SEAMLESS SHARED URBAN MOBILITY

Demonstration & impact evaluation of Leader LLs

Project deliverable D 4.2

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Project Executive Summary

The objective of the SUM project is to transform current mobility networks towards innovative and novel shared mobility systems (NSM) integrated with public transport (PT) in more than 15 European Cities by 2026, reaching 30 by 2030. Inter-modality, interconnectivity, sustainability, safety, and resilience are at the core of this innovation. The outcomes of the project offer affordable and reliable solutions considering the needs of all stakeholders such as end users, private companies, public urban authorities. This deliverable report presents the results from the leader Living Labs focused on advancing sustainable urban mobility in cities such as Munich, Geneva, Jerusalem, and Athens (Penteli). Each city demonstrates unique approaches and outcomes in integrating public transport systems with NSM solutions.

Overall, the SUM project emphasizes the significance of a comprehensive, data-centric, and collaborative framework to maximize the effectiveness of shared and sustainable urban mobility across different environments.

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Deliverable executive summary

The purpose of this deliverable is to provide a comprehensive overview of the findings and insights gained from the leader Living Labs in the Project SUM – Seamless Shared Urban Mobility, which is focused on sustainable urban mobility in cities such as Munich, Geneva, Jerusalem, and Athens (Penteli). Key objectives of the deliverable include summarizing essential outcomes and lessons learned from each Living Lab, which highlight successful strategies and areas for improvement in urban mobility practices. By distilling these insights, the deliverable aims to inform evidence-based policy recommendations (see D5.7 – SUM Policy Recommendations) that can enhance sustainable mobility practices, address existing challenges, and promote effective governance frameworks.

Munich showcases a well-integrated public transport system that, alongside a growing shared mobility ecosystem, lays a strong foundation for sustainable urban mobility. The data indicates a shift towards a multimodal transport system, although challenges like congestion and parking pressure necessitate targeted interventions. The Living Lab emphasizes that while shared mobility, particularly car sharing, can reduce private car ownership, successful implementation requires data-driven planning, user-centred measures, and robust integration with public transport. Continuous data collection and stakeholder involvement are crucial for adapting solutions to real mobility behaviours.

Geneva illustrates a coordinated, multi-layered approach to sustainable urban mobility, achieving measurable results through the deployment of 21 mobility hubs and the expansion of on-demand services. Positive trends include increased partnerships, improved travel times, and high user satisfaction. The findings underscore the importance of embedding mobility hubs in formal planning documents and ensuring stable public funding for long-term sustainability.

Jerusalem highlights the impact of the LRT Red Line extension, which significantly enhances public transit usage and station activity while serving as a backbone for complementary services like 'Jerufun' (shared bike). Despite favourable user attitudes towards on-demand services, the limited fleet size and localized focus present challenges. The findings suggest that mobility interventions should leverage existing infrastructure and be designed hierarchically, with the LRT kept as a foundational layer.

Athens (Penteli) demonstrates that peri-urban municipalities can achieve sustainable mobility through infrastructure changes, shared mobility services, and user-friendly digital tools. The project has fostered collaboration among partners to address local mobility challenges, although bureaucratic hurdles and insufficient central government support remain obstacles. The Penteli case advocates for a combined approach to interventions, emphasizing that change is possible even in car-dependent environments when supported by data, user feedback, and a clear long-term vision.

Additionally, the deliverable facilitates knowledge sharing by serving as a resource for best practices and innovative approaches among cities and stakeholders involved in urban mobility initiatives. This exchange of information is vital for fostering collaboration and learning from one another's experiences, ultimately leading to more effective solutions. Furthermore, the document supports future research and development by identifying gaps in current knowledge and suggesting areas for further investigation. This ensures that urban mobility strategies continue to evolve and be improved in response to emerging trends and challenges. Another important aspect of the deliverable is its emphasis on encouraging stakeholder engagement. It underscores the significance of collaboration among local authorities, transport providers, and community members in achieving sustainable mobility goals. By involving a diverse range of stakeholders, the deliverable aims to ensure that solutions are practical, relevant, and aligned with the real needs of urban populations.

By compiling and analysing the best practices from these Leader Living Labs, this deliverable aims to contribute to the broader discourse on sustainable urban mobility and support the implementation of effective NSM solutions for seamless shared mobility in diverse urban contexts.

Key words: #shared mobility, #NSM solutions, #stakeholder engagement

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1 List of abbreviations and acronyms

Acronym	Meaning
AIC	Akaike Information Criterion
aBIC	adjusted Bayesian Information Criterion
AHP	Analytical hierarchy Process
AI	Artificial Intelligence
AMoD	Autonomous Mobility-on-Demand
AV	Autonomous Vehicle
BIC	Bayesian Information Criterion
CAIC	Consistent Akaike Information Criterion
EV	Electric vehicle
GPS	Global Positioning System
IT	Information Technology
KBA	Kraftfahrt-Bundesamt (German Federal Motor Transport Authority)
KPI	Key Performance Indicator
LCCA	Latent Cluster Class Analysis
LiDAR	Light Detection and Ranging
LL	Living Lab
LRT	Light Rail Transit
MaaS	Mobility-as-a-Service
MLE	Maximum Likelihood Estimation
MoT	Ministry of Transport
NSM	New shared Mobility
OASA	Transport for Athens
ODP	Open Data Platform

OEM	Original Equipment Manufacturer
pid	person identifier
PM	Particulate Matter
P & R	Park and Ride
PT	Public Transport
R & D	Research and development
SIEF	Social Innovation and Engagement Framework
SrV	System repräsentativer Verkehrsbefragungen
SUMP	Sustainable Urban Mobility Plan
TPG	Transports Publics Genevois
TÜV	Technischer Überwachungsverein
WP	Work Package

2 Purpose of the deliverable

The purpose of this deliverable is to provide a comprehensive overview of the findings and insights generated by the leading Living Labs (LLs) on sustainable urban mobility in the cities of Munich, Geneva, Jerusalem, and Athens (Penteli). This document serves as a reference for stakeholders, policymakers, and researchers to understand the effectiveness of integrated public transport systems and new shared mobility solutions.

2.1 Attainment of the objectives and explanation of deviations

The objectives related to this deliverable have been achieved in full and as scheduled. With regard to the activities of the Munich Living Lab, an amendment to the project framework was officially approved in February 2026, that enabled the Living Lab to officially commence its activities in May 2025.

Key objectives of the deliverable include:

Table 1: Deliverable Objectives

Objective	Who
Summarizing Key Findings D4.2: To summarize the essential results and lessons learned from each Living Lab, highlighting successful strategies and areas for enhancement in urban mobility.	Munich Geneva Jerusalem Athens - Penteli
Informing Policy Recommendations: To provide evidence-based recommendations for policymakers aimed at enhancing sustainable mobility practices, addressing challenges, and promoting effective governance.	WP4 – All LL's have contributed towards Policy Recommendations (WP5)
Facilitating Knowledge Sharing: To serve as a resource for sharing best practices and innovative approaches among cities and stakeholders involved in urban mobility initiatives.	All LL's facilitated their best practices in their respective capacities throughout the project duration through expert sessions, Living Lab visits, capacity-building workshops, conference sessions, stakeholder workshops, and more.
Encouraging Stakeholder Engagement: To emphasize the importance of collaboration among local authorities, transport providers, and community members in achieving sustainable mobility goals.	Leader and follower Living Labs
Replicability, Lessons Learned and Best Practices: To identify gaps in current knowledge and suggest areas for further research, ensuring continuous improvement in urban mobility strategies.	Leader and follower Living Labs

2.2 Intended audience

This document serves as a critical reference for stakeholders, policymakers, and researchers, enabling them to understand the effectiveness of integrated public transport systems and shared mobility solutions in addressing urban mobility challenges through measures implemented in several cities across Europe. The intended audience includes city administrations, private companies involved in mobility services, public urban authorities, and academic institutions, all of whom play a vital role in shaping the future of urban transportation. Overall, the report highlights the importance of a holistic, data-driven, and collaborative approach, which can be utilized by these stakeholders as a guide to best practices in sustainable mobility measures. By sharing successful best practices by implemented measures and innovative solutions from various European cities, the document aims to foster a deeper understanding of how shared mobility can complement existing transport systems, reduce congestion, and enhance accessibility for all citizens.

Furthermore, the insights and recommendations provided in this document are designed to inform decision-making processes, encourage innovative solutions, and promote the adoption of strategies that enhance the overall quality of urban mobility for all users. The report emphasizes the need for collaboration among different stakeholders, including local governments, transport operators, technology providers, and community organizations, to create a cohesive and efficient mobility ecosystem.

2.3 Structure of the deliverable and links with other Work Packages

This deliverable is structured to provide a comprehensive overview of the demonstration activities, results, and lessons learned from the four Leader Living Labs (Munich, Geneva, Jerusalem, and Athens–Penteli) within WP4. Following this introductory chapter, Section 3 presents the Living Labs in a harmonised structure, describing their local context, objectives, demonstration activities, stakeholder involvement, implemented measures, evaluation methodologies, results, impacts, lessons learned, and transferability potential. The document concludes with annexes that provide supporting analyses, datasets, methodological details, and cross-Living Lab assessments, including modal shift investigations and KPI evaluations.

The work presented in this deliverable is closely linked to several other Work Packages within the SUM project. First, WP1 provided the methodological foundations for data collection, stakeholder engagement, and the Social Innovation and Engagement Framework (SIEF), which guided Living Lab activities and ensured a common evaluation approach across the project. The Living Labs generated valuable empirical data and stakeholder feedback that contributed directly to the validation and refinement of WP1 outcomes.

Strong synergies also exist with WP2 and WP3, which developed the digital tools, simulation frameworks, data platforms, and modelling capabilities used throughout the demonstrations. Several Living Labs, particularly Munich and Jerusalem, applied and validated SUM-developed tools such as simulation-optimisation frameworks and mobility modelling solutions, providing real-world feedback that supported their further development and refinement.

Finally, the findings generated through the demonstrations contribute directly to WP5, which focuses on impact assessment, replication and policy recommendations. The evidence gathered in the Living Labs, including user feedback, operational results, KPI assessments, and lessons learned, forms an essential basis for the development of policy recommendations and replication guidelines presented in WP5 deliverables. This deliverable provides key inputs for the SUM policy recommendations and supports the transferability of successful mobility measures to follower Living Labs and other European cities.

Through these interconnections, D4.2 acts as a central bridge between the conceptual and methodological work undertaken in WP1, the technological developments of WP2 and WP3, the real-world demonstrations of WP4, and the policy and replication activities of WP5, thereby contributing to the overall objective of fostering seamless, shared, and sustainable urban mobility across Europe.

3 Living Labs

3.1 Living Lab Context

The deliverable D4.2 outlines the measures implemented in the leader living labs and includes an evaluation of their impact. Information regarding the follower living labs will be provided in the deliverable D4.3. For a comprehensive analysis of the modal shift that illustrates the impact of the measures implemented in the Living Labs (LLs) over the course of the project, please refer to the Annex of deliverable D4.2, which contains data for both leader and follower LLs. Specifically, Annex 4.1.5, titled "Investigation of Modal Shifts," highlights the overall impact of these measures across all LLs.

3.1.1 Munich

3.1.1.1 Executive Summary

The Munich Living Lab (LL) supports the city's Sustainable Urban Mobility Plan (SUMP) 2035 by promoting the integration of shared mobility into the urban transport system. Following the approved amendment to the Grant Agreement (February 2026), the LL shifted its focus from the originally planned autonomous mobility demonstration to the data-driven analysis and optimization of car-sharing services and their integration with public transport.

The LL combined operational car-sharing data, user surveys, stakeholder engagement, and the open-source simulation framework FleetPy to analyse mobility patterns, identify demand hotspots, evaluate infrastructure needs, and assess user acceptance. Activities focused on expanding dedicated car-sharing parking, developing mobility hubs, and improving multimodal integration.

A key outcome was the quantitative simulation of operational car-sharing data using FleetPy. Based on historical free-floating car-sharing trips, different ride-pooling scenarios were evaluated, showing that 36.6% of direct inner-city trips could be successfully pooled, highlighting the potential to reduce traffic, parking demand, and vehicle kilometres travelled. FleetPy also enabled the assessment of alternative service configurations and infrastructure concepts before implementation.

Survey results confirm that Munich has a highly multimodal mobility system, with the highest share of shared mobility among all project Living Labs. Car-sharing contributes to reducing private car dependency: 26% of car-sharing trips replace private car trips, while 32% of respondents reported that car-sharing had prevented them from purchasing a private vehicle. At the same time, 72% of users identified blocked dedicated parking spaces as a major operational barrier, underlining the need for improved parking management and better integration with public transport.

Overall, the Living Lab demonstrates that combining real-world data, quantitative simulation, and user-centred evaluation provides a robust basis for planning and scaling shared mobility services. The methodology and lessons learned are transferable to other cities seeking to promote sustainable, multimodal mobility, while the experience gained from the discontinued autonomous mobility pilot also offers valuable insights into the technological, regulatory, and organisational requirements for future autonomous mobility deployments.

3.1.1.2 Living Lab Context

With a population of over 1.6 million inhabitants, Munich continues to be a major European hub for air, rail, and road transport, and a key urban node at the intersection of two TEN-T corridors[1]. The city boasts a highly integrated public transport system connected to the greater Munich region, including buses, subways, metro lines, and trams. Munich is a densely populated and economically strong metropolitan region, with a diverse urban fabric of historic districts and modern business, cultural, and innovation hubs. The city's prosperity and high quality of life drive strong mobility demand from residents, commuters, and visitors alike. Urban growth, changing work patterns (including increased home office), and sustainability objectives are shaping travel behaviour and infrastructure planning. In 2023, Munich participated in the nationwide Mobilität in Städten – System repräsentativer Verkehrsbefragungen (SrV),[2] a survey conducted by the Technical University of Dresden. Over 40,000 residents were surveyed about their mobility habits, providing a robust empirical basis for policy and planning.

According to the SrV 2023 results, environmentally compatible modes of transport (walking, cycling, and public transport) together accounted for 76 % of all journeys in Munich, showing a significant shift towards sustainable mobility. The share of journeys made on foot increased to 33 %, while cycling also rose compared to previous surveys. Public transport usage nearly reached pre-pandemic levels, and car use declined substantially to 24 % of all journeys. Multimodal travel is increasingly common: 62 % of respondents used more than one transport mode in a typical week (up from 53 % in 2017). Shared mobility services also show a notable uptake — around 22 % used carsharing, 12 % rented bikes, and 18 % used e-scooters.

The Living Lab Area was the entire city of Munich. Available public transit modes are Bus, Metro, Tram. New and shared modes are:

Table 2: Munich LL - Shared Mobility providers in Munich

Mode	Company name				
Car-sharing	Miles	STATTAUTO	Sixt	free2move	CarVia
Carpooling	Blabla Car	Mitfahrzentrale (Carpooling platform)			
Bikesharing	MyRadl	Call-a-bike	Lime	Dott	Voi
E-Scooter	Bolt	Dott	Lime	Voi	
Electric Moped-Sharing	Emmy				

[1] The Trans-European Transport Network (TEN-T) is a planned network of roads, railways, airports and water infrastructure in the European Union.
[2] Landeshauptstadt München, Mobilitätsreferat. (2025). Mobilität in Städten 2023: Ergebnisse der Befragung

Ride hailing	Uber	Bolt	
Taxi	Taxi München e.G.		

The Mobility-as-a-Service (MaaS) application is MVGo, which enables users to book and pay for mobility services offered by nearly all shared mobility operators. It also includes a public transport ticket shop and a multimodal journey planning service.

The broader Living Lab Challenges are:

- Traffic Volume and Congestion – Managing peak-hour traffic while balancing street space for cars, public transport, cyclists, and pedestrians.
- Traffic Emissions – Reducing CO_2 and air pollutants through electric mobility, cycling, walking, and public transport.
- Crowded Public Transport – Addressing peak-hour capacity limits and integrating shared mobility to distribute demand.
- Parking Accessibility – Reducing parking pressure and allocating space for shared mobility and active transport.
- Public Space Conflicts – Managing competing uses of limited street space and optimizing infrastructure for pedestrians and cyclists.
- Urban-Rural Differences – Adapting mobility solutions to dense urban areas, suburbs, and surrounding rural regions.
- Equity – Ensuring affordable, accessible mobility options across all neighborhoods and socioeconomic groups.
- Ticketing & Integration – Providing seamless payment and booking across public transport and shared mobility.
- Shared Mobility Operation Areas – Defining suitable zones for carsharing, bikesharing, and micromobility while complementing public transport.

Before the implementation of the Living Lab activities, the expansion of carsharing in Munich had only just begun, and the supporting infrastructure was limited. The system had not yet been widely adopted by citizens, usage had not been formally evaluated. Public awareness and outreach regarding carsharing services were limited, and the deployment of further infrastructure had not progressed significantly.

At that time, the broader shared mobility ecosystem was still in its infancy. Multimodal integration with other shared mobility modes such as e-scooters and bikesharing, but also public transport, digital ticketing, and seamless access to new mobility services had not yet been established. The limited availability of vehicles and dedicated parking zones constrained the potential uptake of carsharing. Consequently, the city had not yet fully leveraged the opportunities offered by shared mobility to address urban challenges such as congestion, parking pressure, and traffic emissions.

This baseline context provided a clear starting point for the Living Lab, highlighting the need for systematic testing, citizen engagement, infrastructure development, and evaluation to enable the successful adoption and scaling of innovative shared mobility solutions.

The Living Lab activities are closely aligned with Munich's Sustainable Urban Mobility Plan (SUMP) 2035 and its overarching mobility strategy. Munich's SUMP[3] sets out a long-term framework for sustainable, safe,

[3] Landeshauptstadt München (2021). Mobilitätsstrategie 2035: Entwurf einer neuen Gesamtstrategie für

and efficient urban mobility. Its main objectives include improving accessibility, enhancing the quality of public (street) spaces, increasing transport efficiency, and promoting safe and easy movement throughout the city.

In line with the SUMP, Munich aims to increase the modal share of public transport to 30 % by 2035. The Living Lab's focus on shared mobility directly contributes to this goal by providing alternatives to private car use, integrating multiple transport modes, and facilitating multimodal journeys.

In January 2022, the City Council approved the first stage of the city's Shared Mobility Strategy, running until 2026 and embedded within the SUMP framework. The strategy seeks to develop a city-wide service level for shared mobility, with a focus on:

- Better networking of all mobility offers across modes
- Integration with urban and open space planning
- Cooperation between the city and surrounding areas, and
- Implementation of suitable push and pull measures to encourage adoption.

By addressing these objectives, the Living Lab supports Munich's strategic goals of sustainable urban mobility, promoting the shift toward low-emission, multimodal transport, reducing congestion, and enhancing the overall quality and accessibility of public space. The Living Lab therefore serves as a practical instrument to test, refine, and scale shared mobility solutions in alignment with the city's long-term policy vision.

3.1.2 Geneva

3.1.2.1 Executive summary

The Geneva Living Lab (LL) supports the canton's transition towards sustainable, multimodal mobility within the fast-growing, transnational Greater Geneva area. In the absence of a formal SUMP, the LL's activities align with several strategic planning documents (PATC, PAMA, and the Sustainable Development Action Plan, covering 2024-2028), guiding progress in public transport, active mobility, and shared services. Independently of the SUM project, several city/canton-led developments took place over the same period, providing useful context for the mobility transition in which the Living Lab operates: two new transnational tram extensions to France (Ferney and Saint-Julien) entered construction in late 2025, road congestion eased, with Geneva moving from the 75th to the 62nd most congested city worldwide between 2021 and 2025 (TomTom), and a new cross-lake boat line ("La Voie Bleue") launched in 2025 to serve daily commuters. These build on a longer-term shift already visible between 2000 and 2015, when public transport and active mobility shares grew by 30% and 31% respectively while car use declined by 28%, underlining a mobility system increasingly shaped by the integration of shared and new mobility services alongside traditional public transport..

3.1.2.2 Living lab Context

Geneva is a vibrant city and canton in Switzerland. Its sustained population growth (+1-2% per year) already surpassing 1 million inhabitants in "Greater Geneva" area have led to a tightly-nit, innovative and transnational transport infrastructure that is characterized by:

- a dense public transport system with busses, trolleybuses, trams, urban / regional / long distance trains as well as local boats ("mouettes") crossing the Lac Léman (combined modal split in 2015: 16.6%, change of modal split between 2000 and 2015: +30%).

- a congested road network (modal split in 2015: 38% incl. motorcycles, change of modal split between 2000 and 2015: -28%, 75th most congested city in the world according to 2021 TomTom congestion ranking; 22% of households without cars in 2015).
- a strongly growing share of active modes (modal split in 2015: 34.1%, change of modal split between 2000 and 2015: +31%).
- a growing share of new and shared mobility services including human-driven on-demand busses, autonomous shuttles, bikesharing, shared e-scooters, carsharing, carpooling, ride-hailing and taxis.

The Canton of Geneva does not have a SUMP however several official planning documents fulfil this function, such as:

- Plan d'actions des transports collectifs (PATC): strategic public transport planning document outlining all main measures to be implemented in 5-year periods (current period: 2024-2028)
- Plan d'actions des mobilités actives (PAMA): strategic active mobility planning document outlining all main measures to be implemented in 5-year periods (current period: 2024-2028)
- Plan d’actions développement durable: strategic plan for sustainable development outlining all main measures to be implemented in 5-year periods (current period: 2024-2028)

Independently of the SUM project, several developments took place over the same period

- Two new transnational tram extensions are under construction since late 2025 (Ville de Genève, Grand Genève), each one connecting neighbouring country France to the Geneva tram network (Ferney and Saint-Julien).
- Geneva's congestion ranking has shifted from 75th (2021) to 62nd in the 2025 TomTom ranking (TomTom, 2025).
- A new cross-lake boat line ("La voie bleue") was introduced in 2025 to serve daily commuters across the lake.

3.1.3 Jerusalem

3.1.3.1 Executive summary

The Jerusalem Living Lab was established in the Yuvalim–Ganim neighbourhood to investigate how ride-pooling services can be effectively integrated with high-capacity public transport in a dense urban environment. During the SUM project, the area underwent substantial mobility transformations, including the extension of the Light Rail Transit (LRT) Red Line, the expansion of bike-sharing services, new cycling infrastructure, improved pedestrian accessibility, and the development of Park & Ride facilities. Although these measures were implemented independently by the Municipality of Jerusalem and its transport partners, they created a unique real-world setting for evaluating how evolving mobility infrastructure influences multimodal travel behaviour and the potential role of ride-pooling as a first- and last-mile mobility solution.

The principal contribution of the SUM project was the development and application of a simulation-optimization framework to analyse more than 2,000 alternative ride-pooling service configurations under realistic operating conditions. Supported by extensive mobility datasets, surveys, public transport records, bike-sharing data, and historical ride-pooling information, the Living Lab identified the operational characteristics that maximize service efficiency while strengthening integration with public transport. The results demonstrate that ride-pooling is most effective as a complementary feeder service to the LRT rather than as a substitute for private car travel, and that its success depends strongly on the surrounding multimodal infrastructure. By combining real-world mobility changes with advanced analytical tools, the Jerusalem Living Lab provides an evidence-based methodology that supports better investment decisions, reduces implementation risk, and offers a transferable framework for planning integrated shared mobility services in other cities. Although the Living Lab focused on ride-pooling in response to priorities identified by the Municipality of Jerusalem, the developed simulation-optimization framework is service-agnostic and can be readily applied to evaluate a broad range of demand-responsive mobility concepts, including flexible commuter services, Dial-a-Ride operations, and other on-demand transport services.

3.1.3.2 Living Lab context

The Jerusalem Living Lab is in the Yuvalim-Ganim area in southwestern Jerusalem. It covers the neighborhoods of Kiryat Yovel, Kiryat Menachem, Ir Ganim, and Givat Massua. Together, these residential neighborhoods house more than 40,000 residents, and that population is expected to double by 2050. The area reflects a typical urban environment, with mixed socioeconomic characteristics, varying levels of car ownership, and strong reliance on public transport.

Steep topography and relatively long walking distances to major public transport corridors make first- and last-mile accessibility a major mobility challenge in the area. At the same time, the Light Rail Transit (LRT) Red Line extension and several main bus routes connect the area to the city center and major employment centres.

The project team selected the Yuvalim-Ganim area as a Living Lab because it combines residential neighborhoods, new public transport infrastructure, cycling infrastructure, and shared mobility services. These features make it well suited for testing integration between shared mobility and public transport.

During the project period, the Living Lab area underwent several major mobility infrastructure developments, including the opening of six new light rail stations, the establishment of new bike-sharing stations, and the development of cycling infrastructure connecting the area to the city center. Together, these developments created a unique opportunity to test multimodal mobility integration and assess the impact of shared mobility services in combination with new public transport infrastructure.

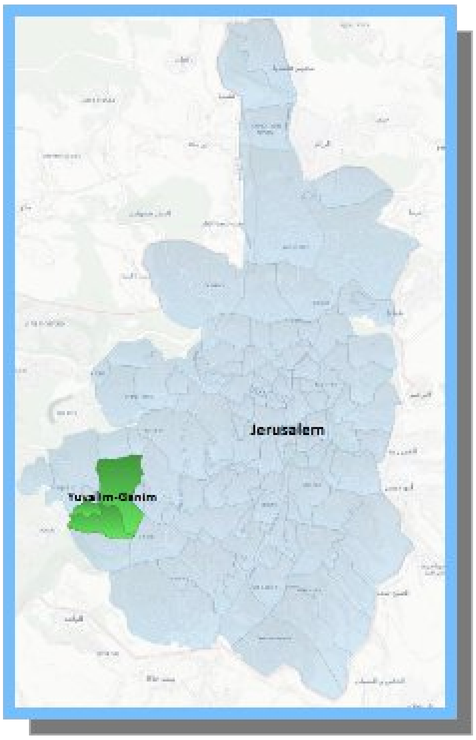

Figure 1: Jerusalem LL - Location of Yuvalim-Ganim area within Jerusalem

3.1.3.3 Existing Mobility Challenges

Prior to the SUM project, the Yuvalim-Ganim area faced a combination of mobility challenges that made access and connectivity difficult. Its hilly topography and dispersed residential structure left many residents with relatively long walking distances to public transport stations, creating first- and last-mile problems and limited access to high-capacity public transport. Before the extension of the Light Rail line, the area also depended heavily on buses and private cars. Travel times to the city center were relatively long, and the main corridors linking the area to employment centres and hospitals often experienced congestion.

Although shared mobility services such as bike sharing, car sharing, and ride- pooling already existed in Jerusalem, planners had not specifically integrated them into public transport planning in the Living Lab area. These services operated independently, and the city did not systematically encourage or plan multimodal trips. At the same time, planners lacked data-driven tools to evaluate shared mobility and ride-pooling services before implementation. As a result, decisions about new mobility services often relied on assumptions rather than on simulation, optimization, and empirical data analysis.

Together, these challenges made the Yuvalim-Ganim area well suited for testing integrated shared mobility solutions and data-driven planning tools within the SUM project.

3.1.3.4 Baseline Situation Prior to the Demonstration

Before the SUM demonstration, the mobility system in the Living Lab area included bus services, limited shared mobility services, and partial cycling infrastructure, but without a strong multimodal integration.

The baseline situation included:

- Bus-based public transport system connecting the area to city center and other areas.
- Initial bike-sharing stations in Jerusalem, but very limited presence in the Living Lab area.
- Limited cycling infrastructure connecting the area to employment centres.
- No ride-pooling service operating in the area after the closure of the previous TikTak[4] service in 2022.
- No integrated planning tools for evaluating shared mobility services.
- Limited multimodal hubs combining public transport and shared mobility services.

During the project period, several infrastructure improvements were implemented in the Living Lab area, including six new Light Rail stations, new bike-sharing stations, a bike lane connecting the area to the city center, and supporting infrastructure such as Park & Ride facilities and public elevators improving access to LRT stations. These infrastructure changes allowed the SUM project to evaluate mobility changes before and after major public transport investments and to analyse multimodal integration between Light Rail, bike sharing, and future ride-pooling services.

3.1.3.5 Alignment with Local and Regional Mobility Strategies

The Jerusalem Living Lab was aligned with the long-term mobility strategy of the Municipality of Jerusalem and the Ministry of Transport, which focuses on increasing public transport usage, reducing private car dependency, and promoting multimodal mobility. Key strategic goals relevant to the Living Lab include:

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[4] Egged brings TikTak smart shuttle system to Jerusalem.
https://www.jpost.com/israel-news/egged-brings-tiktak-smart-shuttle-system-to-jerusalem-642194

- Expansion of the Light Rail network
- Development of Park & Ride facilities
- Improvement of accessibility to public transport stations
- Development of cycling infrastructure
- Expansion of shared mobility services
- Integration between public transport and shared mobility
- Use of data-driven planning tools for mobility planning

The SUM project supported these goals by providing data analysis, simulation-optimization tools, surveys, and policy recommendations related to shared mobility integration and ride-pooling services. The Living Lab therefore served as a real-world test environment supporting local and national mobility policies.

3.1.4 Athens – Penteli

3.1.4.1 Executive Summary

The Athens-Penteli LL demonstrates how a peri-urban, low-density and strongly car-dependent municipality can begin transitioning towards a more active and shared mobility system. The LL aimed to foster an alternative mobility culture, improve access to public transport and local services and transform street space into a safer and more inclusive environment. Rather than concentrating on a single measure, Penteli formulated a coordinated set of measures combining infrastructure redesign, shared mobility, public transport planning, mobility hubs and digital tools. A central achievement was the reallocation of street space to active mobility. More than 5 km of streets were incorporated into a multidimensional cycling network, including cycle streets, i.e., traffic-calmed streets with 30 km/h speed limits and 400 m of an exclusive cycle track complemented by wider street-retrofitting interventions such as improvements to pavements and road surfaces, vertical and horizontal signage, etc. Notably, the measures contributed to substantial improvements in project indicators, with the reported accessibility KPI increasing from 6.35% to 50.53% and the social-inclusion KPI from 2% to 17%.

Additionally, the LL also introduced Penteli's first municipal shared e-bike system, consisting of 38 e-bikes and six docking stations located at strategic points. The service was made available free of charge during its initial three-year period to familiarise residents with shared micromobility. Continuing with some novel mobility solutions for Penteli, a mobility hub was introduced to connect shared mobility with public transport by establishing an bilingual information totem, while a MaaS platform, containing a multimodal web map as well was developed to provide residents with rich mobility information and ease their travel experience. Even though, the measures were successfully deployed, some shortcomings were encountered. More specifically, although the e-bike system became fully operational, its initially limited use (considering also vandalism phenomena) showed that service availability alone does not immediately generate behavioural change. Greater visibility, an expanded network, better communication and stronger links with public transport are required to build familiarity and regular demand.

Nevertheless, the project indicated that these measures and especially, their combination, could be a pivotal first step for a car-oriented suburb to reach sustainable mobility. It should be underlined that accessibility analysis confirmed the value of implementing these measures as an integrated set rather than as stand-alone actions. Combining the mobility hub with shared e-bikes, planned local public transport and complementary infrastructure measures was estimated to increase average accessibility to non-residential activities by approximately 45% through sustainable transport modes. Survey and participatory evaluation results also indicated generally positive perceptions of the mobility hub and the proposed local e-bus services. However, the planned e-bus routes could not be deployed within the project period because of procurement, administrative and institutional constraints. Consequently, the full operational impact of public transport coordination could not yet be evaluated.

Overall, the Penteli LL illustrates that meaningful sustainable-mobility progress is possible even in car-oriented suburban environments when physical infrastructure, shared services, digital integration and user engagement are pursued together. The main lesson arising is that mobility hubs and shared services are most effective when supported by safer streets, readable networks, public transport connections, monitoring and co-creation. At the same time, the experience gained, calls for less bureaucracy, safety measures and more flexible procedures that will facilitate residents' participation. Last but not least, the integrated Penteli approach could be transferable to other peri-urban municipalities aspiring to reduce car dependence, although long-term success will require expansion of the cycling and bike-sharing networks, completion of the local e-bus system, additional mobility hubs, continued data collection and active public engagement.

3.1.4.2 Living Lab Context

The Municipality of Penteli is situated in the northeastern part of Athens' Northern Sector, within the Region of Attica (see *Figure 2*). Established under the Kallikratis Program, it was formed by merging the former municipalities/communities of Melissia, Penteli, and Nea Penteli. According to the 2021 census by Hellenic Statistical Authority (ELSTAT), it has a population of 35,610 permanent residents. Covering an area of 36.1 square kilometres, its administrative centre is in Melissia. The area is characterised by extensive urban and peri-urban green spaces, especially around Mount Penteli, which form an important environmental and social asset for residents. Penteli's transport planning efforts are oriented towards improving access to work, education, goods, services, and social activities, with the broader goal of creating a more vibrant, liveable, and sustainable municipality.

Prior to the demonstration, the transport available modes were a) public transport (OASA) and ride-hailing services (FREENOW taxis). In the context of SUM, Penteli will establish NSM services including an e-bike sharing system. The baseline NSM modal distribution was below 2%. Interestingly, Penteli was characterised by strong car dependence, fragmented central areas divided by major roads and mobility conditions that did not sufficiently support active and shared modes. Existing mobility challenges included:

i) improvement of pedestrian safety and accessibility,

ii) safe connection of the fragmented - by the major roads - central areas of the Municipality,

iii) special planning for the transport of vulnerable groups of users such as people with disabilities and school children and

iv) improvement of the distribution of public spaces, between those allocated to vehicular traffic and those allocated to pedestrians (streets-pedestrian-squares). Additional challenges included

v) addressing traffic congestion in the central points of the Municipality,

vi) promotion of soft and mass transport means while reducing the use of private cars,

vii) promotion of green spaces and the elements that constitute the city identity,

viii) reduction of pollutants and overall improvement of environmental conditions and

ix) creating a network of soft mobility routes (woonerf, cycle paths, pedestrian, walkways, clean pavements).

The Living Lab is fully aligned with the municipality's Sustainable Urban Mobility Plan and the wider sustainable mobility planning direction of the Athens metropolitan area. Penteli's strategy aims at a complete reconfiguration of its transport network by prioritising sustainable mobility. This includes revisiting the road hierarchy with a stronger focus on pedestrians and cyclists, pedestrianising selected streets, constructing cycling infrastructure, reintroducing local bus lines, integrating these with services provided by OASA and offering new mobility options such as bikesharing, ride-hailing, and Mobility as a Service (MaaS). The municipality is also planning electric vehicle (EV) charging infrastructure and places strong emphasis on open consultation and citizen participation. Notably, the municipality argues that with transparency, good communication, interaction, and empathy, the needs and expectations of all citizens are considered, without exceptions.

In this context, the SUM project provided the framework for Penteli to test how shared mobility, active mobility, public transport integration and digital tools can work together in a peri-urban municipality. The Living Lab focused mainly on creating the conditions for a suitable shared mobility ecosystem through mobility hubs, shared bicycles, improved bus coordination and a MaaS platform, while also supporting safer and more inclusive public space re-design.

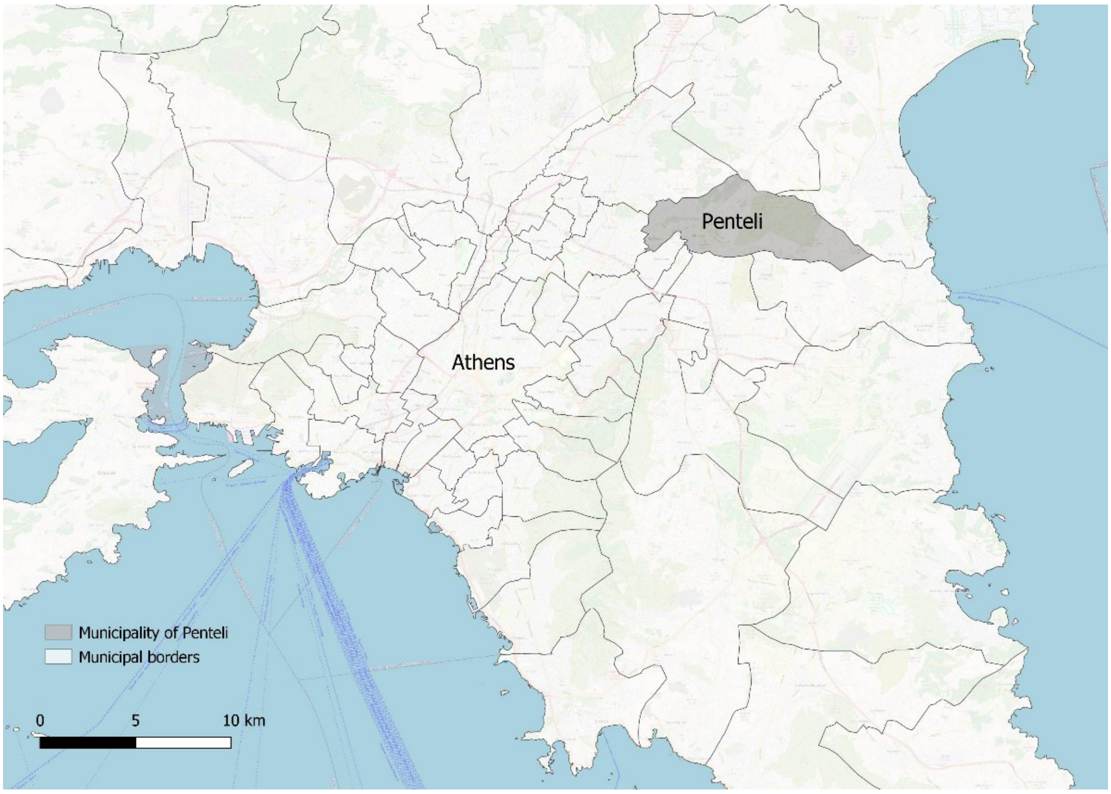

Figure 2: Penteli LL - Location of the Municipality of Penteli within Attica Region

3.2 Objectives of the Living Lab

3.2.1 Munich

Due to the amendment, the overall objectives of the Munich Living Lab have been revised and differ from those originally defined in the Grant Agreement. The following content is based on the amendment, which was officially approved in February 2026. As the amendment had been anticipated, the Munich Living Lab began implementing the corresponding activities as early as May 2025.

The Living Lab focuses on leveraging data from free-floating car-sharing services to better understand and support the role of shared mobility in the urban mobility transition.

In this context, the specific objectives of the demonstration focus on building and analysing a comprehensive data foundation. Operational data from a car-sharing provider is collected and analysed to identify usage patterns as well as spatial and temporal hotspots for pick-up and drop-off activities. The data basis is partly derived from datasets provided by the free-floating car-sharing provider SIXT, which is one of the most significant car-sharing operators in Munich, as well as from data on car-sharing infrastructure. Car-sharing infrastructure in Munich includes dedicated parking spaces reserved exclusively for car-sharing vehicles, enabling a more convenient and reliable user experience for car-sharing users. According to the city council resolution, up to 1,000 free-floating car-sharing parking spaces are to be established in Munich in order to improve the use of car-sharing services. At the time of the data analysis, approximately 630 designated car-sharing parking spaces are available. Data from station-based car-sharing providers cannot be used due to data protection regulations.

Building on this data, the open-source simulation framework FleetPy[5] is validated and further developed to investigate different operational strategies and the integration of new and shared mobility services into public transport and mobility hubs. Furthermore, surveys targeting both current and potential users are conducted to assess acceptance levels and identify potential barriers to the use of shared mobility services.

The activities of the Munich Living Lab primarily target citizens, policymakers, cities, and public transport operators, as they are designed to demonstrate the benefits and potential of car-sharing and to promote its wider use. By generating and analysing data on car-sharing operations and infrastructure, the Living Lab provides evidence-based insights that support informed decision-making and strategic planning.

Citizens, including both current and potential users, are addressed through analyses and surveys that highlight the advantages and practical relevance of car-sharing in everyday mobility. At the same time, policymakers and city administrations benefit from data-driven findings that inform the development of effective mobility policies and infrastructure measures. Public transport operators and other cities are also key target groups, as the results contribute to the integration of car-sharing into broader mobility systems and support the development of sustainable, multimodal transport strategies.

Through these activities, the Munich Living Lab contributes to more sustainable, seamless, and integrated urban mobility. By generating a robust and data-driven understanding of shared mobility systems, it enables better planning and optimization of services. The integration of car-sharing into public transport networks and mobility hubs supports intermodal travel and reduces reliance on private car ownership. Moreover, the knowledge generated and shared within the project provides valuable guidance for other cities, thereby supporting the wider transition towards more sustainable urban mobility systems.

3.2.2 Geneva

The Geneva LL focuses on three main objectives:

i. The extension of two on-demand mobility services: human-driven on-demand buses in the rural parts (“Champagne”) and autonomous shuttles in the urban area (“Belle-Idée”). To achieve this, the LL will utilise SUM tools to evaluate extension scenarios for human-driven on-demand buses from a transport planning perspective. It will also create synergies with the ULTIMO[6] project by harvesting autonomous driving technology. This involves leveraging public transport autonomous vehicle (AV) capacity for on-demand goods transportation during off-peak hours and integrating transport options into a mobility hub that serves both people and goods.

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5 FleetPy is a simulation framework to model and control the tasks of vehicle fleets and part of WP2 and WP3.

6 The Horizon ULTIMO project aims to establish and launch the world's first economically feasible on-demand AV public transport service focused on passengers. For more information see https://ultimo-he.eu

ii. The integration of NSM with PT through the creation of new mobility hubs across the Geneva region and a MaaS app. These hubs will act as central locations where individuals can seamlessly access multiple transport modes, including public transit, bike-sharing, and car-sharing. By providing a variety of sustainable mobility options, these hubs aim to encourage a shift away from private car use, making travel more efficient and environmentally friendly. Mobility hubs are designed to be the cornerstone of integrated multimodal mobility systems, optimising urban transport while reducing reliance on private vehicles.

iii. The development of a comprehensive mobility management plan. This plan aims to provide commercial partners, such as companies and municipalities, with a solution that enables them to assess the current mobility habits of their employees or residents. It will also offer customised support and solutions to encourage the adoption of sustainable modes of transport.

One minor deviation from objective has been agreed upon with the project coordinators during the project: synergies with the ULTIMO project (i.e. integrated people and goods transportation) were not possible to be realized. In exchange, logistics services have been successfully deployed at selected hubs, most notably through WECHIP connected lockers, which contribute to facilitating the goods transportation dimension and lay the groundwork for further integration. Otherwise, all foreseen activities and objectives were pursued with the results presented below in the project.

3.2.3 Jerusalem

3.2.3.1 Overall Objectives

The overall objective of the Jerusalem Living Lab was to examine how shared mobility services might be integrated with public transport in a residential urban area, and how this integration can improve accessibility, reduce car dependency, and support sustainable urban mobility.

Focusing specifically on the Yuvalim-Ganim area, the Living Lab aimed to evaluate multimodal mobility solutions that combine Light Rail, buses, and potential ride-pooling services. Its objective was not only to implement mobility measures, but also to develop and apply data-driven planning tools and simulation-optimization models to support future mobility policy decisions.

3.2.3.2 Specific Objectives of the Demonstration

The central objective of the Jerusalem Living Lab was to evaluate the feasibility and optimal design of an integrated ride-pooling service operating as a complement to public transport. The concurrent expansion of the LRT network, cycling infrastructure, bike-sharing system, Park & Ride facilities, and pedestrian accessibility measures created an exceptional opportunity to assess how ride-pooling performs within an evolving multimodal transport ecosystem. These parallel mobility developments were therefore analysed as enabling conditions that influence the attractiveness and effectiveness of ride-pooling rather than as SUM interventions themselves.

The underlying simulation-optimization framework was developed as a general decision-support tool for analysing alternative on-demand mobility concepts. During the Living Lab, discussions with the Municipality of Jerusalem identified ride-pooling integrated with public transport as the highest planning priority. Consequently, the experimental analysis presented in this report focuses on ride-pooling, while the methodology remains directly applicable to other forms of demand-responsive transport.

In parallel, the project analysed the potential implementation of ride-pooling services integrated with public transport by using the simulation-optimization tools developed within the SUM project. It evaluated multiple service configurations and assessed their effects on travel time, modal split, service efficiency, and user acceptance.

To support this work, the project collected data from multiple sources, including surveys, public transport data, bike-sharing operator data, mobility data, and simulation results, in order to calculate project KPIs and evaluate mobility interventions. It also aimed to support policy development by preparing recommendations for the Ministry of Transport on the possible implementation of ride-pooling services integrated with public transport.

Overall, the demonstration combined infrastructure changes, shared mobility services, data collection, modelling, and policy analysis.

3.2.3.3 Target User Groups and Stakeholders

The Jerusalem Living Lab involved multiple stakeholders from the public and private sectors. Stakeholders included are listed below:

- Municipality of Jerusalem
- Ministry of Transport
- Jerusalem Transportation Master Plan Team (JTMT)
- Public transport operators
- Bike-sharing operator (Jerufun)
- Car-sharing operators
- Mobility technology companies
- Tel Aviv University research team
- Sigma-6 Mobility
- Residents of the Yuvalim-Ganim area
- Daily commuters traveling between the Living Lab area and employment centres

Target user groups included public transport users, bike-sharing users, potential ride-pooling users, residents without private cars, students, employees commuting to the city center, and residents with limited access to public transport stations.

3.2.3.4 Contribution to Sustainable, Seamless Shared and Urban Mobility

The Jerusalem Living Lab contributed to the SUM project by showing how infrastructure investments, shared mobility services, and data-driven planning tools can be combined to improve multimodal mobility in residential urban areas. It highlighted the importance of integrating shared mobility services with high-capacity public transport systems such as Light Rail. The project showed that bike-sharing stations located near Light Rail stations significantly increase multimodal trips and improve accessibility to public transport.

The simulation-optimization framework developed in the project provided evidence that ride-pooling services could improve door-to-door travel and support multimodal trips when integrated with public transport hubs.

The Jerusalem Living Lab also demonstrated the importance of data collection, surveys, and simulation tools for mobility planning and decision-making. Instead of implementing or even just piloting new mobility services with insufficient understanding of how they might be best configured, the LL showed how simulation and optimization can support more efficient public spending and better policy decisions. It provided a real-world case study of multimodal integration between light rail and bike sharing and - via the framework - integration between light rail, bus, and potential ride-pooling services. The lessons learned from this Living Lab can be transferred to other cities implementing similar services or wishing to identify promising service configurations via similar analytical tools.

3.2.4 Athens – Penteli

The Penteli Living Lab aims to foster an alternative mobility culture, promote shared and active transport options and transform public spaces into inclusive and sustainable environments with the potential to reduce dependence on private cars. Within the SUM project, Penteli contributes to the wider objective of integrating new and shared mobility with public transport and demonstrating how innovative mobility solutions can improve accessibility and sustainability in peri-urban contexts.

To achieve this, the Living Lab has focused on seven main intervention areas: a) the development of cycling infrastructure; b) the introduction of e-bikes and ride-hailing services; c) the integration of bus timetables across service providers, d) complemented by local e-buses; e) the establishment of mobility hubs; f) the development of a MaaS platform and g) the pedestrianisation of streets together with the redefinition of the street hierarchy and the transformation of shared public space. These interventions combine push and pull measures and are intended to improve safety, accessibility, multimodality, and the attractiveness of sustainable transport options.

The Penteli Living Lab also addresses a set of practical research questions emerging from the local context: a) how to coordinate local and metropolitan public transport successfully; b) which are the impacts of street retrofitting and shared mobility services in a car-centric environment; c) how to design an efficient multimodal hub and d) what functionalities and capabilities are needed in a MaaS platform adapted to local conditions.

The target groups of the Penteli Living Lab include a broad range of users and actors who are directly or indirectly affected by local mobility conditions and by the measures introduced through the SUM project. On the user side, the Living Lab addresses residents of the municipality, who are the main beneficiaries of safer, more inclusive, and more sustainable transport options in their everyday movements. It also concerns visitors, who need clear and accessible mobility solutions when travelling within Penteli, as well as current and potential public transport users, whose travel experience depends on better connectivity, improved local services, and stronger integration with metropolitan public transport. Cyclists and pedestrians form another key target group, since many of the implemented interventions focus on improving infrastructure, comfort, and safety for active mobility. Special attention is also given to vulnerable users, such as children, older people, and persons with disabilities, whose mobility needs often require better accessibility, safer crossings, calmer streets, and more inclusive public space design.

Through its activities, the Penteli Living Lab contributes to sustainable, seamless, shared, and urban mobility by addressing both the physical and organisational barriers that currently limit the uptake of more sustainable transport options in a peri-urban context. Its contribution to sustainability lies in reducing dependence on private car use and promoting cleaner, more efficient forms of mobility, including walking, cycling, shared e-bikes, and future e-bus services. It contributes to seamless mobility by improving connections between different transport modes, especially through the development of a mobility hub, the coordination of local and metropolitan public transport, and the integration of shared mobility options within a broader multimodal system. The Living Lab also supports shared mobility by introducing and testing services such as bike-sharing and ride-hailing, while exploring how these can complement public transport and help cover first- and last-mile needs. More broadly, it contributes to better urban mobility by redesigning public space, improving road safety, supporting active travel, and creating stronger links between physical infrastructure and digital tools such as the MaaS platform and the web map of Penteli's transport system. In this way, the Living Lab does not treat mobility measures as isolated interventions, but as interconnected elements of a wider transition towards a more accessible, integrated, and people-centred local mobility system.

