; Low Emission Zones – areas controlled by cameras in which only cars with a high Euro standard can enter on days with air pollution; Congestion charging – testing and preparation to introduce a congestion charge in certain urban areas; Introducing a "Loyal Eco Citizen" system, through which the green behavior of citizens and companies brings them incentives and rewards.

The project consortium is a guarantee for achieving synergies and knowledge transfer at the local, national, and European level.

Project partners:

Sofia Municipality;
Sofia University "St. Kliment Ohridski";
Plovdiv University “Paisii Hilendarski”;

Sofia Development Association;
National Association of Municipalities in the Republic of Bulgaria;
Urban Mobility Center EAD;
Modeshift Europe EAD;
National Institute of Meteorology and Hydrology.

Start date: 1 July 2020
End date: 30 June 2023
Budget: 3 712 553.52 EURO from ERDF through UIA initiative

Project Innovations

1. Sofia context

Population	1 383 435 (September 2022)
Area	492 km²
Density	6 800 inhabitants per km²
Public transport system	underground, tram, bus, trolley
Modal split.	public transport: 36.8%; car: 35.3%; walking: 20.9%; bike: 1.1%; e-scooter: 0.4%, public transport + walking: 4.6%
Car ownership	867 000 cars (407 cars 1000 inhabitants)
Cars per household	0.98
Congestion level	30% (on average 30% longer than during non-congested conditions)

Sofia Municipality is among the EU cities struggling the most in terms of air pollution and regular exceeding of toxic substances in the atmosphere (e.g. PM10, PM2.5), in breach of Directive 2008/50/EC. In 2017, the Court of Justice of the EU confirmed Bulgaria's (incl. Sofia district) failure to comply with the limit values for PM10, in 2019 the EC constituted second referral to the court for country's unhealthy levels of CO2 in Bulgaria. In addition, in 2019, Sofia District Court issued interim measures to Sofia Municipality obliging the city to provide real-time data on air quality and to wash streets twice a month. As confirmed by WHO air pollution is the 2nd global cause of health issues, economic losses, and reduced crop yields, also contributing to climate change and in Europe alone leading to more than 400 000 premature deaths. As an EU capital city, Sofia needs to take fast and innovative actions to tackle the problem and fulfil its obligations not only in terms of legal compliance but more importantly in terms of peoples' health and wellbeing. Additionally, Sofia experienced steady growth in terms of new buildings and districts (residential & office) during the past years, which compliments the overall expansion trend since 2007. Sofia's population grew with approx. 10%, thus increasing the number of vehicles drastically and respectively traffic jams. In addition, Sofia attracts working people from nearby cities, leading to more traffic and air pollution. In geographic standpoint Sofia is surrounded by high mountains preventing natural air flow, increasing the smog and fog, especially in winter. Although, a set of measures has been taken already, air quality remains constant issue. 2017 analysis performed by the World Bank confirms that traffic in Sofia has the highest impact in terms of pollution of ambient air - 51% for PM2.5, mainly by old vehicles (bellow Euro, Euro1). In addition, diesel vehicles contribute to 80% of total PM10 concentration.

INNOAIR tests several innovative solutions. It piloted for the very first time in Europe the concept of "Demand responsive green public transport" to reduce air pollution generated out of traffic congestions in the urban environment. It is based on data analytics modelling of traffic congestion and air pollution and impact assessment to define the districts where intervention is needed the most - in addition to pilot districts. The "On-demand public transportation platform" /ODPTP/ provides the ability to request e-busses and create optimized route depending on real-time data such as citizen demand, traffic, weather conditions, roadblocks, etc. The platform utilizes machine learning /AI/ and advanced analytics to ensure optimal speed and convenience to citizens. The developed and adopted innovative tariff model is meant to ensure sustainability of the initiative. 5 electric minibuses were bought and joined the city public transport fleet, together with 6 charging stations.

In addition to this innovative public service on a European scale, the project introduced several other nation-wide innovations. The "Green Corridors" set are essential part of the concept - they foster zero emission transportation throughout the city: electric public transport vehicles, e-scooters, e-bikes, shared e-cars.

Regulatory framework improvements have been introduced to facilitate the implementation and sustainability of the project pilots and demonstrations. Most notably this is valid for the concept development and the implementation of Sofia low emission zone – not only the first of its kind in Bulgaria, but also in Central and Eastern Europe. The roadmap for the introduction of congestion charging also includes all aspects needed: zoning, more of operation, charging scales, regulatory and normative amendments necessary, etc.

A critical success factor for the project approach was to engage citizens in the efforts to safeguard clean air, reduce pollution and become greener and more sustainable in daily life. All incorporated activities under the project were supported by wide stakeholder engagement which is envisaged at a very early stage of the project, as well as active dissemination and communication of the project, followed by dedicated to knowledge transfer, closure, and scaling of the initiative.

INNOAIR is built on the idea to propose integrated solution which is capable to address not only air pollution in urban areas, but also to scale and impact directly additional aspects such as climate change, carbon emissions, environment, city mobility, citizen satisfaction of public transportation and most of all health of citizens. Key focus is placed on measurable and well-defined KPIs resulting in clear and concise benefits to public authorities, business, and people across various dimensions of urban life. Holistic overview of all envisaged activities and subsequent deliverables demonstrates that at the heart of INNOAIR lays down a transformational initiative never tested in Europe before – namely, "Green on-demand public transportation". In addition, the applied multidimensional approach aims to avoid "siloed" thinking and set a number of pivotal complementary activities that in their entireness deliver innovation at scale – improving air quality and ensuring easy replication across other cities. The novel concept of e-busses providing on-demand public transportation shifts the way people move around in ever expanding cities, creating new paradigm of 1) Zero emission transportation – available at greater scale, 2) Dramatic reduction of traffic - among the top sources of air pollution, 3) Behavioural

shift towards Green and more sustainable way of living, 4) Active citizen engagement in the process of air quality improvement, 5) Multistakeholder cooperation and contribution.

2. Innovative Urban Mobility Measures

Within the INNOAIR project 8 demonstrations/pilots have been implemented, which differed widely in terms of context, type, and underlying policies. These demonstration measures were not an isolated attempt to improve the living conditions of the citizens, but they were integrated into Sofia urban transport policies and plans. In general, the focus of the INNOAIR project was on translating urban transport policy into practical implementation of innovative measures, whereas 'innovative' is understood in the city-specific context, except for the green on-demand public transport, which is an innovation on a European scale. However, not all measures were concerned with implementation, but some aimed at preparing the ground while others supported strategies and measures by developing a concept to be implemented later and/or through a different scheme. Out of the 8 INNOAIR measures 2 were aiming at direct implementation, 3 at concept development and implementation, and 1 measure developed concepts only (see Figure 1).

