POLICY BRIEF

MAROUSSI, GREECE

SOCIO-BEE is a HORIZON-funded project that took place over 2021 – 2024, by an international consortium of 18 organisations across Europe.

The Municipality of Amaroussion (Maroussi) was one of three pilot cities that conducted citizen science campaigns to measure air quality and pollution.

Citizens were at the heart of SOCIO-BEE, driving climate research and greater community engagement in urban planning.

INTRODUCTION

The HORIZON 2020 SOCIO-BEE Project (Wearables and droneS fOr CIty socio-environmental Observations and BEhavioral changE) is a pioneering effort in citizen science, empowering European communities to monitor and enhance air quality for a cleaner, healthier, and more sustainable future. This multidisciplinary initiative engaged diverse demographics across European cities, fostering active citizen participation in environmental stewardship and the fight against climate change.

From September 2021 to September 2024, citizens in pilot sites in Italy, Spain, and Greece used wearable sensors and other technologies to measure and assess air quality. This process connected them with scientific research and encouraged behavioural change, contributing to improved climate resilience. The data generated may support local policymakers in developing evidence-based air pollution reduction strategies.

*This document shares key insights from the SOCIO-BEE pilot in **Municipality of Amaroussion (Maroussi), Greece**, with a focus on the motivations, challenges, and outcomes observed. These findings can serve to inform air quality policies and advance community engagement in climate resilience at both the local, national, and European levels.*

SOCIO-BEE & CITIZEN SCIENCE

Citizen science is an approach that involves public participation in scientific research, where individuals can contribute to data collection, analysis, and interpretation, consequently bridging the gap between scientific research and community engagement.

SOCIO-BEE used this approach to engage communities in air quality monitoring and environmental stewardship. By involving citizens in the scientific process, the project expanded data collection to under-monitored areas, raised environmental awareness, and provided valuable data for policymakers to potentially inform urban planning.

What is citizen science?
Read more about citizen science and how it was used in the SOCIO-BEE Project in the 'White Paper: Enhancing Air Quality Monitoring Through Citizen Science: Insights and Recommendations from The Socio-Bee Project'.

SOCIO-BEE involved diverse groups, including school children, older adults, and commuters, emphasising inclusivity and gender equality through tools like the Project's *Social Inclusion and Non-Discrimination Checklist*. Participants identified local issues, tested hypotheses, and designed experimental campaigns using wearable technologies.

The project used a bee colony metaphor to structure roles within *Hives* (local action groups): *Beekeepers* managed local groups of volunteers, *Queen Bees* led and coordinated the experimental campaigns, *Worker Bees* collected air quality data, *Drone Bees* were non-participants that were indirectly influenced by campaigns and disseminated the project and its results to the wider audience, and *Bears* – such as policymakers – connected the campaigns to local governance and wider social impact.

Through this type of collaboration, which engaged citizens across various levels of involvement, SOCIO-BEE empowered communities to take ownership of air quality issues, fostering a foundation for informed, community-driven solutions to urban pollution.

For more information on how to integrate citizen science into local governance, see Scivil's guide:
Citizen Science and Local Government

AIR POLLUTION

Given the growing concerns about the impact of air pollution on public health and the environment, effective air quality monitoring is essential, especially in urban areas. Accurate and reliable data plays a fundamental role in shaping policies, driving pro-environmental actions, and safeguarding community well-being. High-quality citizen science data is particularly valuable to authorities and decision-makers, as it helps inform evidence-based policies from a citizen-centred perspective, contributing to public health, environmental protection, and overall quality of life based on local indicators.

TECHNOLOGY & INNOVATION

The SOCIO-BEE Project recognised the importance of data accuracy for local governance and developed innovative, wearable-based technologies to monitor air quality. These included the AcadeME web platform (which allowed the management of citizen science campaigns and the visualisation of the data gathered in the campaign), wearable air quality sensors produced by BETTAIR *(see right)*, and a mobile app connected to the sensors that enhanced participant interaction by recommending optimal routes and locations for taking measurements and uploading the collected data to a database. Citizens used these three technologies to take part in campaigns to measure pollution levels in precise locations. Additionally, SOCIO-BEE employed drones equipped with the air quality sensors, allowing for additional real-time air quality measurements.

The project's innovative approach and technologies has been show-cased at various international conferences, including the EuroGEO 2022, 21st European Week of Regions and Cities 2023, Ecsite 2023, EU Green Week 2023, SPlitech 2023, WHO European Healthy Cities Annual Business Meeting and Technical Conference 2023, and XVIIth International Congress of Educating Cities 2024.