3.3 Description of the Demonstration

3.3.1 Munich

In the following, the description of the demonstration in the Munich Living Lab is based on the amendment letter officially approved in February 2026.

The Living Lab in Munich focuses on the analysis, optimization, and scaling of car-sharing and shared mobility services, including both free-floating and station-based systems. Key measures include the collection and analysis of operational data from car-sharing providers in order to identify spatial and temporal hotspots for vehicle pick-up and drop-off. In addition, the City of Munich supports the expansion of station-based car-sharing infrastructure through a public tender, which foresees the provision of up to 600 dedicated parking spaces across the urban area by 2026. Two thirds of the car-sharing infrastructure, such as parking spaces, are located directly at mobility hubs. The remaining locations are distributed throughout the city (see impressions below, Figure 3 and *Figure 4*).

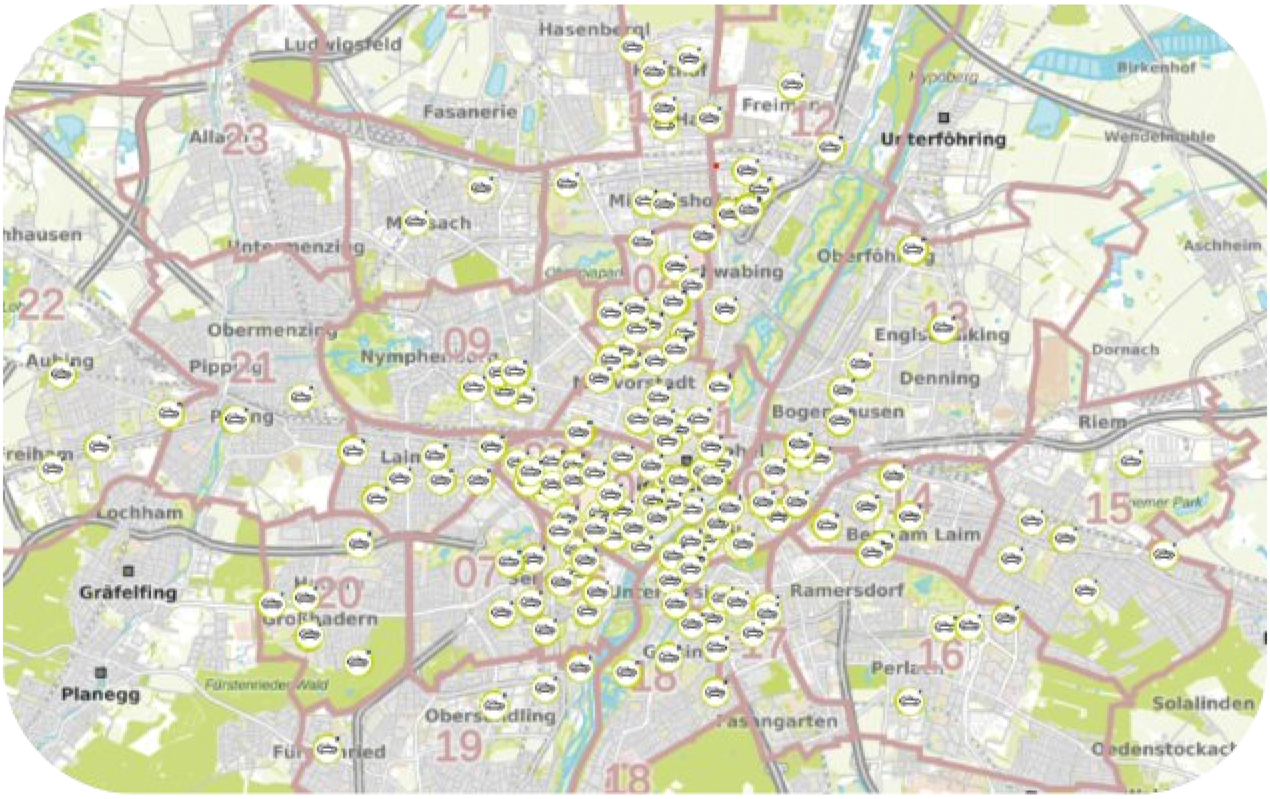


Figure 3: Munich LL - Overview of carsharing parking infrastructure in Munich. Source: GeoPortal Munich

Figure 4: Munich LL - Examples of mobility hub infrastructure in Munich. Source: Dobner & Angermann.

These measures are complemented by user-centred approaches, including the design and implementation of surveys targeting both existing and potential users, in order to better understand usage behaviour, acceptance levels, and barriers to adoption. A central objective of the Living Lab is to improve integration of shared mobility services with public transport. This includes the investigation of operational strategies that enable better coordination between car-sharing and public transport, as well as the development of mobility hubs that physically and functionally connect different transport modes. By facilitating seamless first- and last-mile connections and promoting multimodal travel behaviour, shared mobility services are positioned as a complementary component of the overall transport system, supporting a reduction in private car dependency.

The Living Lab relies on advanced technological components and digital tools, in particular the open-source simulation framework FleetPy. This tool is validated and parameterized using real-world operational data to simulate and assess different service configurations and integration scenarios. In parallel, detailed datasets such as booking behaviour, trip characteristics, and pick-up and drop-off locations are processed and analysed. Survey-based data collection further complements these datasets by providing insights into user perspectives and behavioural patterns. Together, these data-driven approaches enable evidence-based decision-making and the evaluation of alternative operational strategies.

The demonstration is structured in several phases (see *Figure 5*), starting with a data collection and analysis phase, followed by a planning and simulation phase in which different scenarios are tested using FleetPy. This is complemented by an implementation phase, which includes infrastructure expansion and the conceptual development of mobility hubs. Subsequently, an evaluation phase focuses on user engagement and the assessment of system performance, including the identification of acceptance and barrier factors. Finally, the results are consolidated in a policy development and scaling phase, in which recommendations are derived for long-term implementation and transferability to other urban contexts.

Timeline*:

Year	2025												2026				
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5
Living Lab Munich T 4.1																	
Milestones						M1		M2			M3			M4			M5

Description of internal task 4.1 milestones for Munich Living Lab:

M1	Collection of car-sharing, mobility hub and public transportation data
M2	Data analysis and preparation
M3	Analysis of the following research questions (revisions included): • Identify hotspots for car-sharing pick-up, and drop-off points • Correlate hotspots with public transportation data • Evaluate the role of mobility hubs in reducing parking search traffic
M4	Final revision and discussion of results
M5	Write policy recommendations and assess the impact of results on mobility hub and car-sharing planning in Munich as well as other cities.

Figure 5: Munich LL - Description of Milestones and Timeline for Munich Living Lab

The Living Lab involves a range of stakeholders with clearly defined roles. The City of Munich provided the strategic and regulatory framework, supported data collection, and les infrastructure development, while also facilitating knowledge exchange with other cities. The Technical University of Munich (TUM) was responsible for the scientific analysis, including data processing, simulation modelling, and the design and evaluation of user surveys. The car-sharing provider SIXT contributed operational data and participated in the testing and refinement of service strategies. Users and citizens were involved through surveys and feedback mechanisms, providing essential insights into mobility behaviour and acceptance. In addition, collaboration with project partners and other cities supported the exchange of knowledge and enhances the potential for replication and scaling of the developed solutions.

3.3.2 Geneva

In the following, we present the demonstrations along the three objectives outlined above.

1. ***Extension of two on-demand mobility services***

Human-driven on-demand buses have been operational in Geneva since 2021 through "tpg flex", a service operated by the Transports Publics Genevois (TPG), the main public transport operator in Geneva. The service was initially launched in the "La Champagne" region and later expanded to the rural Seymaz-Voirons area. Ridership grew significantly, rising from 120 to over 900 passengers per month between January and December 2022, while the number of stops served doubled from around 30 to 60. The LL has used the project's tools to simulate potential extensions and improvement in synchronization of on-demand and fixed-line public transport.

The on-demand service tpg flex has now expanded to new areas, extended its operating hours and added new vehicles to its fleet. In December 2024, a new on-demand service for tpg employees was launched, enabling early morning transport (0:30 AM to 6:00 AM) using three 15-seater sprinter vans, bookable through the same public app.

Extensions and schedule integration were simulated using the consortium's tools, see for example TUM section on FleetPy.

Regarding the second on-demand service, autonomous shuttles in the urban area ("Belle-Idée"), the deployment timeline has evolved considerably over the course of the project and remains subject to change. According to the latest planning, the first vehicles are expected to arrive in Geneva between September and October 2026, with authorisation to operate in manual mode expected between October and November 2026, followed by authorisation for automated driving mode in November 2026. A shuttle test in the Industrial Zone, initially planned for September 2026, has been postponed to December 2026 due to the time required for the validation process.

2. *Enhanced integration of NSM and PT*

The planning and preparation of mobility hubs includes four main areas of action:

Learning from experts: before implementing mobility hubs, the tpg team engaged with experienced professionals and industry experts through UITP (International Association of Public Transport) training sessions on Mobility Hubs and the *Annual POLIS Conference 2023 in Leuven, Belgium*, to gain valuable insights into innovative solutions and successful case studies.

Coordination with public authorities, to raise awareness about the project's benefits and ensuring its sustainable implementation. In Geneva, the project has served to integrate mobility hubs as a key measure in several cantonal strategic mobility planning documents:

- Plan d'actions des transports collectifs (PATC)
- Plan d'actions des mobilités actives (PAMA)
- Plan d'actions du transport professionnel de personnes, de marchandises et de services (PATPRO)

as well as two strategic roadmaps addressing commuting in industrial zones and mobility in Geneva municipality:

- Feuille de route pour les pendulaires en zone industrielle
- Feuille de route pour les mobilités Canton -Ville de Genève

Regular meetings and workshops with regional and local transportation, urban planning, and environmental departments were organized to secure approvals for hub locations. Authorities' involvement also facilitated the creation of a legal framework for public land use, ensuring compliance with regulations. In September 2024, tpg obtained formal permits for installing mobility hubs (for people and goods) on public land, streamlining the deployment process.

Partnership with sustainable services providers: tpg has partnered with shared mobility providers, including bike sharing (Donkey Republic) and cargo bike sharing (Carvelo) to ensure successful service delivery at mobility hubs. These partnerships involve promotional efforts targeting businesses and cities, as well as commercial agreements offering discounts and attractive bundles for bike sharing and PT. Over the course of the project, the network of partners grew to 5+ NSM operators, with some providers proactively reaching out to join the initiative, demonstrating the growing attractiveness of the mobility hub concept.

Design concept: the design of effective totems for mobility hubs was a collaborative effort involving stakeholders such as public authorities and internal tpg teams. The totems serve the following purposes:

- Information dissemination: clearly displaying route maps, service locations, and QR codes linking to apps or websites.
- Wayfinding: guiding users to transportation options, with walking times indicated on map.

- Branding and identity: creating a visually appealing design that reflects the brand identity of the hub and the city. The totem upper border features the Geneva Skyline, including the famous water fountain to mark its local identity.

Coordination with regional authorities was required to ensure compliance with accessibility standards and regulations regarding height, size, and colour. tpg also worked on the totem design refinement in partnership with students from the École Supérieure des Beaux-Arts and the Haute École d'Arts Appliqués, HEAD.

Throughout the project, the visual identity of the hubs is being progressively consolidated into a coherent and unified system, designed to be recognisable across all deployment sites while remaining adaptable to different urban contexts, whether city centre, residential area, park-and-ride facility, or industrial zone. This flexible identity approach is reflected in the second-generation totem design, currently being finalised, which features a 4-face structure, pictogram-based signage and artistically designed surfaces, allowing for both standardisation and local customisation.

The hub network has grown significantly over the course of the project, scaling from 0 at project launch in May 2023 to 7 hubs by early 2025, and reaching 29 deployed hubs today (Mai 2026), across a wide range of settings, from the city centre and residential areas to park-and-ride facilities, Geneva Airport, and large transit hubs:

- Lancy-Bachet
- Lancy-Pont-Rouge, gare/étoile
- Bernex P+R
- Gardiol
- Les Ouches
- Genève Aéroport
- Place du 1er août
- Lancy-Pontets
- Prairie
- Grange-Collomb
- Chêne-Bourg
- Crêts-de-Champel
- ArchParc
- The Hive
- Satigny, Moulières
- Annemasse, Parc Montessuit
- Genève, Uni Mail
- Lancy-Pont-Rouge gare
- Lancy, Palettes
- Plan-les-Ouates, ZIPLO
- Zimeysa, gare
- Meyrin, village
- Plan-les-Ouates, Aviateurs
- Bel-Air
- Champel, gare
- Eaux-Vives, gare
- Cornavin
- Meyrin, gare
- Place-de-Neuve

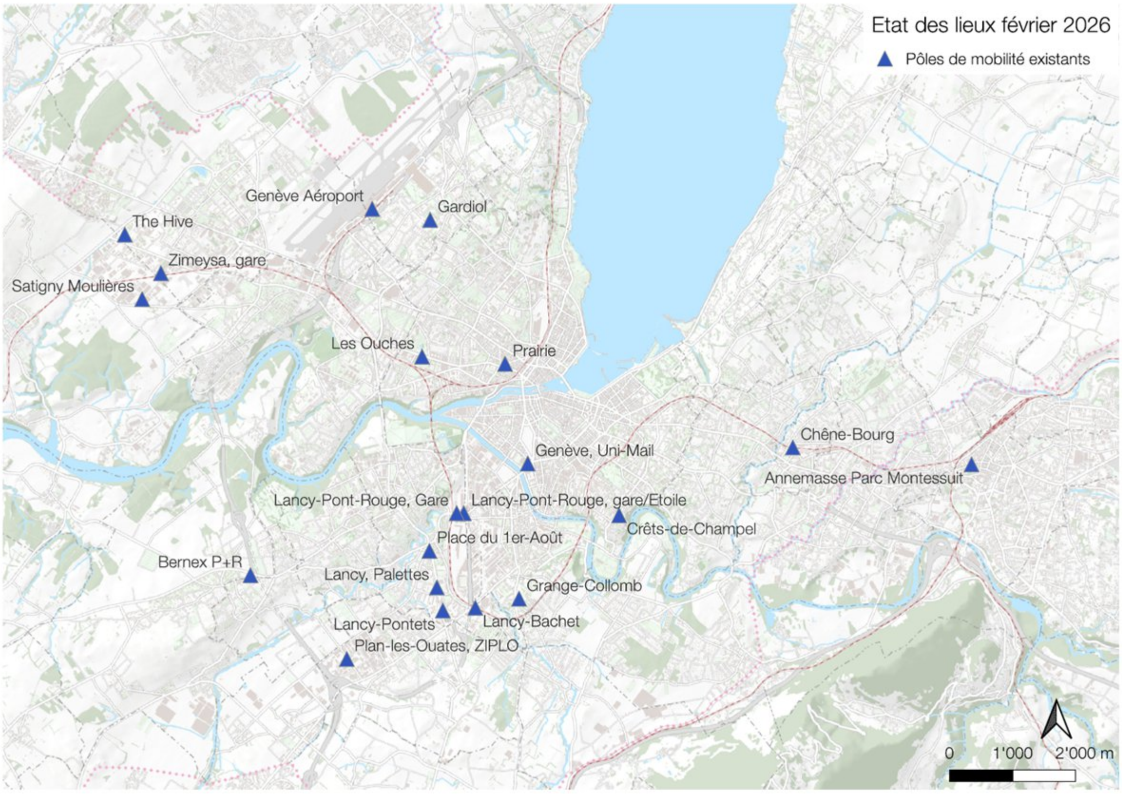


Figure 6: Geneva LL - Current mobility hub network (Source: tpg)

This acceleration, with 18 additional hubs deployed in just over a year, reflects both the growing operational capacity of the team and the increasing demand from partners and territories. A notable expansion has been the integration of industrial zones, responding to strong demand for both passenger and goods mobility in these areas. The network is also progressively extending beyond Geneva city's core, with new municipalities in the surrounding agglomeration now being integrated, deliberately targeting a broader diversity of urban and peri-urban contexts. By the end of the project in this year, an additional 5 to 10 hubs are planned for deployment, further consolidating the mobility hub model as a scalable and replicable solution across the Great Geneva agglomeration.

Service usage at mobility hubs, such as shared bike rentals, has been monitored since launch. Preliminary results show that usage is higher in central areas than suburban ones, likely due to population density differences. To increase uptake in suburban areas, tpg organised public workshops, information sessions, and targeted campaigns in collaboration with community groups, schools, and businesses.

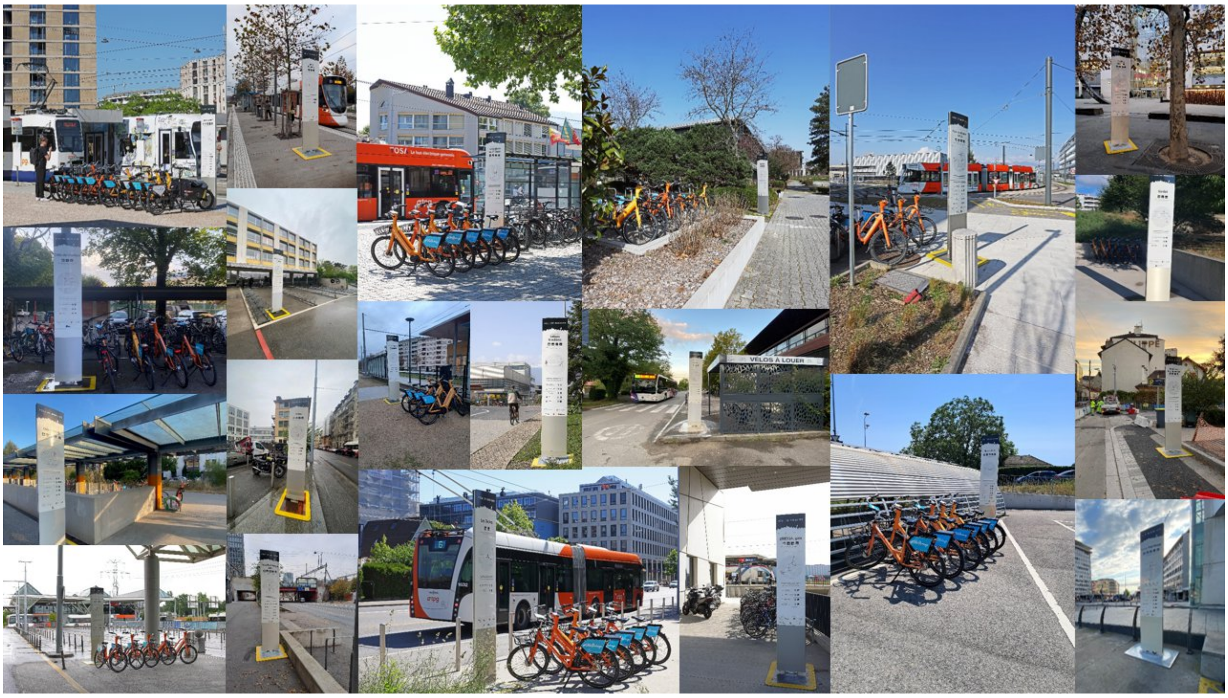


Figure 7: Geneva LL - 21 of the 29 mobility hubs deployed as part of the SUM project

Digital integration

In 2024, tpg launched integrated public transport and shared mobility monthly bundles, giving users access to bike-sharing, cargo bike-sharing, and carsharing alongside PT tickets, with discounts for PT subscribers.

Building on this, a new dedicated mobile application is scheduled for mid-2026, replacing the current tpg app. It will cover tpg services including on-demand shuttles, Mouettes Genevoises, CFF, SNCF, and intercity bus lines, with a modernised design based on user testing. It will be delivered in three phases: core PT features (Lot 1), purchasing module (Lot 2), and physical accessibility features displayed as pictograms in journey search (Lot 3).

tpg is also exploring a broader MaaS application to unify travel planning, booking, and payment across the region. A joint tender with Bern, Basel, and Zurich (budget: 20 million CHF) was cancelled due to lack of suitable offers, and tpg is now investigating alternative cooperation and federal funding opportunities.

A particularly notable aspect of the new tpg application is its cross-border scope. The application's transport perimeter already integrates services from multiple French operators, including TAC (Annemasse), the Alpbus lines 271, 272 and 274, the lines of the Communauté de Communes du Genevois (M and N), the lines of the Pays de Gex, the Sibra network, as well as the Léman Express and TER regional trains. While no fixed geographical boundary has formally been defined, some proposed itineraries extend as far as Lyon. The ticketing/sales perimeter remains considerably narrower and is managed separately.

Operationally, all participating operators export their timetable data to the Swiss open data platform (opentransportdata.swiss), from which tpg imports updated schedules every two weeks as exogenous data feeding into its web and app channels. This cross-border MaaS integration is considered a particularly relevant and replicable practice for other cities operating in transnational contexts.

3. ***Deployment of a mobility management platform***

"tpg evomoov" is a comprehensive mobility management platform designed to optimise workforce travel patterns for companies and municipalities. Leveraging digital technology, it enables organisations to design and implement personalised mobility strategies that drive behaviour change among employees. This collaborative approach is underpinned by three key pillars:

i Understanding workforce needs: via a user-friendly digital platform, employees share insights into their travel habits, challenges, and preferences. This data is analysed to identify opportunities, and barriers to adopting sustainable mobility solutions.
ii Crafting tailored mobility strategies: tpg mobility experts provide guidance to develop customised strategies aligned with organisational goals and priorities.
iii Implementing effective solutions: tpg's network of mobility professionals delivers a range of multimodal solutions, including bike-sharing schemes, carpooling programmes, and PT incentives.
iv Evomoov offers support in partner selection, solution sizing, and deployment, while monitoring the results of actions taken.

It should be noted that tpg evomoov was launched in 2020, prior to and independently of the SUM project. Since its launch, tpg evomoov has grown significantly, including during the SUM project period. It has been adopted by 130 companies and public institutions representing over 32,000 employees, using the platform's digital tools, including mobility subsidies and mobility wallets, to support behavioural change. Among these, 20 companies have signed up for complete Mobility Plans, achieving a satisfaction score of 87/100 (partner company's, identified in ex-post sessions). On the municipal side, 48 municipalities covering over 30,000 inhabitants are now using the platform, with a proof of concept for full mobility plans currently underway with 6 municipalities..

3.3.3 Jerusalem

During the SUM project period, several major mobility measures were implemented in the Living Lab area by the Municipality of Jerusalem and other transport stakeholders. These measures were not themselves implemented as part of SUM; rather, they created the evolving mobility environment within which the project's principal intervention, the simulation-based analysis and design of ride-pooling services, was carried out. Understanding these parallel developments is essential because they directly influence multimodal travel behaviour and the attractiveness of ride-pooling as a feeder service to public transport.

1. ***Six New LRT Stations on the Red Line***

The municipality extended the Light Rail Transit (LRT) Red Line by adding six new stations within the Living Lab area. These stations opened in February 2025 as part of the gradual operation of the full 35-station Red Line. The extension connects the Living Lab area to major employment centres and to Hadassah Hospital.

The new stations have reduced public transport travel times and increased public transport use. They currently generate approximately 33,000[7] daily passenger movements.

The LRT expansion also strengthened multimodal travel in the area. Three of the newly installed Jerufun bike-sharing stations were placed at new LRT stations, and data show that 30% of bike rides now start or end at these rail stations.

[7] Based on internal OD matrices

Figure 8: Jerusalem LL - LRT Red Line extension

Figure 9: Jerusalem LL - Map of the LRT red and green lines and the six new stations within the LL

2. New LRT Park & Ride Facility

A new Park & Ride facility is currently under construction to support LRT use and reduce private car dependency. Construction began in December 2022, and the facility is expected to open in Q4 2026, with 2,275 parking spaces[8].

The facility will offer free parking for LRT users and is intended to encourage drivers to shift from private car travel to public transport. By linking parking directly with the LRT network, the measure supports multimodal trips and is expected to increase public transport ridership.

Figure 10: Jerusalem LL - Construction of the LRT Park & Ride Facility

3. Twenty New Public Elevators

Twenty new public elevators are planned in different locations across Jerusalem, including four in the Living Lab area. The elevator project began in January 2024. Five elevators are planned to open in 2026, with full project completion expected by December 2029.

The elevators are intended to improve accessibility to LRT stations, particularly given Jerusalem's hilly terrain. By making it easier to reach LRT stations, this measure is expected to expand the effective coverage of the LRT system and increase public transport use.

8 https://j-t.org.il/parking/

Figure 11: Jerusalem LL - Public elevator

4. Jerufun Bike-Sharing Expansion

Eighteen new Jerufun bike rental stations were deployed in the Living Lab area between February 2024 and April 2024. The measure was implemented to promote cycling, support first- and last-mile connections, and reduce car use.

The bike-sharing system was integrated with the LRT network by locating three of the new bike stations at new LRT stations. This integration supports multimodal travel, and current data indicate that 30% of bike rides now start or end at LRT stations. Since the opening of the new LRT stations, bike rentals in the Living Lab area have increased by 80%, suggesting a strong connection between LRT access and bike-sharing demand. Jerufun operator data were also used as one of the project's data sources for evaluating mobility patterns and measure performance.

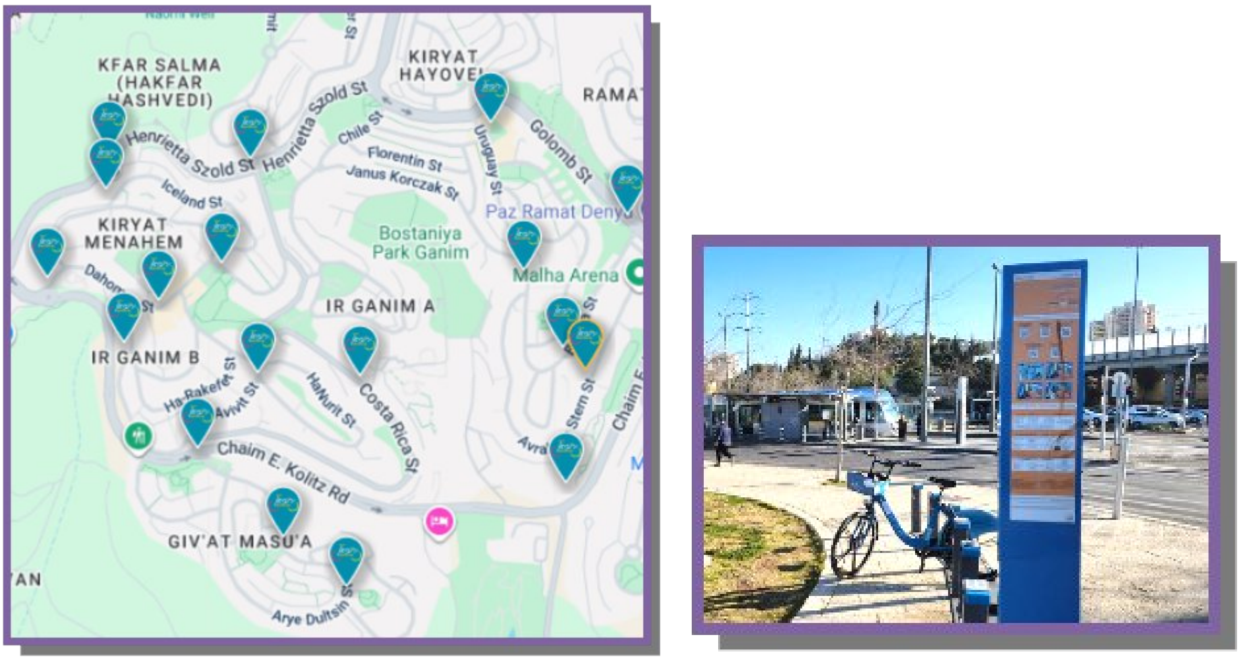


Figure 12: Jerusalem LL - Map of the 18 Bike Sharing stations within the LL and a representative station

5. ***New Bike Lane on Golomb Street***

A new bike lane was constructed on Golomb Street to promote cycling and reduce dependence on private cars. The lane was implemented in October 2023. In 2025, the Golomb Street bike lane recorded approximately 700 rides per day. This indicates that the lane has become an active cycling corridor within the Living Lab area and supports the broader goal of encouraging non-car mobility.

While the previous measures describe mobility infrastructure and services implemented by local authorities during the project period, the principal contribution of the SUM project was the development and application of a simulation-optimization framework for analysing future ride-pooling services. The preceding measures were explicitly incorporated into this analysis because they substantially affect travel demand, modal choice, and the potential success of multimodal ride-pooling services. The flexibility with which new hubs (the new LRT stations) and multimodal alternatives can be defined within the framework is a testament to its flexibility. In this case, these hubs became fixed facts on the ground--but their very location could be part of a multi-scenario analysis within the framework.

6. ***Ride Pooling R&D Measure***

The ride-pooling measure was developed as an R&D activity using a generic simulation-optimization framework for analysing demand-responsive mobility services. While the framework is capable of evaluating a wide variety of operational concepts, including Dial-a-Ride, commuter shuttles, and other flexible transport services, the Municipality of Jerusalem identified ride-pooling integrated with the Light Rail network as the highest planning priority. Accordingly, the Living Lab focused on evaluating more than 2,000 ride-pooling configurations. The results are summarized in Section 4.5.3. The simulation framework included an outer loop for search or experiment specification and an inner loop for demand generation, mode choice, and service simulation. The service simulation was powered by FleetPy. The ride-pooling analysis showed that higher vehicle occupancy can be achieved when the service is designed as a few-to-many systems connected to rail hubs, compared with a many-to-many system without hubs. The results also indicate that ride pooling is associated with a significantly higher number of multimodal trips than previously observed in the Living Lab.

The project used several data sources to support the ride-pooling analysis, including field surveys, Rav-Kav transit card usage data, smartphone-based mobility data, old TikTak service records, and other operator data. Future upgrades to the simulation framework include improving the metaheuristic algorithm and introducing parallel processing across multiple machines with load balancing.

Involved Stakeholders and their Roles

- **Municipality of Jerusalem & JTMT:** The city municipality and the Jerusalem Transportation Master Plan Team (JTMT) were key implementers for the LRT stations, the Park & Ride facility, public elevators, the new bike lane, and the ridepooling initiative
- **Ministry of Transport (MoT):** Actively involved in continuous discussions for the ridepooling R&D. The project will provide the MoT with a final policy report and support for future service design and decision-making.
- **Academic and Corporate Partners:** Tel-Aviv University (TAU) gained better insights into city planning processes and internal data collection, while Sigma 6 LTD demonstrated how simulation-optimization delivers greater public spending efficiency.
- **Operators and Platforms:** Entities involved in mobility operations and data included Jerufun, Moovit, Cfir, Egged, Super-Bus, Extra, Shlomo Share, Go To, and Pango.

3.3.4 Athens – Penteli

The Penteli Living Lab developed a comprehensive demonstration strategy combining infrastructure measures, public transport planning, shared mobility services, mobility hubs and digital integration tools. The overall purpose of the demonstration was to reduce car dependence, improve safety and accessibility and support the uptake of active and shared mobility through coordinated push and pull interventions. The main five measures and interventions are the following (depicted also in *Figure 13*): a) street space allocation (push-pull), b) e-bike sharing scheme (pull), c) mobility hub creation (pull), d) local public transport with e-buses (pull) and e) Mobility as a Service (MaaS) (pull).

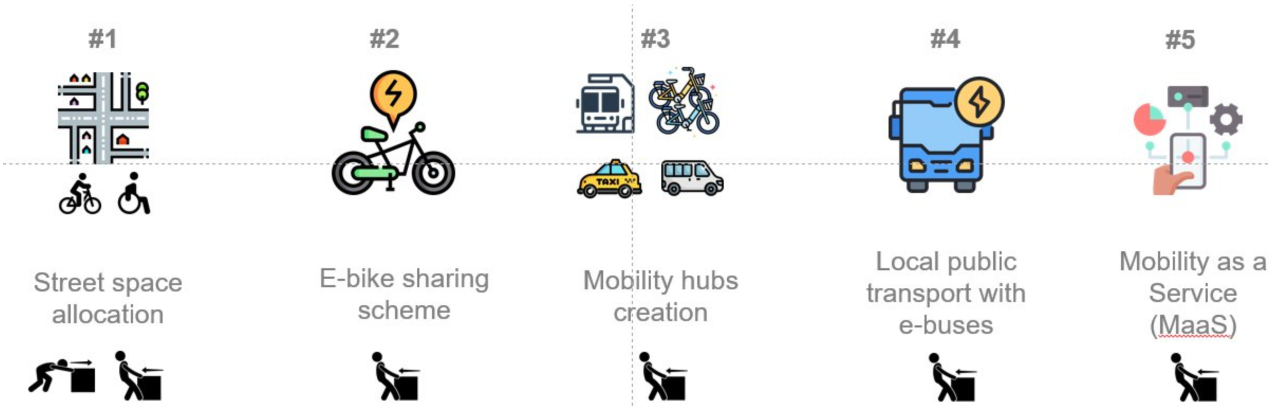


Figure 13: Penteli LL - Penteli living labs main policy measures and interventions

A central part of the demonstration involved street allocation or retrofitting measures. These included the construction of pedestrian and cycling infrastructure, such as cycle tracks, cycle streets, regenerated pavements and road surfaces using cold materials and broader road safety interventions (cycle streets were funded by SUM project, while cycle tracks by the municipality). The street space redistribution project focused on Gennimata, Zoodochou Pigis, and Thiras streets (length: 400m). The interventions formed part of a wider effort to rethink street hierarchy and create a network of active mobility routes. According to the project's objective for Penteli Living Lab, more than 5 km of streets were transformed, with speed limits reduced to 30 km/h. This multidimensional cycle street network is ready, making it the first initiative of this kind in Penteli.

Another major demonstration measure was the deployment of an e-bike sharing scheme (funded by the central government but operated by the municipality). The system comprised 38 e-bikes and six docking stations placed at strategic points. The service is offered free of charge for the first three years in order to familiarise users with the new mobility option. This fully operational service represents an important first step in expanding shared mobility options within the municipality.

The establishment of a central mobility hub was another important milestone (funded exclusively by SUM project). The hub was created at Melissia Square on Dimokratias Avenue and was designed as a multimodal point connecting local and metropolitan public transport, shared e-bikes, ride-hailing and active mobility routes. A totem was designed, redesigned, finalised, printed and physically installed in both Greek and English in order to increase visibility and provide useful information on the available transport options. This intervention aimed to strengthen multimodal integration and make shared and public mobility more visible in the urban environment.

Moreover, Penteli included a MaaS component in the demonstration (funded exclusively by SUM project). This work included precision geofencing, multimodal integration, advanced API interconnectivity and the gradual development of a digital platform for the municipality. The MaaS-related activities were connected both to the FREENOW shared mobility service and to the development of a web map presenting Penteli's transport system. Notably, this platform brings together the e-bike sharing system and ride hailing.

Finally, the demonstration also included the reintroduction of local public transport through three local lines plus one university line, combined with the planned purchase and deployment of electric buses. One of these lines was intended to connect local centres and neighbourhoods with Athens' metro and suburban railway stations outside the municipality. It should be noted that the final delineation of the lines was funded by the SUM project, while the operation would be funded by the municipality. This measure aimed to improve efficiency through schedule coordination, vehicle and crew planning, and better integration with OASA services. However, although the routes had been identified, the e-buses had not yet been purchased and deployed due to bureaucratic and external constraints as the tendering was handled by the central government. Only one line, i.e., the school line, was realised (funded by the municipality). Instead, the rescheduling of the other lines was simulated (funded by SUM project).

In terms of implementation phases, 2023 was an introductory year for the project. The municipality tried to organise its objectives and identify its needs for materialising them into concrete results. During this period, the project team selected the location of the central mobility hub and started to draft potential changes in the transport system. Furthermore, in the first months of the project, the LL developed and distributed the first travel behaviour and acceptance survey. Moving on, 2024 focused on preparation and early rollout, including customer survey design, construction of cycle tracks, initial totem design, launch of the shared mobility service and first planning of cycle streets. In 2025, implementation accelerated through Analytical Hierarchy Process (AHP) deployment, a well-known method for assigning weights, two co-creation workshops (online and physical), MaaS development, survey analysis, traffic counts, public presentations (CIVITAS event), operationalisation of the MaaS platform, finalisation and installation of the mobility hub totem and submission of the cycle street plan for approval. In 2026, final survey distribution was completed (acceptance and travel behaviour survey), cycle street construction progressed towards completion, ex-post ODP measurements were carried out, detector locations were finalised, and the final policy measures and interventions were considered completed.

The demonstration involved several local stakeholders. The main ones were the Municipality of Penteli, NTUA and FREENOW. The municipality led the local planning and implementation of key measures; FREENOW supported the MaaS and ride-hailing related components and NTUA acted as the scientific partner supporting analysis, planning, and evaluation. Plus, in addition, the company AMCO S.A. contributed to the bike-sharing system; OASA represented the metropolitan public transport interface; these two stakeholders were outside the SUM project; however, their services affect the shared mobility landscape of the municipality. Altogether, these actors play a central role in planning, implementation, coordination, evaluation, and knowledge generation, making them essential contributors to the success of the LL.

3.4 Data Collection Plan (Overview) & Living Lab specific KPI's - Focus on the results

3.4.1 Munich

The Living Lab in Munich implemented a comprehensive and multi-stage data collection plan between 2024 and 2026 to analyse urban mobility patterns, support the implementation of measures, and evaluate their impacts over time. This approach combined quantitative and qualitative methods, including surveys, operational data analysis, simulation tools, and stakeholder engagement, thereby ensuring a robust evidence base for decision-making.

The process began with a pre-implementation survey (WP1) conducted from January to March 2024 among 202 Munich citizens. This survey provided a baseline understanding of public transport and shared mobility usage, as well as general mobility behaviour in the city. Building on this, stakeholder interviews (WP5) were carried out between January and February 2025 to gather insights from key actors within Munich's mobility ecosystem, highlighting both opportunities and barriers for implementing innovative mobility solutions.

A central component of the data collection plan was the comprehensive customer survey (WP4), conducted between June and August 2025 with 215 participants. This survey, complemented by an acceptance assessment (WP1), provided in-depth insights into user behaviour, awareness levels, preferences, perceived barriers, and satisfaction with the existing transport system. A post-implementation survey (WP1/WP5), conducted from January to March 2026 with 205 participants, enabled a longitudinal comparison of mobility behaviour.

These survey-based approaches were complemented by operational data from carsharing providers, including booking data, trip characteristics, and pick-up and drop-off locations. This data enabled the identification of spatial and temporal usage patterns and hotspots. In addition, simulation tools such as FleetPy were used to test different service configurations and integration scenarios with public transport. FleetPy is an open-source agent-based simulator designed to model Mobility-on-Demand services with very high fidelity. The main components and the modular interactions within the framework are illustrated in *Figure 14*.

By simulating the dynamic evolution of requests and real-world fleet operations, the framework allows cities and operators to evaluate the impacts of various regulatory settings. This supported the implementation of optimized and risk-reduced planning within the Living Lab. Co-creation processes and stakeholder engagement further contributed qualitative insights into implementation challenges and opportunities.

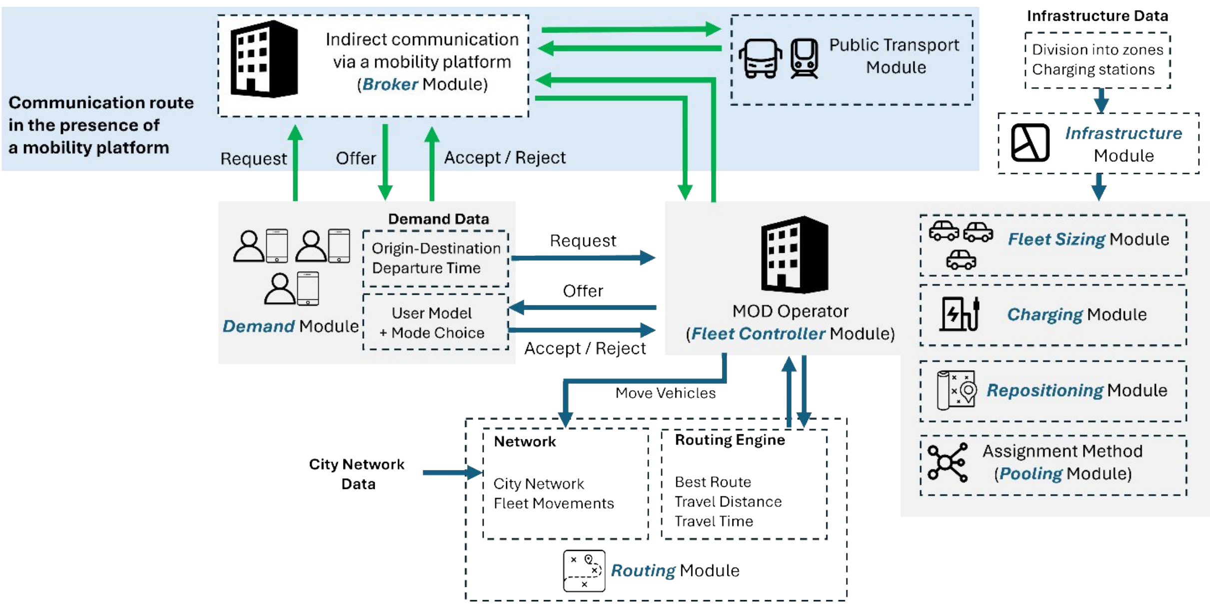


Figure 14: Munich LL - Main components / modules and their interactions in the FleetPy framework.

The collected data directly supported the implementation of measures within the Living Lab. Usage patterns and modal substitution effects helped to better position carsharing within the mobility system, while spatial and temporal data informed infrastructure planning, such as the placement of mobility hubs and dedicated parking spaces. Perception data on travel time and safety highlighted the importance of improving reliability, accessibility, and user confidence.

Several Living Lab-specific KPIs were defined to support implementation and evaluation. These include the share of carsharing users (e.g. 65%), modal shift indicators (e.g. replacement of private car and public transport trips), and impacts on car ownership (e.g. 32% not purchasing a car, 13% considering selling) see chapter 3.5.1. Additional KPIs relate to system performance, such as parking search time, walking distance to destinations, frequency of blocked parking spaces, and awareness and usage rates of dedicated infrastructure. These indicators enabled a combined assessment of behavioural change and operational efficiency and ensured that measures were aligned with user needs and system performance.

3.4.2 Geneva

Data collection for the Mobility Hubs and Ticketing Integration measures relied on a combination of surveys, GPS tracking, usage monitoring, and co-creation processes with local stakeholders.

For the *Mobility Hubs*, five main survey instruments were deployed:

1. Within the SUM survey framework, the WP1 post acceptance and acceptance surveys in 2026 included a dedicated section assessing mobility hub perception, while the WP4 Customer Survey collected direct user feedback on the first implemented hubs.
2. Prior and post surveys combined with GPS tracking were conducted (prior in November 2024, post planned for November 2025) to capture changes in actual travel behaviour.
3. Usage monitoring of shared vehicle services is ongoing.
4. Two additional surveys were carried out in collaboration with companies located in industrial areas where mobility hubs are being installed; a prior survey in 2025 and an evaluation in 2026, focusing on commuters' current transportation needs as well as design and service evaluation at the hubs.
5. For the *Ticketing Integration* measure, data collection focused on tracking the uptake of the bundled public transport and bike-sharing discount offer, which was distributed both online and through agencies since July 2024.

For the Geneva Living Lab, KPIs were selected to capture both service evolution and user behaviour across the two main measures. The number of NSM operators integrated into the hub network doubled from 3 to 6 between 2023 and 2026, reflecting a progressive enrichment of the mobility offer. Intention to use shared services remained high, with 75% for car-sharing and a notable +22-point increase for micro-mobility. Door-to-door travel time for sustainable modes became significantly more competitive compared to private car use over the project period, and overall user satisfaction reached 78%. Modal shift indicators showed a decrease of -3.3% in private vehicle use, alongside increases in both NSM (+5.2%) and public transport usage (+7.7%). For the Ticketing Integration measure, a reduction in travel costs was observed across all evaluated transport modes, suggesting tangible economic benefits for users.

3.4.3 Jerusalem

The Jerusalem Living Lab data collection plan focused on three primary interventions: a ride-pooling service, a bike-sharing system, and the extension of the Red LRT line. The KPI assessment was supported by a comprehensive set of data sources, including SUM project surveys (WP1 first and second waves, and WP4), operational data from the LRT operator, rental data from the Jerufun bike-sharing service, and smart card ("Rav-Kav") usage records. In addition, the simulation–optimization framework developed for the ride-pooling analysis in the Yuvalim–Ganim neighbourhood incorporated several complementary data inputs, including smartphone-based mobility data, historical records from the discontinued TikTak ride-pooling service, a mobility preference survey conducted in Jerusalem in 2017, and service-level indicators defined and monitored by JTMT. This multi-source data environment enabled a robust and multi-layered evaluation of both behavioural responses and system-level impacts.

3.4.3.1 Ridepooling Service

The analysis of the ride-pooling service integrates both global and local KPIs, providing a comprehensive perspective on system performance. Local KPIs were derived using a dedicated simulation–optimization framework designed to evaluate alternative operational configurations and identify those best suited to the specific characteristics of the study area. In contrast, global KPIs capture broader behavioural and system-wide impacts.

At the global level, the findings reveal a clear contrast between **strong user acceptance and limited system-wide impact**. Survey results indicate that 61.8% of respondents express a positive intention to use the service, exceeding the initially expected moderate uptake. This favourable perception is further reinforced by a relatively high willingness to pay, with 72% of respondents indicating readiness to spend an additional €2 alongside a public transport (PT) ticket. These results suggest that, from a behavioural standpoint, NSM is perceived as a valuable complement to existing mobility options, particularly when positioned as part of an integrated multimodal system.

However, these positive perceptions are not matched by competitive operational performance, particularly in terms of travel time. Empirical measurements show that NSM incurs significantly longer door-to-door travel times compared to private car use (assuming no parking constraints), ranging from approximately two to four times longer depending on the configuration. These estimates explicitly account for walking and waiting times, which substantially affect overall service attractiveness. While initial simulations pointed to potential advantages in specific peak-period conditions, further simulations indicate that, in most real-world scenarios, ride-pooling remains less competitive than direct car travel.

At the same time, one of the most notable strengths of the service lies in its ability to **enhance multimodal integration**. The introduction of ride-pooling leads to a substantial increase in multimodal trips, particularly those connected to LRT services. The findings suggest that NSM performs especially well in structured operational settings that concentrate demand around key hubs, thereby enabling efficient first- and last-mile connections. This reinforces its role not as a direct substitute for private vehicles, but rather as a **strategic feeder mode** that extends the reach and usability of high-capacity transit systems.

Despite this contribution, the overall modal shift remains modest. The observed modal share of NSM, in combination with walking and PT, ranges between 0.6% and 2.7% across configurations. Consequently, the reduction in private car usage, and in other modes such as walking and cycling, is minimal. This limited uptake directly explains the absence of measurable impacts on congestion and travel delays, confirming that the scale of adoption is insufficient to influence overall network performance. In this sense, a neighbourhood-oriented ride-pooling service introduces **incremental rather than transformative changes** at the urban scale.

Focusing on local KPIs provides a more nuanced view of system performance, highlighting important **efficiency gains alongside operational trade-offs**. Simulation results indicate that optimized configurations can reduce vehicle idle time (to approximately 19–23%), increase vehicle fill rates (from 1.3 up to 3.7 passengers per vehicle/ride), and improve service rates (ranging from 45% to 78% request acceptance). However, these gains are not uniform across configurations. Higher efficiency, reflected in increased occupancy, is associated with lower service rates and a higher proportion of trips involving long walking distances (up to 60% for walks exceeding 500 meters). This underscores a fundamental trade-off between operational efficiency and user experience.

Overall, the combined evidence suggests that ride-pooling performs best as a **locally efficient, multimodal-supporting service**, delivering targeted improvements in accessibility and system utilization. However, its broader impact on travel behaviour and network conditions remains limited, emphasizing the importance of careful system design and parameter calibration.

3.4.3.2 Bike-Sharing Service

The introduction of 18 new bike-sharing stations within the living lab area reveals a **marked gap between infrastructure provision and user adoption**. Survey results indicate low levels of acceptance among actual users (6.9%), as well as limited intention to use the system among non-users (7.2%). These findings point to a relatively weak behavioural response, suggesting that the mere expansion of infrastructure is insufficient to generate substantial uptake.

A more nuanced picture emerges when examining the relationship between safety perceptions and actual usage behaviour. While perceived safety was expected to be high, the results indicate mixed engagement: approximately 50% of respondents report having used the service, while 30.5% report non-use. This suggests that, although safety is an important enabling factor, it does not constitute a primary driver of adoption. Other barriers—such as accessibility, convenience, and entrenched travel habits—likely play a more significant role in shaping user behaviour.

