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MOBI-MIX
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Impact of shared mobility & MaaS in MOBI-MIX partner cities

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INTRODUCTION TO MOBI-MIX

Urban transport, often dominated by private car use, is responsible for around 23% of GHG emissions in European cities. Besides pollution, current car use also causes increased congestion, which results in a 1% loss in GDP/year in the EU.[1] Two emerging trends that could contribute to reducing congestion, emissions, and economic loss are shared vehicles (often integrated through mobility hubs) and Mobility as a Service (MaaS).

So far, the first generation of Shared Mobility and MaaS has proven its attractiveness to users, but its rapid implementation by the private sector resulted in significant and unexpected drawbacks, such as short life cycles of vehicles and safety issues for citizens. This has led to suboptimal deployment and cancelled projects since cities do not yet have the expertise and tools in place to facilitate this implementation of the private sector in such a way that the new mobility solutions fulfil their potential and generate a positive impact on CO_2 reduction.

The MOBI-MIX project aims to fill this gap and support five cities in their efforts to decarbonise road transport, by reducing private cars, in particular. Within the project, cities facilitate the private sector to implement shared mobility solutions (e.g., bikes and e-bikes, e-scooters, mopeds, cars) and MaaS solutions (the integration of various forms of transport services into a single mobility platform) more effectively. The overall aim is a reduction of CO_2 emissions in urban transport of 5 cities/regions in the 2 Seas.

To foster long-term uptake, MOBI-MIX will:

1. Embed lessons learned and best practices in the urban mobility plans of the five cities, serving 1.5M inhabitants and leading to significant carbon emission reduction beyond the project's lifetime.
2. Create a comprehensive decision-making framework for urban mobility planners of cities across Europe to facilitate the implementation of MaaS and shared mobility more effectively.

The project is set up to run for three years, from March 2020 until September 2022. The consortium includes five cities – Rotterdam, Antwerp, Norfolk, Mechelen, Valenciennes, two knowledge partners – Ghent University and Gustave Eiffel University, and partners such as POLIS, CoMoUK, Transalley technology park and Cambridge Cleantech.

[1] According to European Commission EUROPEANMOBILITYWEEK 2016 – Sustainable Tansport is an Investment for Europe (here)

EXECUTIVE SUMMARY

This report is a MOBI-MIX WP1 A1.3 output that shows the potential impact of different Shared Mobility and MaaS solutions to be applied in the partner cities. The impact assessment will benefit the public and private sector within and outside the project consortium, demonstrating the potential of shared mobility and MaaS solutions in reducing carbon emissions.

This report first describes the impact assessment methodology to evaluate new mobility solutions' contribution to carbon emission reduction. The described methodology is applicable at different stages of pilots' implementation, starting from an initial exploratory analysis to assess their potential impact based on evidence from case studies elsewhere, and finishing with an ex-post evaluation once each pilot finishes. Which concerning this report, just the exploratory analysis is applied as information on behavioural changes introduced by the different pilots is not yet available.

We describe partner cities' local contexts and mobility ecosystems, including the mobility goals pursued by each of them, and the details and timelines of the pilots they implement. Based on the described exploratory impact evaluation, we assess that all pilots combined are expected to yield a 495 CO_2 equivalent tonnes/year reduction around their implementation date (short-run) with a reduction of 3,3M vehicle-km travelled by car. Such figures are higher than the initial target of the project. Additionally, once expected car ownership reductions arise, such impact could increase up to 6.695 CO_2 equivalent tonnes/year (long run) with a reduction of 39,5M vehicle-km travelled by car, exclusively driven by pilots involving carsharing solutions (being the only ones with available evidence on car ownership reductions). The sensitivity of results to change on inputs values used in the analysis is also reported, showing that they are relatively robust but heavily depend on the transferability of impact assessed in other case studies and the non-negligible limitations of such studies.

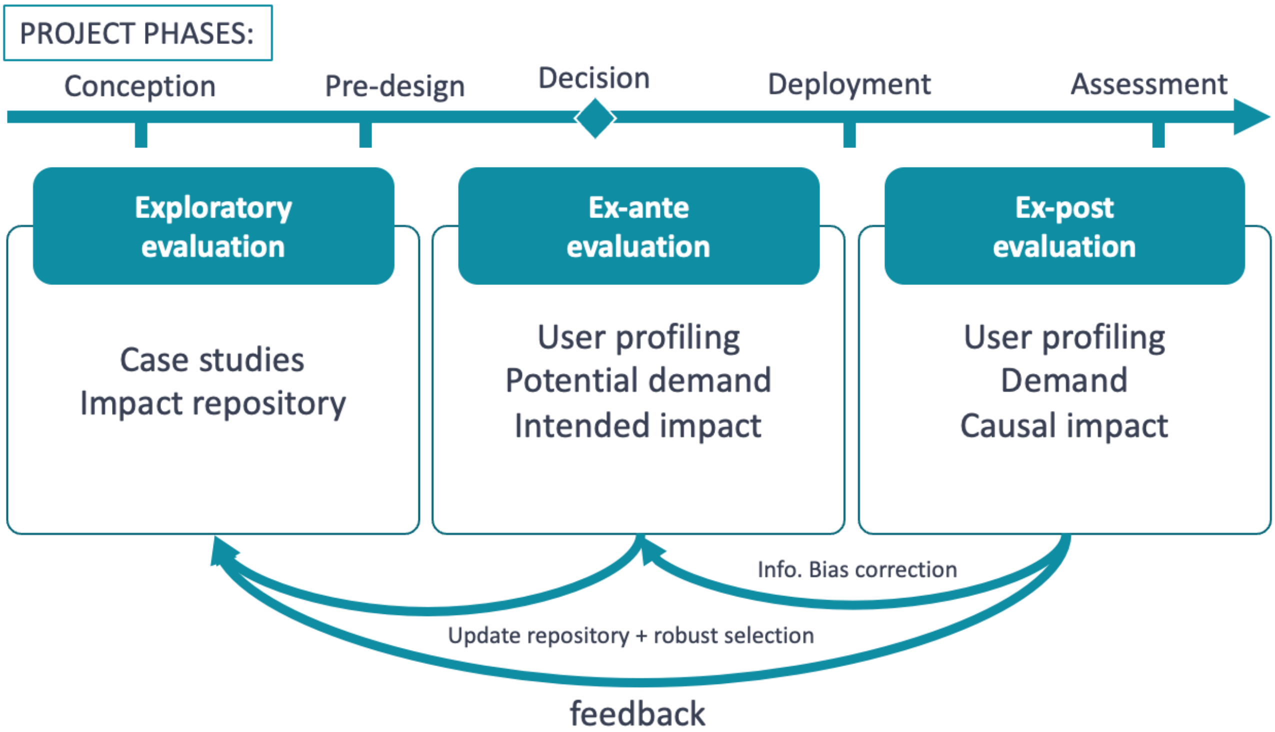
In any case, given these limitations, the exploratory analysis results will be re-evaluated after pilots' implementation (WP3), following the methodological path described before. An updated and expanded analysis will be considered in the improved Urban Mobility plans in WP4.

IMPACT ASSESSMENT METHODOLOGY

METHODOLOGICAL FRAMEWORK

We have developed a sequential methodology to assess the impact of the different shared mobility solutions deployed by cities. This methodology can provide insights at each project phase, adapting to the available evidence. Thus, the impact analysis translates into three differentiated approaches.

FIGURE 1. METHODOLOGICAL FRAMEWORK ACROSS PROJECT PHASES, BASIS FOR THE ANALYSIS AND FEEDBACK ACROSS APPROACHES.



First, the ‘Exploratory analysis’ comes into play when the pilot-specific evidence is not available. In this case, the impact assessment is conducted based on evidence provided by the review of available similar case studies. The information for this review was collected through desk research and was compiled into an *impact repository*[2]. From there, ‘change factors’ depicting behavioural adaptations are directly transferred to the studied city on a per-vehicle basis. The actual potential behavioural change is constructed based on such change factors per shared mobility vehicle, and the descriptive evidence on mobility and their usage in each city. Such a method implies a great deal of uncertainty about the transferability of figures across cities. To account for

[2] The *impact repository* includes academic and non-academic studies which analyse the impact of shared mobility on aspects such as environmental pollution, travel behaviour, quality of public space, accessibility, health, etc. Although the rest of this document refers to the impact repository and to specific studies included in it, the repository is currently only for internal use. A complete list of resources can be provided upon request.

uncertainty, we conduct both sensitivity and risk analyses to assess the robustness of the estimated pilot's potential impacts.

Second, the 'Ex-ante evaluation' comes into play once there is actual pilot-specific evidence on the intended behavioural adaptation, reported by potential users. In MOBI-MIX, such evidence is collected through two dedicated surveys (pre- and post-pilot). Using surveys to gather users' stated preferences allows inspecting who intends to join a given shared mobility solution, as well as their subjective perception regarding their potential travel behaviour adaptations. This information is then used to estimate a discrete choice model able to assess how the respondents' characteristics, mobility patterns and attitudes affect their likelihood to enrol in each shared mobility service. This gives a pilot-specific estimation of the intended demand and the most relevant user profiles to target during the pilots.