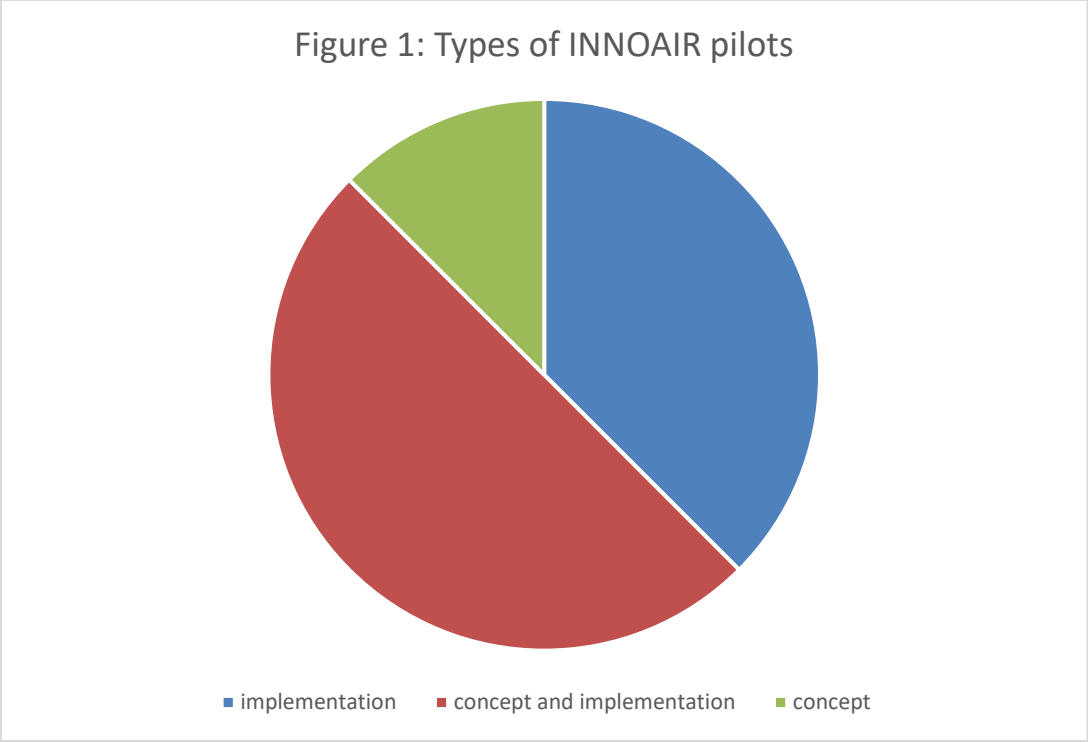

Figure 1: INNOAIR Pilot Measures by Type

Low Emission Zones Controlled areas for restricted vehicle access and eco mobility enhancement	**Concept & implementation**
Green Corridors Online tool assisting citizens to plan their journeys using only zero mobility electric public and shared transport vehicles	**Concept & implementation**
Software for public transport scheme enhancement Software for analysis, modelling, and upgrade of public transport timetables to decrease travel times and traffic	**Implementation**
New public transport tariff policy Setting up a fair and balanced tariff model	**Concept & implementation**
Calculation of background concentrations in Sofia region Modifying the Bulgarian Chemical Weather Forecast System (BgCWFS) at NIMH to provide background concentrations for the Sofia region, a necessary input for local air pollution dispersion models. Assessing the effect of low emission zones and green on demand public transport on the air quality in the respective areas of the city	**Concept & Implementation**
Green on-demand public transport E-public transport service in selected neighborhoods requested with the mobile app BUSINN, using AI to determine the optimum routes taking maximum people and creating minimum traffic.	**Concept & implementation**
Congestion charging A conceptual model, an analysis of regulatory framework, mathematical modelling of expected effects, recommendations for policy and normative amendments and improvements that would allow for the introduction of Congestion Charging.	**Concept**
SofiaCoin A municipally owned mobile app incentivizing and rewarding active transportation in Sofia.	**Implementation**

Table 1: INNOAIR measures by type

3. INNOAIR objectives, targets, and stakeholders

The INNOAIR project set itself ambitious transport-related, environmental, and societal objectives to be reached after four years. Moreover, the project formulated target quantifications also for 2023 (see Table 2). This orientation towards objectives emphasised the process character of the project not ending with its financial assistance but bringing effects for the city beyond this phase.

Indicators	Quantification for 2020	Quantification for 2023
AIR QUALITY		
Reduced PM as a result of pilots and increased public transport use	669 tons	550 tons
Reduced NO2 as a result of pilots and increased public transport use	2 925 tons	2 230 tons
Reduces CO2 as a result of pilots and increased public transport use	958 130 tons	824 172 tons
TRANSPORT		
Reducing single use vehicles	109 500 000 cars	103 354 000 cars
Satisfaction with transport innovations	n.a.	4 out of 5
Less time spent in traffic	30 minutes	20 minutes
SOCIETY		
Citizens using innovative urban mobility measures	n.a.	330 000 persons
Improved intra-organizational and quadruple helix cooperation	not specified	not specified
Achieve extensive political and public awareness	not specified	not specified

Table 2: INNOAIR objectives and indicators

Implementing each innovative measure is linked to underlying city strategies and policies – in some cases also project partners' strategies and policies. They were not an isolated attempt to organise urban transport in a more sustainable way, but instead they were related to the cities' local transport policies and their respective transport plans. They are part of the many urban transport activities undertaken in Sofia Municipality. Furthermore, the societal objectives set by INNOAIR aimed at improved intra-organisational co-operation and public private co-operation and thus the objectives called for strengthening integration and co-operation with urban transport stakeholders. The involvement of different departments of the city administration and politicians, but also the huge number of private partners ranging from universities, entrepreneurs, public transport companies, NGOs give evidence of the strong integrative character of the project.

The INNOAIR pilot measures were implemented in different geographical contexts. Some are general, all-encompassing measures, while others are site-based (on-demand public transport), area-based (low emission zones, congestion charging), or corridor-based (green corridors) measures. The geographical context of the demonstration measures is relevant for the reference area of the impact-related evaluation. The consideration of different contexts is important for both, the impact evaluation on measure level and the evaluation on city level. The area-based demonstration measures were expected to hold impacts within the area itself, whereas the site-based demonstration measures should have had impacts that extended into the adjoining areas. The corridor-based demonstration measures were supposed to generate effects along the corridor area. Some of the measures did not have a distinct geographical focus at all but they were concerned with processes and structures (congestion charging concept), which cannot be spatially located.

Project target groups as described in the AF include citizens, public and private organizations, non-governmental organizations, research and academic institutions in Sofia and Europe. Communication and dissemination activities target activization of citizens in Manastirski livadi and Baxton (piloting districts) and engagement of the entire population in terms of behavioural shift towards public transport uptake. Public and private entities are engaged to promote public transportation among their employees. Research and academia contribute to the innovation development and facilitating innovation validation and uptake.

Primary stakeholders are those that are immediately affected by and at the same time immediately affect the project outputs: the residents of Manastirski livadi, public and active transport users, environmental and community NGOs, transport companies, policy- and decision-makers. They are all included in the project evaluation.

Also included in the evaluation are external primary stakeholders: representatives of other municipalities in Bulgaria and EU, mobility and public transport companies, policy makers – participants in INNOAIR events and in transfer webinars, in networks where Sofia is a member, media representatives that cover sustainability, mobility and innovation domains.

1 Evaluation Method

The selected evaluation method is based on the Theory of change[1]. A theory of change explains how the activities undertaken by the project contribute to a chain of results that lead to the intended or observed impacts.

The following steps elicit the theory of change:

Theory of change steps	INNOAIR project actions
Step 1: Focus on the long-term vision of the project, likely to relate to a timescale that lies beyond its timeframe. Its aim should be closely linked to the existence of a local, regional or national problem.	INNOAIR overall objective is to improve air quality in the city of Sofia.
Step 2: Having in mind the ultimate aim of the project, define the necessary results by the end of the project if such an aim is to be met in the longer term.	Reduce single use vehicles. Increase public transport uptake. Foster citizen behavioural change.
Steps 3 and **4**: Types of outputs and short-term results that will help achieve the specified targets.	INNOAIR outputs as described in the AF. INNOAIR deliverables as described in the AF.
Step 5: Resources that can realistically be brought to bear on the planned interventions.	INNOAIR AF budget and work plan.

Table 3: Theory of change underlying INNOAIR evaluation map

The evaluation team then takes the project change map generated through this process and, using various data (qualitative and quantitative) collection techniques as relevant, monitored and analysed the unfolding of the project in practice and integrated the findings. The purpose was to provide empirical evidence for the project impact. To explore elements of the theory of change (e.g., cross fertilization, policy development, etc.) some quantitative techniques were used.

A number of potential limitations, assumptions and constraints were identified. One of the main limitations was contact with the direct beneficiaries of the project. The participants of this kind of

[1] https://ec.europa.eu/regional_policy/sources/evaluation/guide/evaluation_sourcebook.pdf, p. 54

projects are disperse and do not usually have an overall picture of the project. It was also difficult to contact them due to GDPR. Thus, participation often remains limited to the "usual suspects." Another limitation was that the project wass a complex one. By itself, it would not have been able to produce the expected results, as it also needed support from the context/s and other stakeholders, complementarities, and synergies with other work. Also, to establish the (final) impact on the environment of the new normative arrangement including the on-demand transport and low emission zones would take years.

Despite these limitations, these findings are considered to present a credible assessment of the project's progress and status. They are also comparable with other recent documents and evaluations of demonstration on-demand transport projects and technologies, which were analyzed for the purpose of this report. They are listed in the Reference section of this report.