At the system level, the bike-sharing service demonstrates **strong but highly localized effectiveness in supporting multimodal integration**. Only 3 out of the 18 stations (14%) are located at major transfer hubs, yet these stations account for 30% of total bike rentals. This disproportionate usage clearly indicates that **spatial integration with high-demand transit nodes significantly enhances utilization**, even when implemented on a limited scale.

This pattern underscores the critical importance of **station placement strategy**. Stations located at key hubs function as focal points that concentrate demand and facilitate first- and last-mile connectivity, thereby amplifying their impact. Conversely, stations located outside these high-demand areas exhibit lower utilization, limiting the overall system effect.

As a result, the system's aggregate impact remains constrained. Despite strong performance at strategically located stations, the limited share of such locations reduces the overall contribution to multimodal travel. The findings therefore suggest that the system has not yet fully leveraged the potential synergies between bike-sharing and public transport.

In summary, the bike-sharing system is characterized by **low overall adoption but high localized effectiveness**, with performance driven primarily by spatial integration rather than network scale. The key implication is that **targeted deployment and network design are more critical than simple expansion**, highlighting the need for a more strategic approach to infrastructure planning.

3.4.3.3 LRT Red Line Extension

At the behavioural level, the extension of the Red LRT line generates a **strong and clearly positive user response**. Acceptance of the implemented measures reaches 64.7%, indicating broad public support. Moreover, intention to use public transport increases significantly from 51.5% to 63.1% following the opening of the new stations. This substantial increase suggests that the LRT extension not only improves accessibility but also actively reshapes travel preferences, strengthening the attractiveness of public transport.

A particularly striking result is observed in **perceived safety**, which reaches 95.6% in the vicinity of LRT stations. This exceptionally high level indicates that the new infrastructure successfully creates a safe and user-friendly environment, which is likely to play a critical role in sustaining and further increasing ridership.

At the system performance level, the new stations quickly establish themselves as **high-activity mobility hubs**, with approximately 33,000 daily boardings and alighting recorded across six stations. This level of demand reflects strong integration into the existing transport network and confirms the central role of the LRT in the urban mobility system.

The data also reveal a **reconfiguration of modal usage patterns**. Bus ridership decreases by approximately 10% (from 5,350 to 4,800 daily boardings), indicating a shift of passengers toward the higher-capacity rail system. At the same time, bike-sharing usage increases substantially—from 9.5 to 24 daily rentals—demonstrating improved first- and last-mile connectivity and stronger multimodal linkages.

These dynamics point to a **dual transformation mechanism**: consolidation of core transit demand onto the LRT, alongside strengthened connectivity through flexible access modes such as bike sharing. The increase in bike usage, in particular, highlights the effectiveness of LRT stations as multimodal interchange points, extending the reach of the rail network beyond its immediate corridors.

Overall, the LRT extension represents a **structural intervention with system-wide impacts**, in contrast to the more incremental effects observed for other measures. It significantly enhances public transport attractiveness, improves perceived safety, and strengthens multimodal integration, thereby reshaping mobility patterns and reinforcing the role of transit hubs as central components of the urban transportation system.

3.4.4 Athens – Penteli

Data collection in the Penteli Living Lab was designed to support both the implementation and the evaluation of the demonstration measures. It was developed in close synergy with WP1, WP3 and WP5, ensuring that local evidence could inform not only monitoring activities but also the improvement, prioritisation and communication of the measures implemented in the LL. The overall aim of the data collection plan was to better understand user needs, perceptions and behavioural patterns, while also documenting the effects of the interventions package including street space reallocation, shared mobility, mobility hubs, local public transport and digital tools. In this sense, data collection was not treated as a secondary activity, but as an integral part of the LL process, helping local partners to adapt the measures to Penteli's specific context and to assess whether the proposed interventions were moving in the desired direction.

A combination of quantitative and qualitative methods was utilised. The main data collection tools included survey-based instruments, co-creation activities, traffic and environmental monitoring as well as spatial and operational data related to the implemented measures. Together, these sources provided complementary insights: surveys captured user needs, preferences and levels of acceptance, co-creation activities generated qualitative feedback from local stakeholders, experts and organisations, especially addressing the prioritisation of the policy measures, monitoring data supported the evaluation of changes and operational data helped assess the real-world uptake of services such as the e-bike scheme. This mixed-methods approach was particularly important in Penteli, where several of the measures were novel for the municipality and where both behavioural and institutional barriers had to be understood in parallel.

One of the most important components of the data collection plan was the use of survey-based tools. A first survey, under the WP1, was used to assess the needs, characteristics and mobility-related perceptions of Penteli's residents and visitors (November 2023-January 2024). This helped the LL build a very first understanding of the local mobility context, including how users perceive existing conditions and what types of interventions are considered most relevant. At the same time, the LL also developed and distributed a customer survey under WP4, which was designed to support the prioritisation of the proposed measures (the entire process lasted from July 2024 to May 2025). In this case, the survey applied an AHP, allowing stakeholders, experts, policymakers and citizens' organisations to compare proposed interventions through pairwise comparisons (see Saat, 1994; Goepel, 2018; Duleba and Moslem, 2019). This process generated structured feedback on the relative importance and desirability of the measures and supported the municipality in identifying where local support and value were evident. The AHP-based approach was especially useful because it moved beyond general opinions and allowed a more systematic prioritisation of the Penteli interventions, even materialised with weights values. The collection of responses lasted three months (January to March 2025).

Additional survey work was linked to WP1 and WP5, especially through social acceptance and intermediate assessment questionnaires. This survey was administered to citizens and visitors of Penteli between December 2024 and March 2025. These tools aimed to capture how local users perceived both already implemented and planned measures. Such data were important because the LL sets forth interventions that directly affect daily movement patterns and the use of street space, such as cycle streets, mobility hubs and the future deployment of e-buses. Understanding whether these measures were perceived as useful, acceptable and relevant undoubtedly helped the LL partners improve communication around the interventions and strengthen the social ground for implementation. In this respect, the survey activities did not only generate evaluation evidence; they also supported implementation by identifying user concerns, expectations and opportunities for better local awareness raising.

A second important pillar of the data collection plan consisted of co-creation activities and stakeholder engagement processes (WP3). These included two workshops engaging local actors, academics, planners, organisations and municipal employees: one physical and one online. The online workshop was held on 16 January 2024, while the physical workshop took place on 18 February of the same year. Notably, 16 participants joined the first, while the second had 11 participants. This difference could be anticipated, since physical workshops are more challenging for gathering large groups. The profile of the participants was not entirely the same; nevertheless, nearly half of the first workshop's participants joined the physical event. The co-creation dimension was important because the Penteli LL operates in a context where sustainable and shared mobility measures are relatively new and, it should be underlined that in some cases, challenge long-standing car-oriented habits and attitudes. Through co-creation, the LL was able to gather qualitative feedback on the feasibility, acceptance and visibility of the measures, while also strengthening dialogue with local stakeholders. These actions helped ensure that the interventions were not only technically sound, but also better aligned with local concerns and everyday issues. Co-creation also played a role in raising awareness about the measures and building broader acceptance around the Living Lab's objectives, which is particularly relevant in a municipality where behavioural change cannot be expected from infrastructure changes alone.

Beyond surveys and workshops, Penteli also collected traffic, environmental and spatial data. The traffic data were collected in April 2025 and the environmental data in March 2026. On the contrary, spatial data were recorded and collected throughout the project. These data were particularly relevant for the implementation and monitoring of the physical interventions. For example, pre-cycle street traffic counts were carried out in the LL area to establish a basis for understanding traffic conditions before the full implementation of the cycle street network. In addition, the LL monitored aspects such as speed distributions, traffic density and selected (strategic) traffic count points in relation with the cycle street interventions. These data are important because one of the core objectives of the Penteli LL is to improve conditions for active mobility and road safety through street space reallocation and retrofitting measures. In response to that, these measurements were repeated after the implementation of the cycle streets. Traffic-related data therefore helped local partners understand whether the interventions were beginning to influence traffic patterns in a way consistent with the entire project's objectives.

Environmental monitoring formed another key part of the data collection plan (March 2026). The Living Lab identified and finalised the locations of air quality and noise detectors and measurement activities were carried out to support the monitoring of local environmental conditions. Measurements were reported for key locations such as the town hall, the swimming centre and the cultural centre, covering indicators including PM10, PM2.5 and noise levels before the interventions. These data are particularly useful in a LL such as Penteli, where sustainable mobility is closely connected to broader environmental goals, including the reduction of pollutants, improvement of local environmental quality and enhancement of liveability conditions. Even where causal attribution remains complex, these monitoring activities provide important evidence for understanding the environmental dimension of the interventions and for strengthening the case for robust sustainable mobility strategy in the municipality.

The Penteli Living Lab also drew on spatial data and accessibility-related information. Spatial analysis supported the understanding of how different interventions interact across the municipality's boundaries, especially in relation to the mobility hub, cycle streets and public transport links. One of the most relevant findings mentioned in the Living Lab material is that accessibility was assessed based on non-residential uses and compared across scenarios with and without the mobility hub and complementary interventions. This is a remarkable example of how spatial and accessibility-related data can directly support implementation: rather than evaluating each measure in isolation, Penteli was able to show the value of integrated action, and the synergies created when infrastructure, public transport and shared mobility are developed together. A further category of data concerned the operational performance of the e-bike sharing scheme. The Living Lab monitored usage levels of the system, including information on the number of available e-bikes, docking stations, and trip patterns. Operational data did not simply describe performance; they pointed directly to implementation needs and possible next steps. The Living Lab-specific KPIs and monitoring elements therefore reflected the broad and integrated nature of the LL interventions. The most relevant KPIs and data categories include:

- Shared-mobility related KPIs such as KPI4: Number of NSM integrated in the system, KPI6.2: Transport System - Safety/Comfort/micro-mobility, KPI7.2: Transport System – Time/Micro-mobility only, KPI7.3: Transport System – Time/ride-hailing and shuttle services only, KPI12.1.3: Transport System - Safety/Comfort/personal safety diff – bicycle.

- Accessibility effects linked to the combination of mobility hub, cycle streets/tracks and public transport interventions, such as KPI20: Accessibility ratio, KPI21: Horizontal social equity, KPI22: Vertical social equity, KPI23: Social inclusion.
- Participation and engagement indicators related to workshops and co-creation activities (KPI2: Community involvement)
- Traffic-related indicators connected to cycle street implementation, such as traffic counts, speed distributions and density, such as KPI24: Congestion and travel delays.
- Perceived usefulness and acceptance of interventions such as the mobility hub and e-buses, based on survey evidence such as KPI13: Transport System - Safety/Comfort/User satisfaction, KPI14: Perceived affordability
- Usage of the e-bike sharing scheme, including number of trips, origin-destination patterns and station activity levels. Plus, intention of use was also measured through questionnaires.
- Environmental indicators, including PM10, PM2.5 and noise levels at selected locations, such as KPI16: Greenhouse emissions, KPI17: Air pollution emissions and KPI18: Noise hindrance.

These KPIs helped the Living Lab not only evaluate progress but also identify where stronger effort was needed. For example, survey evidence on perceived usefulness could influence communication strategies; traffic and environmental measurements could support the justification of street space retrofitting (customer survey) and usage data from the shared e-bike system could inform operational improvements (e.g., rebalancing) and local promotion measures. This illustrates the practical role of data in the LL setting: it supported evidence-based decision making throughout implementation, not only at the final evaluation stage.

Altogether, the main finding from the Penteli data collection effort is that implementation and evaluation need to be closely linked, especially in a LL that combines interventions, organisational and digital measures. Survey and co-creation data showed that public perception and stakeholder engagement are essential for introducing unfamiliar mobility concepts. Traffic, environmental and spatial data helped monitor whether the physical interventions were beginning to produce the expected changes in safety, accessibility and local environmental conditions. Operational data assisted in illustrating that a new service, such as bike sharing, is an important first step, but that uptake depends on additional factors such as visibility, integration and awareness. In an overall view, the data collected in Penteli helped the ecosystem partners understand both the achievements and the limitations of the demonstration, while also providing direction for future improvements and long-term planning. This contributed to a more evidence-based pathway towards sustainable, seamless and shared urban mobility.

3.5 Gathered Data & Results

The following subsections present a thorough overview of the gathered data and findings related to the respective leader Living Labs (LLs). Each section will explore specific findings and insights that emerged from the analyses, emphasizing key trends and patterns observed during the implementation of various measures.

Moreover, the annex accompanying this document contains supplementary information which includes detailed outputs and data visualizations that have been referenced and discussed throughout the report, offering a deeper understanding of the methodologies employed and the significance of the results obtained.

Furthermore, an important aspect of the project involved analysing modal shifts, which were assessed through both ex-ante and ex-post implementation surveys conducted within the LLs. These surveys offered valuable insights into the behavioural changes and adaptations experienced by participants before and after the implementation of various interventions. By examining these modal shifts, we aim to draw meaningful conclusions about the effectiveness of the implemented measures and their overall impact on the target users. Refer to Annex 4.1.5 for detailed information on modal shifts.

3.5.1 Munich

The collected data reveals that Munich has a highly multimodal mobility system with a relatively low dependence on private cars. Cars account for 18.5% of trips, while public transport dominates with 32.7%. Shared mobility services, including carsharing, ride-hailing, and micro-mobility, represent 11.4% of trips - the highest share among the Living Labs - while taxis account for 17.8%. These results highlight the already significant role of shared mobility in the city.

Temporal analysis shows clear morning and afternoon peak periods, with strong reliance on public transport, taxis, and cars. In the evening, metro usage increases, and bicycles become more prominent. Trip purposes are mainly recreation-oriented, with fewer work-related trips, and different transport modes serving different purposes.

The WP4 customer survey provided additional key findings. Carsharing is already widely used (65% of respondents), often in situations where public transport is less convenient. At the same time, 26% of carsharing trips replace private car trips, indicating a positive contribution to reducing car dependency. However, 35% of trips replace public transport, highlighting the need for better integration between modes.

Building on these insights into modal substitution, further research was conducted to evaluate the potential of integrating ride-pooling as a complementary strategy. Utilizing historical trip data from SIXT, one of Munich's primary free-floating carsharing providers, the study simulated an operational shift toward Mobility-on-Demand in the urban core. By filtering for "direct journeys"—trips with both origins and destinations within the city and no significant detours or stops—the analysis assumed these requests could be effectively transitioned to ride-pooling services. To leverage existing urban infrastructure, carsharing parking spaces were designated as Pick-up and Drop-off nodes within the FleetPy simulation framework. The results reveal that 36.6% of direct inner-city trips can be successfully pooled, highlighting the substantial potential of this shared mobility mode to reduce traffic volume and alleviate parking demand, particularly during peak periods. The spatial distribution and intensity of this pooling potential are visualized in Figure 15.

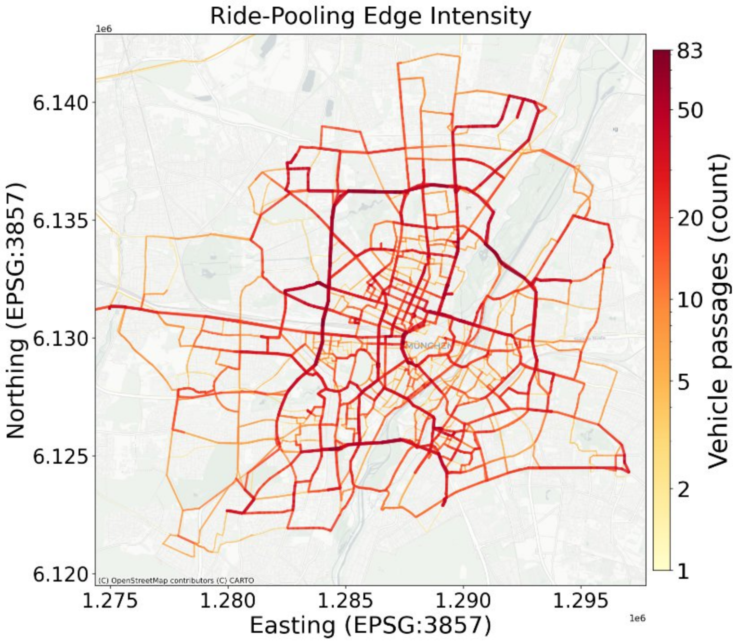


Figure 15: Munich LL - Simulated Ride-Pooling Edge Intensity and Traffic Load in Munich City Center, based on vehicle passage counts from FleetPy simulation

A critical operational challenge identified is parking. A total of 72% of users reported that dedicated carsharing parking spaces are frequently blocked, making this one of the most significant barriers to usability. While awareness of carsharing infrastructure is high (92%), actual usage is mixed, indicating potential for improvement. Users also expressed a strong need for real-time information on parking availability.

Perception-related findings show that cars are considered the fastest and most efficient mode, while public transport is perceived as slower, and active modes as more time-consuming. At the same time, safety perception is relatively low across all modes, particularly for walking and cycling.

These findings directly informed the implementation of measures within the Living Lab. Key actions include improving enforcement and monitoring of dedicated parking spaces, exploring sensor-based solutions for real-time availability, enhancing communication and awareness campaigns, and further analysing spatial usage patterns to guide infrastructure expansion. In addition, efforts were made to strengthen the integration of carsharing with public transport to promote multimodal travel behaviour.

Initial results from an internal survey conducted by the Department of Mobility in early 2026 indicate a positive trend: carsharing usage has increased significantly, with active users rising markedly in recent years, alongside a broader uptake of shared mobility services. While the number of trips and overall usage are increasing, usage per vehicle has remained stable, likely due to the growing number of available vehicles.

At the same time, survey results indicate that the modal split reflects a decline in private car usage by 10% and an increase in active mobility by 12%, which supports the measures implemented in Munich as part of the city's overall mobility strategy.

Overall, the results demonstrate that carsharing has strong potential to reduce private car ownership and contribute to more sustainable mobility patterns in Munich. However, addressing operational barriers - particularly parking issues - and improving system integration are essential to fully realise this potential.

3.5.2 Geneva

Monitoring of key performance indicators across the implemented measures revealed encouraging trends in service integration, user behaviour, and modal shift toward more sustainable transport options.

Mobility Hubs

A) NSM integration

The number of NSM operators integrated in the hub system grew from 3 to 6 between 2023 and 2026, progressively enriching the offer with complementary services. Carpooling was added alongside the existing Mobility car-sharing offer, providing a flexible alternative where users keep their own vehicle rather than returning a shared one. The cycling offer was strengthened through the addition of secure bike parking, addressing a key barrier to cycling adoption. Finally, the integration of WECHIP connected lockers has further supported the cargo bike offer, as the lockers allow users to store and charge cargo bike batteries directly on-site, significantly facilitating the use of shared cargo bikes.

Services in 2023:

(a) (b) (c)

Figure 16: Geneva LL - (a) Car sharing by Mobility; (b) Bike sharing by Donkey Republic; (c) Cargobike sharing by TCS

Additional services in 2026:

(a) (b) (c)

Figure 17: Geneva LL - (a) Carpooling by Ecoy; (b) Bike stations by OVO; (c) Connected lockers by WECHIP

B) Intention to use NSMs: Intention to use remains high and stable, with 75% of respondents intending to continue or start using car-sharing. A notable 22-point increase was recorded for the intention to start using micro-mobility services.

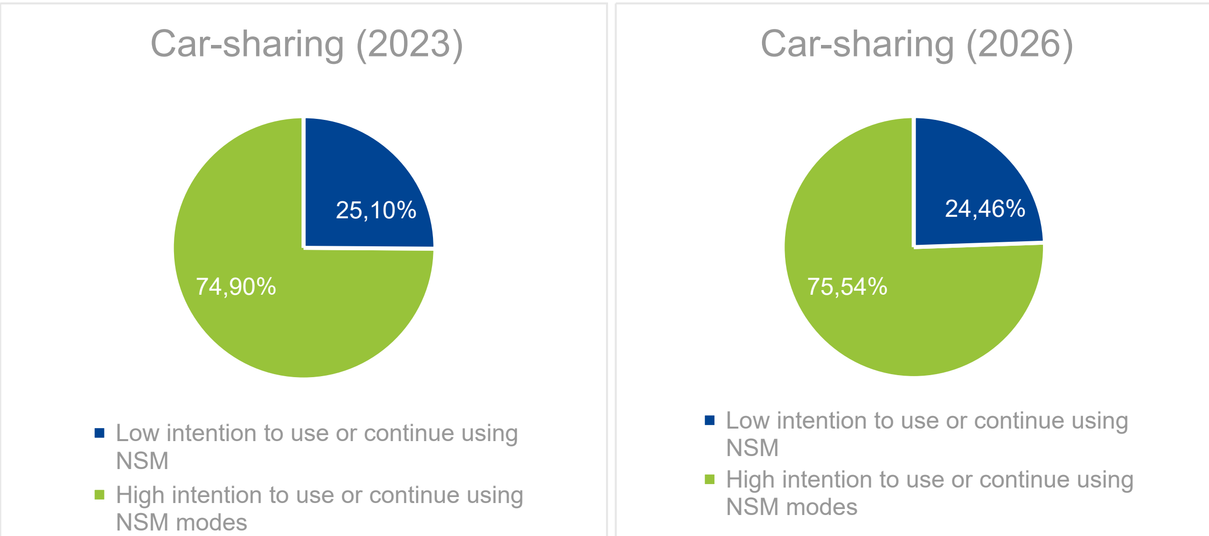


Figure 18: Geneva LL - Car-sharing 2023 and 2026

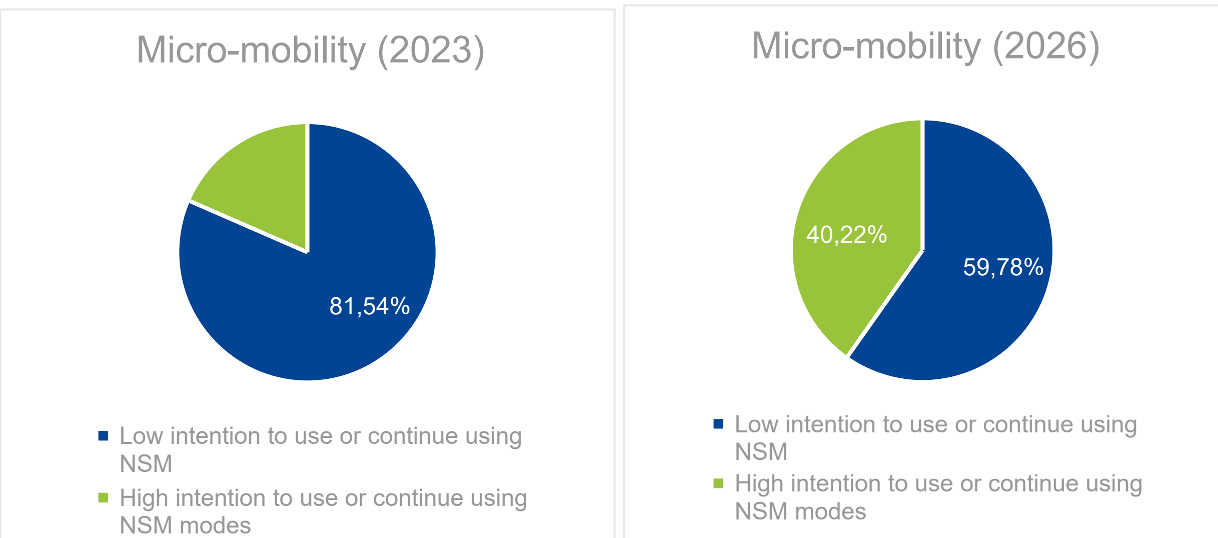


Figure 19: Geneva LL - Micromobility 2023 and 2026

C) Actual door-to-door travel time

The door-to-door travel time ratio (NSM + PT vs car) shows a significant overall decrease across all critical routes and all transport modes between 2023 and 2026, indicating that sustainable mobility alternatives have become considerably more competitive compared to private car use over the course of the project.

2023

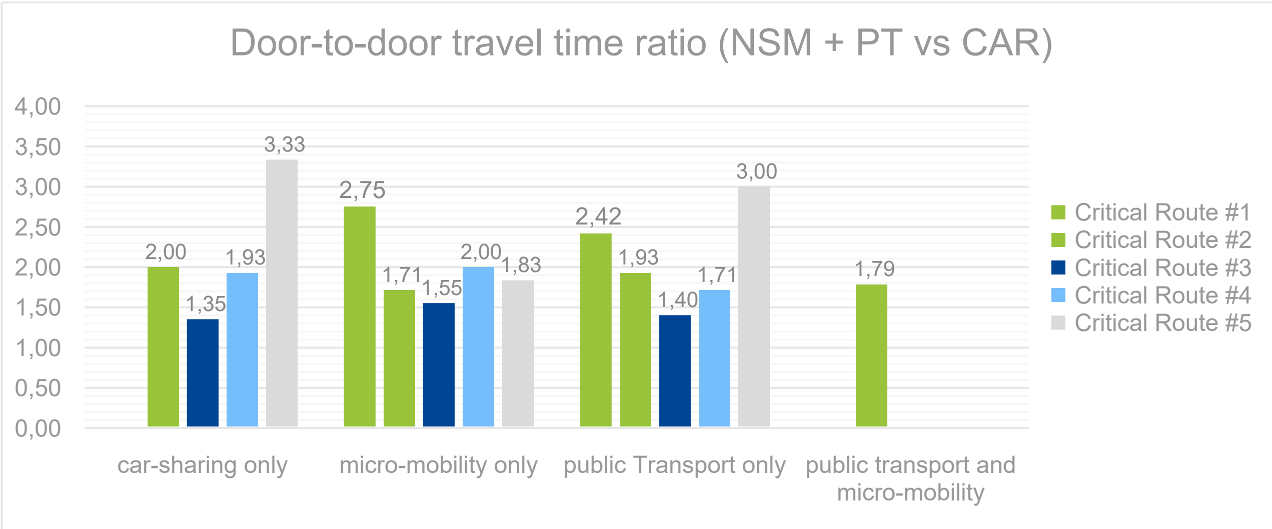


Figure 20: Geneva LL - Door-to-door 2023

2026:

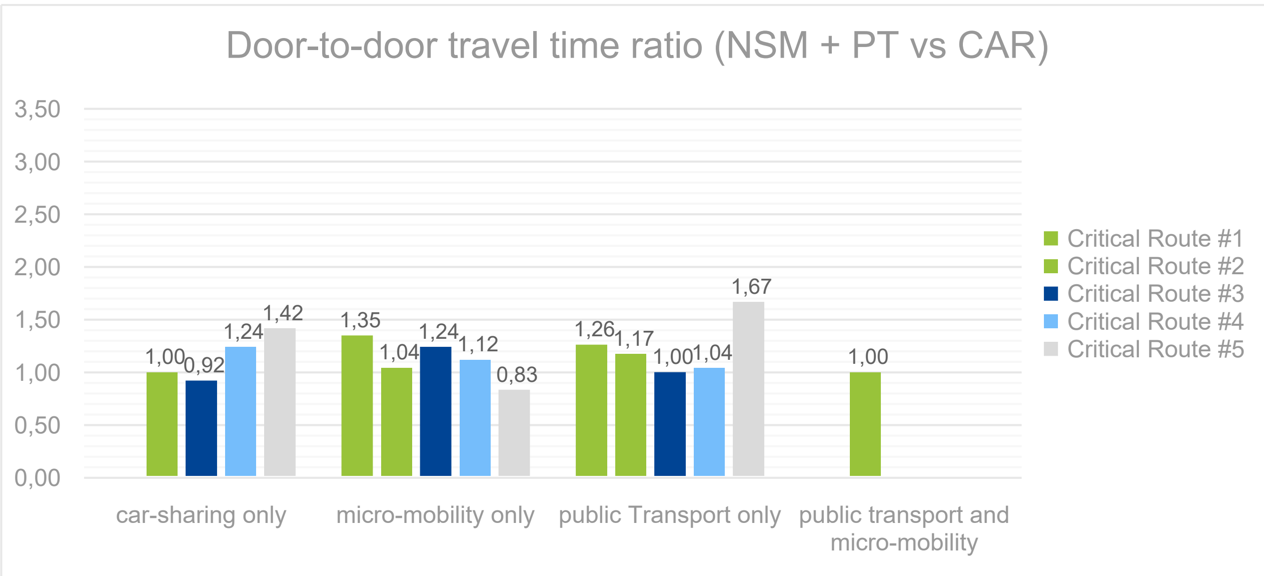


Figure 21: Geneva LL - Door-to-door 2026

D) Multimodal integration

Multimodal integration in stations and stops has led to an 8% increase in the number of services available per hubs.

Figure 22: Geneva LL - Lancy-Bachet Hub

E) Perceived door-to-door travel time

While perceived travel time compared to private car remains higher for public transport and bicycle across both peak and off-peak periods, a notable reduction is observed between 2023 and 2026 for most of the modes. Taxi perception remained largely stable over the same period.

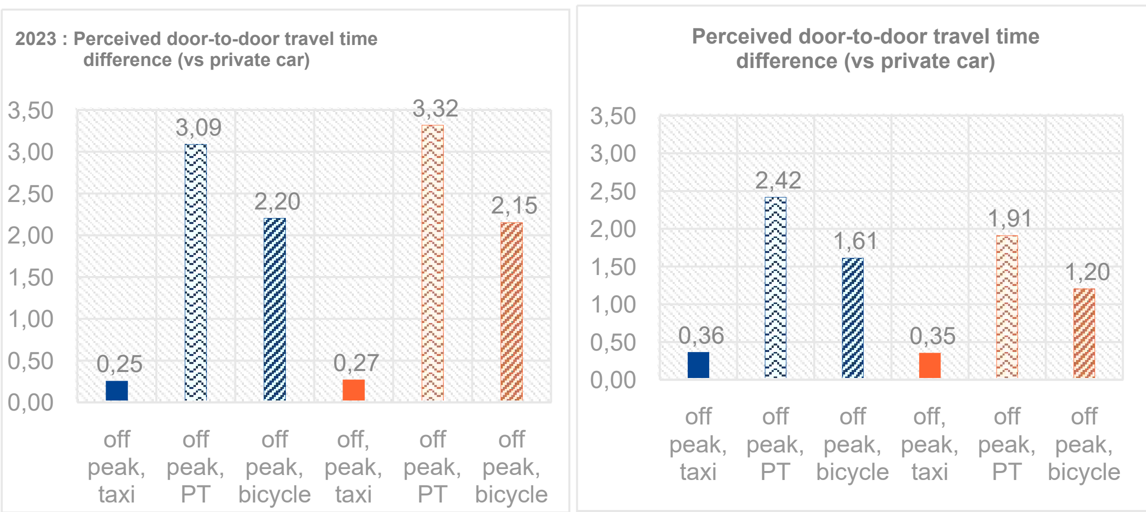


Figure 23: Geneva LL - Perceived Door-to-door for 2023 and 2026

F) User satisfaction: 78% of users expressed satisfaction with the system in place.

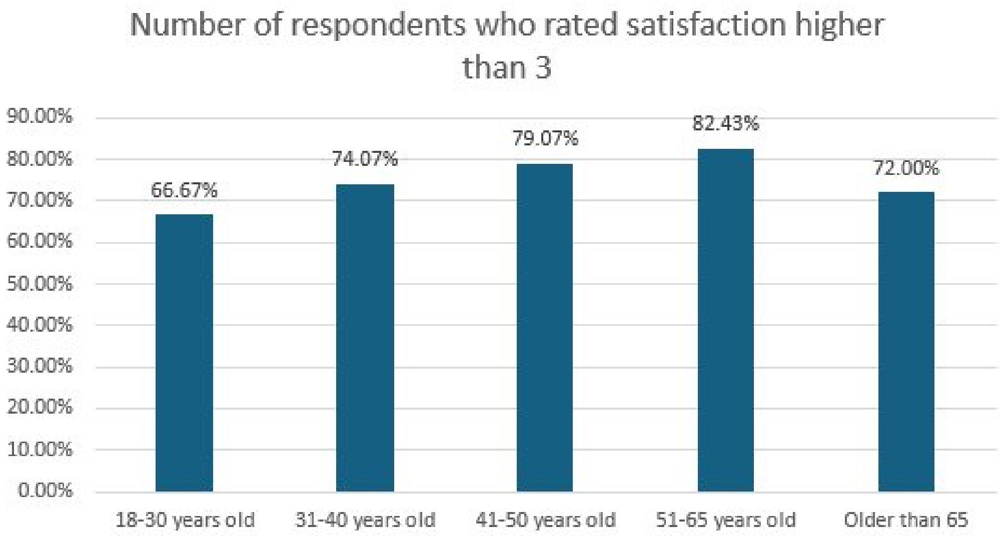


Figure 24:Geneva LL - User satisfaction

Modal split: Positive shifts were observed among respondents from the project's study area, with NSM usage increasing by +5.2% and public transport use by +7.7%, while private vehicle use decreased by -3.3%. These results are based on the SUM Ex ante Survey (184 respondents), a sample composed predominantly of existing shared mobility users in Geneva, which limits the representativeness of the findings. Public transit modes were distinguished based on national-level distance distribution (Source: National Statistics Office, Microrecensement mobilité et transports), and only responses including mode, origin and destination were considered.

G) Ticketing Integration (NSM and PT – SUM)

- Travel cost ratio: A general reduction in costs was observed across all five transport modes evaluated, suggesting that the bundled discount offer is beginning to produce measurable economic benefits for users and may support modal shift toward more sustainable options.

Figure 25: Geneva LL - Travel cost ratio 2023 vs 2026

3.5.3 Jerusalem

This section highlights the strongest findings from evaluating over 2,000 on-demand, ridesharing service configurations using the SUM Simulation-Optimization Framework developed as part of WP2. Replacing the outer optimization loop with a factorial experiment design and several narrower investigations permitted rigorously examining service options for the morning commute from 7am to 10am. As is explained more fully in Deliverable 2.2, the framework simulates a single configuration in a loop with service performance fed into the next simulation repeatedly until supply and demand converged, which required 5.6 iterations on average. Then that configuration received an evaluation and the framework proceeds to the next configuration to evaluate. To increase statistical rigor, each iteration averages the results of at least ten replications (simulations based on distinct random demand realizations) at 1/20 total volume. Higher demand volumes produce similar results but require more time and memory per iteration and more iterations before convergence.

The team found that in a small service area, operating ten to twenty vehicles on a many-to-many (taxi-like) basis serves more customers and is therefore more profitable than a few-to-many service (hub-based) with higher occupancy rates. The many-to-many service achieves this by favouring customers taking short trips, many of whom previously walked. The study assumed that a service can pick-up and drop-off as quickly and safely at any bus stop as at a designated hub. Future studies should interrogate this assumption and consider the possibility of mixed policies or dual systems that offer a many-to-many service to users with personal mobility challenges and a few-to-many service to the general population to promote walking and a healthy lifestyle.

These are the parameters and settings explored in the experiment:

- **Service area:** Four sets of traffic analysis zones in and around the Yuvalim-Ganim neighbourhood.
- **Policy:** Either many-to-many (any bus stop to any bus stop) or few-to-many (begin or end at a hub).
- **Hubs:** Few-to-many policy configurations explored four sets of hubs. These included the same points-of-interest identified by surveying potential users (WP4 customer survey). The sets differed by the addition of light rail stations (1-rail, 2-rail, 3-rail, 6-rail). The selected stations were as centred and evenly distributed as possible.
- **Cost:** 1.5, 2, or 2.5 euros, based on surveyed willingness to pay (1₪ = roughly 0.28€).
- **Fleet Size:** 10 or 20 vehicles.
- **Detour:** Shared rides can take up to 25% or 50% longer than a direct trip.
- **User decision time:** User will wait either 5 or 10 seconds for an offer after making a request.
- **Minimum wait time:** Initially fixed at zero minimum wait (user ready for pickup immediately) but higher values explored in focused investigations.
- **Pickup window**: Initially fixed at 5 minutes but higher values explored in focused investigations.
- **Vehicle capacity:** Fixed at 4-passengers after earlier applications of the framework showed this being sufficient.

Configurations operating on a many-to-many policy, untethered from the constraints of any hub, proved especially prone to surpassing available computer memory or triggering user-defined time limits during framework execution as fleet size, user decision time, minimum wait time, and pickup window increased. For this reason, the additional, focused investigations involved few-to-many configurations.

3.5.3.1 Outcomes

The experiment tracked many KPIs as an output of simulation, five of which are reported herein: NSM mode share, service rate, occupancy, travellers served, and profitability. The contribution of each parameter to the outcome is ranked by a driver score that combines the degree to which the parameter affects the outcome and the degree of confidence in that relationship. Strong, highly statistically significant effects have higher driver scores than weaker, less significant effects.

For each outcome, the Jenks natural breaks algorithm divides the parameters by driver score into three classes with a statistically significant impact (primary, secondary, and minor) and a fourth class with no effect. For clarity and brevity, the figures show only the primary and secondary parameters, the adjusted low-to-high change, and the two Jenks lines.

3.5.3.2 NSM Mode Share

NSM mode share is percentage of journeys using the service for at least one leg of the morning commute. The highest NSM mode share of 2.72% came from a configuration with a policy of many-to-many, a fleet size of 20, an NSM cost of 1.5€ and a maximum detour of 50%

Policy and Fleet Size were the strongest drivers of NSM mode share. Few-to-many yielded a mode share of 0.55% and many-to-many yielded a mode share of 1.31%. The share increased from 0.70% with 10 vehicles to 1.31% with 20 vehicles. NSM Cost and Maximum Detour Allowance were secondary parameters. For NSM cost of 1.5€, 2€, and 2.5€ the mode share was 0.79%, 0.70%, and 0.61%, respectively. The mode share increased from 0.64% with a 25% detour to 0.76% with a 50% detour. Hub Configuration and Service Area were minor factors. User Decision Time Allowance did not significantly affect the NSM mode share.

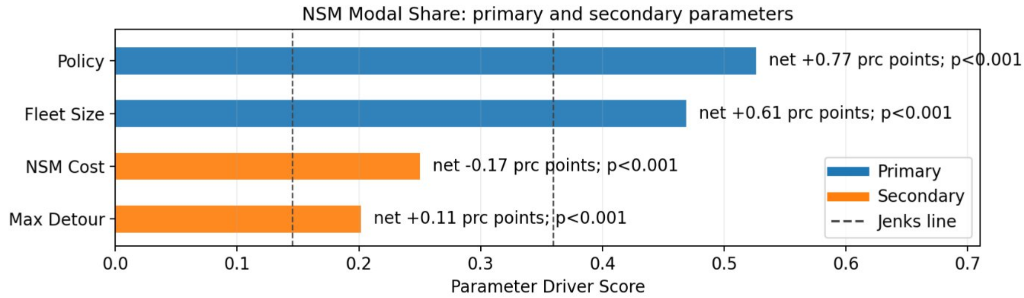


Figure 26: Jerusalem LL - NSM Modal Share – primary and secondary parameters

Analysis of few-to-many configurations with 10 vehicles and zero minimum wait time showed that increasing pickup-window duration from 5 minutes to 10 minutes increased NSM mode share by 0.11%. With few-to-many configurations having 10 vehicles, a 5-minute pickup-window, and a 25% maximum detour, increasing minimum wait time from immediate pickup to a 5-minute advanced reservation increased mode share by 0.04%.

3.5.3.3 Service Rate

The service rate is the chance that a given request will receive an offer and result in a completed trip. It acts as a utility penalty representing risk whenever the rate is less than perfect (100%). In the experiment, the penalty was not extreme since requesters received a response from the operator quickly (within 5 seconds) and could theoretically make alternative arrangements. The highest service rate of 78% came from a configuration with a policy of many-to-many, an NSM cost of 1.5€, a fleet size of 20, and a maximum detour of 50%.

Policy, NSM Cost, and Fleet Size were the strongest drivers of service rate. Service rate was 45% under few-to-many and 54% under many-to-many. For NSM cost values of 1.5€, 2€, and 2.5€, service rate was 44%, 47%, and 50%, respectively. Service rate increased from 47% with 10 vehicles to 52% with 20 vehicles. Maximum Detour had a secondary ranked effect. Service rate increased from 46% at 25% detour to 47% at 50% detour. Service Area was the only minor factor. User Decision Time and Hub Configuration did not significantly affect service rate.

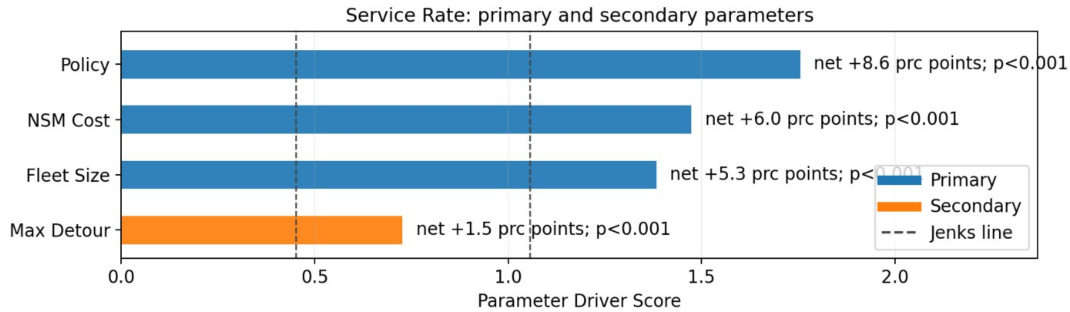


Figure 27: Jerusalem LL - Service Rate - primary and secondary parameters

Analysis of few-to-many configurations with 10 vehicles, a 5-minute pickup-window, and 25% maximum detour showed that increasing minimum wait time from immediate pickup to a 5-minute advanced reservation increased the service rate by 8.5 percentage points. With few-to-many configurations having 10 vehicles and zero minimum wait time, increasing the pickup-window from 5 minutes to 10 minutes increased the service rate by 3.6 percentage points.

3.5.3.4 Travelers Served

The most travellers served of 1,653 came from a configuration with a policy of many-to-many, a fleet size of 20, and a maximum detour allowance of 50%. Policy and Fleet Size were the strongest drivers of travellers served. Travelers served was 202 under few-to-many and 595 under many-to-many. It increased from 280 travellers with 10 vehicles to 611 travellers with 20 vehicles. Maximum Detour Allowance had a secondary effect. Travelers served increased from 254 at 25% detour to 307 at 50% detour. Minor factors were NSM Cost, Service Area, and Hub Configuration. User Decision Time Allowance did not significantly affect travellers served.

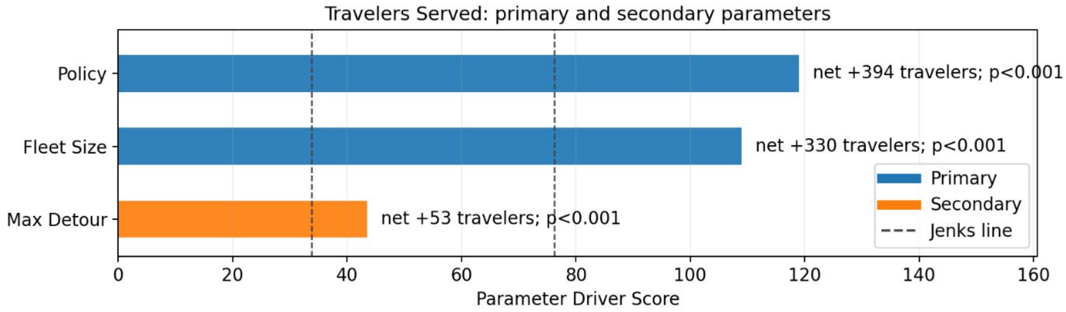


Figure 28: Jerusalem LL - Travelers served - primary and secondary parameters

Analysis of few-to-many configurations with 10 vehicles and zero minimum wait time showed that increasing the pickup-window from 5 minutes to 10 minutes permitted serving an additional 61 travellers (+29%). With few-to-many configurations having 10 vehicles, a 5-minute pickup-window duration, and 25% maximum detour, increasing the minimum wait time from immediate pickup to a 5-minute advanced reservation permitted serving an additional 54 travellers (+28%).

3.5.3.5 Occupancy

Occupancy measures the average number of passengers in a vehicle across the service. The highest occupancy of 3.7 came from a few-to-many configurations using the 1-rail hub set with a maximum detour of 50%, a fleet of 10 vehicles, and an NSM cost of 1.5€.

Policy and Maximum Detour Allowance were the strongest drivers of occupancy. Occupancy was 2.1 under few-to-many and 1.1 under many-to-many. Occupancy increased from 1.5 at 25% to 2.2 at 50%. Hub Configuration, Fleet Size, and NSM Cost had secondary effects. At 1-rail, the occupancy was 2.2; at 6-rail, it was 1.9. This estimate uses the balanced factorial core, few-to-many only. Occupancy increased from 1.9 at 10 to 2.0 at 20. For NSM cost values of 5.0, 7.0, and 9.0, occupancy was 1.9, 1.9, and 1.8, respectively. Service area was the only minor factor. User Decision Time Allowance did not significantly affect occupancy.

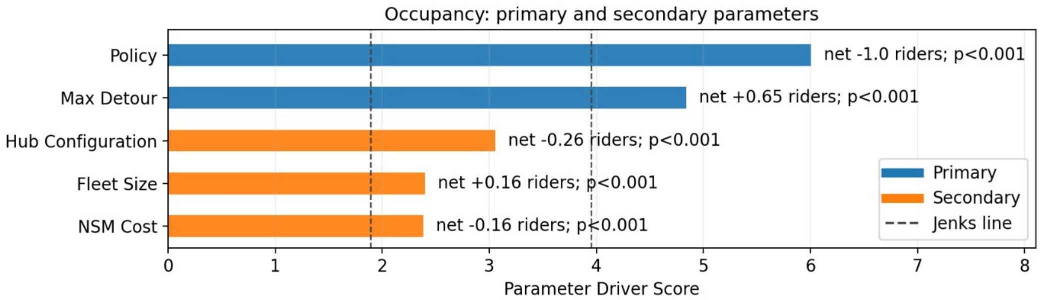


Figure 29: Jerusalem LL - Occupancy - primary and secondary parameters

Additional analysis of few-to-many configurations with 10 vehicles and zero minimum wait time showed that increasing pickup-window duration from 5.0 minutes to 10 minutes increased occupancy by 0.49 riders (+25%). Also, with few-to-many configurations having 10 vehicles, a 5-minute pickup-window duration, and 25% maximum detour, increasing minimum wait time from immediate pickup to 5.0-minute minimum wait time increased occupancy by 0.39 riders (+23%).

3.5.3.6 Profitability

Profitability is the operator revenue-to-cost ratio. Values over 1.0 suggest the configuration will be profit-producing. Revenue is NSM users served multiplied by the ticket price. Operator cost is calculated based on a fleet of internal combustion vehicles with a fuel consumption of 0.06 litres/km with fuel at 2.2€/litre. Depreciation costs 0.1€/km and maintenance costs 0.03€/km. The daily cost of each vehicle for insurance, parking, and licensing is 28€ and the driver earns 16.8€/h.

The highest profitability of 4.4 was achieved with a configuration featuring a policy of many-to-many, a minimum wait time of zero, an NSM cost of 9.0€, a fleet size of 20, and a maximum detour allowance of 50%.

Policy was the strongest driver of profitability. Profitability was 0.77 under few-to-many and 2.3 under many-to-many. NSM Cost and Maximum Detour Allowance had secondary effects. For NSM cost values of 5.0, 7.0, and 9.0, profitability was 0.80, 1.1, and 1.3, respectively. Profitability increased from 0.97 at 25% to 1.2 at 50% of detour.

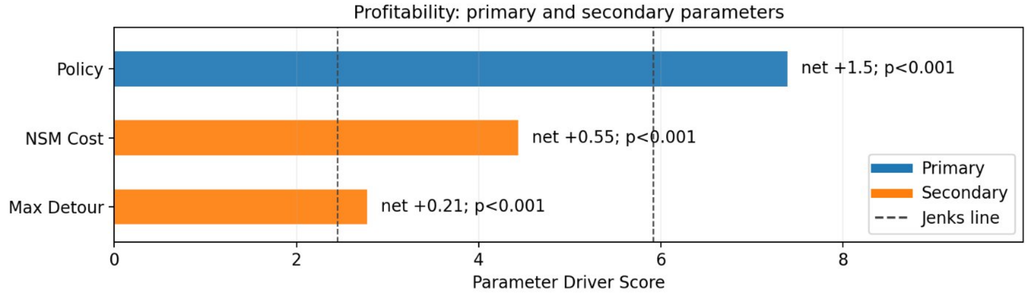


Figure 30: Jerusalem LL - Profitability - primary and secondary parameters

Minor factors were Fleet Size, Hub Configuration, and Service Area. User Decision Time Allowance did not significantly affect profitability.

Additional analysis of few-to-many configurations with 10 vehicles and zero minimum wait time showed that increasing the pickup-window duration from 5 minutes to 10 minutes increased profitability by 0.19. Analysis of few-to-many configurations with 10 vehicles, a 5-minute pickup-window, and 25% maximum detour showed that increasing minimum wait time from immediate pickup to a 5-minute advanced reservation increased profitability by 0.17.