Third, the 'Ex-post' evaluation combines the pre- and post-pilot surveys, tracking users' behaviour and attitudes at two different moments in time. This observational study aims at assessing the causal impact of each of the proposed shared mobility solutions on users' behaviour and its associated carbon emission. The impact of the pilots will be determined by the difference in behavioural change among users enrolled in a specific pilot with respect to the changes that occurred in a control group. This approach is consistent with the CIVITAS process and impact evaluation framework[3]. Different control group specifications will be designed to test for potential biases on our estimation due to substantial dissimilarities across treated and control groups arising from users' self-selection into the programme. Examples of the control groups that will be used are:

(1) the whole population of non-enrolled (Difference-in-difference),
(2) a selected group of users matched based on observable characteristics (matching them based on a discrete choice model describing their probability to enrol), and
(3) specifications including just 'almost' users or infrequent ones (whenever surveys' sample size allows for it).

Caveats

Our analysis does not include any empirical measurement of carbon emission changes, and all the impact derives from the measurement of behavioural change. The translation of such behavioural adaptations (changes in vehicle-km and passenger-km) into CO_2 savings will be made by applying standard emission factors per transport mode.

Additionally, it is important to highlight that the methodological approach is skewed towards the assessment of short-term impacts given the time framework of proposed pilots within MOBI-MIX. Surveys in the ex-ante and ex-post evaluations include questions to assess both the change in motorization rates and the attitudes towards cars,

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[3] CIVITAS. (2020). Refined CIVITAS process and impact evaluation framework. SATELLITE Project, WP2. https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5b4b337fe&appId=PPGMS

considering the latter as a precursor of the former in a mid-to-long-term scenario. In the exploratory analysis, car ownership changes have only been considered for the shared mobility solutions reporting quantitative evidence on it. No attitudinal change evidence has been transformed into actual changes in motorization rates, to avoid arbitrary assumptions that can bias our estimates.

DATA SOURCES & DATA COLLECTION PROCESS

The city profiles section reflects data gathered through desk research and conversations with city representatives from the start of the project in March 2020 until the first iteration of the reports, in June 2021. Cities' goals have been extracted from mobility plans and other relevant documents to which city representatives have offered further details. In some cases, cities have decided to emphasise fewer goals, focusing on the ones directly connected to the pilots, and which might be more tangible and easier to assess.

The shared mobility ecosystem can be relatively unstable and has been visibly affected by the COVID-19 pandemic. This might also mean that the information below reflects the situation in June 2021 and is liable to change. Similarly, the pilots' descriptions and timelines are indicative of the status quo (June 2021) and will contain more information as pilots are deployed.

The indicators used in the analysis have been provided by the 5 cities. Due to certain data gaps, some cases required replacing with a national average or a similar proxy. More specifically, for the motorization rates, defined as the average number of private cars per inhabitant, city-level data was possible to collect for all the cities, except for Norfolk, where regional data from the East Midlands was used. Regarding the average utilisation rate, defined as the number of kilometres each car does per year, national-level data were used, apart from Antwerp and Mechelen, where Flemish-level data was available. Finally, to account for the share of rail and bus usage within public transport in each city (due to difference in emission levels), we assumed an equal share of 50% for the cities where no information was available (Rotterdam and Valenciennes). For Norfolk, we used the national averages obtained in the National Travel Survey from 2018. In the case of Mechelen, as there is no tram or metro available in the city, and the train is only used for intercity trips, we considered that all public transport trips are done by bus. Finally, for Antwerp, we considered the split provided in the last employees travel survey carried out by the Smart Ways to Antwerp since the pilot in Antwerp is anyway only targeting employees.

Also, as mentioned, wherever shared mobility adoption and usage data was impossible to obtain for the moment, it was replaced by evidence from similar studies, gathered in the impact repository. This is the approach followed in this specific report, where we conduct an exploratory assessment of the potential impact of the pilots.

In later stages, the analysis will be enhanced with survey data both in the ex-ante and ex-post assessments. The survey was designed in dialogue with city representatives, through multiple rounds of feedback. The translated versions of the survey (in French and Dutch) also went through multiple iterations, to ensure legibility. Due to the COVID-19 pandemic, pilots have been postponed multiple times, affecting the survey launch, too. City representatives commonly agreed to launch surveys at a later stage, to ensure sufficient and representative responses. For this reason, the ex-ante impact assessment will be complemented with more data, as pilots and surveys are being deployed.

CITY PROFILES

ANTWERP

LOCAL CONTEXT & CURRENT MOBILITY ECOSYSTEM

Antwerp has developed a comprehensive programme to stimulate sustainable mobility behaviour. *Smart Ways to Antwerp* was initially developed to provide information on major infrastructure works and their impact on traffic. It has currently grown into a platform that aims to increase intermodality and accessibility, raise awareness, and nudge behaviour, while also inviting mobility providers to cooperate as partners within the marketplace for Mobility.

To encourage a modal shift towards active and shared mobility, Antwerp aims to take advantage of the Belgian mobility budget – a scheme that allows Belgian employees to exchange their company car for a more sustainable means of transport. For this, the city brings together employers and MaaS operators, piloting three different schemes within MOBIMIX. MaaS platforms have a comprehensive offer since shared mobility operators must make their data available and open their sharing system for reservation and ticketing through at least three MaaS applications active in Antwerp.

To safeguard public order and safety, Antwerp requires mobility providers to obtain a permit for free-floating sharing systems for bikes, scooters, and mopeds. This does not seem to be a limitation, looking at the table below which demonstrates the rich shared mobility ecosystem in Antwerp.

Operator	Solution offered	Business category	Model
Velo	bikes	B2B & B2C	Free-floating with pool stations
Blue-bike	bikes	B2B & B2C	Roundtrip, station-based
Mobit	bikes	B2C	Free-floating with an operational area
Cloudbike	Bikes	B2C	Free-floating with an operational area
Swapfiets	bikes, e-bikes	B2C	Leasing
Bird	e-scooters (step)	B2C	Free-floating with an operational area
Lime	e-scooters (step)	B2C	Free-floating with an operational area
Cozywheels	P2P mobility	P2P	-
Dégage!	P2P cars	P2P	-

Cambio	Cars & e-cars	B2B & B2C	Free-floating with an operational area
GreenMobility	e-cars	B2C & B2B	Free-floating with pool stations
Wizkey/Flexifeet	cars	B2B	Station-based, roundtrip home zone-based
Poppy	cars, e-cars, e-mopeds, e-scooters (step)	B2B & B2C	Free-floating with an operational area
GoSharing	e-mopeds	B2C	Free-floating with an operational area
Whim	MaaS	B2C & B2B	-
Skipr	MaaS	B2B	-
Olympus	MaaS	B2B	-
KBC Mobile	MaaS	B2C	Via Bank-app
4411	MaaS	B2C & B2B	Originally car parking app-

MOBILITY GOALS

As an extension of the city's mobility strategy from 2005, Antwerp developed in 2015 the "Active and Accessible Antwerp" plan. Besides, the local council approved a Vision Paper for the 2030 Roadmap at the regional level, which lays out important goals to which the MOBIMIX pilots can contribute:

- achieve a 50/50 modal split at the regional level (no more than 50% car trips)
- ensure multimodality, facilitating transfers for smooth door-to-door transport experiences

The table below summarises the wider goals and motivations in the city's mobility plans (also included in the program of Smart Ways to Antwerp) and the means to measure their potential results

Goal	Details and targets (if available)	Means of measurement
Multimodality	Reach 50/50 split in the entire region by 2030 through the: • development of a multimodal plan of action for workers in the port area. • cooperation with companies - support for at least 120 companies (employers' approach).	Map current travel behaviour of employees and highlight the behaviour change potential

	• further development of the multimodal travel planner. • introduction of private MaaS offers for private companies. • Implement targeted measures (e.g., free trials, bike discount schemes, etc.)	
Environment	Improve air quality in the city centre (through a Low Emission Zone) and lower emissions in the port area. Reduce the number of residents exposed to average noise levels over 70 dB to 0.	Number of km of car-free streets in the city
Active & healthy city	Improve bike lanes and walking routes, and encourage active travel.	Number of: • km of separated bike lanes • km of bike streets (*fietsstraten*) • people reached through promotional campaigns on walking
Accessible & inclusive city	Further develop multimodal mobility hubs. Improve efficiency and further expand the geographical coverage of waterbus and water taxis.	New mobility hubs implemented
Improved public space	Introduce car-free streets in the city centre	Number of km of car-free streets in the city
Road safety	Ensure safer bike lanes Create a sustainable road hierarchy, giving priority to walking and biking, then public transport and lastly to private cars.	Number of traffic accidents
Low-carbon economy	Enhance charging infrastructure for electric vehicles Create a low emission zone	Number of charging points on and off-street
ICT &/or innovation	Use standardized mobility data to establish realistic, comprehensive	Number of • organisations using the API-store

	insights to make the right policy decisions for travel behaviour. Further develop the SWtA multimodal travel planner. Introduce private MaaS offerings into the SWtA the travel planner	• data streams made available Integration of ITS systems
Education & awareness raising	Introduce commercial ads in the Smart Ways to Antwerp Program. Develop an incentives program for sustainable mobility shifts (e.g., MaaS demonstrators with built-in incentives).	Number of accounts

MECHELEN

LOCAL CONTEXT & CURRENT MOBILITY ECOSYSTEM

Mechelen has been actively implementing measures to encourage a shift towards sustainable mobility and to reduce transport-generated CO_2 emissions. Through its participation in various EU projects (e.g, Surflogh, Sprout, CCCB, Novelog, ULaaDS, etc.), the city has been able to experiment and pilot different solutions for shared mobility and sustainable urban freight. Besides, it has implemented specific policies to attract shared mobility operators (such as offering free parking for shared cars) and to encourage behaviour change (e.g., information campaigns and engagement events, allowing citizens to test shared mobility).