THE SOCIO-BEE CONSORTIUM

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PILOT FINDINGS

Background on the Municipality of Amaroussion (Maroussi)

Maroussi, located 13km from Athens city centre, is a critical part of the capital's metropolitan area. As a major transportation hub, the suburb is intersected by heavily trafficked highways. These accommodate around a million vehicles per day. This intense traffic significantly contributes to the region's pollution, with the impact able to extend up to 400m away, affecting nearby residential areas. In addition to this pollution, Maroussi has experienced an increase in domestic heating emissions. Following the 2009 economic crisis, a shift towards biomass combustion, including wood and pellets, has led to higher concentrations of pollution, exacerbating air quality challenges in the community.

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While Maroussi's transportation infrastructure enhances its accessibility, it also worsens air quality. Traffic emissions remain the primary source of pollution, with levels fluctuating based on congestion and weather. Residents often report poor air quality – though these perceptions are difficult to verify without real-time data. Pollutants like ozone (O3) have been noted to exceed safe levels at times, particularly in the summer, highlighting the need for targeted interventions to protect public health.

Maroussi faces air quality issues more severe than the national average due to urban congestion and heavy traffic. The suburb records higher levels of nitrogen oxides (NOx) and particulate matter compared to many other regions in Greece. However, its air quality is somewhat comparable to other large cities or Athenian suburbs, and in some cases, even better. Despite this, the elevated pollution levels in Maroussi pose significant public health risks, contributing to increased respiratory and cardiovascular diseases. The environmental impact also underscores the need for policies aimed at reducing traffic emissions and promoting cleaner alternatives for heating and transportation.

SOCIO-BEE in Maroussi

The SOCIO-BEE pilot conducted by the Municipality of Maroussi aimed to engage local commuters, schools, and other stakeholders in monitoring and mitigating air pollution. By deploying advanced wearable and stationary air pollution sensors and drones, the project collected, mapped, and analysed air quality data across the city. This technical data was further enriched with social insights, offering a comprehensive understanding of how to improve engagement with citizens to maximise their contribution to pollution monitoring for furthering local air quality management efforts.

Key Campaigns and Data Collection

During the pilot in Maroussi, a series of campaigns were designed and conducted by citizen science participants using SOCIO-BEE tools to investigate various air quality concerns and test multiple hypotheses across different regions within the municipality. Air quality sensors were also positioned alongside the official air quality station for more than six months to evaluate their performance

against certified monitoring equipment, thereby enhancing the accuracy and reliability of the collected data. Additionally, wearable sensors were placed on municipal buses, where bus drivers participated by collecting air quality measurements during their regular routes, offering valuable insights into the pollution levels commuters are exposed to during daily travel. Drones equipped with air quality sensors were deployed to capture pollution data at various altitudes, providing a dynamic view of pollution across Maroussi. These diverse methods effectively complemented different air quality readings, integrating citizen engagement with innovative technologies.

Community Engagement

The pilot successfully engaged diverse participants, structured around the SOCIO-BEE's bee metaphor, which included 15 Hives, 6 Queen Bees, 75 Worker Bees, and 4 Drone Bees across two pilot iterations. Over 9 hypotheses were developed with several sub-campaigns facilitated through the AcadeMe platform. A total of 1,161 air quality measurements were collected by the volunteers. Feedback from key groups such as teachers and students was overwhelmingly positive.

> A teacher noted, *"The project sparked significant interest among my students. We would gladly continue the collection of air quality measurements after the summer break"*. A retiree also expressed satisfaction, saying, *"SOCIO-BEE allowed me to contribute a small part towards creating a better future for the next generation"*.

Educational Impact

The testimonials received underscore the project's educational impact, especially within youth-focused communities and organised volunteer groups. The initiative fostered a sense of ownership over local air quality and significantly raised awareness about local environmental issues and challenges among participants and the broader community. This increased awareness about air quality and pollution emerged as a crucial secondary outcome, influencing public discourse on environmental stewardship.

Additionally, the pilot effectively involved a particular group of commuters, i.e., students, acknowledging that they commute daily and can be considered a particularly vulnerable group. By directly involving this group in data collection, students were able to provide valuable insights into local air quality conditions during the morning rush hour. The groups that were reached in this pilot demonstrated the potential for citizen science initiatives to engage and educate diverse populations on environmental issues.