3.5.3.7 A few parameters in focus

This section examines a few of the previous findings from the perspective of the parameter affecting one or more outcomes. Higher fleet sizes resulted in higher service rates—but also in **more opportunities to share rides and therefore higher occupancies** in both many-to-many and few-to-many configurations. This translated to more travellers served and higher mode shares.

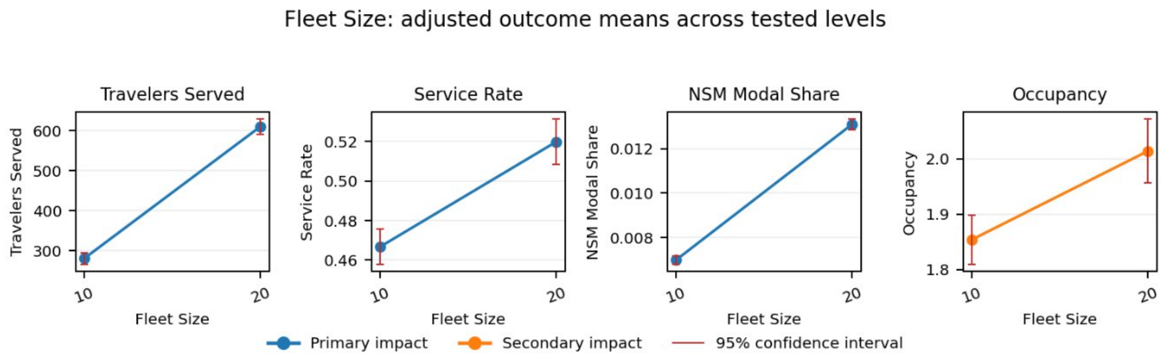


Figure 31: Jerusalem LL - Fleet Size -adjusted outcome means across tested levels

Higher ticket prices resulted in fewer requests, higher service rates, and higher overall profitability. But occupancy and NSM mode share fell.

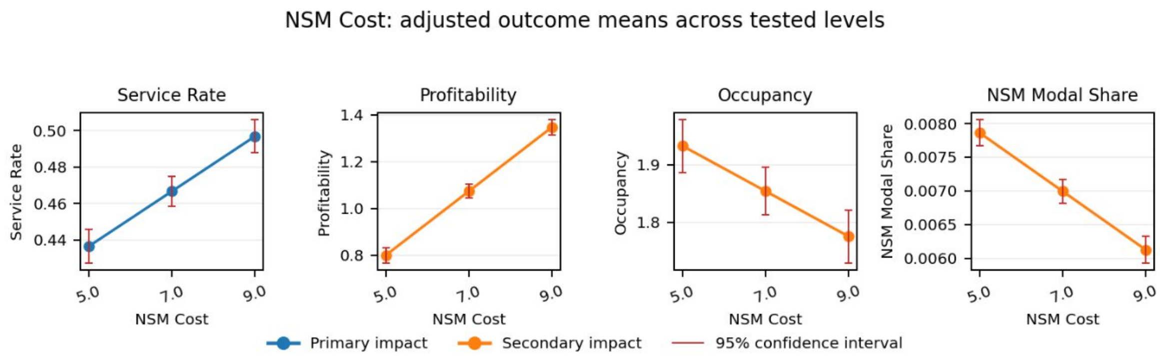


Figure 32: Jerusalem LL - NSM Cost - adjusted outcome means across tested levels

Adding more rail stations to the set of hubs decreased occupancy but had no other significant impacts.

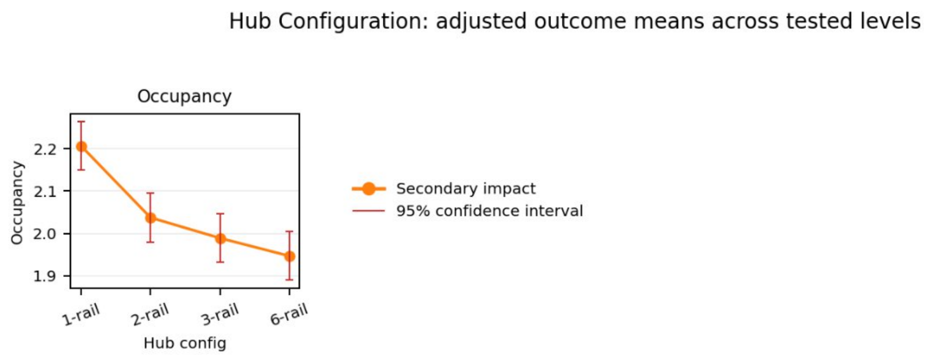


Figure 33: Jerusalem LL - Hub configuration - adjusted outcome means across tested levels

3.5.4 Athens – Penteli

As aforementioned, the data collected through surveys, traffic monitoring, environmental measurements, operational service data, accessibility analysis workshops, and co-creation activities provide a first overview of the effects of the implemented measures. Hereby, we present some key results of the qualitative and quantitative processes followed.

1. ***Quantitative results: main findings from KPIs and implemented measures/ interventions***

First and foremost, one of the most important sets of quantitative findings is associated with street space retrofitting. This is a push-pull measure including cycle tracks and cycle streets, introduced in Penteli for the first time. Evidently, more than 5 km of streets were radically transformed and speed limits were reduced to 30 km/h. Notably, this wide network hosts 400m of exclusive cycle tracks following a major urban regeneration and street reallocation project. The rest of the cycle network is comprised of cycle streets, sharing roadway with cars and pedestrians. One may see the network in Figure 34.

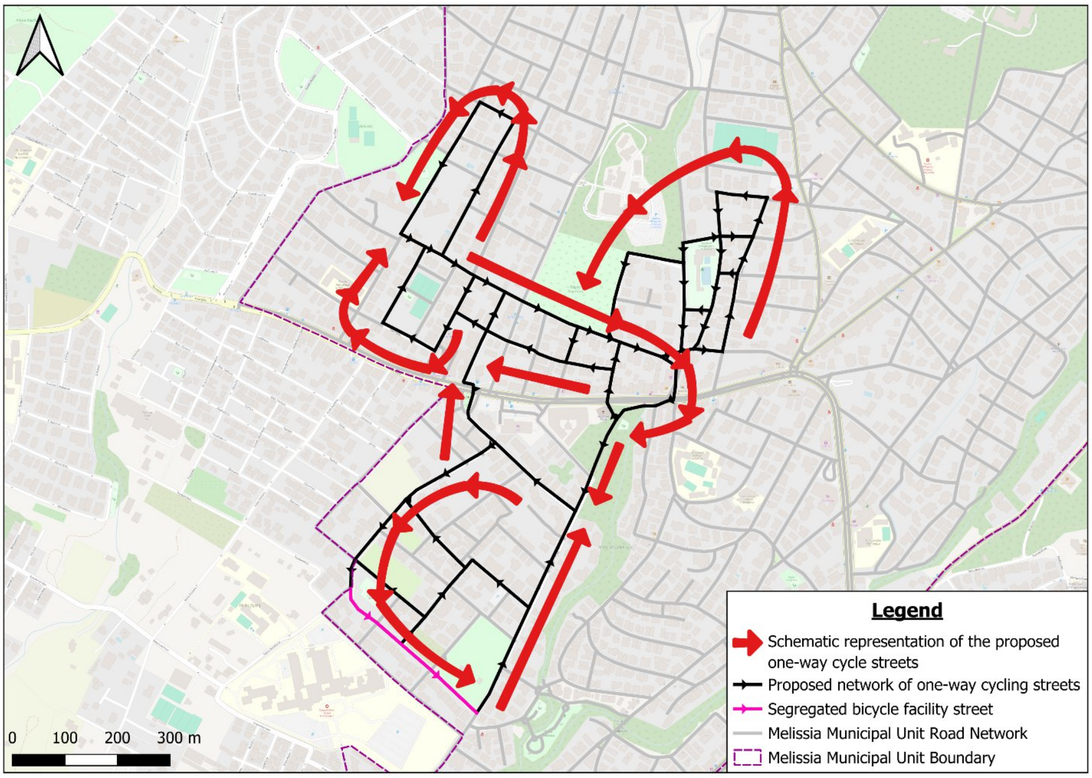


Figure 34: Penteli LL - Cycle network implemented in Penteli (length 5km)

Figure 35 demonstrates example streets belonging to the cycle network of the LL.

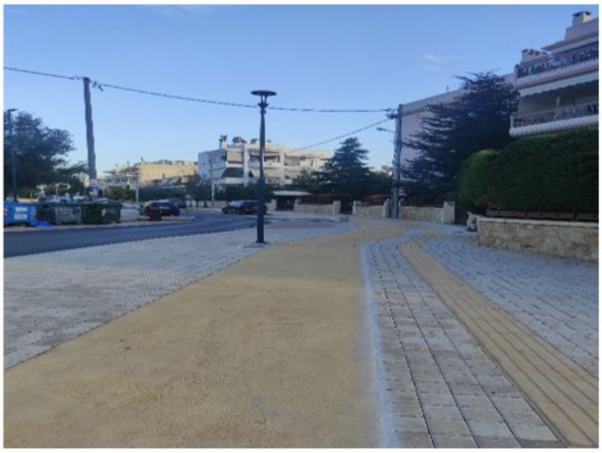


Figure 35: Penteli LL - a) Exclusive cycle track (Gennimata street) and b) cycle street (Al. Panagouli street)

This pivotal intervention was accompanied by pre and post traffic and environmental measures. Penteli LL carried out street traffic counts and monitored traffic-related indicators such as speed distributions, density and V85 speed levels at selected traffic count points. These data were intended to provide an evidence base for understanding how traffic conditions evolve as the cycle street network is introduced. Furthermore, environmental measures included air and noise measurements, thus, identifying the levels of potential issues to residents and visitors. Moreover, this measure contributed to improvement of some main KPIs. In particular, KPI20 (accessibility) increased from 6.35% to 50.53%, KPI23 (social inclusion) from 2% to 17%

and KPI24: Congestion and travel delays dropped from 1.66 to 1.57. Another key KPI was KPI7.3, which increased from 1.45 to 1.61.

The second measure refers to the introduction of the e-bike sharing system. This newly introduced system in the municipality, included 38 e-bikes and 6 docking stations deployed at strategic locations in the municipality (see ¶

Figure 36). It should underline that the provided service during the SUM project was free of charge.

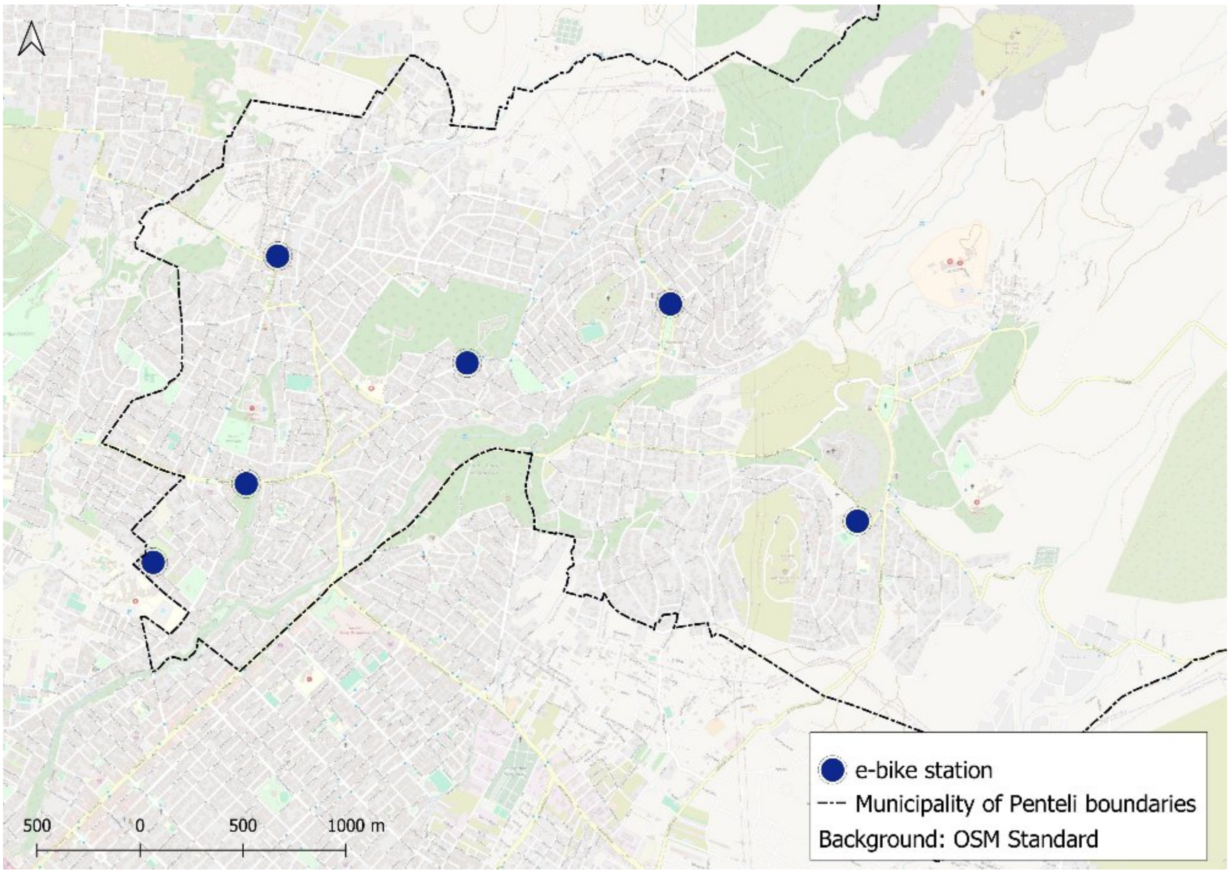


Figure 36: Penteli LL - Deployment of e-bikes stations

Although, the service was fully functional; vandalism phenomena forced the municipality to limit the working hours and the e-bikes rolling out. The service didn't operate during the night, while during the day, e-bikes were not deployed at their full capacity. Usually, 15-20 e-bikes were available for using. The newly introduced nature of the measure and the external phenomena of vandalism, led to a relatively low usage. Fewer than 100 trips were recorded during the project. This result suggests that while the technical rollout was successful, behavioural uptake was limited. At the same time, trip mapping showed that the most active origins and destinations were associated with the central stations, indicating that demand was concentrated in the core parts of Penteli (for instance, in the mobility hub location) rather than evenly distributed across the entire system. These findings are useful because they point to where the service is gaining traction and where additional awareness raising, network expansion or stronger integration with other measures may be needed. Nevertheless, the introduction of the system has contributed to the improvement of some main KPIs, like KPI4, where NSMs increased from 2 to 3 and KPI24: where congestion and travel delays dropped from 1.66 to 1.57. Another key KPI was KPI7.2, which increased from 1.61 to 1.68.

The third measure is the mobility hub creation. The Penteli LL established an initial central mobility hub in Melissia Square, Dimokratias Avenue. Interestingly, this hub functions as a central point for integrating modes such as public transport, e-bike sharing, ride-hailing and active mobility. Apart from the physical infrastructure encapsulating a bus stop, a taxi pick-up point and a bike-sharing station, the LL established a well-articulated totem both in English and Greek. This totem is the first of its kind being established in Penteli (see Figure 37).

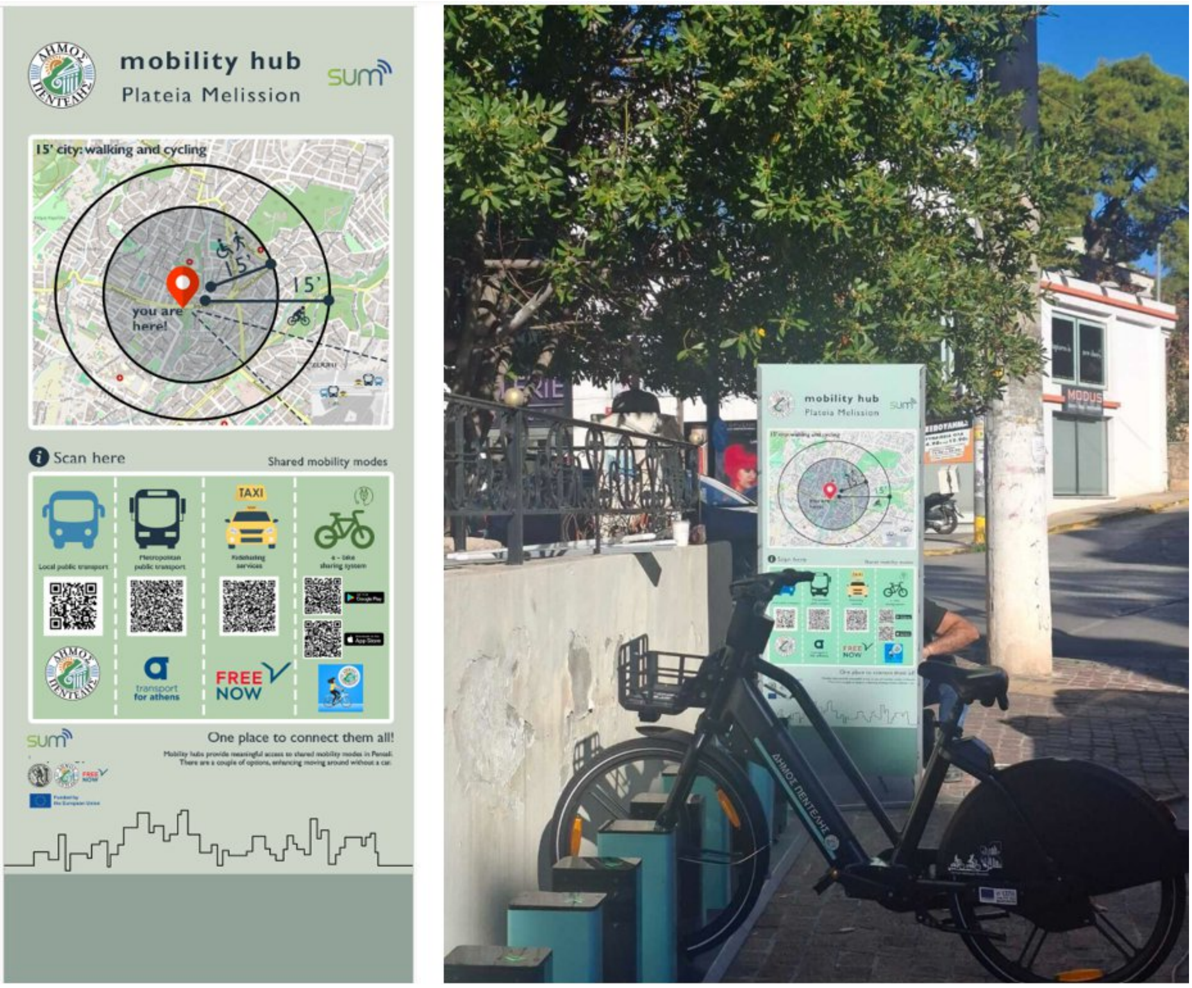


Figure 37: Penteli LL - a) Designed totem and b) Actual totem

As stated above, this mobility hub brought together 3 transport modes, reflecting a 37.50% multimodal integration per mobility hub (KPI9). Notwithstanding, the contribution of the mobility is depicted later in this sub-section through an overall evaluation of all measures.

The fourth measure incorporates the e-buses, relating SUM strategy with local public transport. The LL identified and designed the reintroduction of three local lines (see Figure 38) plus one university line, intended to improve internal municipal connectivity and link neighbourhoods with key transport nodes, including connections towards Athen's metro and suburban railway services. However, while this measure progressed in planning terms, the e-buses had not yet been purchased and deployed due to bureaucratic and administrative barriers. This is an external issue, since the municipality has undergone all the required procedures to speed the tendering process. As a result, the main quantitative results in this area currently relate more to planning and expected usefulness than to actual operational performance. The Penteli LL generated important preparatory outputs for the local public transport component, but its full measurable impacts could not yet be observed within the reporting period. To be more precise, NTUA examined how overcrowding affects timetable synchronisation and the perceived travel times of passengers in a bus network. Computational results illustrated that small values of in-vehicle passenger loads significantly shift the point at which overcrowding impacts service coordination, increasing perceived travel times and reducing overall synchronisation efficiency. These findings highlight the importance of accounting for user perception in transport policy and planning, particularly when designing timetables focusing on passenger convenience.

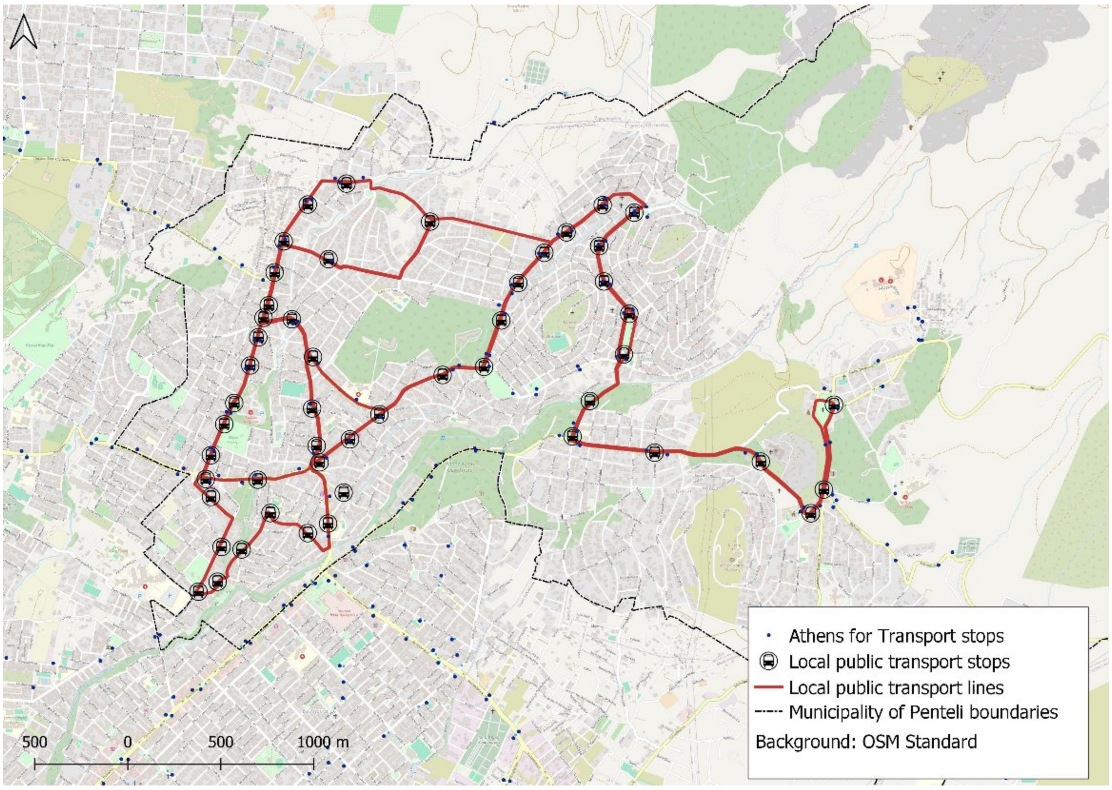


Figure 38: Penteli LL - Planned local e-public transport in Penteli

However, at this point, the notion of implementing the measures all together should be appraised. Through an accessibility assessment we compared a scenario without the mobility hub, but with the complementary measures to one where these interventions were in place (see Figure 39).

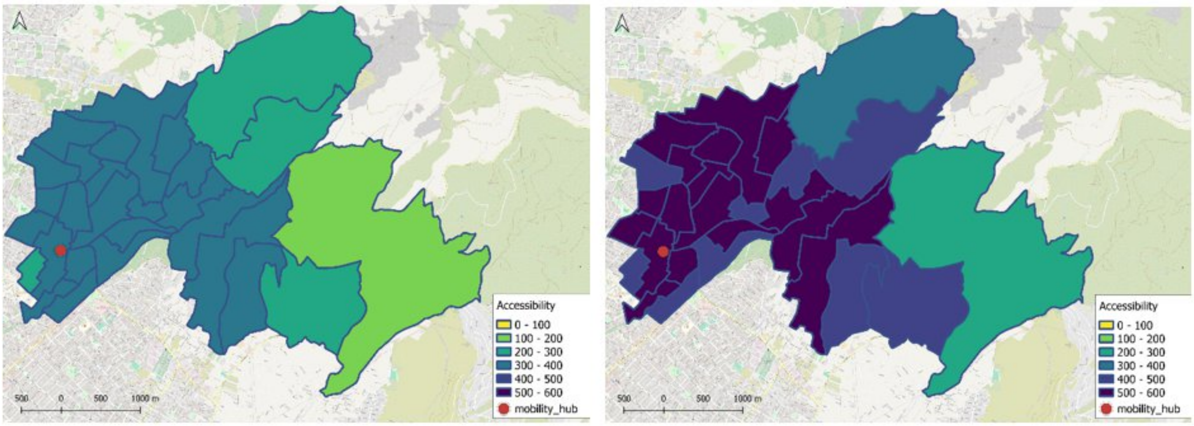


Figure 39: Penteli LL - a) Accessibility without mobility hub, but with complementary interventions, b) Accessibility with mobility hub and complementary interventions

Based on non-residential uses, the analysis suggested a strong positive effect of combining interventions, with the project material referring to an increase of approximately 45% in average accessibility by using sustainable transport modes (e-bikes and local public transport). This is one of the most significant quantitative findings of the LL, as it shows that the value of Penteli's interventions lies not only in the individual measures, but also in the synergy created by combining them. Prominently, the mobility hub plays a strategic role in bringing together all the other measures.

Finally, the last measure is a digital one and we specifically refer to the MaaS application (see Figure 40). It is the first time in Penteli and in Athens in general, that such an application has been developed. This application has multimodal integration, advanced API interconnectivity and precision geofencing. During the project, there were more than 100 clicks for using e-bikes and more than 50 clicks for downloading the application from FREENOW's website. Complementary to this service, the LL also developed a web map (which was integrated into the MaaS app) depicting the Penteli transport system (see Figure 41). In particular, this web map demonstrates in detail the cycle network, the e-bike sharing stations, the metropolitan bus stops, the mobility hub and data from environmental detectors within the boundaries of the municipality.

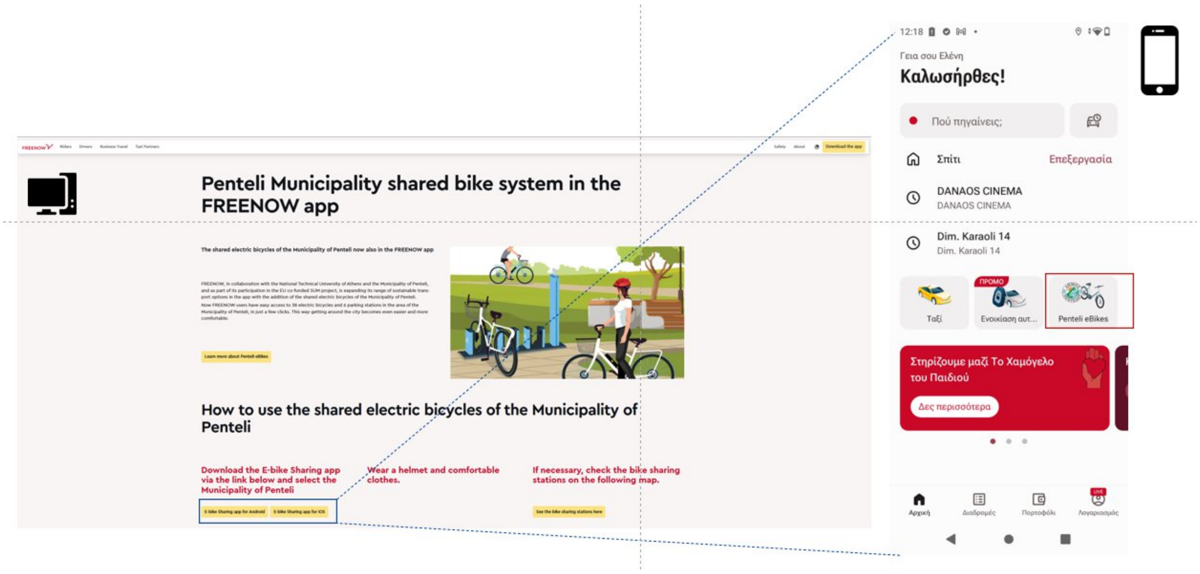


Figure 40:Penteli LL - Interface of the MaaS application for PCs and mobile phones

Figure 41: Penteli LL - Web map of the Penteli LL transport system

2. *Qualitative results: surveys, interviews, workshops and co-creation*

The qualitative findings from Penteli are particularly important because many of the measures implemented in the LL were relatively new for the municipality and required social acceptance, visibility and user understanding to succeed. Surveys, co-creation processes and stakeholder interactions helped the LL identify how local actors perceived the interventions and which measures were seen as the most useful or promising. In a glimpse, the LL carried out three major surveys, one customer survey and two co-creation workshops. Regarding the surveys, there were 201, 209 and 202 responses in the initial, mid-term and final survey respectively. The customer-survey had 26 participants, while the first co-creation event held online had 16 participants and the second event held physically 11 participants.

One of the most eminent qualitative findings concerns the perceived usefulness of the mobility hub. According to the mid-survey evidence respondents considered the mobility hub to be a useful intervention (see Figure 42).

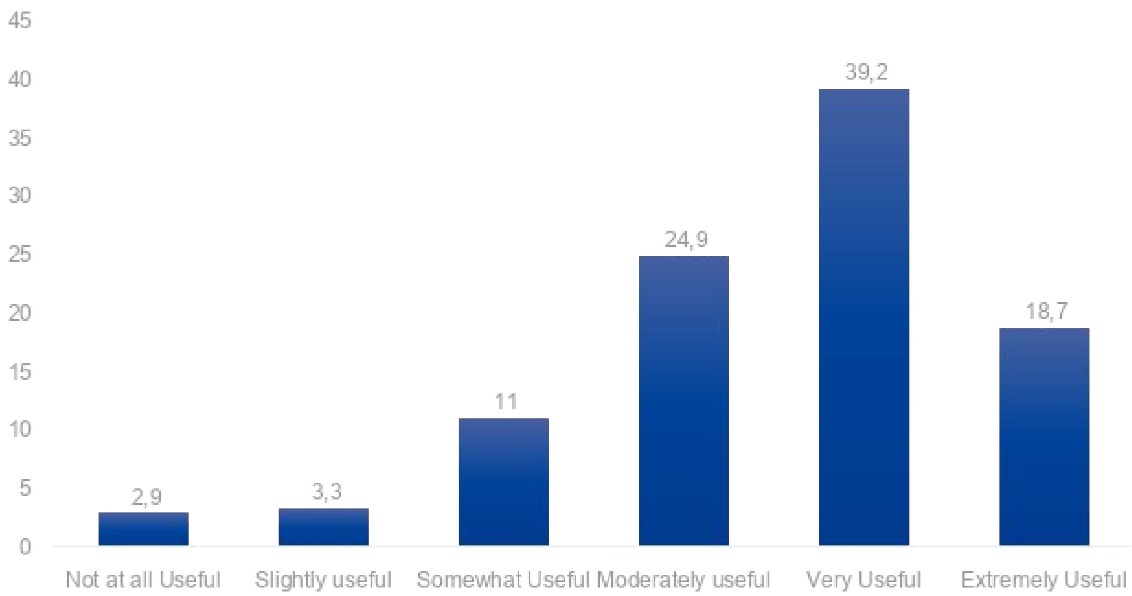


Figure 42: Penteli LL - Usefulness of the mobility hub

This is a significant result, because it suggests that even in a municipality with traditionally high car dependence, people recognise the value of visible and well-designed multimodal interchange points. The physical installation of the totem also likely supported this result by making the concept of multimodal mobility more tangible within the local urban space.

Moving further, the final survey also indicates positive qualitative feedback regarding the local public transport with e-buses. Survey questions explored how useful respondents considered the e-buses and how often they might use them. Most of the respondents stated that they found the e-buses very useful or extremely useful (76%) and that they use them frequently or very frequently (66%). This is an important result because it shows that, even before full deployment, the measure appears to have social and strategic relevance from the perspective of users. Detailed information for the usefulness of the e-buses could be found in Figure 43.

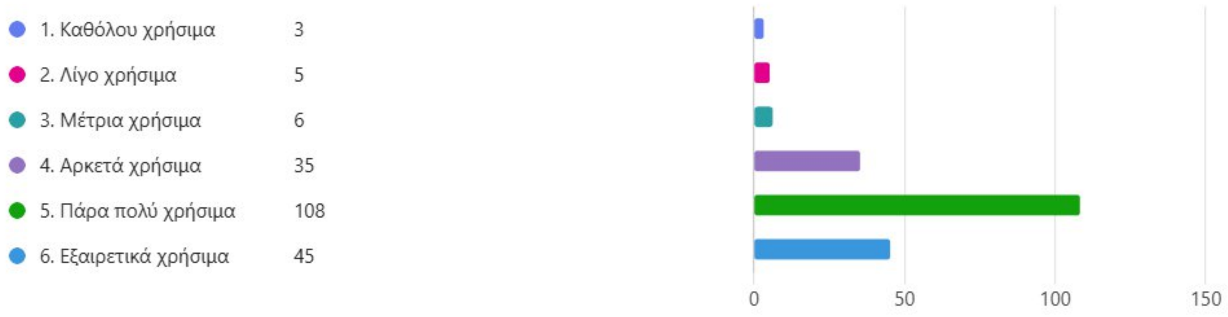


Figure 43: Penteli LL - Usefulness of the e-buses (1: Not at all useful, 2: Slightly useful, 3: Somewhat useful, 4: Moderately useful, 5: Very useful and 6: Extremely useful

Next, the customer survey and co-creation outputs also support the prioritisation of measures (improvement of KPI2, from 1 to 3). Through the AHP-based customer survey, stakeholders, policymakers, experts and organised local actors were invited to compare the proposed interventions. This process provides structured feedback on the relative importance of the measures and gives the municipality a more evidence-based way of understanding local priorities. It demonstrates that Penteli did not rely only on top-down planning but also invested in participatory and comparative evaluation to guide local mobility planning. The ranking is showed in Figure 44.

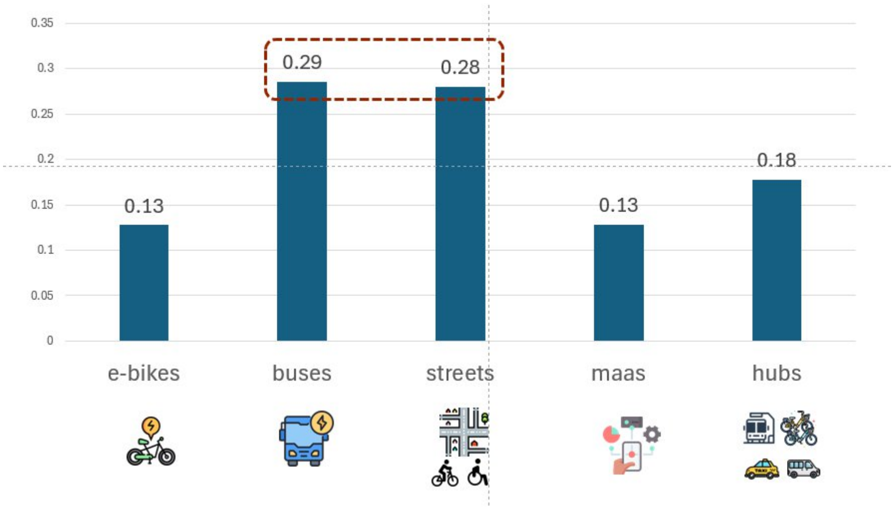


Figure 44: Penteli LL - Scoring for each policy measure and intervention according to AHP

According to Figure 44, the highest weights were assigned to bus services (0.29) and street reallocation (0.28), indicating a primary focus on enhancing traditional transport systems. Notably, street reallocation might be favourable for the promotion of e-bikes and walking. Next, mobility hubs followed with a weight of 0.18. Strikingly, e-bikes received a relatively low priority (0.13), equal to MaaS, suggesting that active and digital mobility solutions are still emerging in the local policy agenda, as this was defined by the experts.

At the same time though, the qualitative evidence also reveals several barriers. According to the final survey (Figure 45) bikes and e-bikes are still perceived as an unsafe mobility solution. More precisely, compared with other travel modes, micromobility modes were rated among the least safe options by respondents. Their safety ratings were concentrated at the lower end of the scale, with relatively few participants considering them safe or very safe. This pattern suggests that perceived safety may be an important barrier to the use of bikes and e-bikes for everyday travel. Complementing the actual usage data, the low uptake and perceived view of the e-bike system suggests that awareness and behavioural change remain limited. Hence, more measures employing holistic and integrated approaches are essential.

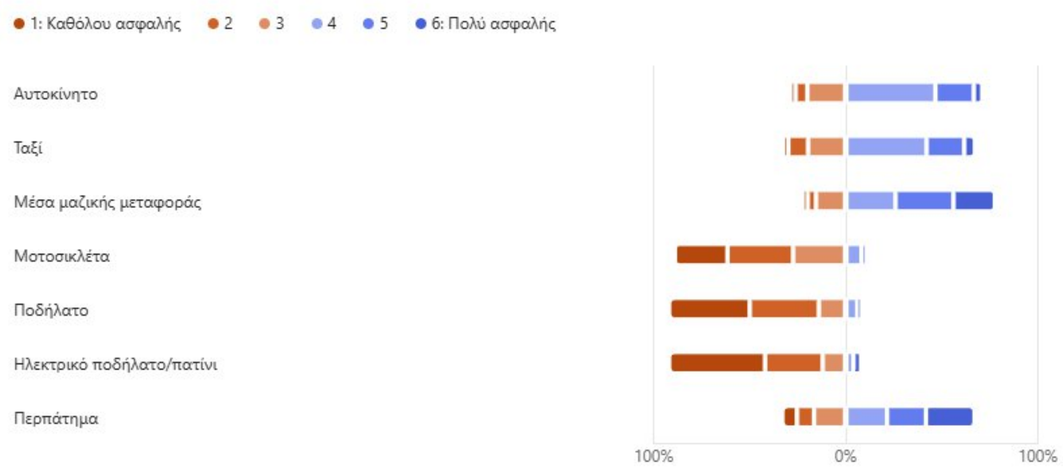


Figure 45: Penteli LL - Perceived safety of transport modes in Penteli (1: Unsafe, 6: Very safe). Modes are presented hierarchically, car, taxi, public transport, motorbike, bike, e-bike/e-scooter and walking

However, if someone has used a shared e-bike before, then the intention of using this service again is higher. Figure 46 below depicts this interesting output encountered in the mid-survey.

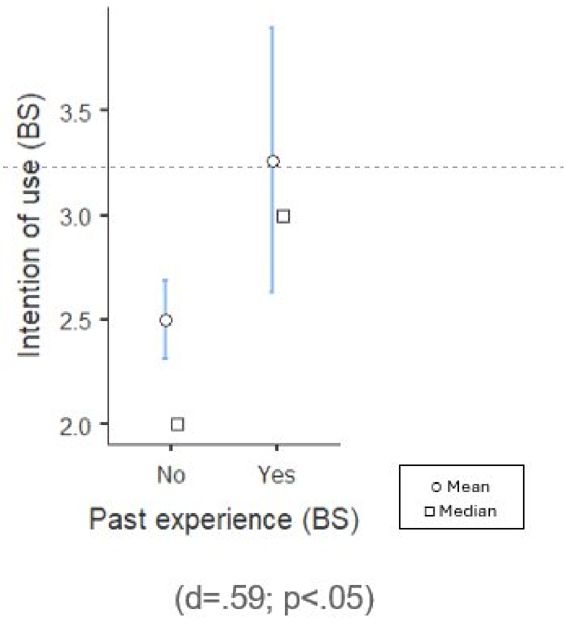


Figure 46: Penteli LL - Intention of use in relation with past experience (mid-survey results)

More specifically, participants with prior bike-sharing experience reported a higher intention to use bike-sharing than those without prior experience. The difference was moderate and statistically significant, indicating that past experience is positively associated with future bike-sharing use intentions ($d = .59$, $p < .05$). In addition, both the mean and median intention scores were higher among experienced users, reinforcing this pattern.

3. Overall interpretation of measures and project progress

Altogether, the project process can deliver meaningful key insights. First, the Penteli LL succeeded in delivering visible and measurable implementation outputs, especially in relation to street space reallocation, cycle street planning, mobility hub establishment, e-bike system deployment and MaaS development. Second, the data show that combined interventions generate stronger effects than isolated ones, as illustrated by the accessibility findings linked to the mobility hub and complementary measures. Third, the results indicate that social acceptance and perceived usefulness are generally positive for some of the measures, particularly for the mobility hub and the planned e-bus services. In contrast, however, the overall acceptance was found to decline, which might be attributed to the fact that radical changes occurred so quickly in such a car-oriented regime. In line with this, one may find the fourth point, in which the data also reveal that service availability does not automatically lead to intensive use, as demonstrated by the low initial uptake of the e-bike scheme. Tellingly, time is needed to successfully establish novel measures and cultivate a new mobility culture. This is confirmed by the negligible change in the modal shift; in three years, only walking increased very slightly (around 0.6%), whereas all other sustainable modes declined. It should be anticipated that residents of a car-oriented municipality like Penteli cannot completely change their travel behaviour within such a short period. Finally, the evidence makes clear that institutional and organisational constraints, especially bureaucracy, remain a major factor influencing implementation outcomes in the Penteli context. To summarise, Penteli is moving towards a more sustainable and seamless local mobility model, even though some results remain partial and further implementation is still required. Through SUM, Penteli LL has set the scene by significantly increasing accessibility and infrastructure (both digital and physical); now time is needed for people to start actively using and benefiting from this new mobility landscape.

3.6 Replicability, Lessons Learned and Best Practices

3.6.1 Munich

The Munich Living Lab provides valuable insights into the implementation and scaling of shared mobility solutions in a complex urban environment. Based on the activities carried out and the results obtained, several lessons learned, best practices, and considerations for transferability can be identified.

3.6.1.1 Transferability to other cities and regions

The approach developed in Munich is highly transferable to other urban contexts, particularly cities with a strong public transport backbone and growing shared mobility markets. A key success factor is the combination of data-driven analysis, user-centred approaches, and simulation tools such as FleetPy. This integrated methodology allows cities to better understand local mobility patterns, test scenarios before implementation, and adapt solutions to their specific context.

The focus on integrating carsharing with public transport and mobility hubs is especially relevant for cities aiming to promote multimodal travel and reduce private car dependency. However, transferability depends on local conditions such as regulatory frameworks, data availability, market maturity of shared mobility providers, and urban density. Cities with less developed shared mobility ecosystems may require additional efforts in awareness building and infrastructure development.

3.6.1.2 Risks and mitigation measures

Several risks were identified during the Living Lab implementation. A key risk relates to data availability and quality, particularly due to data protection regulations and limited access to certain datasets (e.g. station-based carsharing data). This was mitigated by focusing on available datasets (e.g. free-floating providers) and complementing them with survey data and stakeholder input.

Another risk concerns user acceptance and behavioural uncertainty. While shared mobility shows strong potential, the data also revealed substitution effects with public transport and operational barriers such as blocked parking spaces. These risks were addressed through targeted measures, including improved infrastructure management, communication campaigns, and the planned integration of real-time information systems.

Operational risks, such as misuse of dedicated parking spaces, were mitigated by proposing enhanced enforcement and technological solutions (e.g. sensors and monitoring systems). Additionally, simulation tools helped reduce planning risks by allowing the testing of different scenarios before implementation.

3.6.1.3 Technical, organisational, and operational lessons learned

At the beginning of the project, it was assumed that expanding carsharing infrastructure alone would be sufficient to significantly increase usage. However, the results showed that infrastructure must be complemented by user-oriented measures, such as improved communication about the usage in general, signage, benefits and reliability.

A key technical lesson is the importance of combining real-world data with simulation tools. The use of FleetPy enabled the evaluation of different operational strategies and supported more informed decision-making. However, this also highlighted the need for high-quality and comprehensive datasets to ensure reliable simulation outcomes.

From an operational perspective, the findings emphasized that parking management is a critical success factor. The frequent blocking of dedicated parking spaces significantly reduces system reliability and user satisfaction. Addressing such practical issues is essential for the success of shared mobility services.

Organisationally, the project demonstrated the importance of continuous data collection and iterative evaluation. The combination of pre- and post-implementation surveys allowed for a longitudinal perspective, supporting adaptive planning and continuous improvement of measures.

3.6.1.4 Governance and cooperation aspects

The Living Lab highlighted the importance of strong cooperation between public authorities, research institutions, and private mobility providers. The City of Munich played a central role in providing the regulatory framework, supporting infrastructure development, and facilitating stakeholder coordination. The Technical University of Munich contributed scientific expertise in data analysis and simulation, while carsharing providers supplied essential operational data.

Effective governance was supported by clear role distribution and continuous stakeholder engagement, including co-creation elements and user feedback mechanisms. This collaborative approach ensured that measures were both technically feasible and aligned with user needs.

Furthermore, the Living Lab demonstrated the value of knowledge exchange with other cities and project partners, enhancing the potential for replication and scaling. The alignment with Munich’s Sustainable Urban Mobility Plan (SUMP) also ensured that the implemented measures contribute to long-term strategic goals and policy coherence.

3.6.1.5 Best practices

Key best practices emerging from the Munich Living Lab include:

- The integration of data-driven planning, simulation, and user feedback
- A strong focus on multimodal integration and complementarity with public transport
- The use of KPIs to monitor behavioural and system-level impacts

- The implementation of targeted measures addressing real user barriers, such as parking issues
- The establishment of multi-stakeholder cooperation frameworks

In conclusion, the Munich Living Lab demonstrates that successful implementation of shared mobility solutions requires a holistic, data-driven, and collaborative approach. While challenges such as data limitations and operational barriers exist, they can be effectively addressed through adaptive strategies, stakeholder cooperation, and continuous evaluation. These insights provide valuable guidance for other cities seeking to develop and scale sustainable urban mobility solutions.

3.6.1.6 Lessons Learned – Reflection of the prior scope for Munich LL

The Munich living lab has created a lesson learned document, as agreed upon by the Munich partners during the amendment of the Munich LL measures. This document is available in Annex section 4.1.1.2 Munich. Living Lab. Munich was originally planned as a real-world pilot for an Autonomous Mobility-on-Demand (AMoD) service based on Level 4 autonomous vehicles. The initiative brought together the City of Munich, SIXT, and the Technical University of Munich (TUM) to explore the operational, regulatory, and societal implications of autonomous ride-hailing services.

However, the planned pilot could not be implemented due to a combination of technological, regulatory, and organizational challenges. The most significant obstacle was the technology partner's decision to discontinue the development and certification of the vehicle platform intended for the project, resulting in the unavailability of Level 4-certified vehicles. Additional barriers included regulatory uncertainties, delays in approval procedures, supply-chain and resource constraints, and the lack of contractual access to alternative autonomous vehicle providers.

Although no real-world operation took place, the project generated valuable insights into the requirements for deploying autonomous mobility services. Key lessons include the need for diversified technology partnerships, early consideration of regulatory risks, flexible project governance, and phased implementation strategies. The experience highlights that successful deployment of autonomous mobility services depends not only on technological readiness but also on regulatory, contractual, and organizational preparedness.

3.6.2 Geneva

3.6.2.1 Transferability to Other Cities and Regions

The mobility hub model developed in Geneva is highly transferable, provided that a few key conditions are met. Engaging landowners, particularly municipalities and cities, early in the process and involving them in the deployment strategy significantly simplifies integration, acceptance and the installation of services and information infrastructure. Urban density proved to be a strong driver of hub and shared mobility usage, meaning that replication in suburban or rural contexts requires dedicated outreach efforts and a tailored service offer focused on the most relevant local needs rather than a one-size-fits-all approach.

3.6.2.2 Risks and mitigation measures

Mobility hubs: diverse landscape of landowners

This risk was mitigated by identifying key actors able to re-engage stakeholders and restart the process when needed. We are currently in active discussions with more than 6 municipalities across the Grand Genève agglomeration to develop mobility hubs in a strategic and coordinated manner.

MaaS app: high costs of development

The high costs associated with MaaS development resulted in longer timelines than initially anticipated. A new application will soon be delivered, although it does not yet fully integrate shared mobility services. This remains a next step planned for the longer term.

Integrated people and goods transportation

Logistics services have been successfully deployed at selected hubs, most notably through WECHIP connected lockers, which contribute to facilitating the goods transportation dimension and lay the groundwork for further integration.

3.6.2.3 Technical, Organisational and Operational Lessons Learned

Continuous user feedback proved essential to service improvement throughout the project, most notably driving the development of the second-generation totem design, which directly addressed accessibility and readability shortcomings identified in early deployments. A key operational lesson was to keep administrative validation processes as streamlined as possible, limiting the scope for comments from stakeholders reduces unnecessary iterations and keeps deployment on track.