Currently, Mechelen's shared mobility ecosystem includes shared bikes, e-bikes and e-cargo bikes, shared e-scooters, as well as shared cars and e-cars. The table below summarises the active operators, the mobility solution offered, their business category and model.

Operator	Solution offered	Business category	Model
Blue-bike	bikes	B2B & B2C	Roundtrip, station based
Mobit	bikes	B2C	Free-floating with an operational area
Swapfiets	bikes	B2C	Leasing
	e-bikes		
Cargoroo	e-cargo bikes	B2C	Roundtrip, station based

Hoppy	e-scooters (step)	B2C	Free-floating, with pool stations
Cambio	cars	B2C & B2B	Roundtrip, station based
	e-cars		
Dégage!	P2P bikes & cars	P2P	-
Cozywheels	P2P mobility	P2P	-
Get Around	P2P mobility	P2P	-

MOBILITY GOALS

Mechelen developed a Sustainable Urban Mobility Plan (SUMP) in January 2015, and in 2017 signed a Green Deal with the Flemish government. More recently, in 2020, the city adopted the Sustainable and Efficient City Logistics Covenant, reinforcing its commitment to sustainable transport.

Mechelen's overarching goals, to which MOBI-MIX trials will contribute directly, are:

- Becoming a zero-emission city by 2030
- Reaching zero-emission urban logistics by 2030

The table below summarises the wider goals and motivations included in the city's mobility plans and the means to measure them.

Goal	Details and targets (if available)	Means of measurement
Multimodality	Increase the number of shared cars (commercially and privately) – 1 shared car within 150m of everyone's home by 2024, increase the number of parking spots for shared cars and extend the shared e-(cargo)bike scheme.	Number of users of: • shared cars • shared (cargo)bikes • shared e-scooters
Environment	Reduce CO_2 emissions for better air quality, ensuring that 50% of all shared cars will be electric by 2025. Ensure access to shared cargo bikes, as an even better option than shared cars.	number of: • electric shared cars • discounts given for electrical rides
Accessible & inclusive city	Increase inclusivity by increasing access to shared vehicles and shared cargo bikes. These reduce ownerships costs, being more affordable for people with lower incomes.	number of people with lower incomes who make use of shared mobility

Improved public space	Create a greener, better living environment and better public space by reducing the number of cars on the street (1 shared car can replace up to 15 private cars).	number of • car-free zones (km) • removed car parking spots • installed shared cars parking spots
Road safety	Reduce the number of parked cars on the street to make more room for safer streets for cyclists and pedestrians.	number of • car-free zones (km) • removed car parking spots installed shared cars parking spots
Low-carbon economy	Work towards a more sustainable and efficient freight transport, with a primary focus on the city centre and the station environment, encouraging local businesses to use low and zero-emission vehicles.	Number of trips using • cargo bikes • shared electric vehicles
Education & awareness raising	Raise awareness and encourage the use of shared mobility during a 2-year communication campaign.	• increase rate for shared mobility means • number of inhabitants switching to shared mobility

NORFOLK

LOCAL CONTEXT & CURRENT MOBILITY ECOSYSTEM

Norfolk County Council has been investing in clean and shared transport, aiming to reduce congestion and increase the uptake of shared and active travel. To this end, Norfolk has been one of the first cities in the UK to allow the use of shared e-scooters, with approval from the UK's Department for Transport.

At the moment, the shared mobility ecosystem includes bikes, e-bikes, e-scooters and cars. With the implementation of mobility hubs, in collaboration with CoMoUK, the offer might further increase, besides becoming better integrated.

Operator	**Solution offered**	**Business category**	**Model**
Beryl	bikes	B2C	Free-floating with pool stations
	e-bikes	B2C	Free-floating with pool stations

	e-scooters	B2C	Free-floating with pool stations
Liftshare	carpooling	P2P	-
Norfolk Car Club	cars	B2B & B2C	Roundtrip station-based

MOBILITY GOALS

Overall, Norfolk County Council aims to improve the local environment, increase social mobility and provide access to employment and learning. The mobility hubs developed within MOBI-MIX play an important role, as they will facilitate the adoption of public, shared and active transport, besides bringing improvements to the public realm. Mobi-hubs will also contribute to Norfolk County Council's goal to become carbon neutral by 2030.

The table below summarises the wider goals and motivations included in the city's mobility policies and the means to measure them.

Goal	Details and targets (if available)	Means of measurement
Multimodality	Develop multimodality and improve the interaction between sustainable transport options, to increase the number of cycle trips by 20% and walking trips by 18% by 2030.	Number of: • users of shared bikes • new mobility hubs built
Environment	Reach climate neutrality by 2030, reduce air pollution coming from transport sources, and support initiatives that lead to clean air.	CO_2 reduction by number of shared bike trips and e-scooter trips
Active & healthy city	Promote open spaces, active travel and collaborative approaches to improve air quality.	Number of: • users of shared bikes • new mobility hubs built
Accessible & inclusive city	Encourage accessibility for all, especially for disabled people.	

Improved public space	Improve the design of the public realm around mobihubs through community engagement.	
Low-carbon economy	Prioritise a shift to more efficient vehicles, including lower carbon technology and cleaner fuels.	CO_2 reduction by number of shared bike trips and e-scooter trips
Education & awareness raising	Engage the wider community in developing mobility hubs, while also facilitating e-scooter training to ensure safe usage for the user and other highway users.	Number of: • Survey respondents • Users trained

ROTTERDAM

LOCAL CONTEXT & CURRENT MOBILITY ECOSYSTEM

Rotterdam has pledged to become carbon neutral by 2050, and the transition towards sustainable transportation is key. In this sense, the city is actively trying to influence private car usage behaviour, looking primarily to support more sustainable alternatives, either through shared vehicles or active means of transport. One of the newest policy documents, *Policy and Parking for Carsharing*, has been instrumental in defining the scope of the MOBIMIX pilots and has led to certain reorganisations of the carsharing markets (e.g., SixtShare withdrew its fleet to reapply for permit).

Besides shared cars, Rotterdam's mobility ecosystem is relatively well-developed, offering approximately 35 shared vehicles / 10,000 inhabitants[4]. The table below provides an overview.

Operator	**Solution offered**	**Business category**	**Model**
OV-Bike	bikes	B2C	Station-based, roundtrip

[4] Fluctuo. (2021). European Shared Mobility Index.

Donkey Republic	bikes	B2C	Free-floating with an operational area
MoBike	bikes	B2C	Free-floating with an operational area
Swapfiets	bikes/e-bikes	B2C	Leasing
Baqme	e-cargo bikes	B2C	Free-floating with an operational area
Felyx	e-mopeds	B2C	Free-floating with an operational area
GoSharing	e-mopeds	B2C	Free-floating with an operational area
Lev	2 person LEV	B2C	Free-floating with an operational area
Greenwheels	car sharing	B2B & B2C	Roundtrip, station based
Sixt	car sharing	B2C	Free-floating with an operational area
Amber	car sharing	B2C	Free-floating with an operational area
GoToGlobal	car sharing	B2C	Free-floating with an operational area
Tranzer	MaaS	B2C	-

MOBILITY GOALS

Looking to accelerate its transition to becoming an emission-free city, Rotterdam is aiming to reduce the number of private cars, and reclaim the space they take for housing, public and green spaces. As the MOBIMIX pilots are implementing carsharing schemes, the project will contribute to the following goals:

- from January 2021 new shared cars in Rotterdam will be emission-free
- by 2025 all shared cars will be electric
- by 2030 about 5% of all cars in Rotterdam will be shared cars

Some other policy choices included in Rotterdam's SUMP aim to support cycling and public transport use, create a coherent regional and urban transport network, improve regional and urban river crossings, create an attractive and lively (Inner) city, strengthen new modes of transport (water transport and zero-emission Last Mile), ensure zero transport poverty, create a healthy living environment, and invest in smart mobility (technological innovation and ICT).

The table below summarises the goals that city representatives thought were most connected to MOBIMIX pilots, and the means to measure them.

Goal	Details and targets (if available)	Means of measurement
Multimodality	Improve connectivity and enhance the shared mobility offer (including through the development of water transport).	Change in modal split number of users of: • public transport • bikes & shared bikes • shared e-scooters
Environment	Reduce CO_2 emissions by 50% by 2030 (overall target, not specified for mobility).	number of: • avoided fossil km • shared cars/100.000 inhabitants
Improved public space	Create an attractive and lively inner city, and use mobility as means to improve the quality of air and quality of life.	number of • owned vehicles • disposed vehicles

VALENCIENNES

LOCAL CONTEXT & CURRENT MOBILITY ECOSYSTEM

Valenciennes Métropole has joined MOBIMIX to explore possibilities of rebalancing the modal split in favour of active and public transport modes and reduce private car use. The city is interested in learning from the other partners, aiming to become a living lab for decarbonised transport solutions. The city works in collaboration with SIMOUV, the Transalley Technopole and the Polytechnic University Hauts-de-France, valorising the expertise available in the field of transport and sustainability.