The project final evaluation used diverse tools to address all data needs and combine qualitative and quantitative data. Collectively, over 250 persons participated in the extended evaluation process directly:

- User and citizen surveys with people using BUSINN app, SofiaCoin app, residents of Manastirski Livadi, general population (online questionnaires, QR code assessments, and face-to-face surveys).
- Data from Sofia public transport analytic and ticketing system regarding number of passengers, type of payment, occupancy, and time in traffic in different part of the day, etc.
- Operational data from the on-demand system.
- In-depth interviews with experts.
- Focus group with Steering Committee members.
- Project coordination and implementation teams' assessment - individuals directly involved in the ups and downs of the project.
- Events feedback forms – in particular, events like INNOAIR information days, transfer webinars, university, and citizen challenges, INNOAIR air quality hackathons, final conference, etc.
- Project documentation review: risk management reports, quality management plans and reports, project annual reports, milestone reviews, audits, etc.
- Desk research and analysis.

Evaluation Aspects

1. INNOAIR project implementation

As an innovative project, moreover, being implemented in the conditions of pandemic, INNOAIR needed to be evaluated in terms of project process, management, governance and cross fertilization between partners, timeliness, and quality of cooperation.

This evaluation aspect was evaluated based on project documents review and a survey with project partners. A total of 38 surveys filled out were analyzed.

All project deliverables and outputs have been achieved completely, as planned. About 1/5 of them have been delayed mainly due to COVID-19 restrictions and the unstable political situation in Bulgaria with four continuous general elections in a row. However, the delays were overcome at the beginning of year three and did not affect the quality of the deliverables and outcomes.

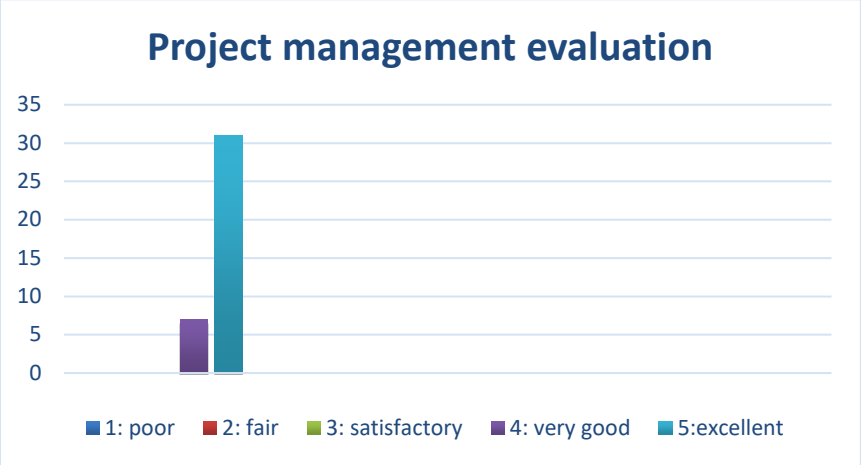

Figure 2: Partners' assessment of project management

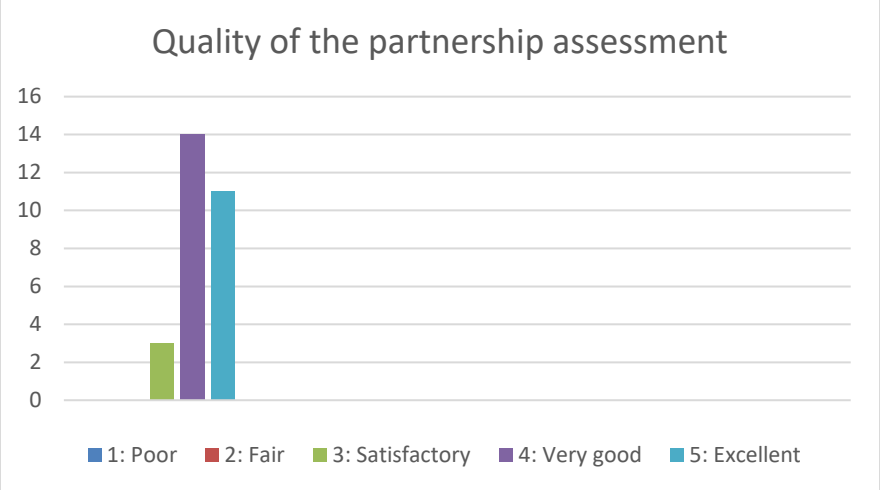

Figure 3: Partners assessment of partnership quality

The project management and coordination were defined as smooth, flexible, and rigorous, contributing to overall efficiency and effectiveness. Much of the success of a project lies in adapting to the changing environment, so the key challenge was to achieve the learning of the group that integrated the project. To do that, four project management components have been identified:

- Project leadership;
- Project structure;
- Project culture;
- Project learning opportunities.

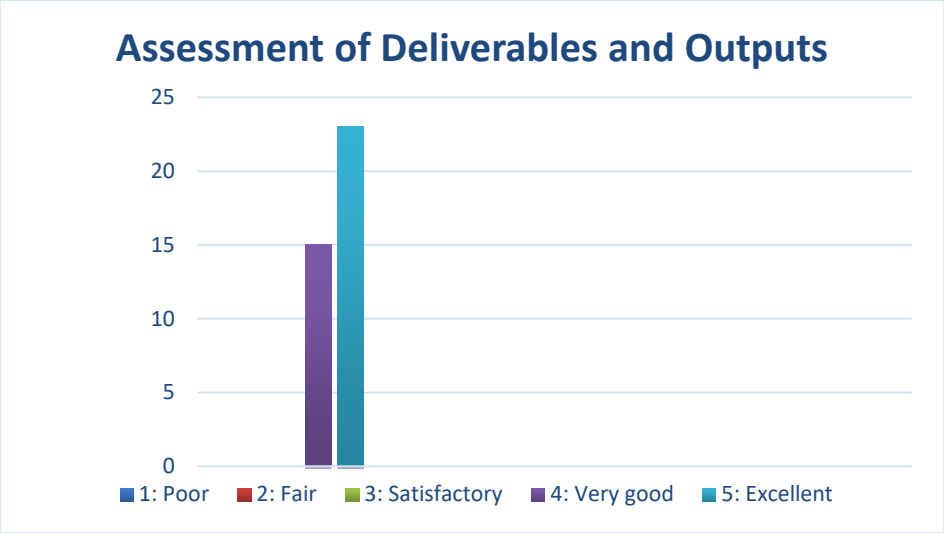

Figure 4: Partners' assessment of quality and usability of project deliverables and outputs

As most efficient project implementation components were identified internal and in particular external communications, co-creation and co-production approaches, innovative use of data and AI.

As main barriers and challenges project partners have faced during project implementation fall into several categories:

- Data related: access to statistical data, reluctance of some partners to share data, GDPR and security protocols, delayed data provision vs. real time, etc. In brief, Sofia Municipality needs to improve its capacity to store, manage and analyze data and develop protocols for sharing with other partners.
- Normative framework related: the lack of respective legal framework for certain project innovations (on-demand transport, congestion charging, etc.).
- Public procurement related: delays in the procurement procedures, appeals, delays in delivery, etc.

- Bureaucracy related: time consuming administrative procedures, municipal personnel does not understand technology.
- Partnership related: numerous and diverse partners, with different administrative procedures and communication culture.
- Target audience related: diverse target groups with diverse goals and opinions, difficulties to change behaviour.
- External: Covid 19 pandemic and restrictions, the war in Ukraine and the subsequent rise of energy prices and costs.

The financial project management was "evaluated" by an independent audit commissioned by UIA in 2022, which registered 0.00% ineligible project costs.

2. INNOAIR project impact

➔ **Awareness, acceptance and user experience and satisfaction**

The implementation and the success of innovations is related to social awareness, acceptance, and social justice. When no information is available on the problems, the plausibility of the intervention being effective is reduced. In addition, it takes time for an intervention to be fully implemented and 'working.'

To evaluate public awareness the team studied the project media relations and earned media, own project website and social media channels and engagements, the project e-newsletter subscription and circulation. The project received significant media interest, with over 2,200earned media for the entire duration of 3 years (at the average over 60 per month). Earned media is impressive not only in terms of quantity, but also in terms of quality. INNOAIR was presented and discussed in all national media outlets – Bulgarian National Television, Bulgarian National Radio, Bulgarian Telegraphic Agency, BTV, Nova TV, etc. but it also attracted the attention of major international media outlets including Politico, …, and was presented at European institutions and network like the European Committee of the Regions, the European Parliament, EUROCITIES, to name a few. The website has 27,500 visits, the newsletter reached a circulation of 600 subscribers, the Facebook page has over 1,300 followers.