3.6.2.4 Governance and Cooperation Aspects

Institutional engagement and close stakeholder collaboration were critical enablers of large-scale deployment. Building strong relationships with municipalities, NSM operators and institutional partners from the outset created the conditions for faster decision-making and smoother implementation. The Geneva experience also highlighted the importance of embedding mobility hubs in formal planning documents and territorial strategies, as this provides the political legitimacy and long-term funding stability necessary to sustain the initiative beyond the project's lifetime.

3.6.2.5 Best practices

The Geneva Living Lab demonstrates that scaling shared mobility solutions requires close institutional collaboration, adaptive service design, and long-term territorial anchoring. Key best practices include:

- Early engagement of landowners and municipalities to streamline deployment and ensure buy-in
- Continuous user feedback as a driver of service improvement
- Tailored approaches for suburban and rural contexts, where urban density is lower
- Embedding mobility hubs into formal planning documents to ensure long-term political and financial sustainability
- Streamlined governance processes to avoid unnecessary iterations and keep deployment on track
- Cross-border MaaS integration, combining Swiss and French public transport data into a single application, as a replicable model for other transnational urban regions.

3.6.3 Jerusalem

3.6.3.1 Transferability to other cities and regions

The Jerusalem Living Lab (LL) project’s core value lies in the high transferability and replicability of its developed frameworks, methodologies, and findings. These are designed to be applied to other cities facing shared mobility and integrated multimodal transport challenges.

The LL serves as a successful real-world proof-of-concept demonstrating how integrating strategic public investments with advanced, data-driven planning and operational tools can improve urban mobility, reduce congestion, and promote sustainability. Its success is rooted in using granular, real-time data for evidence-based strategy.

A central element of the LL's legacy is the plan to deploy its custom-built simulation-optimization framework to other urban environments. This advanced analytical tool can model transport dynamics, test policy interventions, and optimize resource deployment before implementation. By sharing this framework, along with documented lessons learned and a best practices guide, the Jerusalem LL aims to act as a global knowledge platform, accelerating the adoption of best practices worldwide.

3.6.3.2 Risks and mitigation measures

1. Infrastructure Construction Delays and Service Disruptions

Major infrastructure projects, such as the LRT extension and public elevators, are prone to construction delays, security suspensions, or temporary service disruptions (e.g., central section suspensions). This can lead to public frustration and a temporary drop in transit reliance. To mitigate this, implement a phased rollout approach and maintain flexible, alternative transit options (such as overlapping bus routes or interim ridepooling services) during construction periods. Maintaining transparent, real-time communication with residents about disruptions is also critical.

2. Low Adoption of Active Mobility Due to Topographic Barriers

The Yuvalim-Ganim area is characterized by steep slopes and hilly terrain, which can naturally discourage walking and cycling. To mitigate this, use physical barriers by deploying electric micromobility options (like e-bikes) rather than just mechanical ones. Furthermore, the strategic installation of public elevators specifically designed to bridge elevation gaps helps seamlessly connect pedestrians and cyclists to LRT stations.

3. Financial Sustainability of New Mobility Services

Subsidized shared mobility services, such as ridepooling, run the risk of becoming financially unsustainable if demand is miscalculated, a lesson learned from the closure of previous services like TikTak. To mitigate this, utilize the simulation-optimization framework to rigorously test the financial viability of different configurations before deployment. By evaluating variables like fleet size (e.g., 10 vs. 20 vehicles) and service models (few-to-many vs. many-to-many), stakeholders can identify the most cost-efficient operational model that still meets user demand.

4. Capacity Strains Due to Rapid Population Growth

The Living Lab's residential population is projected to double from over 40,000 to over 80,000 by 2050, potentially making current mobility solutions quickly congested or inadequate. To mitigate this, design scalable mobility infrastructure. Continuously collect data and monitor KPIs (e.g., fill rates, modal split) in real-time to dynamically scale ridepooling fleets or add micromobility vehicles as the population grows.

5. Survey Fatigue and Low Data Yield

Long surveys cause audience fatigue, leading to low completion rates and risking unrepresentative KPI data. To mitigate this, streamline data collection with shorter, highly focused surveys to respect respondent time, boost completion rates, and ensure reliable data.

6. Inter-Agency Political Tensions

Complex mobility projects require alignment between the Jerusalem Municipality and the national Ministry of Transport. Tensions, differing priorities, or bureaucratic friction between the local and national levels can stall decision-making and negatively impact project implementation. To mitigate this, establish an effective, ongoing cooperative partnership to bridge this gap. Fostering continuous, structured discussions (like those with the Ministry of Transport) and aligning the project with the shared long-term strategic goals of both the city and the Ministry ensures a unified approach, navigating institutional friction.

3.6.3.3 Technical, organizational and operational lessons learned

Technical evaluations demonstrated that simulation-optimization approaches provide significantly greater public spending efficiency than traditional planning methods focused solely on infrastructure investments. Operational experience from the Living Lab further showed that locating shared mobility services, such as bike-sharing stations, at high-capacity public transport hubs substantially increases multimodal travel; for example, 30% of bike rentals were associated with the new LRT stations. In addition, the Living Lab generated important organizational learning by improving understanding of municipal planning procedures and internal data collection processes. This collaboration successfully created a strong synergy between academic research and practical transportation planning, helping bridge the gap between research and city management.

3.6.3.4 Governance and cooperation aspects

The project’s feasibility will be significantly enhanced by the active collaboration of diverse stakeholders, including municipal departments, national ministries, and private operators. A critical factor for success will be the establishment of an effective and ongoing tripartite partnership involving the public sector, the private sector, and academia. This cooperative governance model will be essential for ensuring that the Living Lab objectives consistently align with long-term regional mobility strategies, such as expanding the Light Rail Transit (LRT) network and reducing car dependency.

3.6.4 Athens – Penteli

3.6.4.1 Transferability to other cities and regions

The Penteli Living Lab, due its characteristics and suburban nature, offers several lessons that are relevant for other peri-urban municipalities seeking to reduce car dependence and strengthen sustainable mobility. A key transferable aspect is the combination of physical infrastructure, shared mobility services, mobility hubs, and digital tools within a single local strategy. Rather than relying on one isolated intervention, Penteli tested a bundle of mutually reinforcing measures, showing that sustainable mobility transitions in peri-urban areas require coordinated action across infrastructure, services, governance and most importantly active user engagement.

3.6.4.2 Risks and mitigation measures

A significant risk for the Penteli Living Lab has been the bureaucratic complexity that often affects Greek municipalities, particularly when measures require approvals, procurement procedures, or coordination with higher levels of government. This risk became especially relevant for the implementation of measures such as the deployment of e-buses and the approval of street reallocation plans. To mitigate this, the Living Lab relied on continuous follow-up, institutional coordination, and sustained pressure on the relevant public authorities in order to keep processes moving forward. Another important risk concerned low participation in co-creation workshops and other engagement activities, which could have reduced the relevance and acceptance of the proposed measures. This was addressed through local awareness-raising and communication efforts aimed at promoting participation and strengthening community involvement. A further challenge related to the continuous monitoring of the implemented measures, particularly for traffic, environmental, and operational data collection. Here, mitigation depended on securing the necessary equipment, strengthening local awareness of the value of monitoring activities, and investing in capacity building so that local actors could support and sustain the data collection process over time.

At the beginning of the project, one of the main assumptions was that Penteli, as a predominantly car-oriented municipality, would face considerable difficulty in moving towards a model based on shared and sustainable mobility. However, the Living Lab demonstrated that, even in such a context, meaningful progress is possible when measures are well designed, locally adapted, and supported by strong cooperation between partners. The project team also anticipated that bureaucratic obstacles would be a major challenge, and while these difficulties did emerge, they proved somewhat more manageable than initially expected through persistent coordination and pressure on the responsible authorities. At the same time, an important lesson was that technical progress alone is not sufficient: time and effort also need to be invested in co-creation processes, local communication, and the development of skills and expertise among technical staff and consultants. Another key lesson was the value of thinking beyond conventional solutions. By exploring novel measures and combining infrastructure, shared mobility, and public transport interventions, the Penteli Living Lab was able to create a more ambitious and integrated vision for local mobility transformation.

3.6.4.3 Technical, organizational and operational lessons learned

One important lesson is that novelty and local relevance matter. Several measures, such as the cycle streets, mobility hub and e-bike sharing system, were introduced for the first time in Penteli and, in some cases, more broadly in the Attica region. This demonstrates that even municipalities with traditionally car-oriented mobility cultures can act as innovation spaces if they are willing to test new ideas and adapt them to local conditions. In parallel, the relatively low usage of the e-bike system shows that introducing new services is not enough on its own; uptake also depends on user familiarity, network effects, visibility and broader behavioural change. To this end, Penteli LL coupled e-biker sharing system with street retrofitting and local awareness.

A second lesson concerns governance and implementation risks. The Penteli case shows clearly that bureaucratic constraints can delay even well-planned interventions, as seen with the non-deployment of the e-buses despite route planning and integration work. This highlights the importance of institutional support, realistic implementation planning and risk mitigation for procurement and administrative processes. Stronger support from central government is explicitly identified in the material as a potential area where implementation could have worked better.

A third lesson is about mapping current conditions and setting the scene for the future. The Penteli case shows that co-creation and data collection are not peripheral activities but pivotal components of implementation. Surveys, workshops, traffic counts, environmental monitoring and prioritisation exercises helped the Living Lab understand local needs, refine measures as well as assess impacts. Other cities can learn from this integrated and cohesive approach, especially when introducing unfamiliar or potentially sensitive changes in public space allocation

3.6.4.4 Governance and cooperation aspects

The Penteli Living Lab benefited from close collaboration between the municipality, research partners, mobility providers and public transport actors, and it also engaged with other SUM Living Labs to exchange knowledge on mobility hubs (especially), MaaS platforms and street retrofitting. This underlines that innovation in local mobility systems is not only a technical issue, but also an organisational and governance challenge that depends on communication, trust and shared learning.

3.6.4.5 Best practices

Based on the above, key best practices emerging from the Penteli Living Lab include:

- A strong focus on street space retrofitting
- Couple shared mobility with physical and digital infrastructure

- The integration of digital and physical tools. Address infrastructure as a holistic component.
- The use of various KPIs to monitor behaviour and impacts related to environment, economy and society
- The utilisation of co-creation activities and participatory actions
- International collaboration and knowledge transfer on key mobility topics

3.6.4.6 Reflections on the future

The long-term plan for the Penteli Living Lab is to continue supporting sustainable mobility after the end of the project by building on the measures already initiated. The project material indicates that future efforts should aim to expand the cycle street network, increase the number of bike-sharing stations and mobility hubs and complete the deployment of e-buses. Moreover, the municipality strongly believes that shared e-bikes are not only important as a stand-alone solution, but also as a complementary mode to public transport. Hence, Penteli will look more deeply for coordinated solutions between these two sustainable modes. Beyond infrastructure and service expansion, Penteli also plans to continue its data collection and monitoring work. This includes maintaining contributions to the Open Data Platform (ODP), carrying out new surveys, conducting additional traffic and environmental measurements, performing spatial analyses and organising further co-creation activities. In this sense, the long-term plan is not limited only to preserving what has already been implemented but also aims to deepen the knowledge base and improve future decision-making for sustainable mobility in the municipality.

3.7 Conclusions

The efficient implementation of several measures in the SUM project derives conclusions that can be referred to by the project partners as well as other stakeholders and cities across Europe.

3.7.1 Munich

Munich demonstrates that a strong, well-integrated public transport system combined with a growing shared mobility ecosystem provides a solid foundation for advancing sustainable urban mobility. The data shows that the city is already moving towards a multimodal transport system, with a high share of environmentally friendly modes and increasing use of shared mobility services. However, challenges such as congestion, parking pressure, limited integration, and uneven user perception highlight the need for targeted interventions.

The Living Lab confirms that shared mobility -particularly carsharing - has significant potential to reduce private car ownership and contribute to a more sustainable modal split. At the same time, it becomes clear that infrastructure expansion alone is not sufficient. Successful implementation requires a combination of data-driven planning, user-centred measures, and strong integration with public transport systems. Operational challenges, especially related to parking management and service reliability, must be addressed to ensure user acceptance and system efficiency.

A key conclusion is that continuous data collection and monitoring, including operational data, surveys, and simulation, is essential for understanding real mobility behaviour and adapting measures accordingly. The use of digital tools and simulation frameworks enables better planning and reduces implementation risks. Equally important is the involvement of stakeholders and users, ensuring that solutions are both practical and aligned with real needs.

Finally, the Living Lab highlights the importance of governance and strategic alignment. Close cooperation between the city, research institutions, and mobility providers, combined with alignment to long-term strategies such as the SUMP, is crucial for successful implementation and scalability. Overall, Munich shows that a holistic, data-driven, and collaborative approach is key to unlocking the full potential of shared and sustainable urban mobility.

3.7.2 Geneva

The Geneva Living Lab has demonstrated that a coordinated, multi-layered approach to sustainable urban mobility can generate measurable and meaningful results within a relatively short timeframe. The deployment of 29 mobility hubs across the canton, combined with the expansion of on-demand services, the scaling of tpg Evomoov to 130 companies and 48 municipalities, and the development of a new MaaS application, has created a coherent and increasingly integrated mobility ecosystem that offers credible alternatives to private car use. Key indicators confirm positive trends: NSM partnerships grew from 3 to 6 operators, multimodal integration at hubs increased by 8%, door-to-door travel time ratios improved significantly across all critical routes between 2023 and 2026, and 78% of users expressed satisfaction with the system. Modal shift, while modest, is moving in the right direction. The continuous development of the totem design, driven by user and expert feedback, and the proactive engagement of new mobility operators who joined the initiative, further demonstrate the growing maturity and attractiveness of the mobility hub concept in the Geneva context.

The lessons drawn from the Geneva Living Lab feed directly into the broader policy recommendations developed within WP5. Key messages for policymakers include the importance of embedding mobility hubs in formal territorial planning documents to ensure long-term political and financial sustainability, the need for stable public funding mechanisms that cover both initial deployment and ongoing operations, and the value of a phased implementation approach that starts with physical infrastructure before progressing to digital integration.

3.7.3 Jerusalem

The LL team examined the potential role of ride-pooling services within the context of ongoing transportation investments, including six LRT stations opened within the LL, which previously had no stations at all. This perspective enabled evidence-based recommendations for future ride-pooling deployment and highlighted the importance of considering surrounding mobility investments when planning new shared mobility services. Although the present case study focuses on ride-pooling, the developed framework is not limited to this application and provides a transferable methodology for evaluating a broad range of on-demand mobility services under different operational policies and urban contexts.

The LRT Red Line extension is the only intervention that produces system-wide changes in the transportation network. It increases the intention to use public transit, generates strong station activity, and even shifts demand away from buses. Moreover, the extension functions as a backbone for both Jerufun and the simulated ride-pooling service, particularly in few-to-many configurations. Jerufun's three bike rental stations located at new LRT stops experienced significantly higher usage than those situated elsewhere. Similarly, results from the optimization–simulation framework show that occupancy rates increase when fewer LRT stations serve as hubs. In fact, when only a single LRT station is designated as a hub, vehicles carry nearly four passengers on average. This indicates that users are willing to travel via the NSM to a less preferred LRT station, given that all stations are interconnected. In other words, concentrating demand around a single hub maximizes the pooling effect. These findings highlight the importance of leveraging existing infrastructure and connectivity, suggesting that mobility interventions should be designed hierarchically, with the LRT serving as the foundational layer.

At the same time, a gap remains between favourable user attitudes, operational efficiency, and meaningful system-wide impact. Survey responses indicate strong openness to on-demand services and a willingness to pay; however, the modelled mode share remains relatively small. While this outcome is not surprising – given the limited fleet size and the focus on a single neighbourhood – it underscores the constraints of localized interventions. Nonetheless, the results demonstrate the value of the NSM as a complementary transit mode that enhances user access to the primary mobility backbone.

Achieving improved mobility outcomes will require a careful understanding of context, the identification of key trade-offs, and tight integration with existing infrastructure. The simulation–optimization framework proves particularly valuable in this regard, as it reveals trade-offs that would be difficult to anticipate through intuition alone, while enabling low-cost, risk-free exploration of alternative system configurations.

3.7.4 Athens – Penteli

The Penteli Living Lab demonstrates that peri-urban municipalities can take meaningful steps towards sustainable, seamless and shared mobility by combining infrastructure change, shared mobility services, mobility hubs, public transport planning and user-friendly digital tools. The project has created valuable synergies, supported the testing of new solutions and enabled partners to work together in addressing local mobility challenges. It is quite intriguing the Penteli held 2 co-creation events for envisioning shared mobility options in the municipality. The novelty of several interventions in Penteli, together with the strong collaboration among SUM partners, stands out as a major achievement. At the same time, the Penteli case also demonstrates that implementation is shaped not only by local ambition but also by institutional and bureaucratic conditions.

The main limitations identified in the material include insufficient support from central government, delays caused by bureaucracy, and the need for stronger awareness-raising activities to increase uptake of the measures. These lessons are particularly relevant for policy recommendations linked to governance, implementation support and simplification of administrative procedures for sustainable mobility projects. However, despite the problems encountered, the LL improved active travel conditions by making 76pprox.. 5km of cycling network (first introduction of cycling streets in Athens), thus increasing accessibility levels by roughly 40%. In addition, 6 strategic e-bike sharing stations were installed and 38 e-bikes were deployed. Moreover, 1 central mobility hub was established to bring together the NSMs which increased from 2 to 3.

All these measures fostered social inclusion (meaning that more people have the potential to travel in Penteli) that increased by 7.5%, while there was a slight reduction in travel delays and congestion of 5.73%. To conclude, Penteli LL strongly advocates that change is possible even in a car-dependent setting, provided that interventions are combined, local actors cooperate, and implementation is supported by data, user feedback, and a clear long-term vision. The core message of the Living Lab is that changes happen, no matter the difficulties, and that this is why the vision should be followed.

4 Annexes

4.1.1 Munich

4.1.1.1 Survey questionnaires:

1. How satisfied are you with the existing transportation system in Munich? Please rate on a scale from 1 (not satisfied at all) to 6 (completely satisfied).

1 (not satisfied at all)

2 (dissatisfied)

3 (somewhat dissatisfied)

4 (somewhat satisfied)

5 (satisfied)

6 (completely satisfied)

• I am with the transportation system in Munich …

Response	Share

1 (strongly disagree)	5.6%
2 (disagree)	7%
3 (somewhat disagree)	14%
4 (somewhat agree)	32.6%
5 (agree)	37.7%
6 (strongly agree)	3.3%

Response	**Share**
1 (strongly disagree)	5.1%
2 (disagree)	8.8%
3 (somewhat disagree)	11.6%
4 (somewhat agree)	30.2%
5 (agree)	30.7%
6 (strongly agree)	13.5%

3. Have you ever used “free-floating” carsharing?

Yes	139
No	76

4. How much do you agree with the following statements? Please use a scale from 1 (not at all) to 6 (completely).

1 (strongly disagree)

2 (disagree)

3 (somewhat disagree)

4 (somewhat agree)

5 (agree)

6 (strongly agree)

- I find that using carsharing on my commute is convenient.
- I believe that using carsharing saves me time on my commute.
- I find it easy to understand how to use carsharing.
- It did not take me long to learn how to use carsharing.
- I intend to continue using carsharing.

Distribution for: “I find that using carsharing on my commute is convenient.”

Response	**Share**
1 (strongly disagree)	41.7%
2 (disagree)	23.7%
3 (somewhat disagree)	6.5%
4 (somewhat agree)	10.1%
5 (agree)	11.5%
6 (strongly agree)	6.5%

5. How often do you use carsharing in combination with public transport on your trip?

Response	Share
Always	1
Often	7
About half of the trips	6
Rarely	54
Never	70
No response	1

6. What are the most common reasons for using carsharing? Multiple selections possible.

Response	Share
Shopping or errands (e.g. major grocery shopping, furniture transport)	66
Weekend trips or leisure rides	59
Visiting friends or family	36
Work-related appointments or commuting	22
Vacation trips / travel	25
In bad weather	39
When the public transport trip is impractical (trip is too long or complicated)	85
When public transport is barely / not available (trips late at night)	82
Moving or larger transports	70
Trips to/from the airport or train station	59

7. What does a typical carsharing trip look like for you? Please select a typical starting location for a carsharing trip at the city district level.

No response	3
I always have different starting locations	10
1. Altstadt – Lehel	3
2. Ludwigsvorstadt – Isarvorstadt	26
3. Maxvorstadt	14
4. Schwabing-West	8
5. Au – Haidhausen	23
6. Sendling	5
7. Sendling – Westpark	10
8. Schwanthalerhöhe	0
9. Neuhausen – Nymphenburg	4
10. Moosach	2
11. Milbertshofen – Am Hart	0
12. Schwabing – Freimann	1
13. Bogenhausen	1
14. Berg am Laim	2
15. Trudering – Riem	0
16. Ramersdorf – Perlach	0
17. Obergiesing	2
18. Untergiesing – Harlaching	13
19. Thalkirchen – Obersendling – Forstenried – Fürstenried – Solln	5
20. Hadern	0
21. Pasing – Obermenzing	4

22. Aubing – Lochhausen – Langwied	2
23. Allach – Untermenzing	0
24. Feldmoching – Hasenbergl	1
25. Laim	0

8. What does a typical carsharing trip look like for you? Please select a typical destination for a carsharing trip at the city district level.

No response	6
I always have different destinations	42
1. Altstadt – Lehel	3
2. Ludwigsvorstadt – Isarvorstadt	11
3. Maxvorstadt	8
4. Schwabing-West	3
5. Au – Haidhausen	9
6. Sendling	2
7. Sendling – Westpark	2
8. Schwanthalerhöhe	0
9. Neuhausen – Nymphenburg	9
10. Moosach	3
11. Milbertshofen – Am Hart	3
12. Schwabing – Freimann	7
13. Bogenhausen	1
14. Berg am Laim	1
15. Trudering – Riem	2
16. Ramersdorf – Perlach	5
17. Obergiesing	4
18. Untergiesing – Harlaching	3
19. Thalkirchen – Obersendling – Forstenried – Fürstenried – Solln	3
20. Hadern	0
21. Pasing – Obermenzing	4
22. Aubing – Lochhausen – Langwied	4
23. Allach – Untermenzing	0
24. Feldmoching – Hasenbergl	1
25. Laim	3

9. To what extent is finding a parking space a problem for you when using carsharing?

Response	**Share**
Always	9
Often	33
About half of the trips	38
Rarely	40
Never	15
No response	4

10. How long does the search for a carsharing parking space usually take when you use carsharing?

0 to 5 minutes	54
5 to 10 minutes	40
10 to 15 minutes	30
15 to 20 minutes	8
20 to 30 minutes	1
30 minutes or longer	0
No response	6

11. Where does the search for a carsharing parking space take you the longest? Please specify the city district.

No response	31
1. Altstadt – Lehel	18
2. Ludwigsvorstadt – Isarvorstadt	24
3. Maxvorstadt	20
4. Schwabing-West	5
5. Au – Haidhausen	15
6. Sendling	4
7. Sendling – Westpark	3
8. Schwanthalerhöhe	0
9. Neuhausen – Nymphenburg	3
10. Moosach	1
11. Milbertshofen – Am Hart	2
12. Schwabing – Freimann	3
13. Bogenhausen	2
14. Berg am Laim	0
15. Trudering – Riem	0
16. Ramersdorf – Perlach	0
17. Obergiesing	0
18. Untergiesing – Harlaching	2
19. Thalkirchen – Obersendling – Forstenried – Fürstenried – Solln	1
20. Hadern	0
21. Pasing – Obermenzing	5
22. Aubing – Lochhausen – Langwied	0
23. Allach – Untermenzing	0
24. Feldmoching – Hasenbergl	0
25. Laim	0

12. Where does the search for a carsharing parking space take you the least time? Please specify the city district.

No response	50
1. Altstadt – Lehel	0
2. Ludwigsvorstadt – Isarvorstadt	3
3. Maxvorstadt	4
4. Schwabing-West	4
5. Au – Haidhausen	5
6. Sendling	4

7. Sendling – Westpark	9
8. Schwanthalerhöhe	1
9. Neuhausen – Nymphenburg	5
10. Moosach	2
11. Milbertshofen – Am Hart	2
12. Schwabing – Freimann	3
13. Bogenhausen	3
14. Berg am Laim	3
15. Trudering – Riem	2
16. Ramersdorf – Perlach	7
17. Obergiesing	4
18. Untergiesing – Harlaching	7
19. Thalkirchen – Obersendling – Forstenried – Fürstenried – Solln	7
20. Hadern	2
21. Pasing – Obermenzing	3
22. Aubing – Lochhausen – Langwied	5
23. Allach – Untermenzing	1
24. Feldmoching – Hasenbergl	2
25. Laim	1

13. How many minutes' walk is the carsharing parking space usually from your actual destination?

0 to 2 minutes	13
2 to 5 minutes	35
5 to 10 minutes	13
10 to 20 minutes	4
20 minutes or longer	1
No response	5

14. Which means of transport do you most often replace with a carsharing trip?

Car (own)	36
Public transport (bus, train, subway, tram)	48
Taxi, ride-hailing (e.g. Uber, Free Now)	13
Bicycle, e-bike (own or sharing service)	4
E-scooter, kick scooter (own or sharing service)	0
Walking	1
Rental car	10
I use carsharing additionally, without replacing another means of transport	25
No response	2

15. Which of the following statements applies to you?

I gave up my private car because of the carsharing service	10
I am considering giving up my private car because of the carsharing service	9
Thanks to the carsharing service, I do not purchase my own car	44
I own a private car and the carsharing service has no influence on this	41

I generally do not need a car	20
None of the statements apply	15

16. For what reasons do you not use carsharing? Multiple selections possible.

I own my own car and have no need	48
I do not need a car	16
Carsharing is not available in my residential area	6
The carsharing stations are too far away	6
I find the use too complicated or cumbersome	12
The costs are too high for me	18
I need the car flexibly and spontaneously – carsharing does not fit my mobility behaviour	18
I have concerns about the availability of vehicles	10
I have concerns about the hygiene or condition of the vehicles	11
I generally do not trust the carsharing system	6
I have not yet looked into the topic	12
No response	9

17. Please indicate on a scale from 1 (strongly disagree) to 6 (strongly agree) how much you agree with each of the following statements.

1 (strongly disagree)

2 (disagree)

3 (somewhat disagree)

4 (somewhat agree)

5 (agree)

6 (strongly agree)

- I think using carsharing on my commute would be convenient.
- I think using carsharing would save me time on my commute.
- I think it would be easy to understand how to use carsharing.
- I think it would not take long to learn how to use carsharing.
- I intend to start using carsharing.

Distribution for: "I think using carsharing on my commute would be convenient."

Response	Share
1 (strongly disagree)	56.6%
2 (disagree)	14.5%
3 (somewhat disagree)	7.9%
4 (somewhat agree)	10.5%
5 (agree)	5.3%
6 (strongly agree)	5.3%

18. Are you aware of the carsharing parking spaces (see figure) set up by the City of Munich? Only carsharing vehicles are allowed to park on these spaces.

Yes	128
No	11

19. How often do you use the carsharing parking spaces set up by the City of Munich?

Response	Share
Always	11
Often	31
About half of the trips	16
Rarely	36
Never	25
No response	9

20. How did you become aware of the carsharing parking spaces? Multiple selections possible.

By passing by / by chance in the cityscape	89
Through the MVGO app	9
Through the app of a carsharing provider	29
Via the website muenchenunterwegs.de	2
Through a mailshot	1
At a citizens' meeting	3
Through friends or family	11
No response	2

21. Have the designated carsharing parking spaces (see figure) ever helped you find a parking space?

Response	Share
Always	18
Often	29
About half of the trips	14
Rarely	21
Never	11
No response	10

22. Have you ever experienced carsharing parking spaces being blocked by unauthorized vehicles (e.g. private cars)?

Response	Share
Always	15
Often	43
About half of the observations	15
Rarely	16
Never	9
No response	5

23. In your opinion, what could be improved about the carsharing parking spaces? Multiple selections possible.

There should be more parking spaces in my area (home, workplace)	39
The parking spaces should be closer to relevant destinations	29
The parking spaces should be closer to public transport stops	29
The blocking of parking spaces by private vehicles should be effectively prevented	73
The marking and signage of the parking spaces should be improved	41
There should be a way to view the occupancy or availability of the parking spaces in real time	67
The safety and lighting of the parking spaces should be improved	5
There should be more information about the locations of the parking spaces	34
No response	10

24. How did you become aware of the carsharing parking spaces? Multiple selections possible.

By passing by / by chance in the cityscape	22
Through the MVGO app	0
Through the app / website of a carsharing provider	0
Via the website muenchenunterwegs.de	2
Through a mailshot	0
At a citizens' meeting	0
Through friends or family	1
Municipal event	0
Via Münchner Fenster (passenger TV) on the subway	2
No response	3

25. For what reasons do you not use carsharing parking spaces? Multiple selections possible.

Response	Share
I do not know how to find them	2
They are too far away for me	6
They are usually occupied by other carsharing cars	0
They are usually occupied by illegally parked cars	3
I take the first free parking space I find	20
No response	4

26. Are you aware of the carsharing parking spaces (see figure) set up by the City of Munich? Only carsharing vehicles are allowed to park on these spaces.

Yes	**61**
No	15

27. How did you become aware of the carsharing parking spaces? Multiple selections possible.

Response	Share
By passing by / by chance in the cityscape	55
Through the MVGO app	3
Through the app of a carsharing provider	2
Via the website muenchenunterwegs.de	0
Through a mailshot	1
At a citizens’ meeting	0
Through friends or family	4
No response	4

28. How would you find out about the locations of the carsharing parking spaces (see figure)? Multiple selections possible.

Google search	20
Through friends or family	4
Via the website muenchenunterwegs.de	5
At a citizens’ meeting	1
Municipal event	1
Through the app or website of a carsharing provider	15
Through the MVGo app	11
No response	1

29. How old are you?

Under 18	0
18–24	10
25–34	67
35–44	57
45–54	39
55–64	30
65 and older	10
No response	2

30. What is your gender?

Female	64
Male	144
Diverse	4
No response	3

31. In which city district do you live?

No response	4
1. Altstadt – Lehel	9
2. Ludwigsvorstadt – Isarvorstadt	31
3. Maxvorstadt	19
4. Schwabing-West	15

5. Au – Haidhausen	50
6. Sendling	5
7. Sendling – Westpark	16
8. Schwanthalerhöhe	0
9. Neuhausen – Nymphenburg	7
10. Moosach	0
11. Milbertshofen – Am Hart	2
12. Schwabing – Freimann	4
13. Bogenhausen	2
14. Berg am Laim	2
15. Trudering - Riem	6
16. Ramersdorf - Perlach	1
17. Obergiesing	3
18. Untergiesing - Harlaching	17
19. Thalkirchen - Obersendling - Forstenried - Fürstenried - Solln	6
20. Hadern	3
21. Pasing - Obermenzing	4
22. Aubing - Lochhausen - Langwied	7
23. Allach - Untermenzing	1
24. Feldmoching - Hasenbergl	1
25. Laim	0

4.1.1.2 Lessons Learned for the Living Lab Munich on the implementation of an autonomous Mobility-on-Demand service

This document was specifically written by Munich LL partners referring to the prior project goals before the amendment was required in the project.

4.1.1.2.1 Motivation of partners in the Living Lab Munich

The following describes the motivation of the key partners to participate in the SUM project and Living Lab Munich. The overview covers the perspectives and goals of Sixt, the City of Munich, and the Technical University of Munich (TUM), thereby providing a basis for understanding their respective roles, contributions, and expectations in Living Lab Munich.

Originally, the objective of Living Lab Munich (WP 4.1) was the staged introduction of an autonomous mobility-on-demand (AMOD) service with a fully automated vehicle fleet (Level 4) operated by Sixt. Level 4 refers to vehicles capable of fully autonomous driving within a defined operational area without human intervention, while still allowing for remote supervision [SAE, 2021]. This pilot aimed to test autonomous ride-hailing in real operation and generate unique data on fleet performance, user behaviour, and acceptance. The central fields of action included (i) step-by-step introduction of the fully automated vehicle fleet in the urban area of Munich, (ii) Collection and analysis of operational data of the fully automated vehicle fleet, and (iii) definition and implementation of surveys of actual and potential users to identify and evaluate acceptance and barrier factors for the use of New and Shared Mobility Services.

The roles of the partners were clearly delineated:

- Sixt was responsible for deploying and operating the automated ride-hailing fleet, providing booking and operational data (e.g., booking requests, cancellations, pick-up and drop-off patterns) via the Sixt Ride app, and facilitating user surveys.

- The City of Munich acted as a municipal partner, supporting the deployment of new mobility services by providing regulatory coordination, municipal data, and integration into public mobility platforms and tariffs. It also documented its experiences and ensured knowledge transfer to other cities.

- TUM assumed the role of scientific partner, analysing operational data (e.g., booking behaviour, charging, cancellations), conducting and evaluating customer surveys, and using the results to validate simulation models (e.g., FleetPy) and develop insights into the traffic impacts and integration strategies [TUM, 2025].

This constellation was designed to ensure that technical operation, municipal governance, and scientific evaluation were closely interlinked, providing a holistic understanding of autonomous and shared mobility services in an urban context. The motivation of each partner is described in more detail in the following.

Sixt's motivation for participating in the Living Lab Munich was to test and validate a future business model in the field of autonomous ride-hailing services. A key expected advantage was the potential reduction in operating costs compared to traditional ride-hailing models, particularly through the elimination of driver-related expenses.

In addition, Sixt aimed to build experience in customer communication and demand management in the context of autonomous mobility services. The project also provided an opportunity to gain practical knowledge in yield management - balancing supply (fleet size) and demand (pricing strategy) - as well as in fleet management processes such as vehicle preparation, charging or refuelling, damage handling, and repair for autonomous fleets.

Furthermore, Sixt sought to develop expertise in dealing with legal and regulatory challenges, as well as in assessing the operational efforts required for safety measures (e.g., tele operations) and quality assurance processes (e.g., remote assistance).

The TUM is involved in the Living Lab with the clear motivation of testing research results under real conditions and gaining a scientifically founded understanding of the interaction between technology, transport systems, and users. The focus is on accompanying scientific research and the establishment of a real-world laboratory in the city of Munich for Autonomous Mobility-on-Demand (AMoD), which closely integrates simulation, data analysis, and traffic modelling with field observations. To this end, TUM intends to develop robust evaluation designs that will make it possible to measure the effects on safety, efficiency, the environment, and user acceptance. Neutral moderation between industry, the city, and the public will also enable a robust data and governance architecture, as well as transfer into teaching and standards. Overall, TUM's motivation for participating in Living Lab Munich is to lay the foundations for scalable, evidence-based innovations in the field of AMoD and to make Living Lab Munich an iterative experimental space in which findings from the field flow directly back into algorithms, operating strategies, and planning tools.

Munich's motivation to test an autonomous on-demand service within the SUM EU project stems from its ambition to explore innovative urban mobility solutions as part of a future-oriented and sustainable city development strategy. The city seeks to better understand how new technologies can enhance public transport efficiency and complement existing mobility services. By piloting autonomous vehicles, Munich can assess their potential to reduce emissions, traffic congestion, and private car dependency. This aligns directly with the city's goals to advance the mobility transition ("Verkehrswende") and promote cleaner, more accessible transportation options. Moreover, the project allows Munich to evaluate the integration of autonomous and digital mobility services into the broader public transport network. Testing such innovations within a controlled, real-world environment helps identify technical, regulatory, and social challenges early on. Importantly, the scope of this pilot directly contributes to Munich's Mobility Strategy 2035 [Mobilitätsreferat 2021], which emphasizes research and innovation, including autonomous driving. The insights gained from the EU project provide valuable learnings for the strategy's future implementation. Ultimately, the city's participation demonstrates its role as a European leader in sustainable, technology-driven urban mobility transformation.

Although the original plan envisioned the introduction of an AMOD service using Level 4 vehicles, unforeseen legal and technological constraints prevented the realization of these objectives. Nevertheless, the experience gained in preparing and restructuring the Living Lab Munich provided valuable insights into the regulatory, procedural, and operational dimensions of autonomous mobility implementation. This Lessons Learned summarize these key findings and are structured into three main parts:

1. Relevant stakeholders involved in the approval, development, and operation of an autonomous MOD service,

2. Process steps required for introducing an autonomous on-demand mobility service, and

3. Barriers and challenges identified through the experience of the Living Lab Munich.

Together, these insights aim to inform future initiatives seeking to implement AMOD services under comparable regulatory and technical conditions.

4.1.1.2.2 Relevant stakeholders in the approval, development, and operation of an autonomous MOD service

The introduction of AMOD services requires the coordinated involvement of a wide range of stakeholders. Each of these actors contributes specific expertise, resources, and decision-making authority to ensure that such services can be approved, deployed, and operated safely and efficiently. The objective of this section is therefore to provide an overview of the most relevant stakeholder groups along the entire value chain - from regulatory approval and political framework setting, through technological development and fleet operation, to user acceptance and supporting services.

The following subsections highlight the perspectives and roles of key stakeholders, including public authorities and policy makers, technology providers and OEMs, fleet operators, users and society, as well as other service providers such as insurers and infrastructure operators. By mapping out these interdependencies, the section illustrates both the complexity of the ecosystem and the critical interfaces that must be managed when establishing an AMOD service.

1. **Public Authorities & Policy Makers**

- Mobility Department of the City of Munich: responsible for integrating the service into existing transport structures, selecting operational zones and stop locations, and ensuring effective communication, digital integration, and monitoring.

- Approval authorities (e.g., KBA, TÜV): responsible for vehicle type approval and granting operating permits for autonomous driving (Level 4).

- Building Department: responsible for the construction and commissioning of physical stops.

- Citizens: their acceptance, trust, and actual usage determine the overall success of the service.

- User requirements: include data protection, safety, barrier-free access (both physical and digital), appropriate pricing, and seamless integration with public transport services.

- Interest groups: represent specific mobility needs, e.g., for people with disabilities or elderly.

2. **Technology Providers & OEMs**

- OEMs are responsible for supplying autonomous vehicles or vehicle platforms that can be further equipped by third-party technology partners.

- Sensor and software providers develop and deliver essential hardware and software components, such as LiDAR systems, high-definition maps, and AI-based driving systems.

- Technology providers must ensure that all relevant legal and regulatory requirements are properly addressed both during development and in operational deployment.

- Autonomous driving functionalities and customer-facing components (e.g., in-vehicle customer displays) are continuously improved either during ongoing operations or through regular fleet renewal cycles.

3. **Fleet Operators**

- The fleet operator is responsible for the technical and operational management of the vehicle fleet.

- This includes maintenance, repair, charging or refuelling, cleaning, and remote monitoring of the vehicles.

- The operator ensures customer interaction through booking platforms and app integration, providing seamless user experience.

- Fleet and yield management are key responsibilities, including balancing supply and demand through pricing and operational strategies.

- Compliance with legal and regulatory requirements must be ensured throughout all operational processes.

- The operator is also responsible for establishing and managing the required infrastructure, such as fleet deployment and retrieval logistics, charging facilities, maintenance areas, and operational centres for customer service and teleoperations.

4. **Users & Society**

- Citizens and potential users in Munich represent a central stakeholder group, as their acceptance, trust in the technology, and actual usage behaviour ultimately determine the success of an autonomous Mobility-on-Demand service.

- Diverse user groups are also key stakeholders, as they articulate specific requirements, particularly regarding data protection, safety, and barrier-free access - both physically (e.g., accessible vehicles) and digitally (e.g., intuitive and inclusive applications).

- Public transport users and commuters form another relevant group, as they are directly affected by how well the service is integrated into existing public transport systems and by the design of pricing models.

- Interest groups and civil society organizations, especially those representing people with disabilities or reduced mobility, are important stakeholders, as they advocate for inclusivity and ensure that the needs of different societal groups are considered in the design and operation of the service.

5. **Other Stakeholders**

- Insurance companies develop tailored insurance products for autonomous vehicles, particularly addressing liability and damage-related aspects.
- Infrastructure providers supply essential services such as charging infrastructure, communication networks, and workshop services required for reliable operations.

4.1.1.2.3 Process steps for introducing an autonomous on-demand mobility service

The following outlines the key process steps required for introducing an autonomous on-demand mobility service from the perspective of an established mobility provider (e.g., a car rental company). The description considers both regulatory and technical aspects, including relevant legal frameworks, vehicle technologies, and involved stakeholders.

Process steps:

1. The process begins with the definition of strategic objectives and the identification of suitable partners across technology, operations, and the public sector.
2. This is followed by a feasibility study and location analysis to assess technical viability, market potential, and operational constraints within the selected area.
3. A comprehensive clarification of legal and regulatory requirements is required, including applicable laws, approval procedures, and operational restrictions for autonomous driving systems.
4. Based on these findings, appropriate technologies and vehicle platforms are selected, and vehicle procurement or provisioning is initiated in collaboration with OEMs and technology partners.
5. Detailed operational planning is then carried out, covering depot infrastructure, staffing concepts, charging infrastructure, and the definition of pick-up and drop-off locations (PuDo points).
6. In parallel, all necessary permits must be obtained, and safety concepts must be developed, including measures for operational safety, remote supervision (e.g., teleoperations), and emergency handling.
7. The service is subsequently tested in a real-world environment through a pilot operation, including the involvement of the public to evaluate acceptance and user interaction.
8. At the same time, booking systems are developed or integrated, and user communication strategies are implemented to ensure accessibility and usability of the service.
9. A comprehensive fleet, pricing, and yield management system is established to balance supply and demand and to optimize operational efficiency.
10. Finally, the service is evaluated based on operational performance, user feedback, and economic viability, forming the basis for a decision on scaling and long-term deployment.

4.1.1.2.4 Barriers and challenges – insights from the Living Lab Munich

The planned operation of a highly automated (Level 4) ride-hailing service in a major city such as Munich has already highlighted the complexity of the interplay between technology, regulation, operations, and partnerships during the preparatory phase. From the perspective of Living Lab Munich, the key barriers and challenges can be summarized as follows.

1. **Dependence on the technology partner**

As the future operator, SIXT was completely dependent on the technology partner to deliver, convert, and certify the vehicles (NIO ES8) for L4. Its own role did not include technical vehicle development or type approval; accordingly, there was a high degree of external dependence regarding homologation and vehicle availability. Without L4-certified vehicles, operations could not commence.

2. **Strategic realignment of the tech partner**

In mid-2023, the technology partner changed its strategy and decided not to bring the specific NIO vehicles to L4. This meant that the technological basis for the planned real-world operation was no longer available for the foreseeable future. Discussions about procuring L4-capable vehicles from alternative OEMs showed that this was possible in principle but would have meant further significant delays. This development was publicly reported in May 2023 and had an immediate impact on other funding projects.

3. **Lack of L4 certification as a significant barrier to market entry**

Real-world operation would require an operating license, which in turn requires L4 homologation of the vehicles used. Since the intended L4 certification for the planned NIO vehicles was dropped and there was no contractual access to other L4-capable vehicles, the mandatory legal and technical basis for the launch was lacking.

4. **Delayed regulatory framework**

Although the German law on autonomous driving came into force on 28 July 2021, specific operational details remained unclear at first. The relevant regulation on approval and operation did not come into effect until 1 July 2022, later than initially expected. This reduced planning security and postponed milestones, as the specific requirements for operating licenses and technical specifications only became binding with the regulation.

5. **Delivery problems and bottlenecks in resources**

The technology partner reported bottlenecks in retrofit capacities and parts procurement (including post-COVID effects). The first test vehicles, initially expected in July 2022, were repeatedly delayed; in February 2023, March 2023 was announced as the new target date for the first vehicles. At the same time, SIXT was busy with extensive preparations (including IT integration, branding, site development including charging infrastructure, and recruitment of safety drivers/teleoperators).

6. **Delays in the funding and approval process**

Several months passed between the initial call for projects (May 2022), the submission of projects (September 2022), and the funding approval (December 2022); the drafting of the grant agreement began in January 2023. These sequences were at odds with the ambitious schedules for rapid real-world operation by mid-2025.

7. **Lack of a contractual basis for alternative vehicles**

After the NIO basis was eliminated, there was no existing contract with the technology partner that would have regulated access to other L4-capable vehicles at short notice. Without a corresponding framework agreement, there was no viable option for building up the fleet with alternative OEM vehicles in a timely manner.

8. **Consequence: Project goal of "real-world operation by June 2025" not achievable**

Due to the loss of homologation prospects, delivery and capacity problems, and the lack of contractual alternatives, real-world operation in the Munich Living Lab was no longer realistic by the deadline. As a result, a revised project scope was prepared (including conceptual work on fleet operation, legal and operational issues, price points, and integration at mobility hubs), but this was ultimately not approved after further clarification in spring 2024.

4.1.1.2.5 Lessons for future living lab projects

- Hedging against multiple technology risks: Review alternative OEM paths and procurement options contractually at an early stage and, where possible, establish second-source arrangements to cushion strategic changes by individual partners.

- Treat regulatory milestones as critical issues: Plan for legislation and implementing regulations as separate risks; define transitional requirements, test/pilot regulations, and "no-regret" preparatory work that will enable progress even in the event of delays.

- Build operational readiness in phases: Develop infrastructure (charging, data lines), IT integration, and operational processes in a modular fashion to generate usable results (e.g., simulation, operational and acceptance concepts) even in the event of vehicle delays.

- Integrate funding and contract logic with implementation risks: Realistically link timelines for grant agreements, awards, and approvals; define clear triggers for scope adjustments, amendments, and exit scenarios.

In summary, Living Lab Munich shows that real-world operation with L4 vehicles is not only a technical challenge, but above all a regulatory, contractual, and partner-related one. The key lesson is that technological paths must be strategically redundant, regulatory transitions must be operationalized at an early stage, and funding must be flexible—otherwise, external shocks can block the path to real-world operation, even if urban and organizational preparations are well advanced.

4.1.2 Geneva

4.1.2.1 WP1/WP5 Survey:

What is approximately the percentage of your monthly budget you spend on your daily trips?

Response	Share
0-10%	73%
10-20%	24%
20-30%	3%
30-40%	0%
40-50%	0%
More than 50%	0%

Please indicate from 1 (not at all satisfied) to 6 (completely satisfied) your level of satisfaction with the existing transport system in Geneva.

Response	Share
1 (Not at all satisfied)	1.1%

2	6%
3	15.2%
4	22.8%
5	41.8%
6 (Completely satisfied)	13%

The people around me think that I should use the existing transport system.

Response	Share
1 (Strongly disagree)	11.4%
2	10.9%
3	19.6%
4	15.2%
5	18.5%
6 (Strongly agree)	24.5%

I am more likely to use the existing transport system if the people around me used it.

Response	Share
1 (Strongly disagree)	20.7%
2	14.7%
3	12%
4	12.5%
5	16.8%
6 (Strongly agree)	23.4%

When using the existing transport system, I can easily switch from on mode of transport to another.

Response	Share
1 (Strongly disagree)	3.3%
2	7.6%
3	16.8%
4	23.9%
5	30.4%
6 (Strongly agree)	17.9%

When using the existing transport system, I can easily switch from on mode of transport to another.

Response	Share
1 (Strongly disagree)	3.3%
2	7.6%
3	16.8%
4	23.9%
5	30.4%

6 (Strongly agree)	17.9%

At off-peak hours, what is the (in-vehicle) travel time in minutes required to perform your daily trip per transport mode?

	Do not know	0-15 minutes	16-30 minutes	31-45 minutes	46-60 minutes	More than 60 minutes
Car	55.4%	16.3%	19.6%	3.3%	3.3%	2.2%
Taxi/ride-hailing	83.7%	6.5%	7.1%	0.5%	0.5%	1.6%
Public transport	9.2%	20.1%	39.7%	20.1%	7.6%	3.3%
Motorcycle	79.9%	12.5%	5.4%	0.5%	1.1%	0.5%
Bicycle	39.7%	29.3%	19.6%	8.2%	2.7%	0.5%
E-bike/e-scooter	55.4%	19%	21.7%	1.6%	1.6%	0.5%
Walking	5.4%	22.8%	28.3%	18.5%	10.3%	14.7%

At peak hours, what is the (in-vehicle) travel time in minutes required to perform your daily trip per transport mode?

	Do not know	0-15 minutes	16-30 minutes	31-45 minutes	46-60 minutes	More than 60 minutes
Car	59.8%	6%	11.4%	11.4%	6%	5.4%
Taxi/ride-hailing	84.8%	2.7%	5.4%	2.7%	2.7%	1.6%
Public transport	11.4%	15.8%	30.4%	27.7%	10.9%	3.8%
Motorcycle	79.9%	10.3%	6%	2.2%	1.1%	0.5%
Bicycle	40.8%	26.6%	21.2%	7.6%	3.3%	0.5%
E-bike/e-scooter	56%	17.4%	20.7%	3.8%	1.6%	0.5%
Walking	7.1%	23.9%	26.6%	17.4%	10.3%	14.7%

On a scale of 1 to 6, how would you rate the risk of experiencing crime or harassment while traveling?