Currently, the shared mobility ecosystem is relatively reduced. The implementation of two mobility hubs should help to further expand it.

Operator	Solution offered	Business category	Model
Donkey Republic	bikes	B2C	Free-floating with pool stations

Assistant Jerico	e-scooters	B2C	Free-floating with pool stations
	MaaS	B2C	-

MOBILITY GOALS

Valenciennes Métropol overarching goals, to which MOBI-MIX pilots will contribute, are:

- reduce the modal share of private cars to less than 60% by 2023
- reduce greenhouse gas emissions coming from the transport system by 23% before 2030

The table below details the different mobility goals expressed in Valencienne's Urban Mobility Plan (PDU) and its Climate Plan (PCAET).

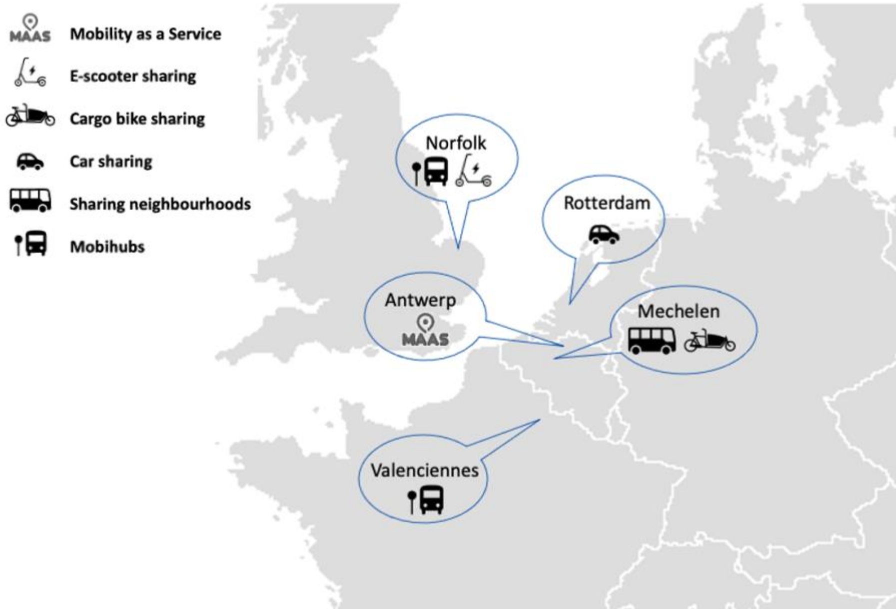
Goal	Details and targets (if available)	Means of measurement
Multimodality	Reduce private car use to less than 60%, by doubling the share of cycling (from 2 to 4%), reaching 10% for public transport, and 27% for walking, through improving multimodality (mobility hubs and P&R).	number of users of: • public transport • shared bikes • shared e-scooters number of bike parking spaces
Environment	Reduce car traffic and road congestion, achieving a 23% decrease in greenhouse gas emissions in the transport sector by 2030.	GHG levels
Active & healthy city	Improving air quality, encourage active travel options to improve health, and reduce car traffic and road congestion.	air pollutants levels
Accessible & inclusive city	Offering mobility services adapted to vulnerable people to increase access to employment, health and leisure, by offering appropriate fares, mobility advice and improving accessibility for people with reduced mobility.	user profile monitoring and comparison
Improved public space	Develop calm traffic areas and sustainable city logistics.	number of • car-free zones (km) • parcels delivered by sustainable means

		number of users of: • shared bikes • shared e-scooters
Low-carbon economy	Reduce energy consumption by 18% across Valenciennes Métropole by 2030.	number of • low carbon vehicles • charging stations
Education & awareness raising	Enable the development of carpooling and carsharing, and raise awareness about sustainable mobility.	Number of • carpooling and carsharing trips • people involved in communication actions • users of sustainable transport means

PILOTS OVERVIEW & TIMELINE

MOBI-MIX partner cities will adopt several mobility solutions as pilot programs, including Mobility-as-a-Service, E-scooter sharing, cargo bike-sharing, carsharing, Shared Neighbourhoods and Mobihubs, as shown in the figure below. The specific details and timelines for each pilot are specified below.

FIGURE 2. OVERVIEW OF MOBILITY SOLUTIONS PILOTS ACROSS MOBI-MIX CITIES



ANTWERP

OVERVIEW

Within MOBI-MIX, Antwerp has opted for MaaS pilots, bundling together public transport and shared mobility. As B2C MaaS schemes are often based on commissions, the small margins obtained make it hard to make the business model profitable. Nonetheless, the city finds B2B more flexible (in the pre- and post-payment), also allowing to include personal trips, along with the business-related ones.

In June 2020 the city of Antwerp launched a thematic call for mobility solutions that contribute to reducing private car use, while also ensuring that employees can travel smoothly and safely.

With this call for projects, the city aimed at smart solutions for work-related travel (commuting, business trips, etc.) tailor-made for companies in search of a successful corporate mobility model. While the COVID-19 pandemic has allowed more flexible working arrangements, it has also led to a substantial increase in private car usage. Following the call for projects, some service providers have developed attractive trial offers. In November 2020, seven projects offering smart mobility solutions for organisations and employees were selected.

Among them, three MaaS projects will be implemented as demonstrators within the MobiMix project. This is a measure to improve the implementation of shared mobility and MaaS and stimulate a modal shift. The overall aim is to reduce car use, through different approaches and incentives, and persuade employers and employees to use MaaS-services

The selected B2B MaaS pilots are developed by three operators: Whim (together with Commuty and Vaigo), Olympus & Skipr. Operators are targeting companies that offer mobility budgets & company cars, although any company can join.

The Smart Ways to Antwerp B2B-programme assists companies in developing suitable company transport plans. When companies join, they receive tailor-made assistance based on the company's size. More than 120 small and big companies in the region of Antwerp are already working together with Smart Ways to Antwerp. Through this, the city is supporting the outreach, communication and connection of the selected MaaS pilots with employers from Antwerp. The three MaaS operators engage with the companies that are members of the SwA-B2B programme, and can also target others who are not members. In November 2020, the city hosted a webinar to promote the three trial offers to different companies, and over 30 companies showed interest..

KPIs are defined by each demonstrator and validated by the city. The main parameters are the number of companies, number of users, number of trips/transactions.

The evolution of these three pilots will bring insights into the efficiency of different engagement and marketing strategies used by operators.

CAR(r)educe Antwerp

Combination of services to reduce car use: Commuty (management of parking space), Whim (MaaS operator where travel budget can be spent) & Vaigo (connection with payroll administration).

Strategy: companies dealing with lack of parking or high parking costs; primarily looking to engage large employers +1000 employees.

Currently offers access to public transport, scooters, Mobit, station-based bikes, etc. Continuously working on further integration.

KPIs: number of large companies involved in intensive information campaigns, number of participants/pilot project in 3 companies.

Olympus4ANTWERP

Three-part offer: Olympus MaaS app (public transport, carpooling, parking, bike-sharing, etc.), Olympus management portal for employers, and simplification of administration.

Strategy: gamification and rewarding elements, possibility to use mobility budget for the users' families, too.

KPIs after 18 months: number of customers (companies), number of potential users, number of active users (10% family members), number of transactions.

Skipr Trial Offer

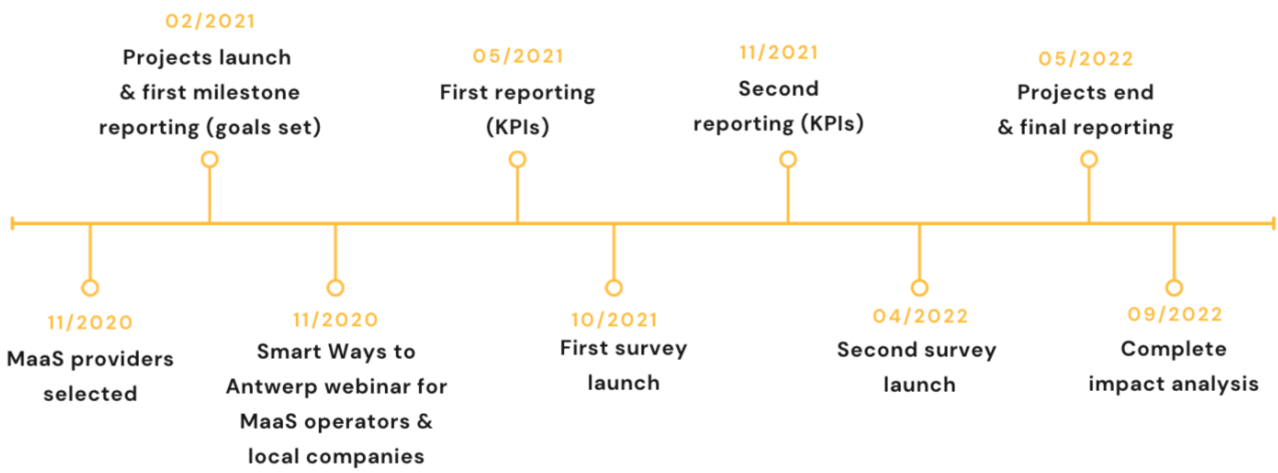
Three-part offer: Skipr MaaS app, Skipr debit card, and web platform for employers.