Reducing the share of singe use vehicles, restrictive measures like low emission zones and congestion charging, on-demand public transport tariff policy are all measures that require public acceptance and social justice to guarantee no one is left behind. This aspect was evaluated based on a survey. It was additionally validated by including INNOAIR as a case study in the Just Green Transition Inception report by the UIA experts Marcelline Bonneau, Peter Ramsden, Alessandro Copolla and Ileana Toscano[2].

[2] The report is available at https://www.uia-initiative.eu/en/just-urban-transitions/inception-report-0

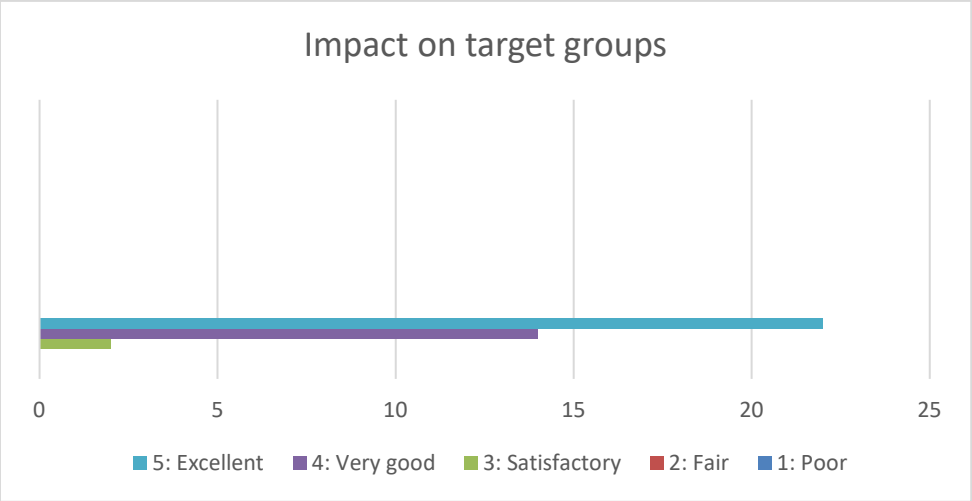

Figure 5: Partners' assessment of project impact on target groups

Client/user satisfaction with the major project innovation – electric on-demand public transport – is measured by user using the mobile app and comparing their level of satisfaction with the Haller system installed in all public transport vehicles in Sofia. In the beginning of 2022, all buses of the public transport were equipped with a QR code leading to the survey questions and the passengers can scan and provide their feedback. The first report with results was issued in June 2022. Despite the lack of communication campaign and the limited scope of the survey (QR code was still not available in trams and trolleybuses), a high level of citizens' activity was reflected. More than half of the people gave positive feedback regarding the transport service. Most active and engaged with the process and at the same time most critical were the young people under 35. As a top priority the passengers would like to use fast transport with clean vehicles, reliable timetables, and drivers with good behavior. Other factors of satisfaction were air conditioning in the vehicles during winter and summer.

A survey among the on-demand app users shows that a considerable share of them would have driven alone had the on-transport not been available. In addition, the improved information accuracy resulted in improved ease of use and overall experience, faster trip options in in the neighbourhoods serviced, and decreased planning and wait times. The numerical values are shown in the table with indicators.

➔ Project contribution to local government policies and programmes

Project achievements at the local level may be undermined and rendered unsustainable if the overall policy environment does not improve to sustain them. Conversely, improvements in the policy environment may prompt considerable social and economic dynamism and project upscaling. Therefore, the project evaluation of the level of municipal policies in the areas of mobility and clean air was conducted based on a review of municipal strategic and normative documents over the period July 2021 – June 2023.

The following municipal policies have been amended:

- Ordinance on the order and conditions for usage of public transport in the territory of Sofia Municipality (July 2022, and February 2023). The amendments introduced the on-demand service and the new tariff.

Since INNOAIR is an innovative project introducing new services and products for the first time not only in Sofia but in Bulgaria as well, certain new normative documents have been developed and adopted due to the project:

- Ordinance of Sofia Municipal Council for the introduction of Low Emission Zones (№31/2022).

National policies have been amended, too, with the initiative and significant contribution of Sofia Municipality. These national normative documents allow for the introduction of innovations at the local level:

- Law on Atmospheric Air Quality (amended in February 2021), allowing the introduction of Low Emission Zones in cities;

Finally, there is still a need to further amend national policies so that other innovations, such as congestion charging, can be introduced locally. Sofia Municipality participated in the working group with the Ministry of Transport, and tabled proposals for amendments in the Law on Automobile Transportation, Ordinance 2/15.03.2002 for the order to develop public schemes for passenger transport with public vehicles; and Ordinance on the conditions and order to provide resources for compensation of the reduced income from the application of prices of public passenger transport, described in the normative acts for specific categories of passengers, for subsidizing public transport on non-profitable bus routes of the urban transport and transport in mountain and other regions, for the issuance of transport documents.

➔ Modal split

Following the Sustainable Urban Mobility Plan measures and the activities required for the update and optimization of the public transport management, Sofia urban Mobility Centre conducts surveys on an annual basis, to determine the modal split and passenger travel behavior as well as the passenger loading of lines. An essential element of the survey is a questionnaire to citizens which provides data for the update and analysis of the modal split by comparing the results from different periods. The data received from the survey is used in the planning and decision-making process for improvement of the public transport service and urban mobility. The “face to face” survey consists of 20 questions on the traveling behavior and citizens’ expectations towards the use of diverse types of transport. The participants are citizens aged between 14 to 80 years.

The distribution by mode of transport - modal split, is made on the basis of single rides. Single journeys can be more than one within a single destination-to-destination trip – for example, a person uses a car and public transport to get to work. However, when public transport is used several times within one trip (i.e., there is a transfer), public transport is counted only once.

The graph below shows the dynamics of the modal split based on data from the 2020, 2021 and 2022 surveys.

Modal split is one of the key elements of urban mobility. INNOAIR aimed at reducing car use in general, and particularly single car use with the objective to contribute to urban sustainability and climate protection, by using restrictive regulations (low emission zones), new services (on-demand public transport and green corridors), stimuli and gamification (SofiaCoin), new tariff policy, measures in the direction of MaaS.

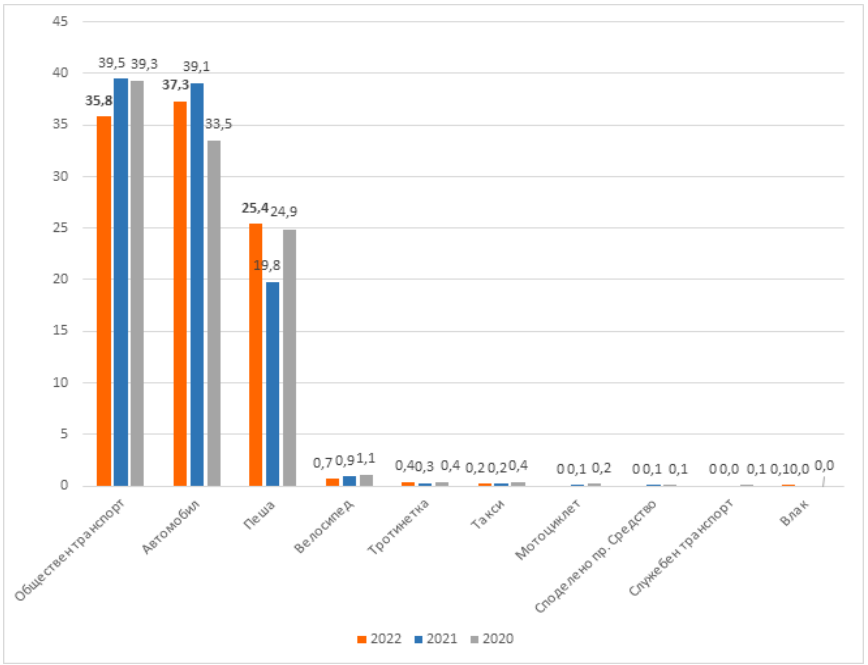

Figure 6: Modal Split trends

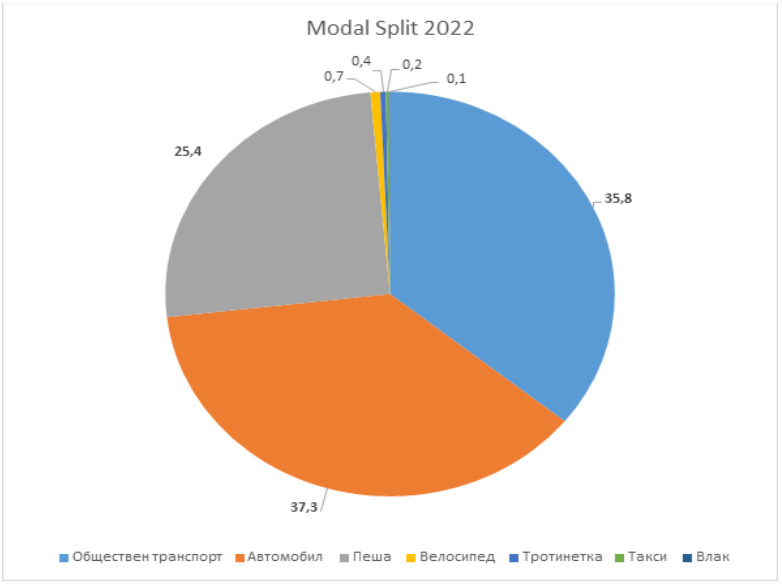

Figure 7: Modal Split 2022

➔ Reduction of CO2 and PM emissions

CO2 and PM emissions reduction through mobility measures was a main project objective, and a main variable to be monitored and evaluated. Data and tools to support CO2 and PM impact analysis include:

- The measurements of the municipal air quality stations (6 certified by the Ministry of Environment and 22 installed by the Air Things project).

- The inventarization of emissions on the territory of Sofia Municipality, which is carried out every 5 years. The latest inventarization was completed in 2020 and the report was published in 2022.

- The regular 3-month, 6-month and 12-month reports on the implementation of the Municipal Program for Atmospheric Air Quality 2021-2026.

➔ User impact and stakeholder involvement and empowerment

Citizens play a key role in developing and implementing innovative solutions to complex challenges. Engaging citizens is of particular importance when behavioral change at the micro level is expected, since it is based on understanding of the need and benefits and is best done in dialogue and partnership. INNOAIR citizen engagement data is collected primarily via events documentation. Throughout the project duration, as outlined in the Stakeholder Engagement Plan, a minimum of one stakeholder engagement event was to be held every trimester, or 12 engagement events altogether. The actual stakeholder engagement events were 24 with over 3,000 direct participants – see details in Stakeholder engagement Report, D2.3.2.

However, the outcomes of citizen engagement are context specific and depend on the local government and citizens' capacity and willingness to engage collaboratively. For that reason, all INNOAIR piloting activities were developed in cycles, or learning loops, to allow for timely citizen feedback. In result, some of the innovative solutions got adapted in the process to respond better to citizen needs. Thus, the Green corridors introduced also a real time map of road works in addition to zero-emission public and shared transport, and on-demand transport started using road information signs in addition to the mobile app BUSINN.

Some project activities were directly aiming at stakeholder empowerment – some project deliverables and products were co-designed, such as "131 Ideas for Empowerment in the transition to sustainable urban mobility", or the mobile app rewarding active transport "SofiaCoin", others – like the 12 citizen competitions and the 3 INNOAIR hackathons - provided meaningful opportunities to university students and citizens to develop own initiatives and be agents of change.

A good indicator to measure engagement is the scope of stakeholders beyond the project partnership that contributed to the project implementation financially or in-kind – over 10 companies (including DXC Technologies, A1, Eventim, Brum, Hobo, Bike Rental, Sofia Film Fest), 6 universities (3 in Sofia – University of Forestry, New Bulgarian University and Technical University Sofia, and 3 in other Bulgarian cities – Technical University Gabrovo, Varna Free University, Plovdiv University of Food Technologies), 3 municipal cultural institutes (Vazrazhdane City Theatre, Off the Channel City Theatre, Toplocentrala center for contemporary art), and others.

➔ Academic impact

Although INNOAIR is not e research project, the development and the implementation of the innovative services was made possible through the partnership with three academic institutions – Sofia University St. K. Ohridski, Plovdiv University P. Hilendarski and the National Institute for Meteorology and Hydrology, as well as researchers from other universities interested in INNOAIR. Their activities also resulted in capturing and sharing knowledge in the form of 13 academic articles, all of which are indexed[3] and all are peer reviewed.

The academic research component of INNOAIR allowed researchers to demonstrate its impact outside of academia – into city services applied into practice and show how this engagement has become a central feature of academic routines.

On the other hand, scholarly publishing captures work-based learning and the development effect of the project activities, research, and pilots.

➔ Impact on project consortium members

All project partners reported that INNOAIR exercised positive influences upon their institutions/organizations. Most have developed new types of partnerships structured in a way that would go beyond the project scope. Some partners have designed new products and services that help them adapt and advance in the changing environment. Most partners also report that the vastly increased media exposure and public interest lead to their improved recognition, public confidence, potential for innovations, and future prospects. The project resulted in new experiences working with multiple partners with different administrative procedures, AI, data sharing and data management, developing new internal policies and practices, successful international independent audits, etc.

[3] All INNOAIR academic articles are also published on the project website:

Evaluation Findings

1. KPI Quantifications

Name	Description	Unit	Baseline	Target value	Achieved
Name/title of the result indicator	The description shall clearly specify: 1. What is measured (number of people, kg, Co2 emissions, etc.) 2. Who measures it (responsible DP) 3. How you are measuring it 4. Frequency of update/follow-up of the indicator	Indicate the unit	The description shall clearly specify: 1. The initial value of the result indicator before the project implementation 2. The information source from where you received the value	The expected result indicator's value at the end of the project implementation.	
1. Reduced PM as a result of pilot "On-demand green public transportation" in Sofia	1. 803 kg of PM10 & PM2.5 annually are avoided (diesel + petrol) in Sofia as a result of the "On-demand green public transportation" pilot. 2. SM, SUMC 3. This metric will be tracked by the number of rides made in the platform and data provided by existing air quality stations in Sofia. 5 vans x 15 approx. people per van / 10 courses per van/day = 750 people using ODPTP / out of 750 people - 517 cars rides which is the official statistics (https://swiss-contribution.bg/uploads/manager/source/SUMP 21-05-2019.pdf) on % ration of registered vehicles to registered people / 517 cars rides x 20 days per month x 12 months x emission according to EURO standard x km. - Measured with ODPTP 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Kg	1. 669 tons PM emissions are generated by traffic annually. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2. Sofia Municipality Programme for Air Quality Management 2015-2020 (adopted by Sofia Municipal Council with Decree N252 of 18.05.2017)	**803**	**725**

2. Reduced NO2 as a result of p "On-demand green public transportation" in Sofia	1. 3,5 tons of NO2 annually are avoided (diesel + petrol) in Sofia because of the "On-demand green public transportation" pilot. 2. SM, SUMC 3. This metric will be tracked by the number of rides made in the platform and data provided by existing air quality stations in Sofia. 5 vans x 15 approx. people per van / 10 courses per van/day = 750 people using ODPTP / out of 750 people - 517 car rides which is the official statistics (https://swiss-contribution.bg/uploads/manager/source/SUMP 21-05-2019.pdf) on % ration of registered vehicles to registered people / 517 cars rides x 20 days per month x 12 months x km x emission according to EURO standard. - Measured with ODPTP 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 2925 tons of NO2 annually generated by traffic. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2.Sofia Municipality Programme for Air Quality Management 2015-2020 (adopted by Sofia Municipal Council with Decree N252 of 18.05.2017)	**4**	**3.16**
3. Reduced PM as a result of pi "Low Emission geospatial urban zones" in Sofia	1. 44,9 tons of PM10 &PM2.5 annually are avoided in Sofia because of the "Low Emission geospatial urban zones" pilot. 2. SM, SUMC 3. This metric will be tracked by CCTV. 300,000 cars enter city centre on average based on camera detection; 125,000 cars enter the city centre – 60 days car ban (w/o EURO 5 and 6 standard cars) per year will result in 125,000 car rides x 60 days x emission EURO standard 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 669 tons of PM emissions are generated by traffic annually. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2. Sofia Municipality Programme for Air Quality Management 2015-2020 (adopted by Sofia Municipal Council with Decree N252 of 18.05.2017)	**45**	**21**