	1: not safe at all	2	3	4	5	6: Very safe
Car	6.5%	2.7%	4.9%	9.8%	31%	45.1%
Taxi/ride-hailing	10.3%	2.7%	10.3%	13.6%	31%	32.1%
Public transport	1.6%	2.7%	15.2%	20.7%	34.8%	25%
Motorcycle	22.3%	8.2%	15.2%	11.4%	20.1%	22.8%

Bicycle	11.4%	12.5%	14.7%	19.6%	23.4%	18.5%
E-bike/e-scooter	14.1%	11.4%	17.9%	16.8%	22.3%	17.4%
Walking	3.3%	3.8%	16.3%	17.4%	35.9%	23.4%

On a scale of 1 to 6, how would you rate the risk of experiencing a traffic accident while traveling?

	1: not safe at all	**2**	**3**	**4**	**5**	**6: Very safe**
Car	4.3%	7.6%	21.7%	22.3%	28.8%	15.2%
Taxi/ride-hailing	8.2%	3.3%	19%	20.1%	29.9%	19.6%
Public transport	1.6%	1.6%	5.4%	7.1%	32.1%	52.2%
Motorcycle	28.8%	21.2%	28.3%	10.9%	6.5%	4.3%
Bicycle	15.2%	27.7%	33.7%	14.7%	6%	2.7%
E-bike/e-scooter	20.1%	29.9%	28.3%	13.6%	5.4%	2.7%
Walking	1.6%	7.6%	9.2%	19.6%	40.8%	21.2%

Are the recent implemented transport policies/strategies in your city acceptable to you?

Response	**Share**
1 (Not acceptable at all)	3.8%
2	8.2%
3	20.7%
4	27.2%
5	26.6%
6 (Fully acceptable)	13.6%

Do you know mobility hubs and if so, have you ever used them?

Response	**Share**
Yes	39%
No	61%

Are the recent implemented transport policies/strategies in your city acceptable to you?

Response	**Share**
1 (Not understandable at all)	2.8%
2	6.9%
3	19.4%
4	20.8%

5	31.9%
6 (Totally understandable)	18.1%

From 1 to 6, indicate how useful you think these totems is?

Response	**Share**
1 (Totally useless)	2.8%
2	11.1%
3	11.1%
4	19.4%
5	27.8%
6 (Totally useful)	27.8%

From 1 to 6, please indicate how please you think the design of these totems is?

Response	**Share**
1 (Totally unpleasant)	2.8%
2	12.5%
3	19.4%
4	25%
5	29.2%
6 (Totally pleasant)	11.1%

Have you ever used car sharing services in your city?

Response	**Share**
Yes	73%
No	27%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	**2**	**3**	**4**	**5**	**6: Strongly agree**
I think using carsharing in my day-to-day commuting is convenient.	23.7%	13.3%	17%	11.1%	9.6%	25.2%

I think using carsharing allows me to gain time in my day-to-day commuting.	28.9%	25.2%	14.8%	6.7%	8.1%	16.3%
I think it is easy to understand how to use carsharing.	0%	1.5%	8.9%	14.1%	31.1%	44.4%
It didn't take me long to learn how to use carsharing.	5.9%	3.7%	6.7%	7.4%	25.2%	51.1%
I can easily access to carsharing services.	0%	2%	5.2%	12.6%	25.9%	53.3%
I intend to continue using carsharing.	0.7%	0.7%	3%	8.9%	16.3%	70.4%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	**2**	**3**	**4**	**5**	**6: Strongly agree**
I think using carsharing in my day-to-day commuting would be convenient.	38.8%	16.3%	12.2%	12.2%	12.2%	8.2%
I think using carsharing would allow me to gain time in my day-to-day commuting.	40.8%	18.4%	22.4%	8.2%	4.1%	6.1%
I think it would be easy to understand how to use carsharing.	14.3%	14.3%	12.2%	16.3%	28.6%	14.3%

I think it would not take me long to learn how to use carsharing.	12.2%	14.3%	8.2%	10.2%	32.7%	22.4%
I could easily access to carsharing services.	14.3%	18.4%	20.4%	14.3%	18.4%	14.3%
I intend to start using carsharing.	51%	18.4%	10.2%	2%	6.1%	12.2%

Have you ever used bike sharing services in your city?

Response	Share
Yes	42%
No	58%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using bikesharing in my day-to-day commuting is convenient.	5.1%	15.4%	17.9%	9%	15.4%	37.2%
I think using bikesharing allows me to gain time in my day-to-day commuting.	6.4%	9%	16.7%	14.1%	15.4%	38.5%
I think it is easy to understand how to use bikesharing.	2.6%	0%	7.7%	10.3%	30.8%	48.7%
It didn’t take me long to learn how to use bikesharing.	1.3%	3.8%	7.7%	6.4%	24.4%	56.4%
I can safely use bikesharing services.	1.3%	2.6%	12.8%	9%	34.6%	39.7%
I can easily access to bikesharing services.	5.1%	0%	5.1%	20.5%	33.3%	35.9%

I intend to continue using bikesharing.	3.8%	7.7%	7.7%	5.1%	19.2%	56.4%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	**2**	**3**	**4**	**5**	**6: Strongly agree**
I think using bikesharing in my day-to-day commuting would be convenient.	34%	15.1%	19.8%	12.3%	9.4%	9.4%
I think using bikesharing would allow me to gain time in my day-to-day commuting.	32.1%	13.2%	23.6%	10.4%	10.4%	10.4%
I think it would be easy to understand how to use bikesharing.	5.7%	5.7%	20.8%	24.5%	18.9%	24.5%
I think it would not take me long to learn how to use bikesharing.	6.6%	6.6%	17.9%	20.8%	18.9%	29.2%
I could safely use bikesharing services.	12.3%	10.4%	22.6%	16%	14.2%	24.5%
I could easily access to bikesharing services.	6.6%	8.5%	16%	19.8%	19.8%	29.2%
I intend to start using bikesharing.	54.7%	17.9%	17%	3.8%	4.7%	1.9%

Firstly, how many vehicles do you have in your household?

	0	**1**	**2**	**3 or more**
Conventional car	71.2%%	24.5%	3.8%%	0.5%
Electric car	95.7%	3.8%	0.5%	0%
Truck, bus, or van	98.4%	1.6%	0%	0%

Motorcycle	79.3%	17.4%	2.7%	0.5%
Bicycle or e-bike	18.5%	29.9%	23.4%	28.3%
E-scooter	94.6%	5.4%	0%	0%

Indicate the origin of your first trip (where did you start traveling?)

Response	Share
Geneva (city)	39.1%
Carouge	6%
Lancy / Grand-Lancy / Petit-Lancy	5.4%
Plan-les-Ouates	3.8%
Chêne-Bougeries	3.3%
Confignon	3.3%
Meyrin	1.6%
Versoix	2.2%
Thônex	2.2%
Nyon	2.2%
Champel	1.6%
Vernier	1.6%
Cartigny	1.1%
Puplinge	1.1%
Bernex	1.1%
Onex	0.5%
Collonge-Bellerive	0.5%
Chambésy	0.5%
Satigny	0.5%
Chêne-Bourg	0.5%
Presinge	0.5%
Founex	0.5%
Leysin	0.5%
Neuchâtel	0.5%
Nendaz (VS)	0.5%
Annemasse	0.5%
Collonges-sous-Salève	0.5%
Not geolocatable (described routes, ambiguous postcodes, etc.)	5.4%

Indicate the destination of your trip (where did you go?)

Response	Share
Geneva (city)	42.4%
Carouge	6.0%
Lancy / Grand-Lancy / Petit-Lancy	8.7%
Vernier	4.3%
Plan-les-Ouates	1.6%
Meyrin	2.2%

Grand-Saconnex	2.2%
Chêne-Bougeries	0.5%
Champel	1.1%
Bernex	1.1%
Thônex	0.5%
Eaux-Vives	1.1%
Plainpalais	1.1%
Onex	0.5%
Collonge-Bellerive	1.1%
Versoix	0.5%
Nyon	0.5%
Les Acacias	1.6%
Lausanne	1.6%
Châtelaine	1.1%
Annemasse	0.5%
Jussy	1.1%
Lignon	1.1%
Saint-Julien-en-Genevois	1.1%
Others	6.5%
Not geolocatable	4.3%

Which transport mode did you choose to reach your destination? Please select the main transport mode of your trip.

Response	**Share**
Train, tram, etc.	39.1%
Personal bike (or e-bike)	27.7%
Walking	16.3%
Bus	13.0%
Personal car	6.0%
Personal motorbike	4.3%
Shared car	2.7%
Shared bike (or e-bike)	1.1%
Personal e-scooter (or another micro-vehicle)	1.1%
Carpooling or shuttle service	0.5%
Other	1.1%

** Total exceeds 184 as some respondents selected multiple transport modes.*

Note the purpose of your trip.

Response	**Share**
Work	59.2%
Leisure	17.4%
Other activities	7.6%
Shopping	7.6%
Health reasons	4.9%
Going home	1.6%
Administrative services	1.1%
Education	0.5%

During which time period did this movement take place?

Time slot	Share
05:00 - 08:00	22.3%
08:00 - 11:00	41.3%
11:00 - 14:00	13.6%
14:00 - 17:00	12.5%
17:00 - 20:00	9.2%
20:00 - 23:00	1.1%

Sociodemographic data

What is your age?

Age group	Share
Under 20	0.5%
20 – 29	6.0%
30 – 39	14.1%
40 – 49	23.4%
50 – 59	26.6%
60 – 69	21.2%
70 – 79	6.0%
80+	2.2%

What is your gender?

Gender	Share
Female	33%
Male	65%
Non-binary	0%
Prefer not to say	2%

What is your education level?

Education level	Share
Master or PhD	54.9%
Bachelor's degree	27.2%
Secondary school / High school	12.5%
Primary school	2.7%
Prefer not to answer	2.7%

What is your current status of employment?

Employment status	Share
Employee	65.9%
Retired	17.8%
Self-employed	11.4%
Student	3.2%
Unemployed	1.6%

Are the recent implemented transport policies/strategies in your city acceptable to you?

Response	Share
1 (Significantly below the average)	10.3%
2	14.7%
3	22.3%
4	28.8%
5	16.3%
6 (Significantly above the average)	7.6%

Do you have any physical disabilities or conditions that affect your ability to move?

Response	Share
Yes	2.7%
No	97.3%

4.1.2.2 KPI’s

NSM Integrate:

Response	Share
Mobility	Car sharing
Donkey Republic	Bike sharing
Carvélo	Cargobike sharing
HéLéman	Car pooling
Ovo	Bike station
WeCHIP	Connected lockers

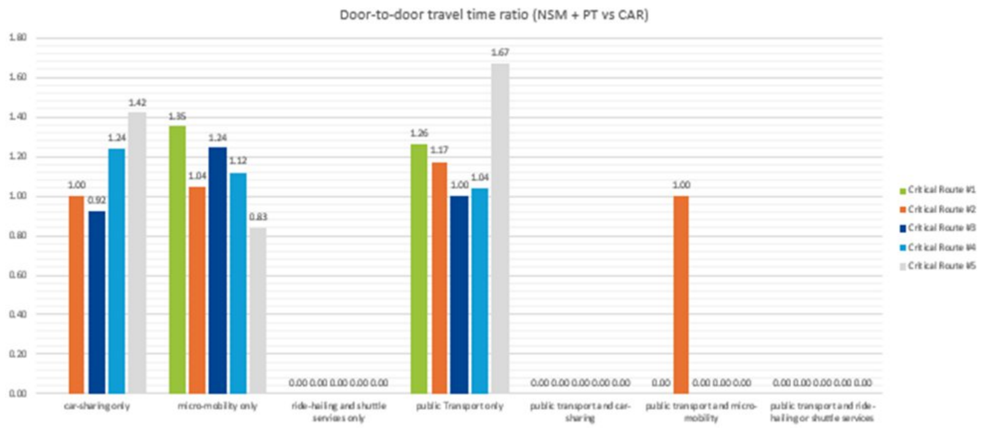
Intend:

Response	Car-sharing	Micro-mobility	Ride-hailing and shuttle services

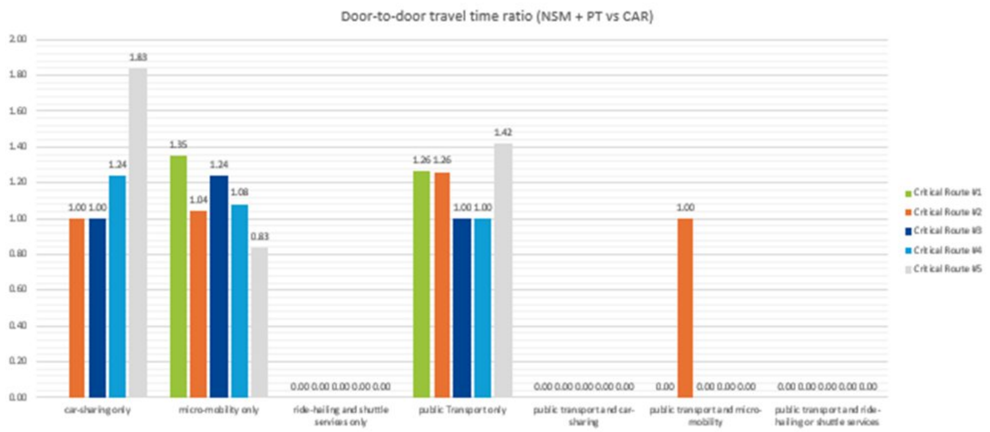
Number of respondents in the survey (total)	184		
Number of respondents who rated acceptance higher than 3	139	74	*No data*
Intention level	75.54%	40.22%	0.00%

Actual DDT:

Off Peak



Peak time



Multimodal:

Mobility Hub 1	**Mobility Hub 2**	**Mobility Hub 3**	**Mobility Hub 4**	**Mobility Hub 5**	**Mobility Hub 6**
Lancy-Bachet, 1212 Lancy, Genève	Lancy-Pont-Rouge, Lancy, Genève	P+R, Bernex, Suisse	Gardiol, Grand-Saconnex, Suisse	HEAD, Genève, Suisse	HEPIA, Genève, Carouge, Suisse
tpg bus/tram lines CFF trains Bike sharing Cargobike sharing Carsharing	tpg bus/tram lines CFF trains Bike sharing Carsharing P+R Bikeparking	tpg bus/tram lines Bike sharing Carsharing P+R	tpg bus/tram lines Bike sharing	tpg bus/tram lines Bike sharing	tpg bus/tram lines Bike sharing

Bikeparking		Bikeparking	Carsharing	Carsharing	Bikeparking
NSM score: 77.78%	NSM score: 66.67%	NSM score: 55.56%	NSM score: 33.33%	NSM score: 33.33%	NSM score: 33.33%

CostR:

Coût DR / Distance moyenne	Private car	Public transport #1	Car sharing #1	Micro-mobility #1	Micro-mobility #2	Micro-mobility #3
Shared mobility service / Transport Operator	—	tpg transports publics genevois	Mobility car sharing	Donkey Republic mosaic Bike sharing	Donkey Republic electric Bike sharing	Carvélo Curbike sharing
Avg. car-parking (1h) or unlock cost (€)	2.60	—	3.52	3.78	8.05	5.37
Avg. cost in €/h (service cost)	—	42.33	—	15.0	25.0	4.83
Avg. speed in km/h	—	—	—	—	—	—
Avg. cost in €/km (fuel or service)	0.30	0.77	0.25	0.32	—	0.001
Avg. trip distance in km (OFS, MRMT 2021)	20	6	20	1	1	1
Public transport ticket in euros (one ride)	3.20	—	—	—	—	—

PercDDT:

	Interval #1	Interval #2	Interval #3	Interval #4	Interval #5
Min time value (min)	0	16	31	46	60
Max time value (min)	15	30	45	60	70
Median time value (min)	8	23	38	53	65
Q2 – Off-peak: Private car	30	36	6	6	4
Q2 – Off-peak: Taxi	12	13	1	1	3
Q2 – Off-peak: Public transport	37	73	37	14	6
Q2 – Off-peak: Bicycle	66	60	18	7	1
Q3 – Peak: Private car	11	21	21	11	10
Q3 – Peak: Taxi	5	10	5	5	3

Q3 – Peak: Public transport	29	56	51	20	7
Q3 – Peak: Bicycle	59	64	19	8	1

Satisfaction:

Number of respondents in the survey	184
Number of respondents who rated satisfaction higher than 3	143
Acceptance rate	77.72%

Modal Split:

SUM-Transport modes	Trips	Share (%)	Pax·km	Share (%)	Avg. occupancy	Veh·km	Share (%)
Car	23	6.183%	261	16.096%	1.25	208,840	21.917%
Taxi	0	0.000%	0	0.000%	1.25	0	0.000%
Train (metro, suburban railway, tram, etc.)	118	31.720%	480	29.613%	6.58	73,038	7.665%
Bus (or trolley bus)	47	12.634%	191	11.795%	6.58	29,090	3.053%
Motorcycle	16	4.301%	182	11.197%	1.00	181,600	19.058%
Bicycle (or e-bike)	97	26.075%	247	15.252%	1.00	247,350	25.958%
E-scooter	3	0.806%	8	0.472%	1.00	7,650	0.803%
Walk	53	14.247%	135	8.333%	1.00	135,150	14.183%
Car sharing	8	2.151%	91	5.599%	2.00	45,400	4.765%
Micro-mobility	6	1.613%	15	0.943%	1.00	15,300	1.606%
Ride hailing	1	0.269%	11	0.700%	1.20	9,458	0.993%
Ferry (or water taxi)	0	0.000%	0	0.000%	2.20	0	0.000%

Please indicate from 1 (not at all satisfied) to 6 (completely satisfied) your level of satisfaction with the existing transport system in Geneva.

Response	Share
1 (Not at all satisfied)	1.1%
2	6%
3	15.2%
4	22.8%
5	41.8%

The people around me think that I should use the existing transport system.

Response	Share
1 (Strongly disagree)	11.4%
2	10.9%
3	19.6%
4	15.2%
5	18.5%

I am more likely to use the existing transport system if the people around me used it.

Response	Share
1 (Strongly disagree)	20.7%
2	14.7%
3	12%
4	12.5%
5	16.8%

When using the existing transport system, I can easily switch from on mode of transport to another.

Response	Share
1 (Strongly disagree)	3.3%
2	7.6%
3	16.8%
4	23.9%
5	30.4%

When using the existing transport system, I can easily switch from on mode of transport to another.

Response	Share
1 (Strongly disagree)	3.3%
2	7.6%
3	16.8%
4	23.9%
5	30.4%

At off-peak hours, what is the (in-vehicle) travel time in minutes required to perform your daily trip per transport mode?

	Do not know	0-15 minutes	16-30 minutes	31-45 minutes	46-60 minutes	More than 60 minutes
Car	55.4%	16.3%	19.6%	3.3%	3.3%	2.2%

Taxi/ride-hailing	83.7%	6.5%	7.1%	0.5%	0.5%	1.6%
Public transport	9.2%	20.1%	39.7%	20.1%	7.6%	3.3%
Motorcycle	79.9%	12.5%	5.4%	0.5%	1.1%	0.5%
Bicycle	39.7%	29.3%	19.6%	8.2%	2.7%	0.5%
E-bike/e-scooter	55.4%	19%	21.7%	1.6%	1.6%	0.5%

At peak hours, what is the (in-vehicle) travel time in minutes required to perform your daily trip per transport mode?

	Do not know	**0-15 minutes**	**16-30 minutes**	**31-45 minutes**	**46-60 minutes**	**More than 60 minutes**
Car	59.8%	6%	11.4%	11.4%	6%	5.4%
Taxi/ride-hailing	84.8%	2.7%	5.4%	2.7%	2.7%	1.6%
Public transport	11.4%	15.8%	30.4%	27.7%	10.9%	3.8%
Motorcycle	79.9%	10.3%	6%	2.2%	1.1%	0.5%
Bicycle	40.8%	26.6%	21.2%	7.6%	3.3%	0.5%
E-bike/e-scooter	56%	17.4%	20.7%	3.8%	1.6%	0.5%

On a scale of 1 to 6, how would you rate the risk of experiencing crime or harassment while traveling?

	1: not safe at all	**2**	**3**	**4**	**5**	**6: Very safe**
Car	6.5%	2.7%	4.9%	9.8%	31%	45.1%
Taxi/ride-hailing	10.3%	2.7%	10.3%	13.6%	31%	32.1%
Public transport	1.6%	2.7%	15.2%	20.7%	34.8%	25%
Motorcycle	22.3%	8.2%	15.2%	11.4%	20.1%	22.8%
Bicycle	11.4%	12.5%	14.7%	19.6%	23.4%	18.5%

E-bike/e-scooter	14.1%	11.4%	17.9%	16.8%	22.3%	17.4%

On a scale of 1 to 6, how would you rate the risk of experiencing a traffic accident while traveling?

	1: not safe at all	**2**	**3**	**4**	**5**	**6: Very safe**
Car	4.3%	7.6%	21.7%	22.3%	28.8%	15.2%
Taxi/ride-hailing	8.2%	3.3%	19%	20.1%	29.9%	19.6%
Public transport	1.6%	1.6%	5.4%	7.1%	32.1%	52.2%
Motorcycle	28.8%	21.2%	28.3%	10.9%	6.5%	4.3%
Bicycle	15.2%	27.7%	33.7%	14.7%	6%	2.7%
E-bike/e-scooter	20.1%	29.9%	28.3%	13.6%	5.4%	2.7%

Are the recent implemented transport policies/strategies in your city acceptable to you?

Response	**Share**
1 (Not acceptable at all)	3.8%
2	8.2%
3	20.7%
4	27.2%
5	26.6%

Do you know mobility hubs and if so, have you ever used them?

Response	Share
Yes	39%

Are the recent implemented transport policies/strategies in your city acceptable to you?

Response	Share
1 (Not understandable at all)	2.8%
2	6.9%
3	19.4%
4	20.8%
5	31.9%

From 1 to 6, indicate how useful you think these totems is?

Response	Share
1 (Totally useless)	2.8%
2	11.1%
3	11.1%
4	19.4%
5	27.8%

From 1 to 6, please indicate how please you think the design of these totems is?

Response	Share
1 (Totally unpleasant)	2.8%
2	12.5%
3	19.4%
4	25%
5	29.2%

Have you ever used car sharing services in your city?

Response	Share
Yes	73%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using carsharing in my day-to-day commuting is convenient.	23.7%	13.3%	17%	11.1%	9.6%	25.2%
I think using carsharing allows me to gain time in my day-to-day commuting.	28.9%	25.2%	14.8%	6.7%	8.1%	16.3%
I think it is easy to understand how to use carsharing.	0%	1.5%	8.9%	14.1%	31.1%	44.4%
It didn't take me long to learn how to use carsharing.	5.9%	3.7%	6.7%	7.4%	25.2%	51.1%
I can easily access to carsharing services.	0%	2%	5.2%	12.6%	25.9%	53.3%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using carsharing in my day-to-day commuting would be convenient.	38.8%	16.3%	12.2%	12.2%	12.2%	8.2%
I think using carsharing would allow me to gain time in my day-to-	40.8%	18.4%	22.4%	8.2%	4.1%	6.1%

day commuting.						
I think it would be easy to understand how to use carsharing.	14.3%	14.3%	12.2%	16.3%	28.6%	14.3%
I think it would not take me long to learn how to use carsharing.	12.2%	14.3%	8.2%	10.2%	32.7%	22.4%
I could easily access to carsharing services.	14.3%	18.4%	20.4%	14.3%	18.4%	14.3%

Have you ever used bike sharing services in your city?

Response	Share
Yes	42%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using bikesharing in my day-to-day commuting is convenient.	5.1%	15.4%	17.9%	9%	15.4%	37.2%
I think using bikesharing allows me to gain time in my day-to-day commuting.	6.4%	9%	16.7%	14.1%	15.4%	38.5%
I think it is easy to understand how to use bikesharing.	2.6%	0%	7.7%	10.3%	30.8%	48.7%
It didn't take me long to learn how to use bikesharing.	1.3%	3.8%	7.7%	6.4%	24.4%	56.4%

I can safely use bikesharing services.	1.3%	2.6%	12.8%	9%	34.6%	39.7%
I can easily access to bikesharing services.	5.1%	0%	5.1%	20.5%	33.3%	35.9%

Please indicate your level of agreement from 1 to 6 with the following statements.

	1: Strongly disagree	**2**	**3**	**4**	**5**	**6: Strongly agree**
I think using bikesharing in my day-to-day commuting would be convenient.	34%	15.1%	19.8%	12.3%	9.4%	9.4%
I think using bikesharing would allow me to gain time in my day-to-day commuting.	32.1%	13.2%	23.6%	10.4%	10.4%	10.4%
I think it would be easy to understand how to use bikesharing.	5.7%	5.7%	20.8%	24.5%	18.9%	24.5%
I think it would not take me long to learn how to use bikesharing.	6.6%	6.6%	17.9%	20.8%	18.9%	29.2%
I could safely use bikesharing services.	12.3%	10.4%	22.6%	16%	14.2%	24.5%
I could easily access to bikesharing services.	6.6%	8.5%	16%	19.8%	19.8%	29.2%

Present travel behaviour

In the next section of the questionnaire, you are asked to describe the trips you made just yesterday.

The maximum number of trips you can describe is 5. **Please describe at least two trips.**

In all cases, you will not be asked to provide the exact location of the starting and ending points and the exact time of each movement.

Please consider that you start from your home location.

1.	Firstly, how many vehicles do you have in your household? Mark one box per row. Trip *1, 2, 3, 4, OR 5*
2.	Indicate the origin of your first trip (where did you start traveling?)
	• Zone 1 • Zone 2 • Zone 3 • + AT LEAST ONE EXTRA ZONE
3.	Indicate the destination of your trip (where did you go?)
	• Zone 1 • Zone 2 • Zone 3 • + AT LEAST ONE EXTRA ZONE
4.	Which transport mode did you choose to reach your destination? Please select the main transport mode of your trip.
	• Private car • Taxi • Metro, tram, suburban railway, etc. • Bus • Walking • Private bicycle (or e-bike) • Private motorcycle • Private e-scooter (or other micro-vehicle) • Ride-hailing or shuttle service • Shared car

	• Shared motorcycle • Shared bicycle (or e-bike) • Shared e-scooter (or other micro-vehicle) • Water taxi • Boat
5.	Note the purpose of your trip.
	• Work • Education • Recreation, sports, events, etc. • Shopping • Health reasons or provision of care • Administration or personal services • Return to home • Other activities
6.	During which time period did this movement take place?
	• 05:00 - 08:00 • 08:00 - 11:00 • 11:00 - 14:00 • 14:00 – 17:00 • 17:00 – 20:00 • 20:00 – 23:00 • 23:00 – 05:00 (next day)
7.	Did you take another trip within the same day? **Please fill in at least 2 trips**. You log a maximum of 5 trips.

Sociodemographic data

1.	**What is your age?**
	Fill in integer

2.	What is your gender?
	• Female • Male • Non-binary • Prefer not to say
3.	What is your education level?
	• Primary school • Secondary or High school • Bachelor • Master or PhD • No education • Prefer not to say
4.	What is your current status of employment?
	• Student • Employed • Unemployed • Self employed • Retired
5.	How would you evaluate your monthly (individual) income level compared to the national average? Rate from 1 to 6. *PLEASE ADD REFERENCE NATIONAL AVERAGE INCOME IF DEEMED NECESSARY*
	1. Significantly below the average 2. 3. 4. 5. 6. Significantly above the average
6.	Do you have any physical disabilities or conditions that affect your ability to move?

NSM Integrate:

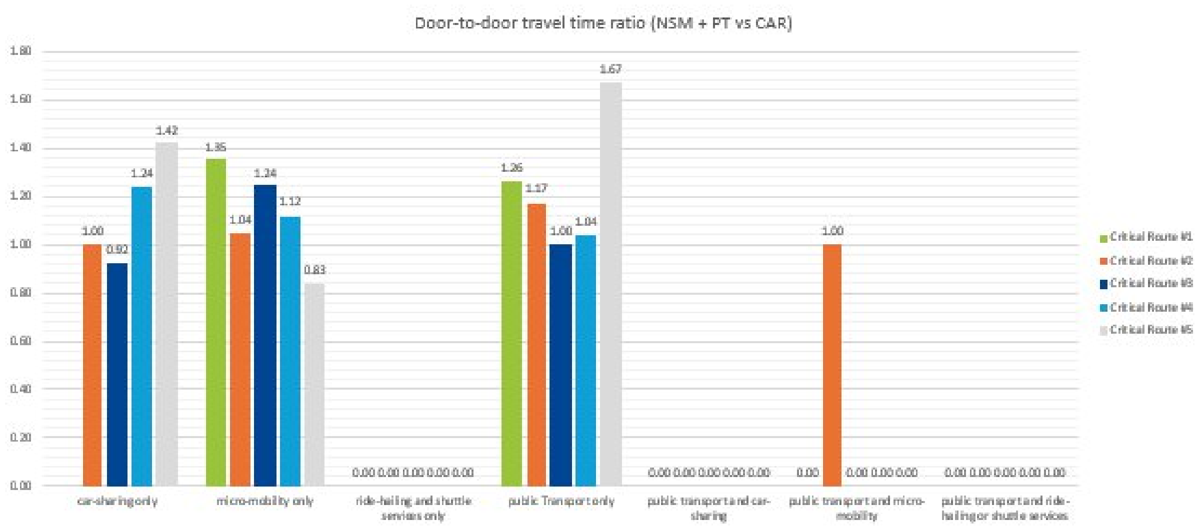
LL NAME:		
GENEVA		
YEAR		
2025		
List of NSMs integrated in the system		
Shared mobility service	**Service description**	**Level of integration**
Mobility	*Car sharing*	*Physical integration at the first Mobilty hub*
Donkey Republic	*bike sharing*	*Physical integration at the first Mobilty hub* *Ticketing integration via pt+NSM bundles for private companies ;* *Seasonal ticket integration via pt+NSM bundles for general public*
Carvélo	*Cargobike sharing*	*Physical integration at the first Mobilty hub*
HéLéman	Car pooling	*Physical integration at Mobilty hubs in industrial zones*
Ovo	Bike station	*Physical integration at Mobilty hubs in industrial zones*
WeCHIP	Connected lockers	*Physical integration at Mobilty hubs in industrial zones and at the first Mobility Hub.*

Intend:

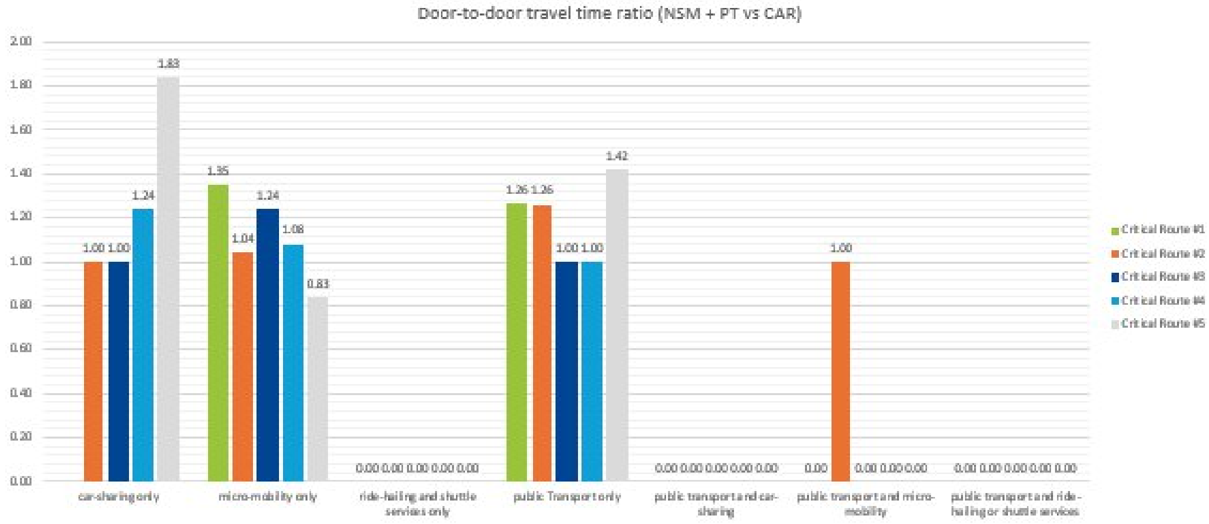
LL NAME:			
GENEVA			
YEAR			
2026			
	car-sharing	micro-mobility	ride-hailing and shuttle services
Number of respondents in the survey (total)	184		
Number of respondents who rated acceptance higher than 3	*139*	*74*	*No data*
Intention level	**75.54%**	**40.22%**	**0.00%**

Actual DDT:

Off peak



Peak time



Multimodal:

Mobility Hub 1	Mobility Hub 2	Mobility Hub 3	Mobility Hub 4	Mobility Hub 5	Mobility Hub 6	Mobility Hub 7	Mobility Hub 8
Lancy-Bachet, 1212 Lancy, Genève, Suisse	*Lancy-Pont-Rouge, Lancy, Genève, Suisse*	*P+R, Bernex, Suisse*	*Gardiol, Grand-Saconnex, Suisse*	*HEAD, Genève, Suisse*	*HEPIA, Genève, Suisse*	*HES-SO, Carouge, Suisse*	*Place du 1er août, Lancy, Suisse*
https://maps.app.goo.gl	https://maps.app.goo.gl/Nmj9oDMMJPQ6uZb86						
tpg bus and tram lines CFF trains Bike sharing Cargobike sharing Carsharing P+R Bikeparking	*tpg bus and tram lines CFF trains Bike sharing Carsharing P+R Bikeparking*	*tpg bus and tram lines Bike sharing Carsharing P+R Bikeparking*	*tpg bus and tram lines Bike sharing Carsharing*	*tpg bus and tram lines Bike sharing Bikeparking*	*tpg bus and tram lines Bike sharing Bikeparking*	*tpg bus and tram lines Bike sharing Carsharing Bikeparking*	*tpg bus and tram lines Bike sharing Carsharing*
7	*6*	*5*	*3*	*3*	*3*	*4*	*3*
77.78%	66.67%	55.56%	33.33%	33.33%	33.33%	44.44%	33.33%

Mobility Hub 9	Mobility Hub 10	Mobility Hub 11	Mobility Hub 12	Mobility Hub 13	Mobility Hub 14	Mobility Hub 15
Pontets, Lancy, Suisse	*Aéroport, Meyrin, Suisse*	*Cité Unversitaire, Genève, Suisse*	*Gare, Chêne-Bourg, Suisse*	*ArchParc, France*	*Gare Zimeysa, Meyrrin, Suisse*	*Palettes, Lancy, Suisse*
tpg bus and tram lines Bike sharing Carsharing	*tpg bus and tram lines CFF lines Bike sharing Carsharing*	*tpg bus and tram lines Bike sharing Carsharing*	*tpg bus and tram lines CFF trains Bike sharing Carsharing Bikeparking*	*tpg bus lines Bike sharing Carspooling Carsharing*	*tpg bus lines CFF trains Bike sharing Carpooling*	*tpg bus and tram lines Bike sharing*
3	*4*	*3*	*5*	*4*	*4*	*2*
33.33%	44.44%	33.33%	55.56%	44.44%	44.44%	22.22%

Mobility Hub 16	Mobility Hub 17	Mobility Hub 18	Mobility Hub 19	Mobility Hub 20	Mobility Hub 21
Parc Montessuit, Annemasse, France	*Planzer, Satigny, Suisse*	*The HIVE, Meyrin, Suisse*	*Uni-mail, Genève, Suisse*	*ZIPLO, Plan-les-Ouates, Suisse*	*Lancy-Pont-Rouge, gare, Lancy, Suisse*
tpg tram lines TAC bus lines Bike sharing Carsharing	*tpg bus lines CFF trains Bike sharing Carsharing Bikeparking*	*tpg bus lines Bike sharing Carspooling Bikeparking*	*tpg bus and tram lines Bike sharing Carsharing Bikeparking*	*tpg bus and tram lines Bike sharing Cargobike sharing Carsharing Carpooling Connected Lockers*	*tpg bus and tram lines CFF trains Bike sharing Carsharing P+R Bikeparking*
4	*5*	*4*	*4*	*6*	*6*
44.44%	55.56%	44.44%	44.44%	66.67%	66.67%

CostR:

Cout DR Distance moyenne	**private car**	public transport #1	car sharing #1	micro-mobility #1	micro-mobility #2	micro-mobility #3
Shared mobility service / Transport Operator		*tpg transports publics genevois*	*Mobility car sharing*	*Donkey Republic mecanic Bike sharing*	*Donkey Republic electric Bike sharing*	*Carvelo Carbike sharing*
average car-parking (1h of parking) or unlock cost in euros	*2.60 /*		*42.93 /*			*5.37 /*
average cost in euros per h (service cost)			*3.52 /*	*3.75 /*	*8.05 /*	*4.83 /*
average speed in km/h (if the service cost has time				*15.0*	*25.0*	
average cost in euros per km (fuel or service, etc.)	*0.30 /*		*0.77 /*	*0.25 /*	*0.32 /*	*0.00 /*
average trip distance in km (OFS, MRMT 2021)	20	6	20	1	1	1
public transport ticket in euros (one ride)		*3.20*				
Travel cost ratio		**1.24**	**6.78**	**0.58**	**0.75**	**12.49**

PercDDT:

	Interval #1	Interval #2	Interval #3	Interval #4	Interval #5
minimum time value (in minutes)	0	16	31	46	60
maximum time value (in minutes)	15	30	45	60	70
median time value (in minutes)	8	23	38	53	65
Question 2 - number of responces per time interval [off-peak]					
private car	30	36	6	6	4
taxi	12	13	1	1	3
public transport	37	73	37	14	6
bicycle	66	60	18	7	1
Question 3 - number of responces per time interval [peak]					
private car	11	21	21	11	10
taxi	5	10	5	5	3
public transport	29	56	51	20	7
bicycle	59	64	19	8	1

Satisfaction:

Number of respondents in the survey	184
Number of respondents who rated satisfaction higher than 3	143
Acceptance rate	77.72%

Modal Split

SUM Transport modes	Trips	Share (%)	Pax * km	Share (%)	Avg. occupancy	Veh * km	Share (%)
car	23	6.183%	261	16.096%	1.25	208.840	21.917%
taxi	0	0.000%	0	0.000%	1.25	0.000	0.000%
train (metro, suburban railway, tram, etc.)	118	31.720%	480	29.613%	6.58	73.036	7.665%
bus (or trolley bus)	47	12.634%	191	11.795%	6.58	29.090	3.053%
motorcycle	16	4.301%	182	11.197%	1.00	181.600	19.058%
bicycle (or e-bike)	97	26.075%	247	15.252%	1.00	247.350	25.958%
e-scooter	3	0.806%	8	0.472%	1.00	7.650	0.803%
walk	53	14.247%	135	8.333%	1.00	135.150	14.183%
car sharing	8	2.151%	91	5.599%	2.00	45.400	4.765%
micro-mobility	6	1.613%	15	0.943%	1.00	15.300	1.606%
ride hailing	1	0.269%	11	0.700%	1.20	9.458	0.993%
ferry (or water taxi)	0	0.000%	0	0.000%	2.20	0.000	0.000%

4.1.3 Jerusalem

4.1.3.1 Detailed KPI tables

Survey questionnaires

4.1.3.1.1 WP1 Survey Questionnaire – December 2024

Section 1. Background Information

1. Neighbourhood

☐ Kiryat HaYovel
☐ Kiryat Menachem
☐ Ir Ganim
☐ Givat Massuah

2. Year of birth

____

3. Gender

☐ Male
☐ Female
☐ Don’t want to answer

4. Religiosity

☐ Secular
☐ Traditional
☐ Religious
☐ Ultra-orthodox

5. Do you have a private vehicle?

☐ Yes
☐ No

6. Which means of transportation do you use most often?

☐ Private vehicle
☐ Public transportation
☐ A combination of different means of transportation
☐ Walking
☐ Shared transport (bikes, shared vehicles, or carpooling)
☐ Motorcycle
☐ Bicycle or personal scooter

Section 2. Existing Public Transportation in Jerusalem

7. What is your level of satisfaction with the existing public transportation system in Jerusalem?

☐ Very dissatisfied
☐ Dissatisfied
☐ Quite dissatisfied
☐ Quite satisfied
☐ Satisfied
☐ Very satisfied

8. People around me think I should use the existing public transportation system.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

9. I am more likely to use the existing public transportation system if the people around me use it.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

10. When I use the existing public transportation system, it is easy for me to switch between different modes of transportation.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

Section 3. Jerufun Bike-Sharing Service

11. Have you used the "Jerufun" bike-sharing service before?

☐ Yes
☐ No
If you answered "Yes" to Question 11, please answer Questions 12–18.

12. Using bike-sharing for daily mobility is convenient for me.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

13. Using bike-sharing for daily mobility saves me time.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

14. It is easy for me to understand how to use the bike-sharing service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

15. It did not take me long to learn how to use the service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

16. Using the service is safe for me.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

17. It is easy for me to get to the bike-sharing service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

18. I intend to continue using the bike-sharing service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree
If you answered "No" to Question 11, please answer Questions 19–25.

19. Using bike-sharing for daily mobility would be convenient for me.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

20. Using bike-sharing for daily mobility would save me time.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

21. It would be easy for me to understand how to use the bike-sharing service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

22. It would not take me long to learn how to use the service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

23. Using the service would be safe for me.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

24. It would be easy for me to get to the bike-sharing service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

25. I intend to start using the bike-sharing service.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

Section 4. Future Use of the Light Rail (LRT)

26. When the six new LRT stations start operating in the area, will you use the light rail service?

☐ Yes
☐ No

27. Using the light rail for daily mobility will be convenient.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

28. Using the light rail for daily mobility will save me time.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

29. It will be easy for me to understand how to use the light rail.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

30. I estimate that using the light rail service will be safe.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

31. It will not take me long to learn how to use the light rail.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

32. It will be easy for me to access the light rail station.

☐ Strongly disagree
☐ Disagree
☐ Quite disagree
☐ Quite agree
☐ Agree
☐ Strongly agree

4.1.3.1.2 WP4 Survey Questionnaire – May 2025

1. Do you live in one of the following 4 neighborhoods?

Kiryat Yovel	Kiryat Menachem	Ir Ganim	Givat Masua	In none of them

Demographic characteristics + Vehicles

2. What is your age group?

13-19 / 20-34 / 35-49 / 50-64 / 65+

3. What is your gender?

Male	Female	Not interested to answer

4. How do you define yourself?

a. Secular
b. Traditional
c. Religious
d. Orthodox

5. Is there a vehicle available for you? (as a driver or passenger)?

a. Yes
b. No
c. Sometimes

6. What is your main mode of transportation?

a. Private car
b. Public transportation (bus/light rail)
c. Bicycle/personal scooter
d. Walking
e. Taxi
f. Motorcycle/moped
g. Other

7. How often do you use public transportation (bus/light rail)?

a. Daily
b. 2-3 times a week
c. At least once a week
d. Rarely
e. I don't use public transportation at all

8. What is the walking time from your home to the nearest light rail station?

a. Up to 5 minutes

b. Between 5-10 minutes
c. Over 10 minutes

9. A point of interest is defined as a place that we visit frequently, such as: work, school, health care, errands, shopping, entertainment place, etc. What are the most important points for you to reach in the area? Choose up to 3 points that are not light rail stations. For each point of interest, you will be asked to answer two additional questions.

10. What is the purpose of the activity at your chosen point of interest?

a. Work
b. Study
c. Leisure
d. Escort/Child transportation
e. Errands/Shopping
f. Other_______

11. What means of transportation do you currently use to get to your chosen point of interest

a. Private car
b. Public transportation (bus/light rail)
c. Bicycle or personal scooter
d. Walking
e. Taxi
f. Motorcycle/moped
g. Other

12. Is there another point of interest? [Questions 9-11 repeat up to 3 times according to the response]

a. Yes
b. No

We are exploring the possibility of operating a shared transportation service in the four neighborhoods that will include the ability to order rides in the area via an app. Pickup will be from the bus stop nearest you or from "points of interest" (such as light rail stations, schools, shopping centres, etc.) to each bus stop. The service will calculate the best route based on similar requests and notify you when the vehicle is on its way to pick you up.

13. How likely is it that you will use this service on a scale of 1-6, with 6 representing "very likely"?

1 | 2 | 3 | 4 | 5 | 6

Imagine that a shared transportation service operates in your area, as we described, and the travel time is shorter than public transportation.

14. In this imaginary situation – what gift would you prefer to receive?

a. 150 NIS per store/gas station in the area.
b. 10 free trips on the new service.

<u>If option a is chosen</u>

15. and what if offered you 100 NIS?

a. 100 NIS per store/gas station in the area.
b. 10 free trips on the new service.

<u>If option a is chosen</u>

16. and what if offered you 75 NIS?

a. 75 NIS per store/gas station in the area.
b. 10 free rides on the new service.

<u>If option a is chosen</u>

17. and what if offered you 50 NIS?

a. 50 NIS per store/gas station in the area.
b. 10 free rides on the new service.

Is there any additional information you would like us know? (open question)

4.1.3.1.3 WP5 Survey Questionnaire – Jan 2026

e. Sociodemographic data

1.	**What is your age?**
	• <16 • 17-24 • 25-39 • 40-65 • >65
2.	What is your gender?
	• Female • Male • Prefer not to say
3.	What is your education level?
	• Primary school • Secondary or High school • Bachelor • Master or PhD • No education • Prefer not to say

4.	What is your current status of employment?
	• Student • Employed • Unemployed • Self employed • Retired
5.	How would you evaluate your monthly (individual) income level compared to the national average? Rate from 1 to 6. NATIONAL AVERAGE INCOME: APPROXIMATLY14,000 NIS
	1. Significantly below the average 2. 3. 4. 5. 6. Significantly above the average
6.	Do you have any physical disabilities or conditions that affect your ability to move?
	• Yes • No • Prefer not to say

f. Transport system

Every day, you travel **within the municipality** for various daily activities. In this section, we'd like to gather your feedback about the transport system of your city. Specifically, how satisfied are you with the current transport system available to you? Please provide some interesting details to help us understand!

1.	**What is approximately the percentage of your monthly budget you spend on your daily trips?**
	• 0-10% • 10-20% • 20-30% • 30-40% • 40-50% • More than 50%
2.	Please indicate from 1 (not at all satisfied) to 6 (completely satisfied) your level of satisfaction with the existing transport system in Jerusalem.
	1. Not at all satisfied 2. 3. 4. 5. 6. Completely satisfied
3.	The people around me think that I should use the existing transport system. Please indicate your level of agreement from 1 to 6.

1. Strongly disagree
2.
3.
4.
5.
6. Strongly agree

4. I am more likely to use the existing transport system if the people around me used it.
Please indicate your level of agreement from 1 to 6.

1. Strongly disagree
2.
3.
4.
5.
6. Strongly agree

5. When using the existing transport system, I can easily switch from on mode of transport to another.
Please indicate your level of agreement from 1 to 6.

1. Strongly disagree
2.
3.
4.
5.
6. Strongly agree

6. At off-peak hours, what is the **(in-vehicle) travel time** in minutes required to perform your daily trip per transport mode? Please provide an approximation.
Mark one box per row.

	Do not know	1-10 Minutes	11-20 Minutes	21-30 Minutes	31-40 Minutes	…	>90
Car							
Taxi/ride-hailing							
Public transport							
Motorcycle							
Bicycle							
E-bike/e-scooter							
Walking							

7. At peak hours, what is the **(in-vehicle) travel time** in minutes required to perform your daily trip per transport mode? Please provide an approximation.
Mark one box per row.

	Do not know	1-10 Minutes	11-20 Minutes	21-30 Minutes	31-40 Minutes	…	>90
Car							
Taxi/ride-hailing							
Public transport							
Motorcycle							
Bicycle							
E-bike/e-scooter							
Walking							

8. On a scale of 1 to 6, how would you rate the risk of experiencing crime or harassment while traveling? Please **assess** the **perceived personal safety** you feel per transport mode.

	1: not safe at all	2	3	4	5	6: Very safe
Car						
Taxi/ride-hailing						
Public transport						
Motorcycle						
Bicycle						
E-bike/e-scooter						
Walking						

9. On a scale of 1 to 6, how would you rate the risk of experiencing a traffic accident while traveling? Please **assess** the **perceived road safety** you feel per transport mode.

	1: not safe at all	2	3	4	5	6: Very safe
Car						
Taxi/ride-hailing						
Public transport						
Motorcycl						

e						
Bicycle						
E-bike/e-scooter						
Walking						

10. Are the recently implemented transport upgrades in this area (6 new LRT red line stations + Jerufun bike sharing stations) **acceptable** to you?
Please rate from 1 to 6.

1. Not acceptable at all
2.
3.
4.
5.
6. Fully acceptable

g. LL specific questions

h. Bike sharing

The shared bicycle service in the city, "Jerufan" includes about a hundred stations and 700 bicycles (450 of them - electric) throughout the city. The service is station dependent. Users can either take out a one-off rental (release fee and charged per minute) or take out a subscription for 1 day, 1 week, 3 months or 1 year.