Strategy: trial offer at lower cost for the employer, different mobility budgets through trial offer for employees, offering bonuses for private spending.

KPIs: number of customers (companies), number of potential users.

TIMELINE

All MaaS projects started in November 2020 and will last for 18months.



MECHELEN

OVERVIEW

Within MOBIMIX, Mechelen is implementing two different pilots: shared electric cargo bikes and free access to public and shared mobility for a limited period.

1. **Shared e-cargobikes**

Mechelen has already experimented with shared e-cargo bikes through a previous European project. The initial MOBIMIX tender, launched mid-November 2020, proved unsuccessful and the city did not receive any proposals. To solve this issue, Mechelen contacted potentially interested providers, trying to reach a satisfactory agreement for both parties. Finally, Mechelen and Cargoroo agreed to continue their previous collaboration. The scheme will now be expanded, from 2 to 9 e-cargo bikes, for an initial agreement of 2 years, continuing beyond the scope of MOBIMIX.

The two existing stations are in the Bethaniënpolder-Auwegemvaart district and the city's ambition is to have the upcoming stations distributed across the city. Mechelen has used a survey to inquire where people would want a cargo bike, allowing the detection of hotspots and guide the station site selection. In addition, the city organised various awareness-raising campaigns and free try-out events, to allow citizens to try e-cargo bikes.

Citizens can rent a bike via the Cargoroo app, paying €1 to unlock and €0.06 per minute or €3.5 per hour. The app allows users to see the battery level. Whenever depleted, Cargoroo typically replaces them during the night. Cargo bikes are equipped with three belts for children and specific baby carriages can also be installed.

2. *Sharing Neighbourhoods*

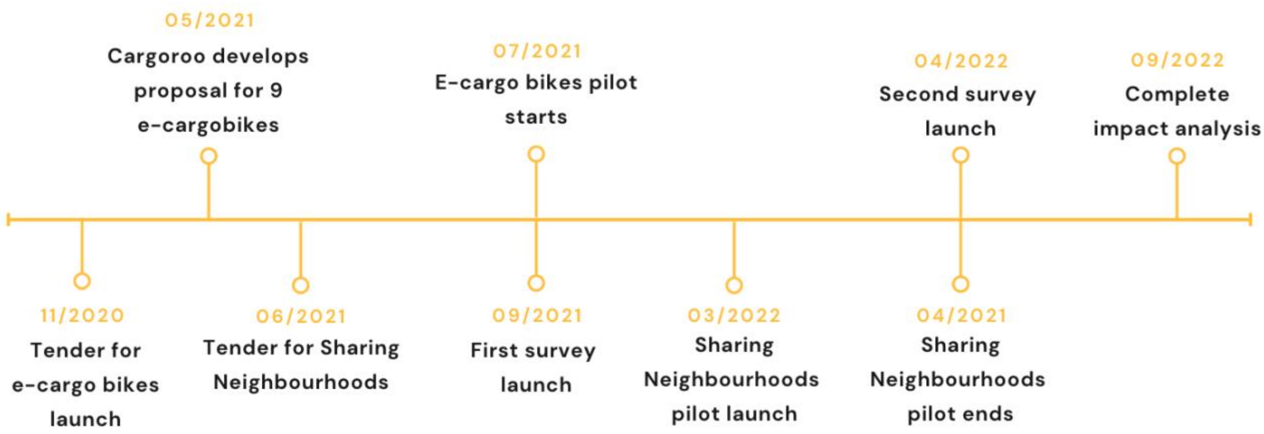
The Sharing Neighbourhoods pilot is the second iteration of a free-mobility experiment conducted by Mechelen in 2019. The city offered free access to public and shared transport modes for 26 people (from 21 households) who agreed to swap car use for more sustainable alternatives for 30 days. Although the majority of the participants did not indicate they would want to dispose of their cars, the pilot was successful in allowing people to experiment with a variety of means of transport. Participants were particularly enthusiastic about the electric cargo bikes, demonstrating the demand for a larger number.

During MOBIMIX, Mechelen wants to expand the pilot from 30days to 2 months, to be able to observe and analyse a longer period. An invitation to a workshop/info session will be sent to all the inhabitants of a specific neighbourhood, and attendees can register for the pilot. The pilot will be closed, allowing only the ones registered to participate.

Initially, the tender deadline for mobility providers was set up for the 1st of June 2021, and the pilot was planned for September-October 2021. However, due to the uncertainty caused by the COVID-19 pandemic, the city has decided to postpone the pilot launch until March 2022.

The tender winner will set up collaborations, runs test trials, conducts surveys, and act as an umbrella association integrating the different shared mobility providers.

TIMELINE



NORFOLK

OVERVIEW

1. Electric scooters and training

Looking to support a 'green restart' of local travel, Norfolk County Council launched two shared e-scooter pilots, one in Norwich and the second in Great Yarmouth. This marks a change towards embracing more diverse micro-mobility solutions, as the use of privately owned e-scooters is still forbidden on public roads. The two operators - Beryl and Ginger – started deploying e-scooters in September 2020, and April 2021 respectively. There are currently 60 e-scooters, and the aim is to double this number.

To avoid issues encountered in other cities, Norfolk has been looking at measures that ensure the safe and legal use of e-scooters (e.g., rental and return to designated parking bays only, geofencing and fining use in prohibited areas such as pedestrianised streets, capped top speed, valid driving license required, etc.). In addition, the city is developing an e-scooter training in partnership with the Bikeability Trust. There is already an intro module and following a procurement exercise in April, the city is also working to provide a digital package.

To reduce the carbon emissions associated with retrieval and redistribution[5], e-scooters are transported by cargo bikes. Besides, some preliminary survey results gathered by

[5] Hollingsworth et al. (2019). Are e-scooters polluters? The environmental impacts of shared dockless electric scooters. *Environ. Res. Lett.* 14 084031

operators are promising. Although previous studies[6] have shown that e-scooters might replace other sustainable modes of transport, the first round of data collected in Norfolk seems to suggest differently. The average e-scooter trip is considerably longer than the average walking trip (3.8 km compared to 1.8 km). Equally, the usage of shared bikes and e-bikes does not seem to have decreased. In addition, 24% of e-scooter trips would have otherwise been done by car. Adding to these encouraging numbers, the injury rates have been very low.

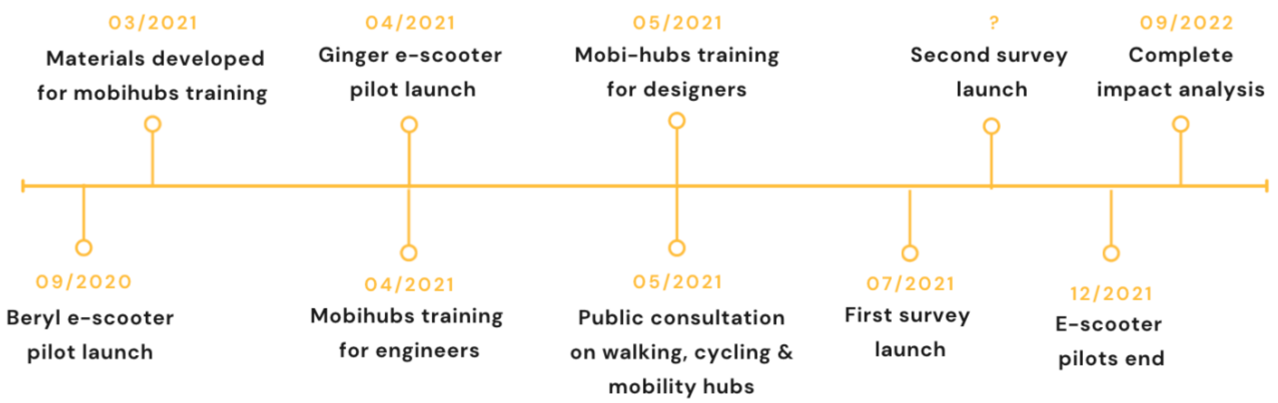
2. Community designed mobihubs

Norfolk is currently creating mobility hubs to facilitate multimodality. Two sites have been already selected – the train and bus stations, and a third is being considered – the university campus (which includes a hospital & a research centre). Norfolk is working closely with CoMoUK to get the accreditation that upholds a collectively agreed set of standards across the industry.

In addition, Norfolk partnered with Healthy Streets, experts of people-focused design, to improve walking, cycling, & mobihub schemes. Healthy Streets developed training materials at the beginning of 2021. The first round of training targeted the wider team (online, approximately 100 employees and 30 designers with the County Council), while the second focused on the engineers who are developing and building mobihubs.

The pilot also includes public engagement, through consultation on the walking & cycling strategy which touches upon mobihubs as well. The detailed design of new mobility hubs and the delivery of improvements is happening between July and December 2021.

TIMELINE



[6] 6t-Bureau de recherche. (2019). Comprendre les usages d'un service de trottinettes électriques en free-floating. Enquête auprès des utilisateurs du service Dott à Paris.

ROTTERDAM

OVERVIEW

Rotterdam is testing three models of carsharing to understand which one (or which combination) is most likely to reduce the number of private cars and improve the quality of air. Since 2021, carsharing schemes can operate only with electric vehicles and the city has defined a new licensing model.