4. Reduced NO2 as a result of pilot "Low Emission geospatial urban zone Sofia	1. 187,8 tons of NO2 annually are avoided in Sofia because of the "Low Emission geospatial urban zones" pilot. 2. SM, SUMC 3. This metric will be tracked by video cameras. 300 000 cars enter city of Sofia on average based on camera detection - 125 000 enter the city centre - 60 days car ban (w/o EURO5,6) per year will result / 125 000 car rides x 60 days x 30 km x emission EURO standard 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 2925 tons of NO2 emissions are generated by traffic annually. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2. Sofia Municipality Programme for Air Quality Management 2015-2020 (adopted by Sofia Municipal Council with Decree N252 of 18.05.2017)	**188**	**88**
5. Reduced PM as a result of pi "Congestion charging" in Sofia	1. 197 tons of PM annually are avoided in Sofia as a result of the "Congestion charging" pilot. 2. SM, SUMC 3. This metric will be tracked by the number of rides made in the platform and data provided by existing air quality stations in Sofia. Congestions charging shall result in additional 20% less cars (300 000 entering daily) meaning 60 000 cars less/daily x 365 days x 0.009 kg emissions per day = 197.1 tones PM avoided annually 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 669 PM tons emissions are generated by traffic annually. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2. LPR Cameras, Google Traffic, Waze Traffic	**197**	--
6. Reduced NO2 as a result of p "Congestion charging" in Sofia	1. 503 tons of NO2 annually are avoided in Sofia because of the "Congestion charging" pilot in Sofia 2. SM, SUMC 3. This metric will be tracked by the number of rides avoided; 60,000 less cars x 66% (diesel vs. petrol) x different types of standards (Euro 1 to 6).	Tons	1. 2925 tons of NO2 annually generated by traffic. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods.	**503**	**147**

	4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.		2.Sofia Municipality Programme for Air Quality Management 2015-2020 (adopted by Sofia Municipal Council with Decree N252 of 18.05.2017)		
7. Reduced CO2 because of pilo "On-demand green public transportation" in Sofia	1. 162,1 tons of CO2 annually are avoided in Sofia because of the "On-demand green public transportation" pilot. 2. SM, SUMC 3. This metric will be tracked by the number of rides made in the platform and data provided by existing air quality stations in Sofia. With "On-demand green public transportation" only we estimate 30 km average from Manastirski Livadi East/West and Baxton to Sofia center and back - 30 km x 130g/km CO2 - 41 567 car rides less annually x 130g x 30km =162,1 tons /annually of CO2 emissions avoided. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 958 130 tons of CO2 emissions generated by traffic. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2. Regulation (EC) 443/2009 (https://ec.europa.eu/clima/policies/transport/vehicles/cars_en)	**162**	**146**
8. Reduced CO2 as a result of p "Low Emission geospatial urban zones" in Sofia	1. 9798 tons of CO2 annually are avoided in Sofia as a result of the "Low Emission geospatial urban zones" pilot. 2.SUMC, SM 3. This metric will be tracked statistically by the number of vehicles not entering the "Low Emission geospatial urban zones. (Baseline will be based on statistics) 41 875 petrol car rides less - 41 875 rides 30 km (On average based on official statistic) - 41 875 x 30 km x 130 g per km (CO2) x 60 days = 9798 tons annually avoided. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 958 130 tons of CO2 emission generated by traffic. If needed, the baseline could be further fine-tuned during project implementation to reflect the values in the targeted neighbourhoods. 2. Regulation (EC) 443/2009 (https://ec.europa.eu/clima/policies/transport/vehicles/cars_en)n	**9 798**	**4557**

9. Reduced CO2 as a result of p "Congestion charging" in Sofia	1. 28 185 tons of CO2 annually are avoided in Sofia as a result of the "Congestion charging" pilot. 2. SM, SUMC 3. This metric will be tracked by the number of vehicles not entering the zone of the pilot. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 958 130 tons of CO2 emission generated by traffic. If needed, the baseline could be further fine-tuned during project implementation in order to reflect the values in the targeted neighbourhoods. 2. LPR video cameras	**28 185**	--
10. Reducing single use vehi as a result of pilot "On-demand green public transportation" in Sofia	1. "On-demand green public transportation" shall result in 124 080 car rides less per year. 2. SM, SUMC 3. This metric will be tracked by the number of rides made in the platform and data provided by existing air quality stations in Sofia. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Car rides per year	1. Baseline to be determined during project implementation. 2. Sofia Municipality Programme for Air Quality Management 2015-2020 (adopted by Sofia Municipal Council with Decree N252 of 18.05.2017 (https://www.sofia.bg/documents/20182/298121/Project_Program_KAV_Sofia_2015-2020.pdf/23a572ba-77ac-45a4-b627-c77ea0e225c7?fbclid=IwAR2w77D2_k4zqBsFxDJdzf3H3mMjfHH_o8x3lGlWSMN-9lOQMhAWVqW6bXU)	**124 080**	**112 080**
11. Reducing single use vehi as a result of pilot "Low Emissio geospatial urban zones" in Sofia	1. "Low Emission geospatial urban zones" shall result in 6 000 000 less cars entering city centre per year 2. SM, SUMC 3. This metric will be tracked statistically by the number of vehicles not entering the "Low Emission geospatial urban zones. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Cars per year	1. 109 500 000 cars 2. Municipal CCTV average daily statistics	**6 000 000**	**3 511 872**
12. Reducing single use vehi as a result of pilot "Congestion charging" in Sofia	1. "Congestion charging" shall result in 20% less cars (300 000 entering daily) meaning 60 000 cars	Cars per year	1. 109 500 000 cars entering city yearly 2. LPR Cameras	**21 900 000**	

	less/daily or 21 900 000 less per year when imposed. 2. SM, SUMC 3. The metric will be tracked by LPR cameras. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.				--
13. Cultural shift of citizens towards wider adoption of publ transportation (NO2 reduction)	1. The expected wider Cultural shift of citizens may top up additional reduction of NO2 emissions on an annual basis. Therefore 453,9 tons of NO2 are avoided annually in Sofia as a result of the wider Cultural shift of citizens. 2. SM, SUMC 3. The metric will be measured by municipal statistical data 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 2925 tons of NO2 2. SUMC public transportation usage data	**454**	**727,7**
14. Cultural shift of citizens towards wider adoption of publ transportation (CO2 reduction)	1. The expected wider Cultural shift of citizens may top up additionally a minimum 10% reduction of CO2 emissions on an annual basis. Therefore, approx. 95 813 tons of CO2 annually are avoided in Sofia as a result of the wider Cultural shift of citizens. 2. SM, SUMC 3. The metric will be measured by municipal statistical data 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Tons	1. 958 130 tons of CO2 annually generated 2. SUMC public transportation usage data	**95 813**	**32876**
15. Cultural shift of citizens towards wider adoption of publ transportation (PM reduction)	1. The expected wider Cultural shift of citizens may top up additional reduction of PM10 and PM2.5 emissions on an annual basis. Therefore, min 118,3	Tons	1.669 tons of PM10/PM2.5 2. SUMC public transportation usage data	**118**	

	tons of PM10 and PM2.5 are annually avoided in Sofia as a result of the wider Cultural shift of citizens. 2. SM, SUMC 3. The metric will be measured by municipal statistical data 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.				**163,8**
16. Citizens using the "On-demand green public transportation" platform	1. Minimum 180 000 citizens (riders/passengers) are using the ODPTP per year 2. SUMC, SM 3. This metric will be measured by the number of citizens using the platform for "On-demand green public transportation" 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Number of citizens (riders/passengers) per year	1. 0 2. N/A	**180 000**	**171 360**
17. Citizens using "Green corridors"	1. Minimum 150 000 citizens using "Green Corridors" per year. 2. SUMC, SM 3. This metric will be measured by the number of citizens using a web platform https://livemap.sofiatraffic.bg/ 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation.	Number of citizens per year	1. 0 2. N/A	**150 000**	**173 592**
18. Average duration of a tri the "On-demand green public transportation" platform	1. On average, each passenger trip will last 15 minutes. 2. SM, SUMC 3. This metric will be measured with the platform for "On-demand green public transportation" 4. Bi-annually	Minutes	1. 0 2. N/A	**15**	**15**