1. Have you ever used bike sharing services in Jerusalem?

- Yes * GO TO NEXT QUESTION*
- No * SKIP NEXT QUESTION*

2. Please indicate your level of agreement from 1 to 6 with the following statements.
Mark one box per row.

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using bikesharing in my day-to-day commuting is convenient.						
I think using bikesharing allows me to gain time in my day-to-day commuting.						
I think it is easy to understand how to use bikesharing.						
It didn't take me long to learn how to use bikesharing.						
I can safely use bikesharing services.						
I can easily access to bikesharing services.						
I intend to continue using bikesharing service.						

SKIP NEXT QUESTION

3.	Please indicate your level of agreement from 1 to 6 with the following statements. *Mark one box per row.*

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using bikesharing in my day-to-day commuting would be convenient.						
I think using bikesharing would allow me to gain time in my day-to-day commuting.						
I think it would be easy to understand how to use bikesharing.						
I think it would not take me long to learn how to use bikesharing.						
I could safely use bikesharing services.						
I could easily access to bikesharing services.						
I intend to start using bikesharing services.						

i. Light train

The red line of the light rail began to operate in its full form: 12 stations were added, of which 6 are in our research area (Yuvalim-Ganim-Givat-Masua). The extended line reaches the "Hadasa Ein-Karem" hospital (in the south-west), and the city center, in the other direction. Trains run every 6 minutes at peak times, and at least every 15 minutes at off-peak times. Users are able to pay for one journey or get a subscription.

1. Are you using one of the new 6 LRT stations in "Yuvalim-Ganim" area (between "Ora junction" to "Shmariahu Levin"?

- Yes
- No

2. Please indicate your level of agreement from 1 to 6 with the following statements.
Mark one box per row.

	1: Strongly disagree	2	3	4	5	6: Strongly agree
I think using light rail in my day-to-day commuting is convenient.						
I think using light rail allows me to gain time in my day-to-day commuting.						
I think it is easy to understand how to use light rail.						
I think it does not take me long to learn how to use light rail.						
I can easily access a light rail station.						

j. Present travel behaviour

In the next section of the questionnaire, you are asked to describe the trips you made just yesterday (or in the last weekday).
The maximum number of trips you can describe is 5. **Please describe at least two trips.**
In all cases, you will not be asked to provide the exact location of the starting and ending points and the exact time of each movement.
Please consider that you start from your home location.

1. Firstly, how many vehicles do you have in your household?

Mark one box per row.

	0	1	2	3 or more
Conventional car				
Electric car				
Truck, bus, or van				
Motorcycle				
Bicycle or e-bike				
E-scooter				

k. Trip *1, 2, 3, 4, OR 5*

2. Indicate the origin of your first trip (where did you start traveling?)

- *ADD LL ZONES - 1*
- *ADD LL ZONES - 2*
- *ADD LL ZONES - 3*
- *+ AT LEAST ONE EXTRA ZONE*

3. Indicate the destination of your trip (where did you go?)

- *ADD LL ZONES - 1*
- *ADD LL ZONES - 2*
- *ADD LL ZONES - 3*
- *+ AT LEAST ONE EXTRA ZONE*

4. Which transport mode did you choose to reach your destination? Please select the main transport mode of your trip.

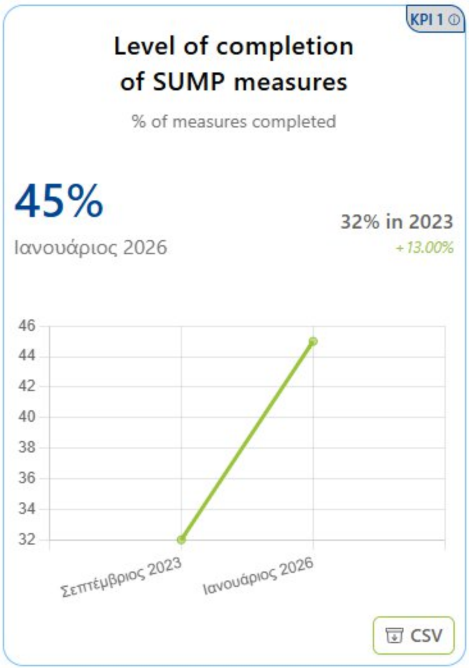
- Private car
- Taxi

	• tram, suburban railway, etc. • Bus • Walking • Private bicycle (or e-bike) • Private motorcycle • Private e-scooter (or other micro-vehicle) • Ride-hailing or shuttle service • Shared car • Shared bicycle (or e-bike)
5.	Note the purpose of your trip.
	• Work • Education • Recreation, sports, events, etc. • Shopping • Health reasons or provision of care • Administration or personal services • Return to home • Other activities
6.	During which time period did this movement take place?
	• 05:00 - 08:00 • 08:00 - 11:00 • 11:00 - 14:00 • 14:00 – 17:00 • 17:00 – 20:00 • 20:00 – 23:00 • 23:00 – 05:00 (next day)
7.	Did you take another trip within the same day? **Please fill in at least 2 trips**. You log a maximum of 5 trips.
	• Yes *START AGAIN FROM QUESTION 2 OF THIS PART FOR THE NEXT TRIP, MAXIMUM OF 5 TRIPS CAN BE LOGGED* • No *END SURVEY*

4.1.4 Athens – Penteli

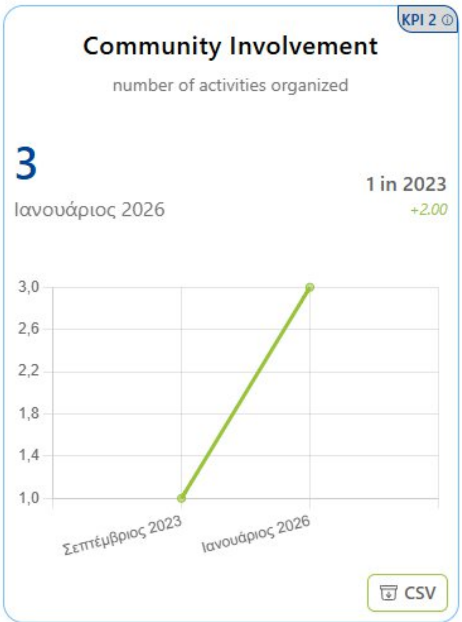
4.1.4.1 Detailed KPI Tables

KPI1: Level of completion of SUMP measures



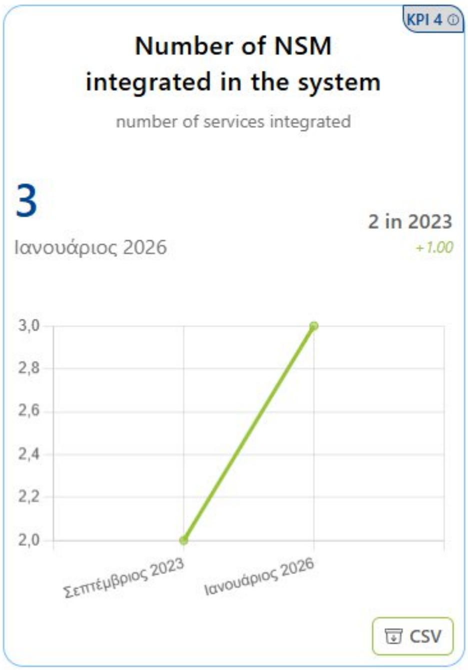
Value	Date
0.32	01-09-23
0.45	01-01-26

KPI2: Community involvement



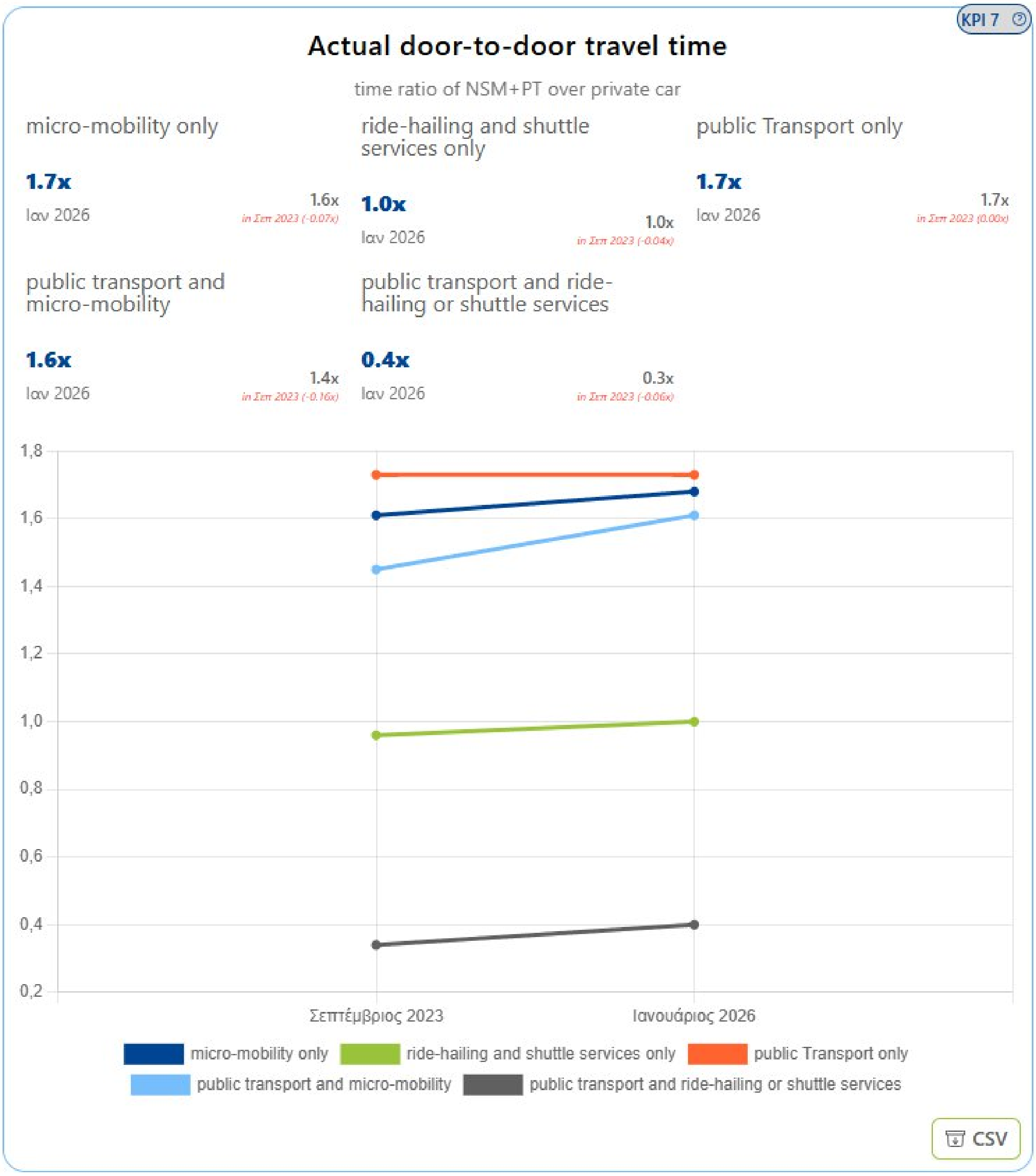
Value	Date
1	01-09-23
3	01-01-26

KPI4: Number of NSM integrated in the system



Value	Date
2	01-09-23
3	01-01-26

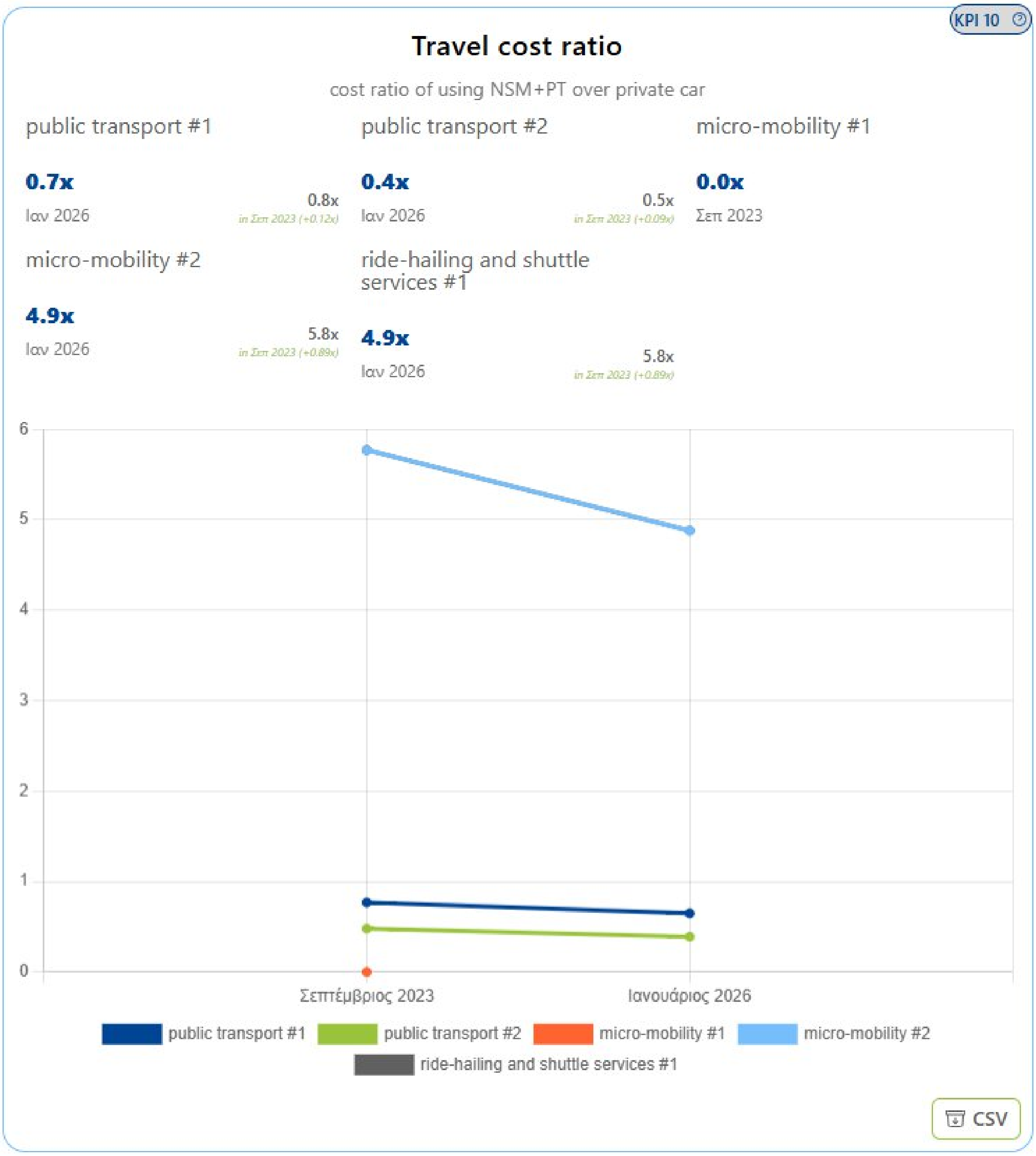
KPI7: Actual door-to-door travel time



KPI Number	KPI Name	KPI Group	Metric	Value	Date
7.2	micro-mobility only	Transport System - Time	ratio	1.61	01-09-23
7.3	ride-hailing and shuttle services	Transport System -	ratio	0.96	01-09-23

	only	Time			
7.4	public Transport only	Transport System - Time	ratio	1.73	01-09-23
7.6	public transport and micro-mobility	Transport System - Time	ratio	1.45	01-09-23
7.7	public transport and ride-hailing or shuttle services	Transport System - Time	ratio	0.34	01-09-23
7.2	micro-mobility only	Transport System - Time	ratio	1.68	05-01-26
7.3	ride-hailing and shuttle services only	Transport System - Time	ratio	1	05-01-26
7.4	public Transport only	Transport System - Time	ratio	1.73	05-01-26
7.6	public transport and micro-mobility	Transport System - Time	ratio	1.61	05-01-26
7.7	public transport and ride-hailing or shuttle services	Transport System - Time	ratio	0.4	05-01-26

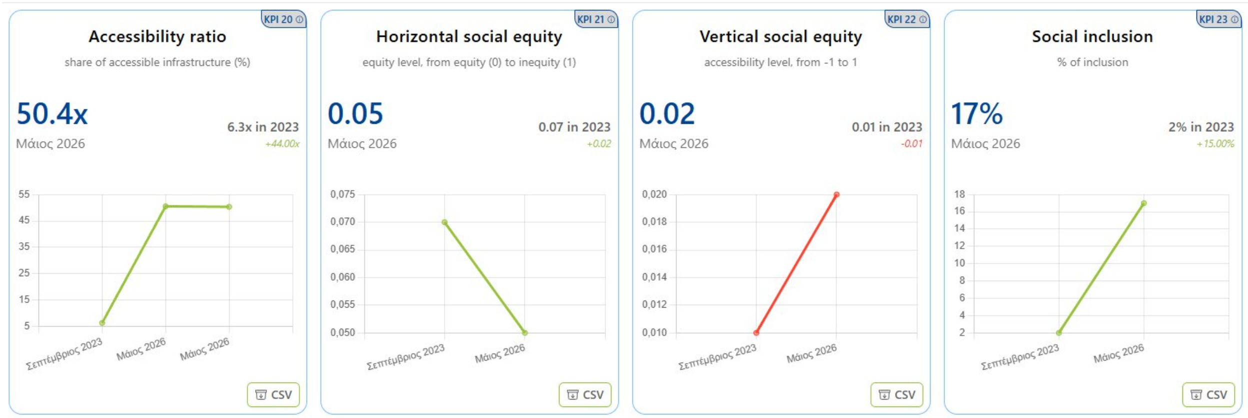
KPI10: Travel cost ratio



KPI Number	KPI Name	KPI Group	Metric	Value	Date
10.1.1	public transport #1	Transport System - Cost	ratio	0.77	01-09-23
10.1.2	public transport #2	Transport System -	ratio	0.48	01-09-23

		Cost			
10.3.1	micro-mobility #1	Transport System - Cost	ratio	0	01-09-23
10.3.2	micro-mobility #2	Transport System - Cost	ratio	5.77	01-09-23
10.4.1	ride-hailing and shuttle services #1	Transport System - Cost	ratio	5.77	01-09-23
10.1.1	public transport #1	Transport System - Cost	ratio	0.65	05-01-26
10.1.2	public transport #2	Transport System - Cost	ratio	0.39	05-01-26
10.3.2	micro-mobility #2	Transport System - Cost	ratio	4.88	05-01-26
10.4.1	ride-hailing and shuttle services #1	Transport System - Cost	ratio	4.88	05-01-26

KPI20: Accessibility ratio, KPI21: Horizontal social equity, KPI22: Vertical social equity and KPI23: Social inclusion



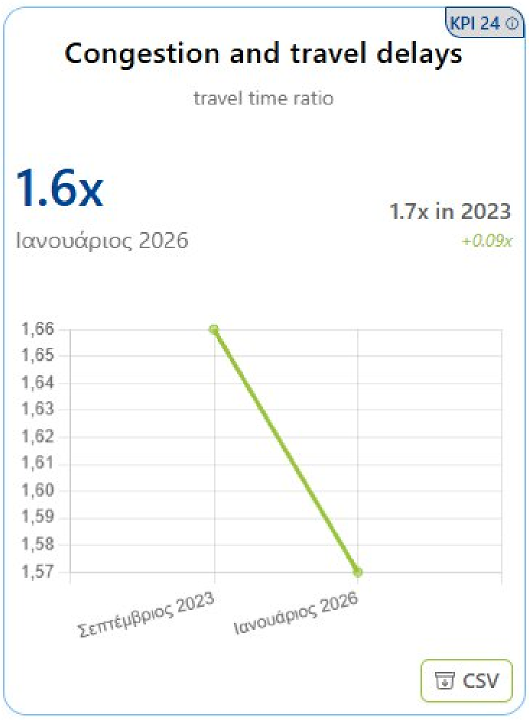
KPI Number	KPI Name	KPI Group	Metric	Value	Date
20	Accessibility ratio	Impact - Society	ratio	6.35	01-09-23
20	Accessibility ratio	Impact - Society	ratio	50.35	31-05-26
20	Accessibility ratio	Impact - Society	ratio	50.53	08-05-26

KPI Number	KPI Name	KPI Group	Metric	Value	Date
21	Horizontal social equity	Impact - Society	custom_unit	0.07	01-09-23
21	Horizontal social equity	Impact - Society	custom_unit	0.05	31-05-26

KPI Number	KPI Name	KPI Group	Metric	Value	Date
22	Vertical social equity	Impact - Society	custom_unit	0.01	01-09-23
22	Vertical social equity	Impact - Society	custom_unit	0.02	31-05-26

KPI Number	KPI Name	KPI Group	Metric	Value	Date
23	Social inclusion	Impact - Society	percentage	0.02	01-09-23
23	Social inclusion	Impact - Society	percentage	0.17	31-05-26

KPI24: Congestion and travel delays



KPI Number	KPI Name	KPI Group	Metric	Value	Date
24	Congestion and travel delays	Impact - Economy	ratio	1.66	01-09-23
24	Congestion and travel delays	Impact - Economy	ratio	1.57	05-01-26

4.1.4.2 Survey questionnaires

4.1.4.2.1 Customer Survey

The survey consisted of four main sections:

Section 1: General questions

Q1: How satisfied are you with the current transport system in Penteli?

A1: Very, Moderately, Neutral, Slightly, Not at all

Q2: Do you know the characteristics of these five main measures and interventions that are being implemented or will be implemented by Penteli LL during SUM?

A2: First column: a) e-bikes, b) e-buses, c) Street space allocation, d) MaaS platform, e) Mobility hubs and second column: a) Fully, b) Moderately, c) Not at all

Section 2: Questions for the Analytical Hierarchy Process (AHP)-first level of pairwise comparisons (prioritisation of key measures).

First some words for guidance are added. These could be useful to the participants.

Q3: Pairwise comparisons between measures and interventions

10 pairwise comparisons (2 to 9 to the left if the left choice is preferred, 2 to 9 to the right if the right choice is preferred and 1 for equal importance)

1) e-bikes vs e-buses, 2) e-bikes vs street space allocation, 3) e-bikes vs MaaS, 4) e-bikes vs Mobility hubs, 5) e-buses vs Street space allocation, 6) e-buses vs MaaS, 7) e-buses vs Mobility hubs, 8) street space allocation vs MaaS, 9) street-space allocation vs Mobility hubs and 10) MaaS vs Mobility hubs

Section 3: Questions for the Analytical Hierarchy Process (AHP)-second level of pairwise comparisons (prioritisation of factors influencing the use of each measure)

Similarly to the previous section, some words for guidance are added first.

Q4: Pairwise comparisons between the characteristics of e-bikes

3 pairwise comparisons (2 to 9 to the left if the left choice is preferred, 2 to 9 to the right if the right choice is preferred and 1 for equal importance)

1) Availability of bikes vs proximity of stations, 2) Availability of bikes vs connectivity with PT and 3) proximity of stations vs connectivity with PT

Q5: Pairwise comparisons between the characteristics of e-buses system

3 pairwise comparisons (2 to 9 to the left if the left choice is preferred, 2 to 9 to the right if the right choice is preferred and 1 for equal importance)

1) Frequency vs line planning (community coverage), 2) Frequency vs connectivity of local PT with metropolitan PT and 3) line planning (community coverage) vs connectivity of local PT with metropolitan PT

Q6: Pairwise comparisons between the characteristics of street space allocation

6 pairwise comparisons (2 to 9 to the left if the left choice is preferred, 2 to 9 to the right if the right choice is preferred and 1 for equal importance)

1) Pedestrian roads vs bike lanes, 2) Pedestrian roads vs shared space, 3) Pedestrian roads vs other measures for active modes (street equipment, greenery), 4) bike lanes vs shared space, 5) bike lanes vs other measures for active modes (street equipment, greenery) and 6) shared space vs other measures for active modes (street equipment, greenery)

Q7: Pairwise comparisons between the characteristics of MaaS platform

1 pairwise comparison (2 to 9 to the left if the left choice is preferred, 2 to 9 to the right if the right choice is preferred and 1 for equal importance)

1) Reliability of service vs ease of use

Q8: Pairwise comparisons between the characteristics of Mobility hubs

3 pairwise comparisons (2 to 9 to the left if the left choice is preferred, 2 to 9 to the right if the right choice is preferred and 1 for equal importance)

1) Connectivity of modes vs Maintain identity of space, 2) Connectivity of modes vs clear signage and 3) Maintain identity of space vs clear signage

Section 4: Questions about personal information

Q9: Occupation status (e.g. researcher, policymaker, organisation/association representative)

A9: Open answer

Q10: Gender

A10: Male, Female and Choose not to say

Q11: Resident of Penteli

A11: Yes or No

4.1.4.3 Maps, Photographs and Figures

4.1.4.3.1 Street space allocation

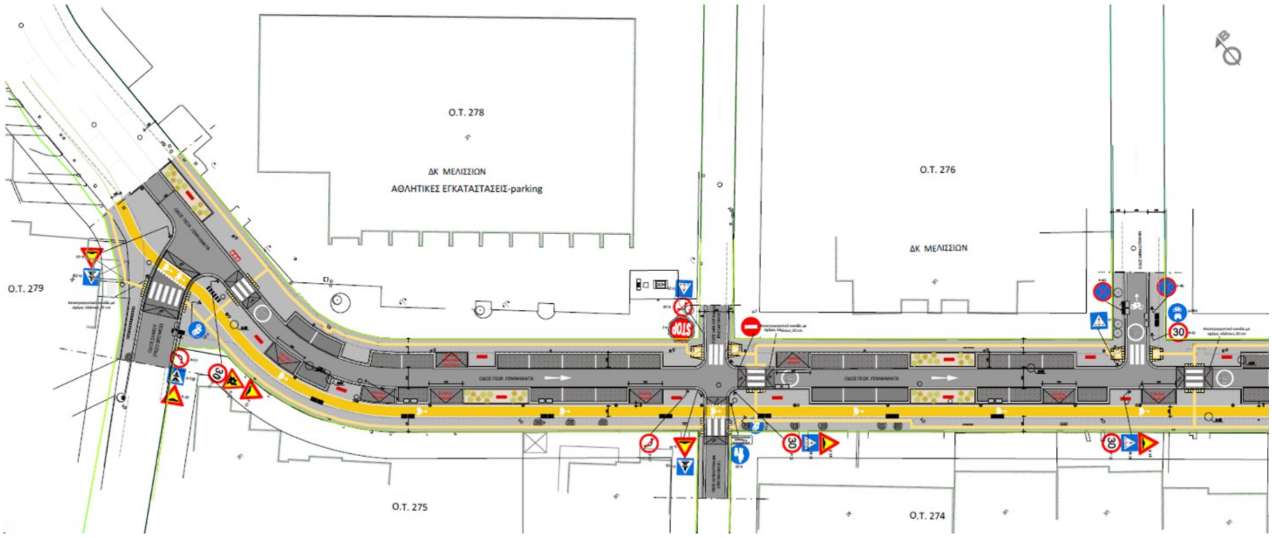


Figure 47: Penteli LL - Street space redistribution project, Gennimata street

Figure 48: Penteli LL - Gennimata street, a) before and b) after intervention

Figure 49: Penteli LL - Cycle streets

Figure 50: Penteli LL - E-bike sharing station

Figure 51: Penteli LL - E-bike sharing

Figure 52: Penteli LL - Usage intensity of e-bikes stations in 2024 a) start points

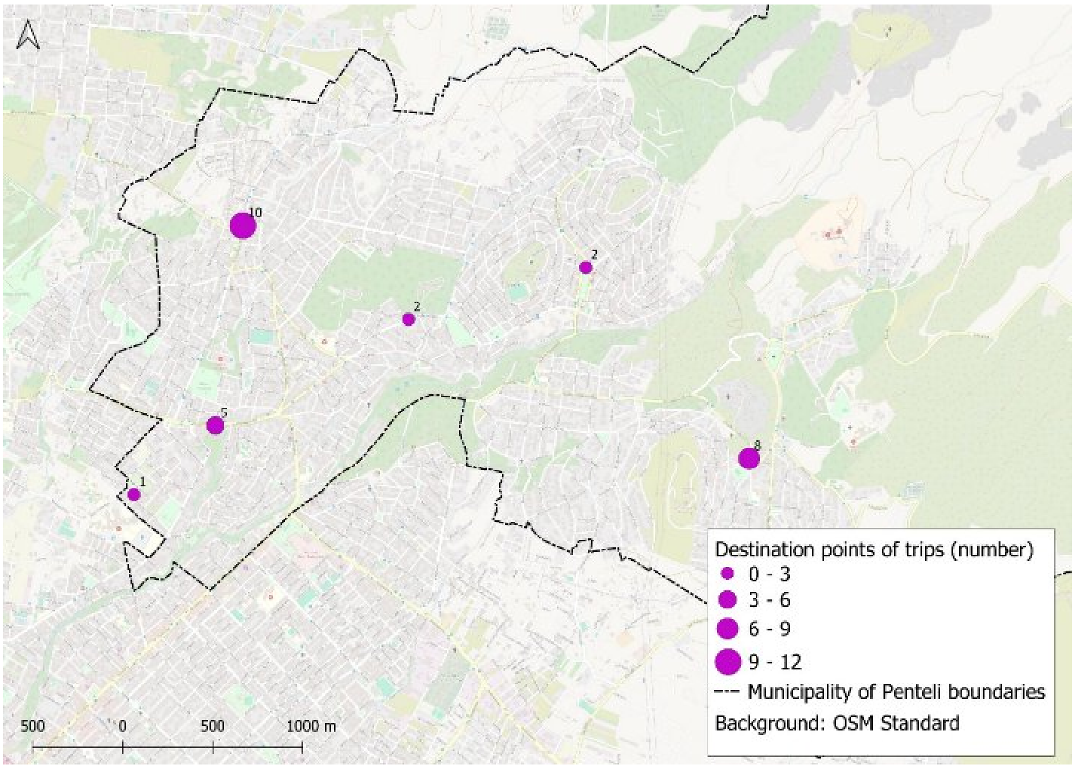


Figure 53: Penteli LL - Usage intensity of e-bikes stations in 2024 b) destination points

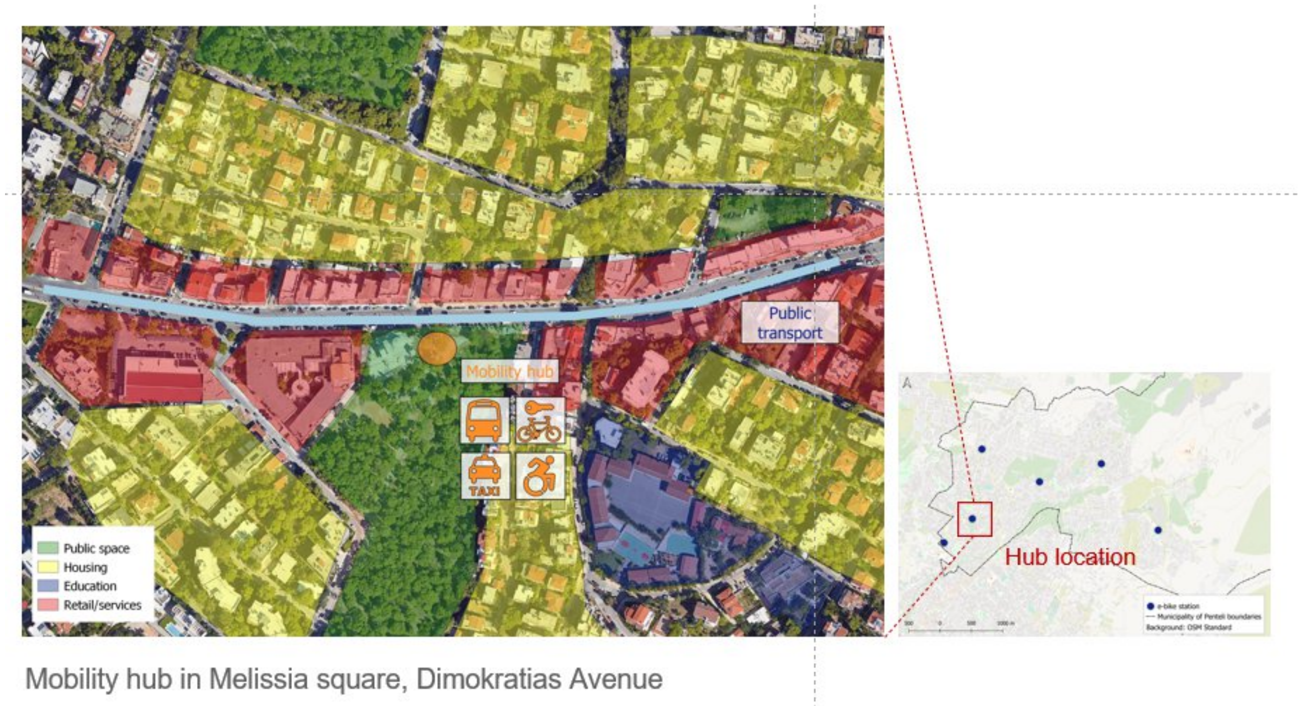


Figure 54: Penteli LL - Mobility hubs characteristics and location

Figure 55: Penteli LL - Mobility hub totem

Penteli Municipality shared bike system in the Freenow app

The shared electric bicycles of the Municipality of Penteli now also in the Freenow app

Freenow, in collaboration with the National Technical University of Athens and the Municipality of Penteli, and as part of its participation in the EU co-funded SUM project, is expanding its range of sustainable transport options in the app with the addition of the shared electric bicycles of the Municipality of Penteli.

Now Freenow users have easy access to 38 electric bicycles and 6 parking stations in the area of the Municipality of Penteli, in just a few clicks. This way getting around the city becomes even easier and more comfortable.

Learn more about Penteli eBikes

How to use the shared electric bicycles of the Municipality of Penteli

Download the E-bike Sharing app via the link below and select the Municipality of Penteli

E-bike Sharing app for Android | E-bike Sharing app for iOS

Wear a helmet and comfortable clothes.

If necessary, check the bike sharing stations on the following map.

See the bike sharing stations here

Enjoy the ride!

About SUM

The overall objective of the SUM project is to facilitate the transformation of mobility in 15 European cities by 2026 and in 30 European cities by 2030. This transformation involves the integration of new shared mobility modes with public transport, focusing on innovation, interconnectivity, environmental sustainability, safety, resilience and replicability. The aim is to ensure the affordability and reliability of these modes for end users, while maintaining financial sustainability that strengthens the competitiveness of European businesses.

Find out more about SUM

Figure 56: Penteli LL - MaaS application for PCs

Link: https://www.free-now.com/gr-en/ride/shared-mobility/penteli-ebikes/

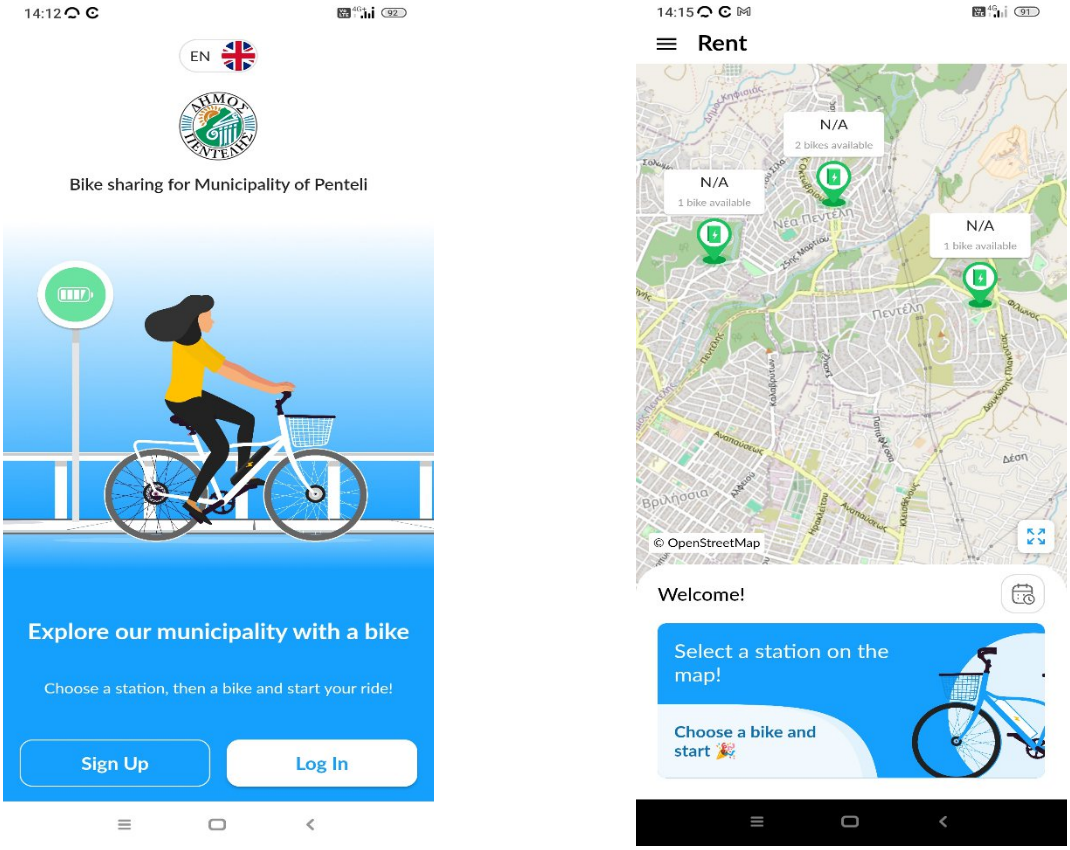


Figure 57: Penteli LL - Penteli's e-bike sharing application

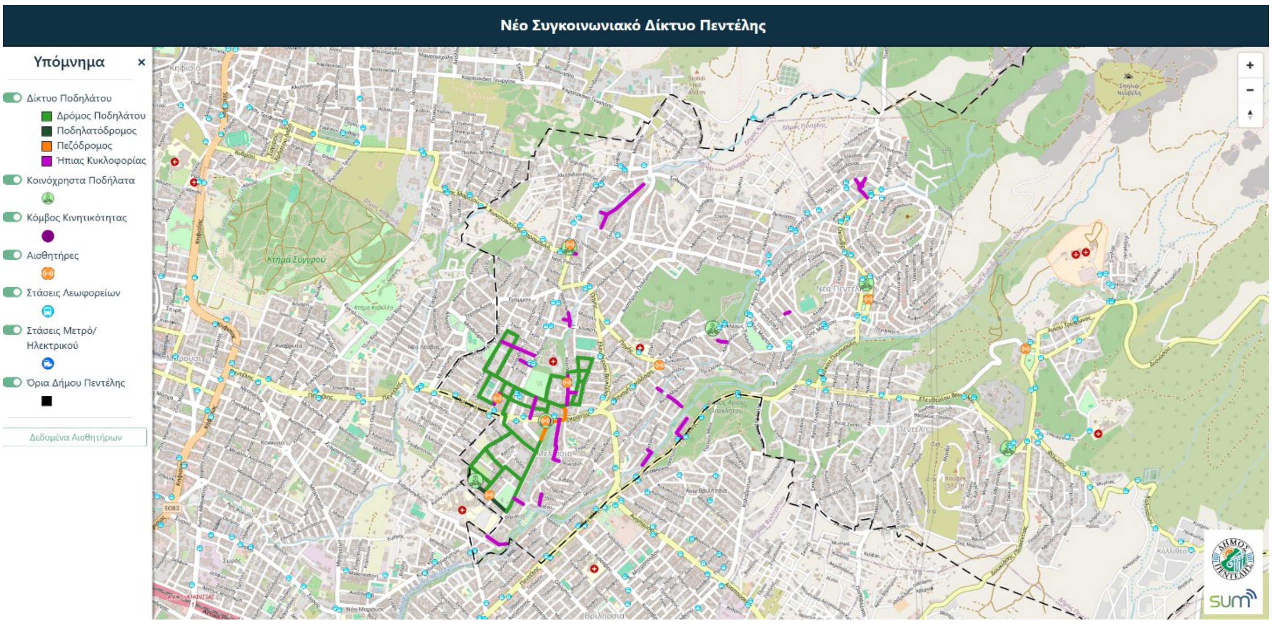


Figure 58: Penteli LL - Penteli's web map depicting the transport system

Link: https://lotentua.github.io/sum_Penteli_LL/

Figure 59: Penteli LL - Pre-intervention traffic measurements

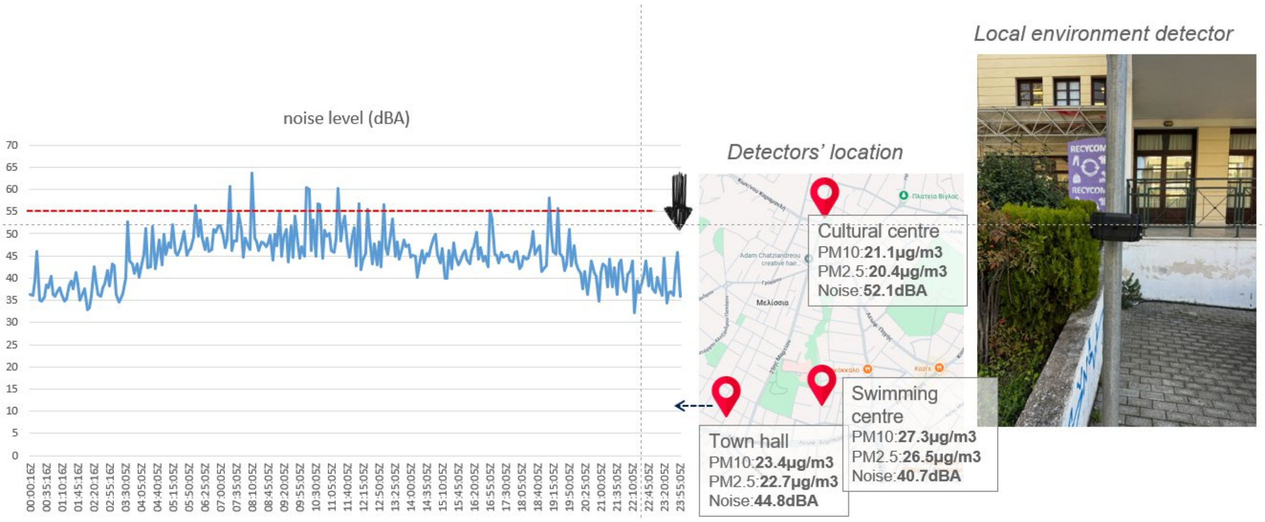


Figure 60: Penteli LL - Pre-intervention environmental measurements

Decision Hierarchy			
Level 0	Level 1	Level 2	Glb Prio.
SUM customer survey (upd)	e-bikes 0.128	available 0.233	3.0%
		prox-bikes 0.292	3.7%
		prox-pt 0.476	6.1%
	buses 0.286	freq 0.411	11.7%
		lines 0.323	9.2%
		conn-PT 0.266	7.6%
	streets 0.280	ped 0.342	9.6%
		cycl 0.187	5.2%
		shared 0.312	8.7%
		other 0.159	4.5%
	maas 0.128	reliable 0.498	6.4%
		easiness 0.502	6.4%
	hubs 0.178	conn 0.567	10.1%
		identity 0.181	3.2%
		signage 0.252	4.5%
			1.0

Figure 61: Penteli LL - Detailed results of the AHP method. Weighting of policy measures and factors

4.1.5 Investigation of Modal Shifts

4.1.5.1 Main datasets

The analysis presented in this report is based on two survey waves conducted within the framework of the SUM project: an ex-ante survey carried out prior to the implementation of the push/pull measures, and an ex-post survey conducted following their deployment. The implemented measures aimed to promote the integration of new and shared mobility services (NSMs) with public transport systems. Both survey waves employed the same questionnaire structure, which is presented in Annex A of Deliverable D1.1: Summary of Current Mobility Status. The present analysis specifically focuses on the travel diary component. The survey form was designed to record a maximum of five trips performed by each respondent during a single day (e.g., yesterday). The sequence of trips always begins from the respondent's home location. In the ex-post survey wave, an additional requirement was introduced, establishing a minimum threshold of two reported trips per respondent in order to improve the completeness of the collected travel diaries. For each reported trip, we captured a set of core mobility attributes, including origin zone, destination zone, transport mode, trip purpose, and time period. In addition, the analysis of modal shifts incorporates several socio-demographic characteristics of the respondents, namely gender, age group, employment status, education level, and income level compared to the national average.

The data collection process across nine different cities and eight different languages constituted a particularly challenging task from the beginning of the project. National Technical University of Athens (NTUA) and University of Twente (UT) were responsible for the development of the original survey questionnaire in English, as well as for the overall data analysis framework. However, each Living Lab (LL) was responsible for translating the questionnaire into the local language, integrating it into the preferred survey platform, and distributing it through effective communication channels. As a result, multiple survey platforms were utilized across the participating cities. Microsoft Forms™ was used in Athens-Penteli, Munich, Geneva, Coimbra, and Jerusalem. Qualtrics™ was employed in Rotterdam, while MOBYApp™ was used in Larnaca. ArcGIS Survey123™ supported the survey implementation in Kraków, and SurveyXact™ was selected by Fredrikstad.

Due to this decentralized implementation approach, the survey coordinators (NTUA and UT) did not maintain full control over the quality, representativeness, or consistency of the collected samples. Most cities relied primarily on snowball sampling techniques. Additional details regarding the data collection process in each city are provided in Table 3. **The end date is the last month which appears the data records in each city.** The ex-ante data collection period extended over more than two months in most cases and, in certain LLs, covered nearly an entire year. In contrast, the ex-post data collection process was considerably faster and was largely completed during the first three months of 2026. Nevertheless, some cities, such as Geneva and Coimbra, had not yet reached the threshold of 103 valid responses at the time of analysis (May 2026). In the case of Fredrikstad, the ex-post survey was not included in the present analysis. Although travel diary data had been collected only a few months prior to January 2026, access to the raw dataset was not available. Instead, only aggregated descriptive statistics, such as modal split diagrams, were provided. Consequently, these responses could not be incorporated into the harmonized analytical dataset. All these deviations indicate the practical challenges associated with collecting comparable revealed-preference mobility data across nine different cities in Europe. They also highlight the inherent complexity of examining and monitoring general modal shift phenomena in multiple Living Labs.

Table 3: Overview of raw datasets (status in May 2026)

LL	**Partners** *involved in data collection*	Language	Ex-ante		Ex-post	
			Start - end date	*N responses*	*Start - end date*	*N responses*
Munich	MUNICH	German	October 2023 - January 2024	202	January 2026 - February 2026	202
Geneva	TPG	French	October 2023 - December 2023	461	January 2026 - February 2026	184
Jerusalem	JERUSALEM, SIGMA6	English	December 2023	235	January 2026 - February 2026	257
Athens	PENTELI, FREENOW	Greek	June 2023 - July 2024	201	January 2026 - March 2026	202
Rotterdam	RET	Dutch	October 2023 - January	260	February 2026 - March	202

			2024		2026	
Krakow	KRAKOW	Polish	October 2023 - December 2023	308	February 2026 - March 2026	224
Fredrikstad	FREDRIKSTAD	Norwegian	October 2023 - December 2023	201	ex-post survey was not conducted	
Larnaca	MOBY	Greek	October 2023 - December 2023	203	January 2026 - March 2026	231
Coimbra	COIMBRA	Portuguese	October 2023 - September 2024	201	March 2026 - April 2026	103

Two main categories of processed datasets were developed for the purposes of the analysis: travel diary datasets and socio-demographic datasets. Table 4 provides an overview of all datasets used throughout the study. The first category contains trip-level observations, whereas the second category contains person-level socio-demographic information. The common linking variable between the two datasets is the person identifier (pid), combined with the city identifier (city). The travel diary datasets are divided into two principal versions corresponding to the ex-ante and ex-post survey waves. The first dataset versions (v1.0.1 for the ex-ante survey and v2.0.1 for the ex-post survey) include all trips for which the transport mode, trip purpose, and departure time were successfully reported.

A second dataset version was subsequently developed in order to incorporate trip-distance information (v1.0.2 for ex-ante and v2.0.2 for ex-post observations). Trip distances were estimated through the geocoding of the addresses or traffic analysis zones specified by respondents. In several cases, LLs additionally provided centroid coordinates for the reported zones, facilitating the estimation process. Observations lacking sufficient spatial specification could not be geocoded, resulting in missing origin or destination coordinates; these records were therefore excluded from the distance-based analysis datasets. The estimation of trip distance was based on Euclidean distance calculations between origin and destination coordinates, multiplied by a correction factor of 1.3 to approximate network distance. This harmonized approach was consistently applied across all cities and transport modes. Detailed network-based distance calculations were intentionally avoided, as their implementation would substantially increase the complexity of the overall analytical process. **For intra-zonal trips, a distance of 1 km was assumed in all LLs.**

The socio-demographic datasets include all respondents who provided complete information regarding gender, age group, education level, employment status, and income category. These variables form the basis for the socio-demographic segmentation and latent class analyses presented in the next section.