To receive the license, the operators must submit an exploitation plan, committing to:

1. encourage the use of shared vehicles in general and for trips longer than 7.5 kilometres in particular;
2. ensure that the distribution of shared cars is appropriate to the demand;
3. contribute to transport inclusiveness;
4. take care of monitoring, data collection, knowledge-sharing and communication regarding the use and quality of the service;
5. make users aware of the applicable legislation and regulations;
6. be service-oriented towards both customers and third parties, including in any event residents;
7. be accessible and guarantees communication with users, the municipality and third parties, including in any event residents;
8. deal with complaints and reports within 24 hours;
9. participate in a six-monthly evaluation discussion with the municipality;
10. make use of an open standard and share anonymised travel data with the municipality;
11. carry out an annual survey of the users of the service, including the aspects of modal shift, effects on car use, trends and developments in the users' travel behaviour.

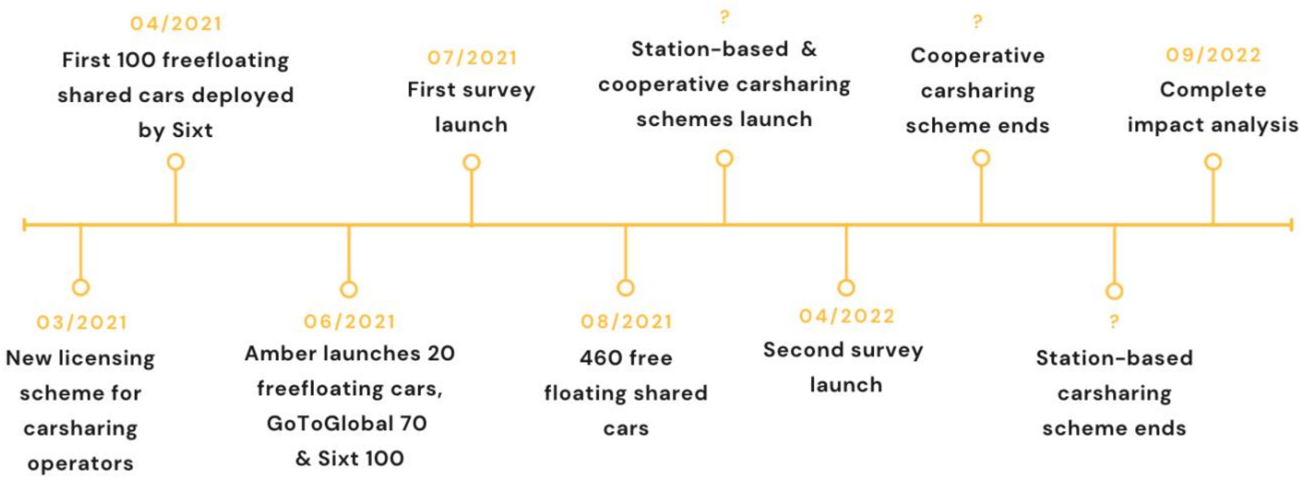
The **free-floating** model allows up to 600 electric vehicles, initially for 1 year (but to continue beyond the MOBIMIX timeframe). Three providers signed up and received positive feedback on their exploitation plans. Each of them can deploy maximum 200 vehicles, and the first cars have been on Rotterdam's streets starting with 1st April 2021. All providers were required to start operating before June and to roll out the entire fleet agreed within three months. In addition, the city and the operators signed a data licensing agreement, requiring carsharing operators to provide quarterly dashboards.

Sixt was the first to bring 100 vehicles in April, aiming to grow to a fleet of 200. Amber aims to launch the first 20 cars in June, and then increase their assets in sets of 10-15 cars, to eventually reach 60. GoToGlobal also aims to have its first 70 shared vehicles by the end of June. It will reach 200 shared cars within 2 months by deployed two more sets of 65 vehicles each.

Rotterdam is also aiming to experiment with a **station based** carsharing model. The location would be in Kruispleingarage, where maximum 20 cars located could operate for one year.

The third pilot is a small scale, neighbourhood-based **cooperative** model, that could potentially last for 6 months. However, for these two, the mobility providers have not been selected yet.

TIMELINE



VALENCIENNES

OVERVIEW

Within MOBIMIX, Valenciennes Métropole is implementing two mobility hubs to improve access to sustainable and shared mobility. Valenciennes has chosen two pilot sites: the Nungesser / Pompidou P&R, and the Mont Houy / Transalley Campus.

The Nungesser / Pompidou P&R was created together with the opening of the tram line n° 1. Located in a dense urban area near the city centre and close to a shopping centre, this mobihub could expand the mobility solutions and encourage active modes for citizens to reach the downtown.

The Mont Houy / Transalley Campus is part of 3 municipalities (Aulnoy-lez-Valenciennes, Famars and Trith-Saint-Léger), covering 79ha. The site is mixed-use, hosting an innovation park dedicated to sustainable mobility, teaching and research institutions, 2 university housing units and 2 restaurants. Pre-pandemic, the site received nearly 8500 users (7000 students and 1500 employees). The mobihub would facilitate multimodal trips within and outside of the campus, increasing access to training, education and employment.

Each site will be equipped with a mobihub, which is expected to provide:

- easy access to public transport;

- shared mobility options: shared bikes, shared e-scooters, shared cars and carpooling;

- a range of services to improve the mobility offer and user experience (e.g., passenger information totem, signage, waiting area, electric charging station, bicycle parking, etc.);

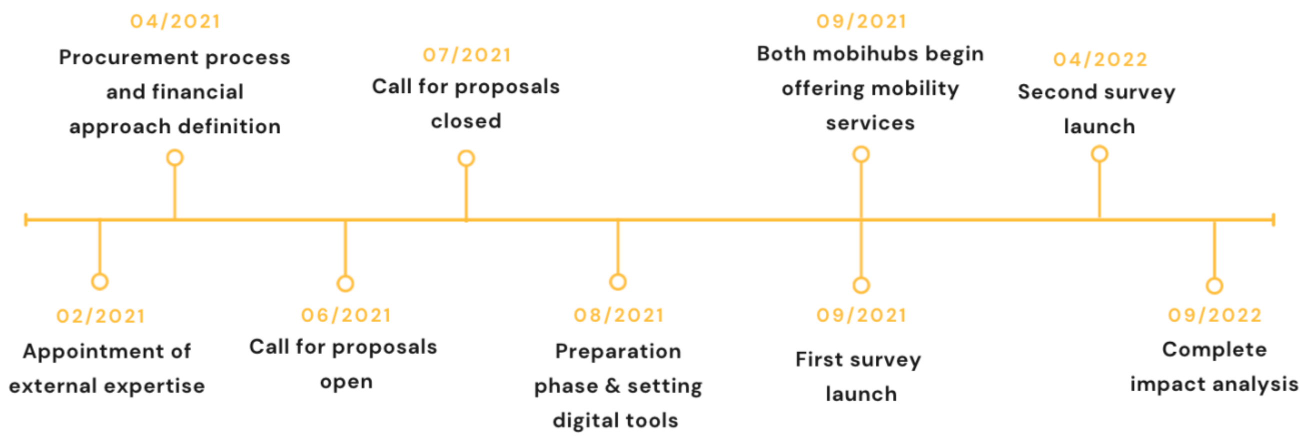
- a range of other extra services (e.g., restaurant/café/snack options, lockers, delivery services, etc.).

For these sites, Valenciennes Métropole launched a call for proposals on 1st June 2021 and operators have one month to apply. The application should focus on one or both axes that the city defined:

1. Shared mobility services (free-floating) and digital tools to support intermodal practices
2. Service innovation to optimize and promote intermodal travel

These two pilots will last between 12 and 18 months. They will help the city track, analyse and understand the impact that a multimodal offer has on congestion and CO_2 emissions, as well as on (private) car use. The results will help to improve the current design of mobihubs, and to guide the development of other future sites. Through this project, Valenciennes Métropole will also benefit from expanding its experience of collaborating with private shared mobility operators.

TIMELINE



PRELIMINARY FORECAST

EXPLORATORY IMPACT EVALUATION

Info at the city level has been gathered using desk research and conversations with city officials, including available information from shared mobility providers' dashboards. This information includes the number of shared vehicles deployed in each pilot (or the number of shared vehicles affected by it, in the case of the mobihubs, MaaS and Sharing Neighbourhoods), and how each shared mobility vehicle is used, as described in Table 1.

Based on this, we get the amount of vehicle-passenger-km (VKM_i) per shared mobility solution (i) by multiplying the number of shared-vehicles deployed (Veh_i), the number of users per vehicle (UPV_i), the number of trips per user in one year (TPU_i), and the average distance travelled per each trip (DPT_i).

$$VKM_i = Veh_i * UPV_i * TPU_i * DPT_i$$

The modal shift effect of each shared mobility solution on the number of replaced VKM is reported in Table 2.[7]

If replaced VKM per transport mode is reported for each of the solutions based on the available evidence reported in the studies collected in the impact repository. For example, for the case of shared bikes, the impacts are computed mostly based on CoMo UK surveys and additional references included in the *impact repository*. In this regard, it is important to stress that available evidence might be slightly over-optimistic about the potential behavioural changes induced by shared mobility services. Most studies included in our impact repository provide naïve before after descriptive measures, failing to account for confounding factors. Most studies disregard factors simultaneously affecting users and non-users, and the systematic differences between those who enrol and those who don't. Thus, these studies might be offering upward biased figures for the different impacts considered, that can only be accurately assessed when information on pre- and post-pilot survey data is available.