19. Average distance of a tri the "On-demand green public transportation" platform	1. On average, each passenger trip will be of 7 kilometres 2. SM, SUMC 3. This metric will be measured by the platform for "On-demand green public transportation" 4. Bi-annually	Kilometres	1. 0 2. N/A	**7**	**4,5**
20. Average occupancy of a on the "On-demand green publ transportation" platform	1. Average occupancy of mini electric busses will be 15 people per trip. The electric buses will have capacity of up to 25 seats (14 + 1 sitting and 10 standing). Therefore, we expect that on average for each bus trip to have occupancy of min 15 passengers inside the bus. 2. SM, SUMC 3. This metric will be measured by the platform for "On-demand green public transportation" 4. Bi-annually	People	1. 0 2. N/A	**15**	**8**
21. Overall average service satisfaction rating of the "On-demand green public transportation" platform	1. The overall average service satisfaction rating of the "On demand green public transportation" platform will be 3.5 out of 5 stars rating system 2. SM, SUMC 3. This metric will be measured via a rating system for citizens using the platform for "On-demand green public transportation" 4. Bi-annually	Stars	1. 0 2. N/A	**4**	**4,1**
22. Average rating per ride on the "On-demand green public transportation" platform	1. The average rating per ride on the "On-demand green public transportation platform" will be 3.5 stars out of 5 stars. 2. SM, SUMC	Stars	1. 0 2. N/A	**4**	**4,2**

	3. This metric will be measured via a rating system for citizens using the platform for "On-demand green public transportation" 4. Bi-annually				
23. Average rating per driver behaviour on the "On-demand green public transportation" platform	1. The Average rating per driver behaviour on the "On-demand green public transportation" platform will be 3.5 out of 5 stars 2. SM, SUMC 3. This metric will be measured via a rating system for citizens using the platform for "On-demand green public transportation" 4. Bi-annually	Stars	1. 0 2. N/A	**4**	-
24. Higher overall user satisfaction in On-demand public transportation compared to the regular public transportation in Sofia	1. The overall user satisfaction in On-demand public transportation will be minimum 50% higher compared to the regular public transportation in Sofia. 2. SM, SUMC 3. This metric will be measured by online client survey. It will be tracked with poll on the website. 4. Annually, the TV refers to the TV to be achieved at the end of the project implementation. In other words, at the end of the project implementation, the satisfaction in ODPT will be at least 50% higher than the regular public transportation in Sofia.	Percentage	1. The Baseline will be determined during the project lifetime. The Baseline will show how much the satisfaction of the regular public transportation service is in Sofia. 2. N/A	**50**	**50**
25. Less time spent in traffic congestions when using ODPT compared to the regular transportation in Sofia	1. On average, each passenger trip using the On-demand public transportation shall result in 10 minutes less in traffic, compared to a similar trip using regular public transportation in Sofia. 2. SM, SUMC	Minutes	1. On average, the duration of a similar trip with the regular public transportation service in Sofia is 30 mins. 2.	**10**	

	3. This metric will measure the time, using the platform for "On-demand green public transportation" 4. Bi-annually, the TV refers to the TV to be achieved at the end of the project implementation. In other words, at the end of the project implementation, the average passenger trip will be 10 minutes shorter, compared to a similar trip in the regular public transportation in Sofia.				**10**
26. Achieved financial sustainability for the On-demand public transportation	1. The project considers that the On-demand public transportation is financially sustainable if it is able to reach similar running costs as regular public bus transportation. 2. SM 3. This metric will be measured, as follows: 20 days x12 months X 10 courses a day x 5 minibuses x 2 (both ways) = 168 000 km, or 33 600 km per bus x 3.16 leva/km (the value includes the total, with subsidy, compensation, transport pass included, without VAT) = 530 880 BGN per year. 4. Annually	BGN per year	1. 2.	**530 880**	**180 000 (900 000 km for 5 years)**

Table 4: INNOAIR indicators, baseline, and achievement

2. Project as a Driver of Change and Recognition

During the three years of implementation INNOAIR managed to concentrate on the efforts and ambitions of Sofia Municipality and its partners in the area of sustainable mobility and cleaner air and thus produce results. It is not surprising that INNOAIR was instrumental in the major developments and achievements of the city in this respect:

- INNOAIR was invited to testify before the European Parliament's Special Committee on Artificial Intelligence in the Digital Age regarding artificial intelligence and its use by public administration.
- Sofia became a finalist in the European Green Capital competition 2023[4].
- Sofia became one of the 100 Climate Neutral and Smart Cities by 2030 to join the EU mission[5].
- Sofia became a finalist in the European Mobility Week competition 2022[6]. Here is what the Commission press release says in confirmation of INNOAIR role:

*"The nominees for the EUROPEAN**MOBILITY**WEEK Award 2022 are: (….) **Sofia** (Bulgaria) for its new transportation service that better combines citizens' mobility demands and reduced environmental impact. Services include electric buses, an on-demand mobile application, green corridors and new more affordable tariffs. In addition to providing cleaner and more accessible transport, the Bulgarian capital is working within the framework of the InnoAir project, which seeks to reduce air pollution through traffic calming measures as part of the European Union's Urban Innovative Actions."*

INNOAIR received national recognition as well. The Mayor.eu at their annual ceremony 'MAYOR OF THE YEAR 2022" awarded a special prize for mobility innovations to the INNOAIR project[7].

All these forms of recognition – together with several others – are evidence of the public interest in the project, the raised expectations and public scrutiny, and the potential and impact of the project as a driver of positive change.

3. Opportunities for scaling up and scaling out

Since INNOAIR is an innovative project aiming at piloting and evaluating products and services that had not been tested in the EU, the team did their best not to keep the results to themselves. To avoid a 'launch-and-leave' approach (do some promotion when an output is launched and then leave the scene hoping an audience will develop by itself) a special emphasis was put in two directions:

[4] https://environment.ec.europa.eu/news/urban-sustainability-which-european-cities-are-competing-eu-green-capital-and-green-leaf-awards-2022-05-24_en
[5] https://ec.europa.eu/commission/presscorner/detail/en/IP_22_2591
[6] https://mailchi.mp/8dce46cb2d26/press-releaseeuropean-commission-announces-awards-finalists?e=%5BUNIQID%5D
[7] https://kmeta.bg/кмет-на-годината-2022-в-снимки/

- Reaching audiences, raising awareness, stimulating debate, and convincing others to get on board to advocate for change and take action. INNOAIR was presented at conferences and events of big European networks (EUROCITIES, ENoLL), major events like the European Week of Cities and Regions, EUI launch event, the UIA Air Quality Club, to EIT Mobility, other EU projects like CompAir, 100KTREEs, etc. INNOAIR was covered in hundreds of popular publications and over a dozen academic indexed ones. The four transfer webinars and seminar attracted around 400 attendees from Bulgaria and abroad with 70 cities and organizations.
- Making transfer and scaling up easier by reflecting on the innovative pilots, developing an Exploitation and Sustainability Report that contains an adaptation model for each of the four innovations, quality, and evaluation reports to measure the impact.

All innovations under the project were considered interesting and scalable by the participants in the knowledge-transfer webinars and seminar. The top ranked innovations were the on-demand transport and congestion charge, followed by the modelling of data and urban simulations to enhance the public transport scheme and emission savings. These topics cover the following outputs: 1) On-demand public transportation platform, 2) Tariff policy and price list model for Green On-Demand Public transportation, 3) District based public transportation scheme enhancement for air quality reinforcement and 4) Final evaluation report on "Sofia Congestion Charge Zone.

Regarding the scalability and willingness to test the solutions in their cities 86% of the participants pointed out as their first choice the on-demand transport, while 52% indicated that for low emission zones. Green corridors took the third place with 45%.

As part of the survey during the first webinar dedicated to Low emission zones and Green corridors 79% of the participants point out that LEZ would be applicable in their cities, while 57% shared the same opinion about the Green corridors.

It is also worth mentioning that the main discussion points under the ODT were the financing of this type of transportation; actions taken for the legal-normative amendments in the field of public transport to realize this service in practice; negotiation/awarding/payment between the municipality and the companies providing urban transport; ideas from the Innoair project, which can be used in drafting project proposals under existing calls and programmes.

Participants were also asked about the most important prerequisites for behavioural shift in citizens preferences towards public transport and active mobility. 70% indicated the need to improve the infrastructure, convenience, and service level of public transport as the most important condition. In second place with 61% was the feedback from citizens and in third place with 52% was the improved digital access to public transport services.

The major project innovation – on-demand transport – has a remarkably high potential for transferability, particularly to big cities with urban sprawl. Although different exploitation models

are possible, the essence of using AI and mobile apps to direct public transport when and where necessary, at the same time serving as many people as possible, has proven both an attractive and effective solution. It works particularly well in city peripheral areas, as a first mile – last mile transport microsystem. It is also suitable as a night transport option. On-demand increases public transport attractiveness and accessibility by providing, at same cost as regular public transport, more geographic coverage, a denser network of stops and a reduction of travel times. It also contributes to mitigating transport poverty in areas with scarce transport options and among transport dependent individuals.