Table 4: Overview of processed datasets (status in May 2026)

Dataset	Version	Period	Attributes	N	Remarks

Travel Diaries	v1.0.1	ex-ante	transport mode, trip purpose, departure time, person id, city	3685 trips	All cities
Travel Diaries	v1.0.2	ex-post	transport mode, trip purpose, departure time, person id, city	3087 trips	All cities except Fredrikstad that did not conduct ex-post survey.
Travel Diaries	v2.0.1	ex-ante	transport mode, trip purpose, departure time, origin zone, destination zone, person id, city, trip distance	3685 trips	All cities: Intra-zonal trips were all equal to 1 km.
Travel Diaries	v2.0.2	ex-post	transport mode, trip purpose, departure time, origin zone, destination zone, person id, city, trip distance	2101 trips	Rotterdam and Larnaca are missing, because they did not provide specific origin-destination locations; Fredrikstad is missing, because they did not conduct ex-post survey; Intra-zonal trips were all equal to 1 km.
Socio-demographics	v1.0.1	ex-ante	person id, city, gender, age group, education level, employment status, income level	1553 persons	All sociodemographic characteristics of these persons are known; Geneva is missing, because income level was not collected.
Socio-demographics	v1.0.2	ex-ante	person id, city, gender, age group, education level, employment status, education level	1387 persons	All sociodemographic characteristics of these persons are known; Fredrikstad is missing, because they did not conduct ex-post survey.

The data processing, and visualization tasks were conducted using the Python programming language. The analytical workflow incorporated several specialized libraries, including pandas (v1.4.4) for data manipulation, Matplotlib (v3.5.2) for graphical visualization, and stats models (v0.3.12) for statistical modelling and inference. One exception to this was the estimation of the LCCA model that was done using R and poICA (v1.6.0.1) package. The processed datasets have been publicly uploaded to Zenodo Repository (https://doi.org/10.5281/zenodo.14887578) and are also available through the SUM Open-Data Platform (https://sum-odp.eu). This open-data approach enables researchers worldwide to further investigate the datasets and identify additional statistical patterns and mobility trends that may extend beyond the scope of the present analysis.

4.1.5.2 Analysis method

The present analysis constitutes a first exploratory assessment of modal shifts observed across the participating LLs. Consequently, the methodological approach relies primarily on advanced visualization techniques and descriptive statistical analysis rather than on predictive or causal modeling approaches. The main objective is to identify the most evident statistical trends emerging from the collected datasets while explicitly acknowledging the limitations associated with sample size, survey heterogeneity, and data collection procedures. The analysis examines modal split across several key dimensions, including the number of reported trips, trip distance, trip purpose, and the spatial context represented by each participating city. In addition, particular attention is given to the socio-demographic composition of the respondents through the latent class segmentation analysis. This perspective enables the investigation of how different socio-demographic classes of European travellers may respond differently to the implemented measures.

4.1.5.2.1 Latent Cluster Class Analysis

Latent Cluster Class Analysis (LCCA) is a person-centred modeling method that has been utilized in the past to probabilistically uncover homogenous groups of travellers (Muchlisin et al., 2024). LCCA follows a more stochastic approach, unlike traditional Cluster Analyses (such as K-means or spectral clustering), which determine clusters based on objective distance metrics (Andrinopoulou and Tzouras, 2025). In LCCA, each individual is assigned a conditional probability of belonging to one class instead of another class (Pantelaki et al., 2023). Thus, the analysis considers all the combinations of socio-demographic characteristics observed in all cities to reveal meaningful classes. Gender, educational level, employment, and income level are the input variables of this analysis.

This study follows a stepwise modelling strategy, first identifying and interpreting classes based on socio-demographic characteristics and then examining their role in modal shifts. This approach ensures that the socio-demographic classes remain meaningful while allowing us to assess the contribution of other dimensions to car usage. The general equation of the LCCA model is given in Equation 1.

$$P\left(y_{n(i)}\right) = \sum_{l=1}^{L} P_i\left(C_{n(i)} = l\right) \times \prod_{s=1}^{S} f\left(y_{n(i),s} \middle| l\right) \quad \mathbf{(1)}$$

<u>where:</u>

$P\left(y_{n(i)}\right)$*: the probability of observing a specific pattern* y_i *of socio-demographic attributes for a traveler n in city i,*

$P_i\left(C_{n(i)} = l\right)$*: the probability of a traveler n in city i of being in class l. The total number of groups is equal to C.*

$y_{n(i),s}$*: the response traveler n in city i to the socio-demographic variable s. The total number of socio-demographic variables is equal to S.*

$f\left(y_{n(i),s} \middle| l\right)$*: the probability distribution density of* $y_{n(i),s}$ *given class l.*

The estimation of the probability distribution of the observed variables within each latent class is achieved using the Maximum Likelihood Estimation (MLE) method. In this study, the optimal number of latent classes is determined using the Bayesian Information Criterion (BIC) and the Akaike Information Criterion (AIC), the adjusted BIC (aBIC), and the Consistent AIC (CAIC) to evaluate the relative fit of different class solutions. In addition, we examine the entropy of the solution. The selection of the optimal number of latent classes is based on the balance between model fit (lower values of AIC, BIC, aBIC, and CAIC) and high classification quality (entropy closer to 1).

4.1.5.2.2 Advanced data visualisation

The development of conventional modal split pie charts for each city constitutes an initial and intuitive approach for inspecting modal shift patterns across the LLs. To ensure consistency and comparability among the visualizations, a predefined and harmonized set of transport modes was adopted throughout the analysis. The considered transport modes include (car, taxi, train, bus, motorcycle, bicycle, e-scooter, walk, car sharing, micromobility, ride hailing, and ferry), each represented using a fixed and standardized colour scheme across all figures. In order to explore the data beyond aggregate city-level distributions, the analysis further investigates modal split as a function of selected explanatory dimensions (x-variables), including trip distance, trip purpose, and socio-demographic class. For this purpose, 100% stacked bar plots were developed, using the same modal colour palette applied in the pie-chart visualizations to preserve graphical consistency. To improve the interpretation of the observed modal distributions, an additional panel is included at the bottom of each figure. This panel presents the absolute number of trips associated with each x-variable category/level, disaggregated by city. Consequently, each figure simultaneously combines three analytical perspectives: the participating city, the transport mode, and the explanatory variable under investigation (e.g., trip distance, trip purpose, or socio-demographic class). At this point, it should be emphasized that **each visualization only includes cities with complete observations for the examined variable**. For example, in analyses involving trip distance, cities or observations lacking valid distance information in either the ex-ante or ex-post dataset are excluded. This filtering strategy was adopted to ensure direct comparisons of modal shifts while respecting the data limitations.

4.1.5.3 Statistical trends

4.1.5.3.1 Modal Split of Trips

The evaluation of modal split was conducted using datasets v1.0.1 and v1.0.2. Although these datasets did not include information on trip distance, they contained a larger number of reported trips and therefore provided a broader basis for the preliminary analysis. It should nevertheless be noted that the sample size within each city remains relatively limited (around 200 travellers), and therefore the results should not be interpreted as fully representative or conclusive. A substantial degree of variability can be observed across the cities in Figure 62 to Figure 69, which present the modal split pies based on the total number of reported trips. Overall, the analysis focuses on highlighting the principal trends observed in the data. At this point, it must be acknowledged that respondents reported only their main travel mode for each trip. As a result, the use of NSMs within individual trip legs was not systematically captured.

The Leading LLs present several notable differences between the ex-ante and ex-post survey waves. In Munich, the most visible changes include the disappearance of taxi trips in the ex-post dataset and the apparent increase in bicycle use from 7.7% to 20.0%. However, a closer inspection of the absolute values reveals that the total number of bicycle trips remained unchanged, with 82 trips reported in both datasets. **The proportion of car-sharing trips remained relatively stable across both survey waves in Munich**. In Geneva, the survey distribution was conducted by TPG among public transport passengers. Consequently, the share of private car trips cannot be considered representative and should not be further interpreted. Nevertheless, the share of trips performed exclusively with NSMs modes increased slightly from 4.38% to 4.80%. Another notable change concerns motorcycle use: while no motorcycle trips were reported in the ex-ante dataset, 16 motorcycle trips appeared in the ex-post survey. In Jerusalem, the reported use of private cars increased in the ex-post dataset, reaching 52.1%. The use of train services also increased considerably, from 14.8% to 19.0%. At the same time, no trips using NSMs as the main travel mode were reported in the ex-post survey wave. A similar tendency was observed in Athens, where car trips reached 66.8% in the ex-post dataset. However, an important methodological difference should be acknowledged. The ex-ante survey was also distributed through taxi passengers of FREENOW, whereas the ex-post survey relied more heavily on face-to-face distribution in streets and public squares. This difference in communication channels likely explains the slight increase in walking trips, from 9.1% to 9.8%. Furthermore, no micromobility trip was reported as the main mode in the ex-post sample collected in Penteli.

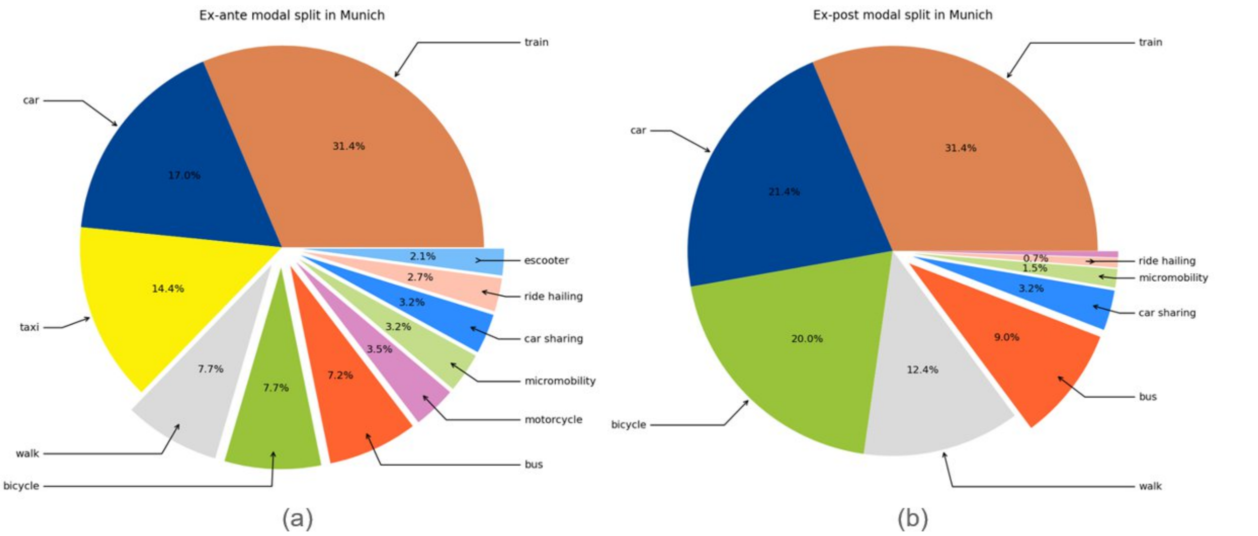


Figure 62: Modal split (a) ex-ante and (b) ex-post in Munich

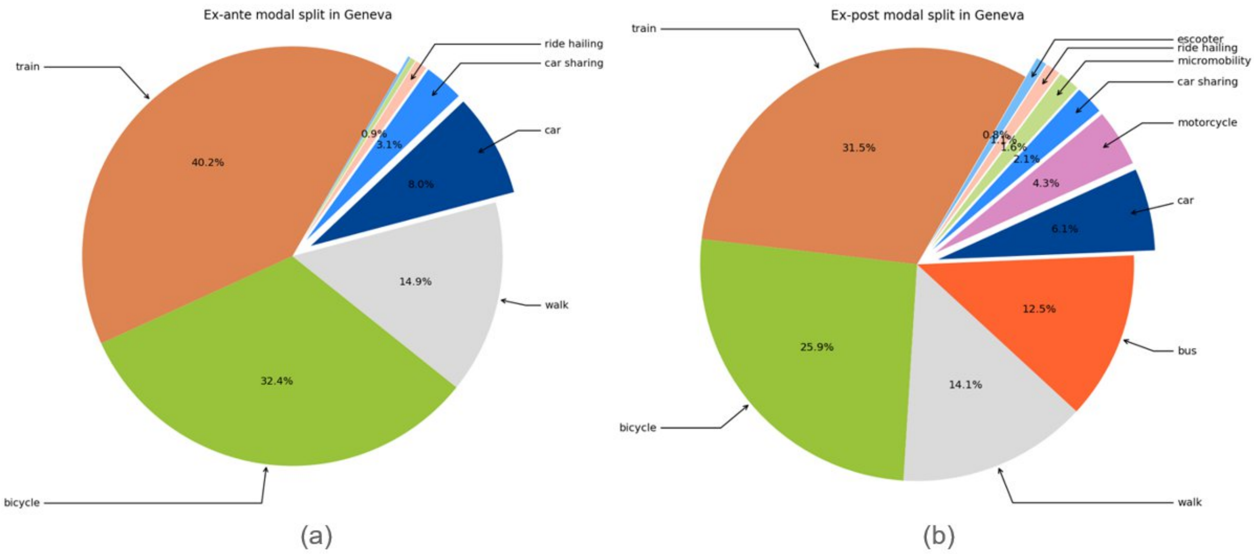


Figure 63: Modal split (a) ex-ante and (b) ex-post in Geneva

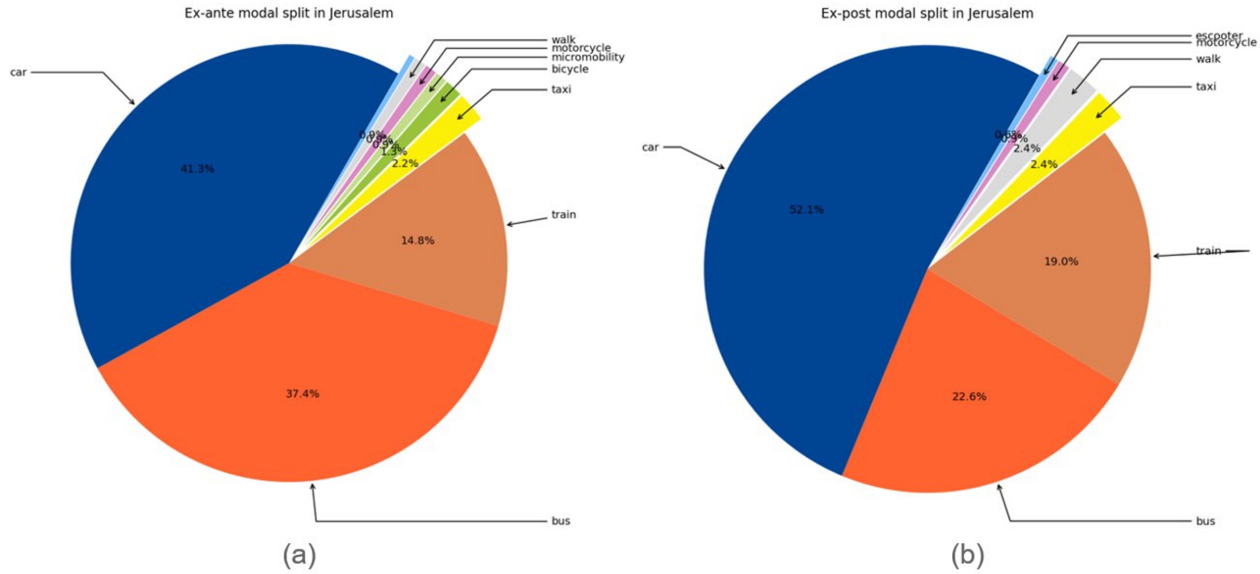


Figure 64: Modal split (a) ex-ante and (b) ex-post in Jerusalem

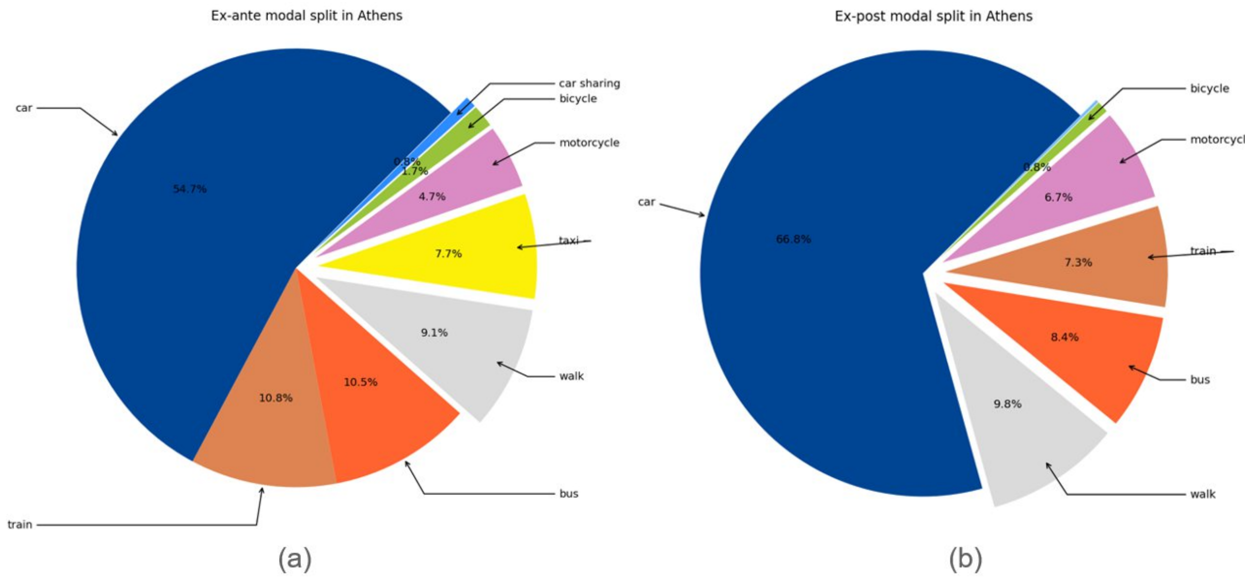


Figure 65: Modal split (a) ex-ante and (b) ex-post in Athens Penteli

The Follower LLs exhibited some more promising trends. In Rotterdam, the share of walking trips increased from 7.5% to 13.4%, while bicycle use showed a moderate decline. At the same time, **the use of metro and tram services seem to increase by approximately 1.5% in the trip samples of Rotterdam**. It should also be noted that the ex-post dataset did not contain trips reported with NSMs as the main travel mode. **In Kraków**, the most remarkable changes appeared. **The share of ride-hailing services** (e.g. LajkBus) **increased substantially, from below 1% in the ex-ante dataset to 14.5% in the ex-post survey.**

Simultaneously, train-related trips, mainly corresponding to tram services in the local context, increased from 8.9% to 32.1%. **These changes were accompanied by a great reduction in private car use, decreasing from 50.7% to 21.9%.** Particularly noteworthy were the results from the Larnaca. **In the ex-post dataset, private car use remained dominant, reaching 85.8%. In comparison, the ex-ante dataset reported a considerably lower share of 47.6% of reported trips in Larnaca.** Bus usage also increased substantially, reaching 34.0%, compared to 8.4% in the previous survey wave. Furthermore, e-scooter and bicycle use accounted for approximately 5.8% and 6.1% of reported trips. In Coimbra, private car use increased significantly, reaching 93.2% of reported trips in the ex-post dataset. This outcome is strongly associated with the timing of the survey implementation. The data collection period coincided with extreme weather events and flooding episodes in 2026, which likely influenced travel behaviour, as it was reported in the diaries.

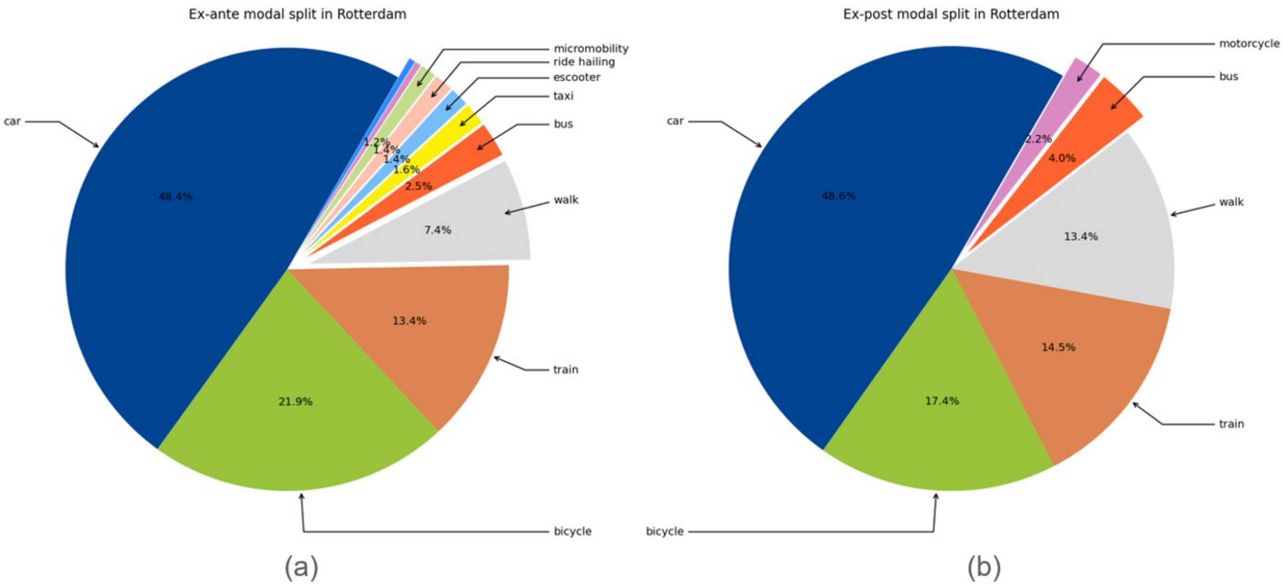


Figure 66: Modal split (a) ex-ante and (b) ex-post in Rotterdam

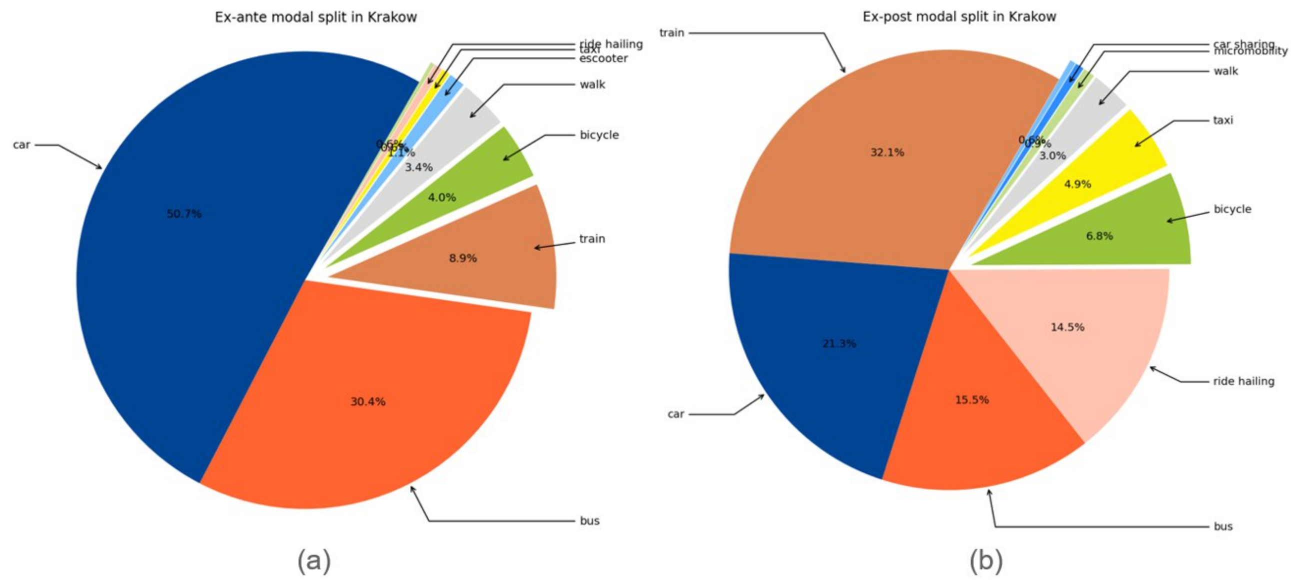


Figure 67: Modal split (a) ex-ante and (b) ex-post in Krakow

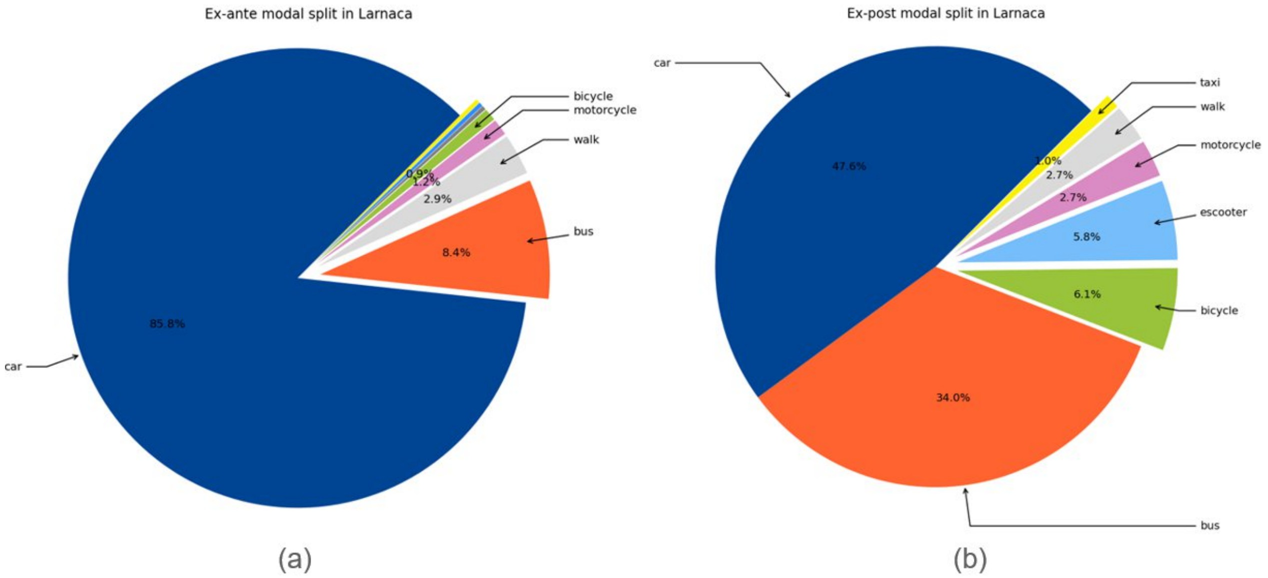


Figure 68: Modal split (a) ex-ante and (b) ex-post in Larnaca

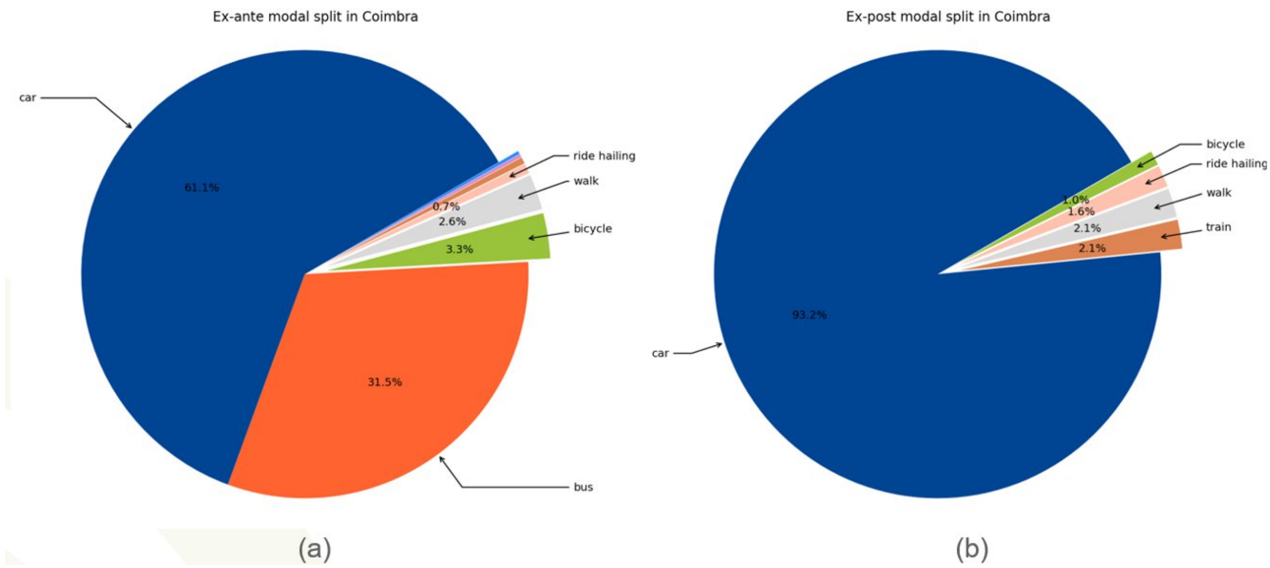
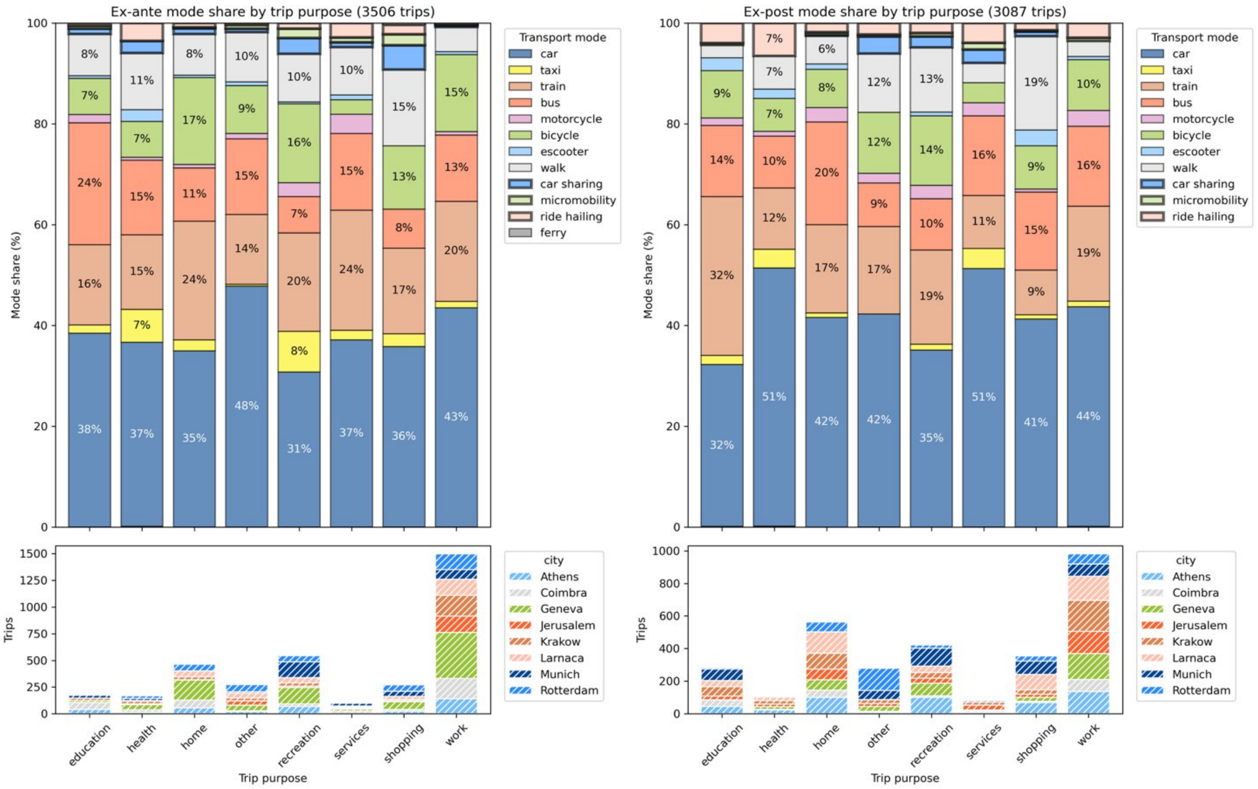


Figure 69: Modal split (a) ex-ante and (b) ex-post in Coimbra

4.1.5.3.2 Trip Purpose as factor of modal split

A total of 3,056 work-related trips were reported in the ex-ante dataset (v1.0.1), while 3,087 work-related trips were included in the ex-post dataset (v1.0.2). These trips formed the basis for the trip-purpose analysis presented in this subsection. The distribution of trips by purpose for both datasets is illustrated in the bottom panel of *Figure 70*. Across both survey waves, work-related trips represented the dominant travel purpose. Excluding return-to-home trips, recreation activities constituted the second most frequently reported trip purpose, indicating a relatively similar overall distribution between the ex-ante and ex-post datasets. This suggests a certain degree of consistency in the reported travel behaviour patterns across the two data collection periods. The most notable variation concerns education-related trips, which exhibited a higher share in the ex-post dataset.

The top panel of *Figure 70* presents the modal split distribution as a function of trip purpose for both the ex-ante and ex-post datasets. Overall, work-related trips exhibit a relatively stable modal composition across the two survey waves. The share of private car use remained almost unchanged, accounting for approximately 43–44% of work trips, while the proportion of train-based trips also remained at similar levels. In the education-related trips, the share of private car use appears to decrease from approximately 38% in the ex-ante dataset to 32% in the ex-post survey. At the same time, **a substantial increase in train (e.g., suburban railway, metro and tram) use can be identified, rising from 16% to 32% of education trips**. **Conversely, the use of bus services declined from 24% to 14%.** For recreation and leisure activities, private car use remains comparatively lower, accounting for around 35% of trips in both survey periods. However, this does not necessarily imply a stronger penetration of NSMs services. Instead, active mobility modes, particularly bicycle use and walking, represent the largest combined share within recreation-related trips, reaching approximately 30% of reported journeys. Finally, **the use of ride-hailing services** (including demand responsive transport) **shows a visible increase across nearly all trip purposes in the ex-post dataset.** In contrast, micromobility services remained marginal, accounting for less than 1% of reported trips across all trip-purpose categories in the ex-post survey wave.



(a) (b)

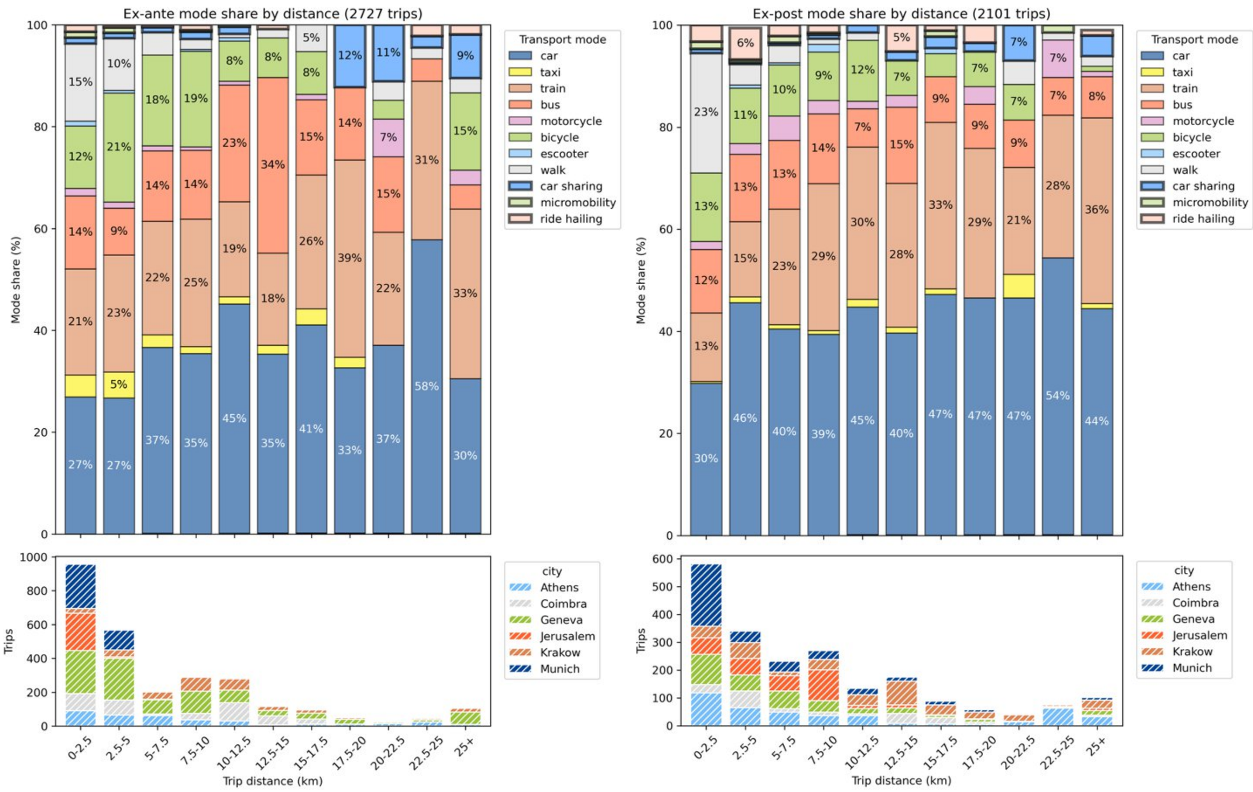
Figure 70: Modal split (a) ex-ante and (b) ex-post vs trip purpose

4.1.5.3.3 Trip distance as factor of modal split

The analysis of modal split as a function of trip distance included only observations from LLs where trip-distance information was available. Consequently, the assessment was limited to the cases of Athens

Pentel), Coimbra, Geneva, Jerusalem, Kraków, and Munich. Restricting the analysis to these LLs ensured a directly comparable evaluation across cities and survey waves. *Figure 71* presents the modal split distributions by trip-distance category for both the ex-ante and ex-post datasets. In general, the ex-post survey wave appears to **contain a higher proportion of longer-distance trips compared to the ex-ante dataset**, leading to a slightly different overall distribution of reported travel distances. This variation can be observed in the bottom panel of c¶

Figure 71, which illustrates the distribution of trips across the considered distance bands. The modal split patterns by trip distance reveal several notable differences between the ex-ante and ex-post survey waves. For short-distance trips, particularly those below 2.5 km, walking activity increased considerably in the ex-post dataset, from approximately 15% to 23%. **For medium-distance journeys**, especially within the 7.5–10 km and 10–12.5 km ranges, **the share of train-based trips increased from around 25% to approximately 30% in the ex-post survey**. At the same time, bus usage declined substantially. In the ex-ante dataset, bus services reached a maximum share of approximately 34% in the 12.5–15 km category, whereas in the ex-post survey the maximum bus share was reduced to around 15% within the same distance range. Overall, an increase in private car use can be identified across most distance categories. However, this trend appears to be strongly influenced by the contribution of the Geneva dataset to the aggregated results. It should be recalled that the Geneva survey was primarily distributed among public transport users, which may introduce distortions when comparing the ex-ante and ex-post modal distributions at the overall level.



(a) (b)

Figure 71: Modal split (a) ex-ante and (b) ex-post vs trip distance

Car-sharing services appear to be more frequently associated with longer-distance trips. This tendency was already evident in the ex-ante dataset, particularly for journeys exceeding 17.5 km, and remains visible in the ex-post survey wave. Nevertheless, the overall picture suggests a changing competitive environment within the shared mobility sector. In the ex-ante dataset, car-sharing services — mainly associated with the Munich LL — appeared to operate with limited competition from other shared mobility options. In the ex-post dataset, **however, ride-hailing seem to gain greater visibility and presence**. In contrast, micromobility services do not appear to have significantly benefited from the implementation of the SUM measures, as their modal share remained relatively marginal across nearly all distance categories.

4.1.5.3.4 Sociodemographic class as factor of modal split

The results of the LCCA are summarized in Table 5. A total of nine model specifications were estimated in order to identify the most appropriate number of socio-demographic classes within the sample. The evaluation of the optimal class solution was based on multiple statistical indicators. As expected, the Log-Likelihood value continuously improved with the increase in the number of estimated classes, reaching its maximum value in the ten-class solution. This behaviour is typical, as models with a larger number of parameters generally achieve a better goodness-of-fit. However, relying exclusively on Log-Likelihood may lead to overfitting and therefore additional model-selection criteria must be considered. Both the BIC and adjusted BIC reached their minimum values in the four-class solution, indicating a favourable balance between model fit and model complexity. Entropy, which reflects the quality and clarity of class separation, was maximized in the three-class solution with a value of 0.9293. It decreased substantially to 0.7601 in the four-class specification. The AIC criterion suggested an eight-class solution, while the CAIC reached its minimum value for the five-class model. Considering the combined interpretation of all evaluation criteria, **the four-class solution appears to provide the most appropriate segmentation of the sample.**

Table 5: Goodness-of-fit statistics vs selected number of classes (with bold letters, the best value)

Number of Classes	Number of Parameters	Log-Likelihood	AIC	BIC	CAIC	aBIC	Entropy
2	39	-16990.00	34058.00	34291.46	34167.54	34330.46	0.8887
3	59	-16548.69	33215.38	33568.57	33381.10	33627.57	**0.9293**
4	79	-16399.22	32956.43	**33429.34**	33178.33	**33508.34**	0.7601
5	99	-16345.86	32889.71	33482.34	**33167.78**	33581.34	0.8003
6	119	-16300.19	32838.38	33550.73	33172.62	33669.73	0.8052
7	139	-16268.41	32814.82	33646.90	33205.25	33785.90	0.8214
8	159	-16239.43	**32796.86**	33748.66	33243.46	33907.66	0.8343
9	179	-16220.01	32798.01	33869.54	33300.79	34048.54	0.8644
10	199	**-16203.47**	32804.94	33996.19	33363.89	34195.19	0.7365

Table 6: Class membership of each sociodemographic group - LCCA results

	Class 1	Class 2	Class 3	Class 4
class size ex-ante (share)	158 (10.17%)	731 (47.07%)	522 (33.61%)	142 (9.14%)
class size ex-post (share)	124 (8.94%)	688 (49.60%)	393 (28.33%)	202 (14.56%)
The trip “owner” is/has				
male	67.95%	63.28%	50.00%	65.13%
female	31.00%	36.04%	47.96%	33.96%
non-binary	1.05%	0.68%	2.03%	0.91%
18 to 30 years old	0.86%	17.54%	23.49%	94.69%
31 to 40 years old	1.41%	41.78%	30.63%	4.93%
41 to 50 years old	0.00%	25.74%	27.22%	0.38%

51 to 65 years old	30.62%	14.26%	18.66%	0.00%
65 or more years old	67.11%	0.69%	0.00%	0.00%
primary school graduate	2.06%	0.00%	3.64%	1.93%
high school graduate	28.10%	4.65%	26.10%	16.47%
bachelor’s degree	32.60%	32.73%	40.51%	57.78%
master or PhD degree	23.18%	60.91%	13.28%	7.10%
secondary school graduate	14.07%	1.71%	16.47%	16.72%
inactive	0.00%	0.72%	3.74%	0.00%
unemployed	1.01%	0.05%	6.38%	2.41%
student	0.00%	0.07%	0.36%	97.59%
employed	8.71%	99.15%	89.12%	0.00%
retired	90.27%	0.00%	0.40%	0.00%
no income	9.39%	0.83%	13.85%	33.68%
very low income	19.71%	5.34%	19.35%	17.61%
low income	30.70%	20.08%	41.52%	18.59%
moderate income	25.38%	42.86%	21.03%	13.87%
high income	10.60%	21.94%	3.27%	14.50%
very high income	4.22%	8.94%	0.97%	1.76%

Table 6 presents the class membership distribution across the identified socio-demographic groups. For interpretation purposes, the classes were reordered according to their dominant socio-economic characteristics and relative population size. Class 1 is characterized predominantly by elderly and economically inactive individuals. Among its members, 67.11% belong to the age group of 65 years or older, while 90.27% are classified as inactive, referring to people who are not actively seeking employment Eurostat. **This class therefore represents an “elderly or inactive” population group.** Class 2 represents the largest segment of the sample and is primarily characterized by employed individuals with medium to high income levels. A total of 731 respondents from the ex-ante survey and 688 respondents from the ex-post survey belong to this class. Approximately 99.15% of its members are part of the employed population, while a substantial proportion reported moderate to very high-income levels (73.74%). Based on these characteristics, **Class 2 can be labelled as “employed with high income”.** Class 3 consists mainly of respondents with lower socio-economic conditions. In total, 522 respondents from the ex-ante survey and 393 respondents from the ex-post survey were classified into this group. Most members reported very low to moderate income levels (81.90%), while 6.38% were unemployed. Consequently, **this segment can be interpreted as “unemployed or employed with low income” individuals**. Finally, Class 4 is strongly associated with younger respondents and students. Approximately 9.14% of ex-ante participants and 14.56% of ex-post participants belong to this category. Nearly all members (97.59%) are students, while 94.69% are between 18 and 30 years old. Accordingly, **Class 4 can be labelled as “young and students”.**

The analysis of modal split across the identified socio-demographic classes reveals several notable changes between the ex-ante and ex-post survey waves (see *Figure 72*). **Significant reductions in private car use are observed in Class 2 and Class 4.** In Class 2, the share of private car trips decreased from approximately 56% in the ex-ante dataset to 47% in the ex-post survey. A similar trend is observed in Class 4, where private car use declined from 36% to 26% following the implementation period. At the same time, Class 4 exhibited a substantial increase in train usage, with the corresponding modal share rising from 18% to 27%. Bicycle use within this socio-demographic group showed a relative increase in the ex-post dataset. Furthermore, all socio-demographic classes seem to increase in the use of ride-hailing services. The most pronounced growth was identified in the largest socio-demographic segment, i.e., Class 2.

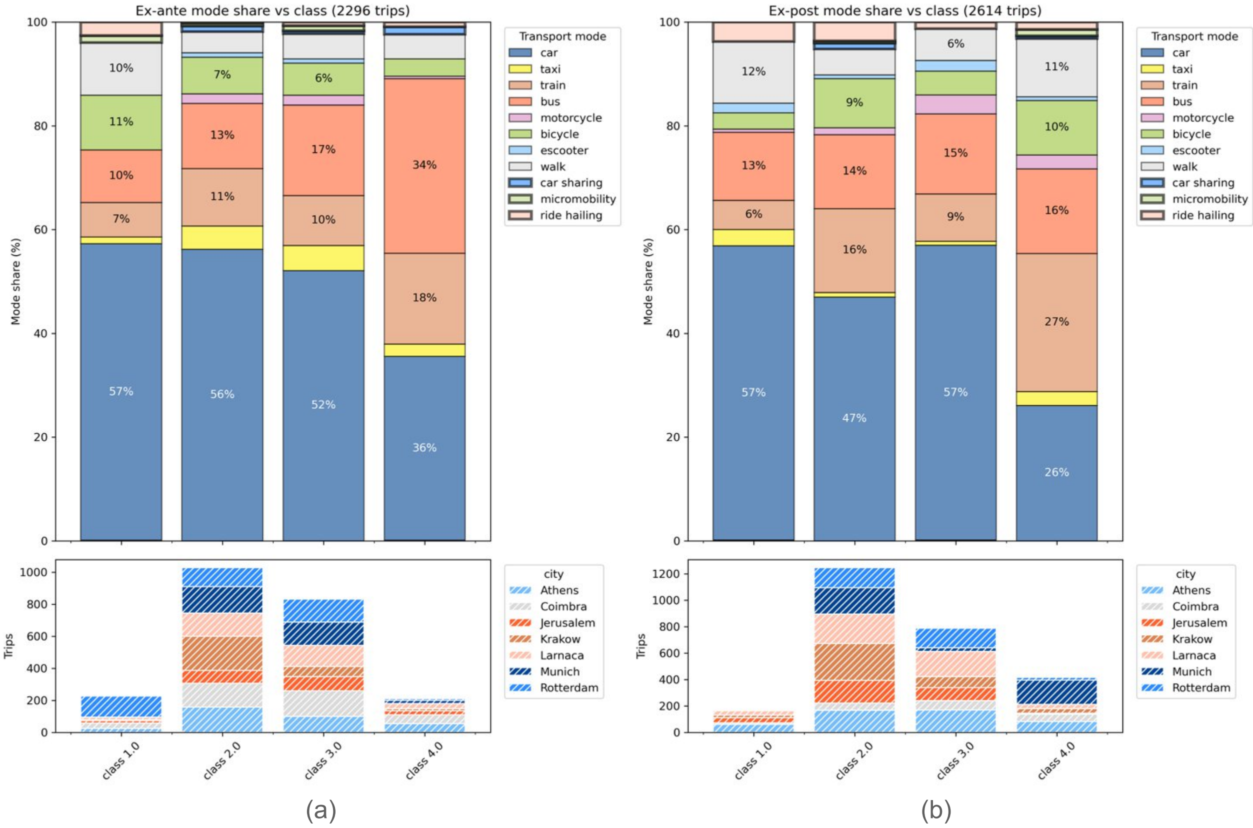


Figure 72: Modal split (a) ex-ante and (b) ex-post vs trip socio-demographic group

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