Given the variability of described impacts, we also report the standard deviation, useful to assess the sensitivity of our estimates to changes in the assumptions and how likely it is that we reach a given carbon emission reduction (risk analysis). Where information on impact figures dispersion was not available, we apply the same ratios between mean and standard deviation as the closest shared mobility service. Specifically, this is applied to cargo bikes (using shared bikes data) and to free-floating carsharing (using the station-based data).

[7] Please, note that percentages refer to the amount of travel shifting from a specific mode to the new mobility solution made available. So percentages across modes are independent of each other and do not need to add up to 100%.

TABLE 1. INFORMATION ON PILOT AND MOBILITY CHARACTERISTICS FOR EACH CITY

	ANTWERP		NORFOLK				ROTTERDAM				MECHELEN				VALENCIENNES	
	MaaS		eScooters		Mobihub		Carsharing (FF)		Carsharing (SB)		Cargo bikes		Sharing Neighbourhoods		Mobihub	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
Number of shared-bikes deployed =	**4812**		0		**50**		0						**15**		**100**	
Number of users/vehicle =	28,93	47,88			23,12	47,88							28,93	47,88	28,93	47,88
Trips per user (per year) =	34,45	45,52			74,19	45,52							34,45	45,52	150	45,52
Average distance (km)/trip =	2,03	0,73			3	0,73							2,03	0,73	2,03	0,73
Number of cargo bikes deployed =	0		0		0		0				**9**		**3**			
Number of users/vehicle =											66,5	31	66,5	31		
Trips per user (per year) =											2	5	2	5		
Average distance (km)/trip =											23,1	10	23,1	10		
Number of shared e-scooters deployed =	**1400**		**120**		**10**		0						**10**		**20**	
Number of users/vehicle =	130,65	26,13	130,65	26,13	130,65	26,13							130,65	26,13	130,65	26,13
Trips per user (per year) =	21,51	4,3	21,51	4,3	21,51	4,3							21,51	4,3	21,51	4,3
Average distance (km)/trip =	3,8	0,76	3,8	0,76	3,8	0,76							3,8	0,76	3,8	0,76
Number of shared cars deployed =	**631**		0		**2**		**460**		**22**				**5**			
Number of users/vehicle =	121,46	53,035			88,99	27,19	153,93	78,88	88,99	27,19			88,99	27,19		
Trips per user (per year) =	9,54	5,39			2,54	0,25	16,54	10,53	2,54	0,25			2,54	0,25		
Average distance (km)/trip =	12,58	9,37			18,48	17,93	6,68	0,81	18,48	17,93			18,48	17,93		
Type of car =	EV				EV		EV		EV							
Type of service =	FF				SB		FF		SB				SB			

Notes: Acronyms in the table should be interpreted as follows, s.d. : standard deviation, EV : electric vechiles, FF : free-floating, SB : station-based

In Table 2 we also report the change factors in car ownership (CF_{carown}), as an additional reduction in VKM can be achieved through the reduction of car ownership levels induced by the shared mobility solutions. Again, the previous disclaimer applies concerning the robustness of the studies on the impacts of shared mobility on car ownership, where even the most recent evidence fails to account for self-selection bias.[8] We compute such reduction based on the number of potential users affected, given by the multiplication of the number shared mobility vehicles (Veh_i) and users per vehicle (UPV_i), and multiplying it by the baseline motorization rates (MR), measured as the number of registered cars per inhabitant, the average utilization rate (AUR) given as the km travelled per year. Again, with AUR figures, we are implicitly assuming that all the vehicle-km previously done by car are forgone, while consumers might adapt their behaviour and still use cars for part of it besides carsharing through car rentals. In any case, assumed figures are reported for each city in Table 3.

TABLE 2. TRAVEL BEHAVIOUR CHANGE FACTORS FOR EACH SHARED MOBILITY SOLUTION. PROPORTION OF TRAVELLERS THAT USE EACH MOBILITY SOLUTION AND PREVIOUSLY USED ANOTHER TRANSPORT MODE.

	Shared bikes		**Cargo bikes**		**e-Scooters**		**Carsharing**			
							Station-based		Free-floating	
	Change	s.d.	Change	s.d.	Change	s.d.	Change	s.d.	Change	s.d.
Replaced CAR	-12%	7%	-46%	27%	-24%	15%	-33%	21%	-24%	21%
Replaced TRANSIT	-40%	18%	-10%	5%	-21%	12%	-33%	12%	-33%	12%
Replaced BIKE	-8%	3%	-28%	11%	-19%	17%	-8%	8%	-8%	8%
Replaced WALKING	-30%	13%	-3%	1%	-41%	11%	-15%	0%	-15%	0%
Car ownership	0%	0%	0%	0%	0%	0%	-22%	18%	-6%	2%

TABLE 3. MOTORIZATION RATES AND AVERAGE CAR USAGE IN EACH CITY

City:	**ANTWERP**	**NORFOLK**	**ROTTERDAM**	**MECHELEN**	**VALENCIENNES**
Car ownership level (vehicles/inhabitants)	0,385	0,432	0,570	0,401	0,512
Average use per year (km/car)	13900	12000	13700	13900	11656

Both modal shift and car ownership changes in VKM can be translated into changes in CO_2 using the appropriate differential on emission factors from the original transport mode (j) to the shared mobility solution (i), which will be notated as ΔEF_i^j. These factors for each transport option are derived from DGMOVE (2019), using COPERT database,

[8] Becker, H., Ciari, F., & Axhausen, K. W. (2018). Measuring the car ownership impact of free-floating car-sharing–A case study in Basel, Switzerland. Transportation Research Part D: Transport and Environment, 65, 51-62.

and adapted to a representative vehicle for standard fleets, as described in Table 4.[9] These figures take into consideration the carbon emission associated with GHG (CO_2, N2O & CH_4), translated to CO_2 equivalent (in grams per vehicle-passenger-km) based on their global warming potential of such gases.

We made the fair assumption that carsharing emission factors are smaller than standard cars due to newer and more energy-efficient average fleets (even with internal combustion engines).[10] This assumption is also supported by new policy measures observed across European cities (e.g., Rotterdam), which require carsharing operators to operate only electric vehicles. We further assumed that bikes, cargo bikes and e-scooters have a negligible emission factor per vehicle-passenger-km, especially taking into account the level of accuracy of our estimates in this exploratory analysis.[11] Related to this, the uncertainty about the actual values in each city imposes the need to assume some standard deviation, ranging between 20-30% of the mean, to check the sensitivity of our results to variations in emission factors.

TABLE 4. EMISSION FACTORS PER TRANSPORT MODE AND SHARED MOBILITY OPTION (PER VEHICLE-KM TRAVELLED)

		Carsharing							
	CAR	ICE	EV	BUS	TRAIN	BIKE	CARGO BIKE	e-SCOOTER	WALKING
gr CO2/vkm	230	200	57	43	20	0	0	0	0
s.d.:	60	40	15	15	5	0	0	0	0

Note: Within carsharing fleet, ICE refers to internal combustion engines and EV to electric vehicles.

Additionally, it is also relevant to highlight that the emission factor for transit travel is computed for each city based on the assumed share of vehicle-passenger-km undertaken either by bus or rail options (trains, metro, and trams). The assumed shares are described in Table 5.

TABLE 5. SHARE OF VEH-PAX-KM TRAVELLED BY BUS AND RAIL OPTIONS IN EACH CITY

[9] We contrasted these computations making use of the approach described in the CBA handbook of the Catalan Regional Government (available here).

[10] As reported in Table 4, we assumed about a13% lower carbon emissions for the internal combustion engines carsharing cars. This estimation is conservative if we look at the evidence reported by COMO UK suggesting an average 26% lower CO_2 emissions (here).

[11] Note that we just consider the carbon emissions associated to operating the different vehicles. We don't take into account carbon emissions that arise in up- and downstream processes (like energy, vehicle and infrastructure production, and its maintenance and disposal). We do so in order to produce fairer and more conservative analysis, due to the lack of readily available evidence for some of the transport modes included.

CITY:	ANTWERP	NORFOLK	ROTTERDAM	MECHELEN	VALENCIENNES
Share of buses	20%	27%	50%	100%	50%
Share of trains	80%	73%	50%	0%	50%

The final computation of the change in CO2 equivalent emissions (ΔCO_2) is derived from the sum of the total modal shift effect and the car ownership effect over all the shared mobility solutions deployed in each pilot.

$$\Delta CO_2 = \left(\sum_{i \in S} VKM_i \cdot \left[(CF_i^{car} \cdot \Delta EF_i^{car}) + (CF_i^{tran} \cdot \Delta EF_i^{tran}) + \left(CF_i^{bike} \cdot \Delta EF_i^{bike}\right) + (CF_i^{walk} \cdot \Delta EF_i^{walk})\right] + \sum_{i \in S} [Veh_i \cdot UPV_i \cdot CF_i^{carown} \cdot MR \cdot AUR \cdot \Delta EF_i^{car}]\right) \cdot MF$$

Where,

VKM_i	: vehicle-passenger-km per shared mobility solution (i)
CF_i^j	: change factor from mode (j) to mobility solution (i)
ΔEF_i^j	differential on emission factors from mode (j) to mobility solution (i)
Veh_i	: number of shared-vehicles deployed for mobility solution (i)
UPV_i	: number of users per vehicle for mobility solution (i)
MR	: baseline motorization rate (number of registered cars per inhabitant)
AUR	: Average car utilization rate (vehicle-km travelled per year)
MF	: multiplicative factor due to shared solutions physical/digital integration

In this formula, a multiplicative factor (MF) term appears to consider the case of shared mobility solutions that act as integrators of existing ones, either by integrating them in a physical space (like Mobihubs) or a virtual one (like MaaS). In such cases, we assume that the impact of such measures will be given by assuming a multiplicative factor ($MF > 1$) on the use (VKM) of the newly deployed shared mobility vehicles in a given location where integration is conducted. For example, this means that the measurement of the impact of a Mobihub will apply a MF of 1.38 to the VKM generated by the new vehicles brought by the different shared mobility solutions (with a standard deviation equal to 0.24). This figure is based on the evidence available on usage increases due to physically integration[12].