The low emission zone is the first one in Bulgaria and in the neighbouring countries. Therefore, the interest in it is significant. Other big Bulgarian cities like Plovdiv, Burgas and Varna are planning or preparing to introduce their LEZ, so exchange and learning from the experience of Sofia is already taking place.

Congestion charging is still not introduced in Sofia or Bulgaria, because the current normative framework does not allow other bodies except the Road Infrastructure Agency to charge for road use. However, the developed by INNOAIR road map, containing step-by-step legal advice, tech equipment, charging model and tariff, and a mathematical model for the expected effect, set up a baseline in Bulgaria in this respect.

The new opportunities provided by EUI for transfer and exchange are also a strong enabling factor for INNOAIR scaling up in the near future.

A specific form of scaling up was achieved through Sofia participation in EC's International Urban and Regional Cooperation program. Sofia was hooked up with Semarang, Indonesia, and the two cities exchange was focused on public transport. Among the takeaways for Semarang professionals was to develop SemarangCoin based on the SofiaCoin example. The software for optimization of public transport timetables was also a good practice transferred to the Asian city.

4. Lessons Learned

Because INNOAIR was focused on monitoring, evaluation, and reflection on the innovations it piloted, it also managed to become a platform for capturing stories and lessons learned. INNOAIR has gained experience and insights for nearly all aspects of technology-enabled mobility: planning, public procurement, exploitation, monitoring, institutional factors. Below are the major lessons learned, aimed to inform transportation practitioners, policymakers, and the public:

- **Policies and regulations**

Specific national and local policies need to be in place for the introduction and even for testing of innovative public services. Certain local mobility innovations are not possible if there are no respective national regulations and provisions. A great deal of project efforts is dedicated to identifying legal gaps, amending local normative framework, advocating for national changes, in addition to developing a complex innovative service. This is especially valid for pioneer cities that pilot an innovation for the first time in their country, which was the case of Sofia. As a minimum,

this means every project needs to have a strong legal team and get acquainted with the legal analysis and good practices well in advance to prepare for the introduction of an innovation. Sofia had to amend several local normative documents and advocate for national legislation amendments to implement successfully INNOAIR.

- **Local authority (technical) capacity**

To implement a successful technology driven innovative mobility project, the respective local authority needs to have adequate technical capacity, physical and digital infrastructure necessary to support on-demand mobility, respective administrative and security protocols, etc. Technical and institutional gaps need to be identified and addressed prior to the implementation of a risky innovative project. Local administrations should be aware of the impacts of artificial intelligence and machine learning, remove their bias, improve AI adoption rates, address cautionary areas. Local authorities need to have the ability to integrate complex technological solutions and to address branding and ownership issues.

- **Data management and data sharing**

Data management and data analysis is challenging in itself for local authorities, at least in Bulgaria. Adding to that, a diverse partnership with private, public, academic, commercial, non-governmental partners poses a significant challenge to data generation, storage, sharing, and analysing in the light of protecting costumers but also proprietary information of individual partners. Data management and data sharing should also be forward looking and develop protocols in case of changes in the partnership, bankruptcies, need to migrate data, etc.

- **Cost**

The on-demand public transport is meant to provide transport services to users at a lower per-trip cost than other options – using own car, or car sharing, or else. Although INNOAIR so far has no sufficient testing time and data after this micro mobility system is established to make life-cycle cost calculations, the initial cost of developing and piloting on-demand schemes is substantially higher than conventional transport services. A balance needs to be achieved between the Just Green Transition goals to eradicate transport poverty and business and cost-efficiency objectives.

- **Partnerships**

Partnerships involving public and private partners, transport operators, technology vendors, due to the different business models of individual partner, are likely to lead to project delays, IPR and open-source issues, challenges developing partnership terms and continuity and sustainability models. The better prepared you are for such risks, the better the chance to mitigate them without significant negative consequences.

- **On-demand transport service area**

One of the most important lessons learned is that it is important to define properly the area to be serviced by on-demand public transport. Public authorities should not assume that there is a latent demand for such a service. Areas with low density cannot generate enough passengers. Residents often want to travel outside of the service area, so it works best if there is a combination of regular

public transport to other city areas and on-demand transport within the service area. It is critical to calculate well how many buses can be allocated to the on-demand service because this would determine their frequency. The very low frequency of the on-demand vehicles would result in fewer users.

- **Users**

Time and resources need to be dedicated to meaningful two-way stakeholder involvement, beyond informing. Citizen involvement in the areas to be serviced by the on-demand service were longer and more intense than planned. Sufficient citizen input is needed at the right time, particularly during planning, and sufficient time and resources need to be allocated to citizen input during piloting. Potential users should be identified, and engagements efforts need to be targeted to achieve impact. Ideally, specific groups need to be addressed individually – potential users with disabilities, people who do not have smart phones, people who have no bank cards, etc. Beyond the immediate users, attention should be also given to the public at large to achieve and preserve public confidence.

5. Recommendations

- Policies

Policies to allow and to prepare the introduction of on-demand mobility need to be developed and put into practice. Generally, changes in the national and perhaps EU legal framework are to be made to provide for flexibility in provision of public transport services and modification of existing offers.

- Integration

Integration of innovative mobility services with traditional public transportation functions and incentive structures for travel using public transport.

- Providing information for pedestrians

The Green Corridors allowing for enhanced trip planning and the use of real time online map with construction works on the roads, as well as feedback from SofiaCoin users led to the conclusion that if accurate sidewalk data is provided, this would optimize pedestrian use of sidewalks and safe low-speed residential streets.

- Cost efficiency

Full life cycle cost estimation needs to be carried out to define the necessary resources for the introduction and exploitation of on-demand mobility. At the same time, on-demand transport, since it is restricted to a relatively small service area, seems to be able to attract enough passengers only if it is the cheaper option. Benefits in terms of delivering access to education, healthcare, culture, work opportunities, should also be considered.

- Impact of on-demand public transport on communities

Further studies are necessary to monitor and evaluate the impact of on-demand transport on diverse groups of citizens and their travel behaviour. Initial observations for instance show that more women

are likely to substitute own car use for on-demand public transport. It is worth comparing on-demand mobility use vs. school buses by high school students.

- Guidance

Detailed guidance for the introduction of on-demand mobility needs to be developed for public agencies responsible for public transport, including needed policies and practices, physical and digital infrastructure, resources, etc. Parallel to that, guidance needs to be developed for incorporating on-demand mobility into modelling and scenario planning.

- Data

In order to accelerate the transition towards more sustainable and smarter mobility, it is essential to unlock the potential of mobility data. Creating common data spaces for mobility will facilitate access, pooling, and sharing of mobility and transport data.

- Funding

Structured funding programmes are necessary, going beyond pilot phase, allowing the deployment of technical planning and operation skills and reaching the desired outcome in terms of significant modal shift and improved accessibility to jobs, education, health, and social services.

Conclusions

This document presents the strategic approach taken by the INNOAIR team to guarantee the sustainability of the project tools and results. The main assets which constitute INNOAIR along with the exploitation paths that are possible to safeguard their long-term sustainability after the end of the project are described within this document.

The report was developed by experts with each member of the project consortium, and with broad participation of stakeholders, with over 300ndividuals directly involved, by means of diverse participation instruments.

This report also explains the paths for further technology developments, as well as adoption models for other urban authorities, including incentives and business models, therefore constituting a "guideline" for the exploitation and sustainability of the INNOAIR offering beyond its lifespan.

The evaluation found that implementation of INNOAIR produced all the main expected outputs and performance indicators. That being said, some outputs were delivered in a protracted fashion and took longer than initially planned. Significant delays and inefficiencies in the project's administration did not however affect the overall outcomes. Efficiency losses resulted from the unstable political situation in Bulgaria during the project implementation, the COVID crisis and the Russian invasion and the war in Ukraine and some weaknesses in the project's planning and coordination. Fortunately, the efficiency weaknesses did not have a major impact on the project's effectiveness.

The project interventions have been evaluated as impactful, efficient, and transferable. The transferability factors are described in detail in D3.6.1 exploitation and Sustainability Report.

As a result of the evaluation findings, lessons learned have been formulated, as well as recommendations.

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