Stakeholder Collaboration and Project Outcomes

The pilot's success was largely driven by strong collaboration among key stakeholders, including local policymakers and air quality experts. Project coordinators managed the deployment of air quality sensors at strategic locations, such as the local air quality station, townhall, and on public buses, and ensured alignment with municipal strategies. Support from local policymakers, such as the Mayor, Mr Ampatzoglou, the Vice Mayor of Environment and Quality of Life, Mr Ioannidis, and the Vice Mayor of Civil Protection and Public Health, Mr Nikolarakos, was crucial in boosting the project's visibility and garnering community support through high-profile events like a 'I Love My City' campaign and social media promotion.

The pilot activities also demonstrated the critical importance of carefully selecting and engaging the right participants for effective data collection. Forming cohesive groups from a diverse pool of individuals required substantial effort to establish collaboration and create functioning 'hives' (i.e., action groups). These activities demonstrated that structured and well-organised groups consistently produced better results than those composed of randomly selected individuals. Furthermore, participants who were already motivated and exhibited pro-environmental behaviours were able to conduct measurements independently and continuously, significantly enhancing data collection efforts.

Findings & Insights in Maroussi

The Maroussi pilot provided a comprehensive overview of local air quality through its innovative approach and high participant engagement. With 85 active participants across two iterations, the project exceeded initial expectations, resulting in 1,161 air quality measurements through the SOCIO-BEE app. Moreover, rich datasets were achieved using advanced methods, including deploying wireless air quality sensors on public buses and drones, as well as fixed sensors at key locations, such as an air quality station.

Citizen Science in Action

During a factory fire in July 2023, a group spontaneously formed to measure air pollution, highlighting SOCIO-BEE's adaptability to extreme events and citizens' commitment to engaging in real-time environmental monitoring, even under urgent and challenging conditions. This Hive collected 32 air quality measurements over 4 days.

The pilot successfully demonstrated the feasibility of these technologies for environmental monitoring and enhanced public awareness of air quality issues through effective communication campaigns and public events. It also had a notable educational impact, engaging schools, volunteer associations, and municipal employees, fostering greater interest in environmental science. Preliminary data analysis shows that the data collected from the air quality sensors were comparable and similar to the data collected from traditional air quality stations and align with expected trends. The initial findings reveal a correlation between high pollutant levels and traffic density, especially near major highways and during peak hours. This underscores the need for better traffic management to improve air quality.

PILOT RECOMMENDATIONS

To maximise the impact and sustainability of the SOCIO-BEE Project based on the pilot in Maroussi, we propose several policy recommendations for national and local policymakers.

1 **Enhance the Integration of Citizen Science into Environmental Monitoring**
By leveraging community-driven data collection, such as SOCIO-BEE's use of wireless sensors, policymakers can gain more granular and real-time insights into air pollution on a local level. By integrating citizen science initiatives into regular air quality monitoring programs, this approach can complement traditional monitoring methods and improve the accuracy of pollution assessments.

2 **Allocate Funds to Integrate Citizen Science Data into Municipal Workflows**
By allocating funds to integrate citizen science data from project such as SOCIO-BEE into existing municipal workflows, local authorities can enhance the effectiveness of environmental management. Leveraging citizen-collected data will enable real-time monitoring of pollution hotspots and support data-driven policy development. This integration can improve the responsiveness of municipal departments to air quality issues, strengthen urban planning efforts, and ensure more efficient traffic management.

3 **Promote Public Engagement and Education Campaigns**
Increasing support raises awareness about air quality and public understanding of environmental issues, fostering a culture of active participation in air quality management. In this way, community groups and organisations can be encouraged to participate in and promote citizen science projects.

4 **Implement Data-Driven Traffic Management Policies**
Using data collected from citizen science projects to inform and guide traffic management and urban planning policies can reduce traffic emissions and improve air quality. Policymakers can use this data to develop targeted interventions, such as congestion pricing or improved public transport options, to mitigate the impact on air pollution.

5 **Facilitate Collaboration Between Stakeholders**
Effective partnerships can enhance data collection efforts, streamline communication, and ensure that findings are translated into actionable policies. Strengthening collaboration between local governments, academic/research institutions, and environmental organisations can optimise the impact of citizen science projects.

CONCLUSION

The SOCIO-BEE pilot in Maroussi demonstrates the effectiveness of citizen science in enhancing air quality monitoring and community engagement. The findings highlight the importance of collaborative efforts in achieving sustainable urban development. Policymakers are urged to use these insights to enact evidence-based policies that prioritise air quality, empower communities, and foster long-term environmental stewardship. By integrating citizen science into policymaking, Maroussi and other cities involved in the SOCIO-BEE Project can lead the way in creating healthier, more sustainable urban environments in Europe.

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