[12] Information provided by CoMo UK regarding observations in Bergen, Amsterdam and The Hague.

Due to the lack of proper evidence on the multiplicative factor for MaaS, we assume that it will be lower than the one assumed for physically integrated services. In our case, we assume a MF = 1.15 (with a standard deviation of 0.20). It is important to stress that in the case of MaaS the multiplicative factor affects the usage of all vehicles integrated into the platform, yet it only applies to the percentage of users enrolled in such platform. This means that the MF is corrected by the share of workers enrolled on smart mobility programs (as an upper bound of the potential impact of the program). In the case of Antwerp, this means that MF is multiplied by 0.094, giving a net multiplicative factor of 0.10 over the whole supply of shared mobility vehicles in the city. Whenever we deal with a non-integratory shared mobility solution (i.e.: bike-sharing, e-scooters or carsharing) we impose that $MF = 1$.

RESULTS

At this stage of the project, without actual data on the effects of the different pilots, our analysis is limited by many unknowns and a great deal of uncertainty on the validity of some of the assumptions made. As its name describes, the exploratory analysis we perform is intended to explore the potential impacts of the different pilots in a short- to long-term scope. Given the data and available evidence limitations, we impose assumptions that need to be tested once survey data is made available. However, we already foresee that the results will most likely deviate towards lower figures than the ones reported in the preliminary forecast due to:

- Impacts on modal shift and car ownership reported in available case studies are likely over-optimistic (no proper causal analysis).
- Regarding car ownership effects, we assumed that all veh-km travelled by forgone cars are also eliminated (even consumers can still use other car options), and the decisions to give up a car will likely arise well beyond the time frame of the pilots (mid- to long-term).
- The assumption that all shared mobility is zero-emission, which might often not be the case. Even for shared zero-emission micro-mobility, the vehicle redistribution can have a significant impact (e.g., if bikes are redistributed across the city by ICE vans, there are CO_2 emissions that are not captured in the current reporting).
- COVID-19 crisis and the associated social distancing measures have triggered behavioural changes that might make assumptions deviate from the ones included here. In particular, the lower level of mobility while the pandemic lasts is also a threat to achieving large carbon emission savings, given surveys will cover the period affected by this new reality

Better information will arise later in the project, with the ex-ante and ex-post evaluations, so figures will be properly updated. However, the exploratory analysis is a useful testbed to assess the key issues that determine carbon emission savings and give a rough first magnitude of the contribution each pilot can make in a best-case scenario.

ANTWERP

The exploratory analysis conducted for the MaaS B2B pilot in Antwerp yields a potential carbon reduction of about 373 tonnes of CO_2 per year. However, this result can be considered an upper bound of the potential impact of the pilot, as we account for the effects of increased use of shared mobility services for the whole subpopulation of employees working in companies adhered to the Smart ways to Antwerp (SwA) and the whole supply of shared vehicles available in the city. This is equivalent to consider that 9.4% of the labour force in the metropolitan area enrols into the pilot. This is unlikely to be the case during the pilot, as just part of the companies will decide to join a specific MaaS provider, not all the vehicles will be available through it, and not all employees will adopt it as a viable mobility option.

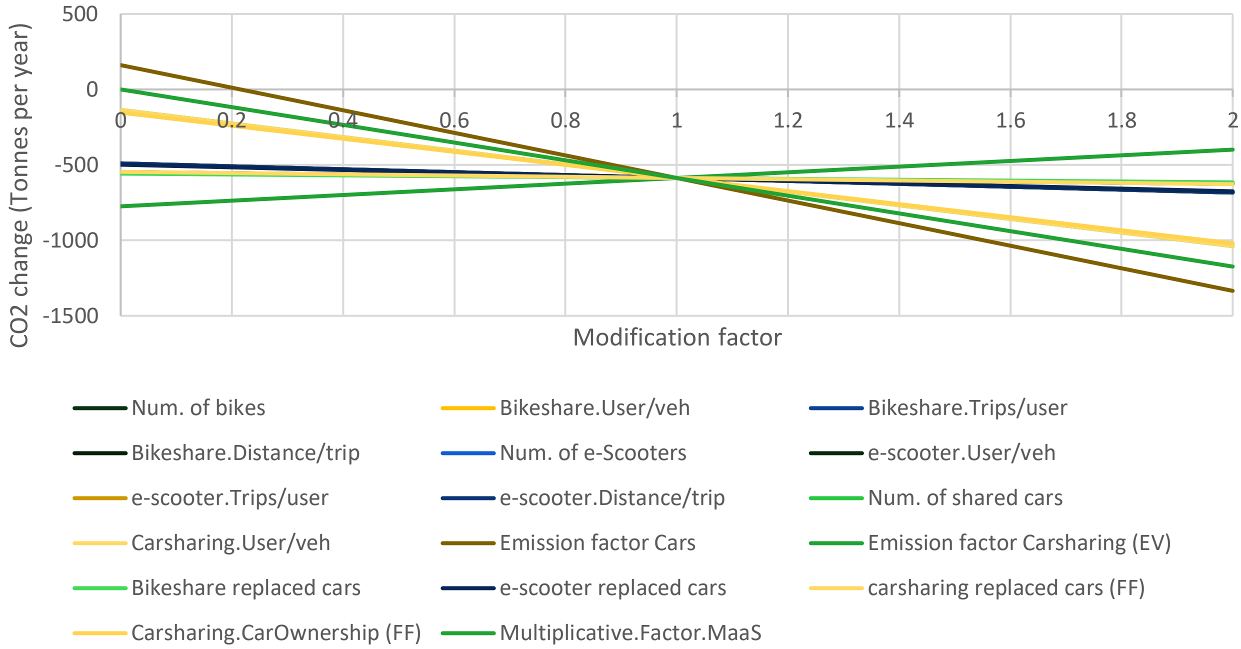
Additionally, the uncertainty in the rest of the values assigned to the inputs of the exploratory analysis forces us to explore how the estimated impacts vary with deviations in each of them. Such analysis suggests that carbon emission savings for the MaaS B2B pilot are most sensitive to deviations in the emission factor for cars, the emission factor of the carsharing fleet (EVs) and the multiplicative factor associated with integrations of services into a MaaS platform.

In this regard, reported in terms of elasticity of carbon saving to each input variable, a 1% reduction in the emission factor of cars (200gr/km) will yield a 1.24% loss in the computed carbon emission savings. The sensitivity to carsharing EVs emission factor (57 gr/km) is similarly relevant with 1% increase leading to a 0.3% reduction in carbon emissions. Although here we explore individual changes in those inputs, the real relevant effect derives from the combination of both, as they yield the actual savings in emission factors due to behavioural change. Besides this, we need to stress that the computations have been done considering just carsharing fleets with EVs, although some of the operators do also offer ICE vehicles. Moreover, changes in the multiplicative factor (increase in utilization concerning non-integrated shared services) show a similar relation but with an exactly proportional change, meaning a 1% reduction in the multiplicative factor reduces the saving by an equivalent 1%.[13] Additionally, the effect of the change in other variables like the impact of carsharing on car ownership levels, the number of users per vehicle, or other impact factors assumed is summarized in more detail in

[13] As a reminder, it is important to stress that the multiplicative factor has been approximated due to the lack of evidence. We set it lower than the one accounted for the physical integration of shared services (Mobihub).

Figure 3. Such figure relates the change in carbon emission for the pilot (vertical axis) given a specific input is corrected by the modification factor (horizontal axis), meaning that values higher than 1 are increases and values below 1 imply reductions.[14]

FIGURE 3. ANTWERP. SENSITIVITY ANALYSIS ON THE IMPACT OF THE MAAS PILOT PROGRAM ON CARBON EMISSIONS (INCLUDING CAR OWNERSHIP EFFECT)



Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

As a summary, Table 6 shows a comparison of the preliminary impact forecast for carbon emissions and car travel vehicle-km for both long-term and short-term approaches, where the short-term one disregards the effect associated with car ownership change.

[14] Applying a modification factor of 1.2 is equivalent to increase a given input by 20% of its original value, while using a modification factor of 0.8 is equivalent to decreasing its original value by 20%.

TABLE 6. ANTWERP. SUMMARY OF SHORT- AND LONG-TERM PRELIMINARY IMPACTS FORECAST

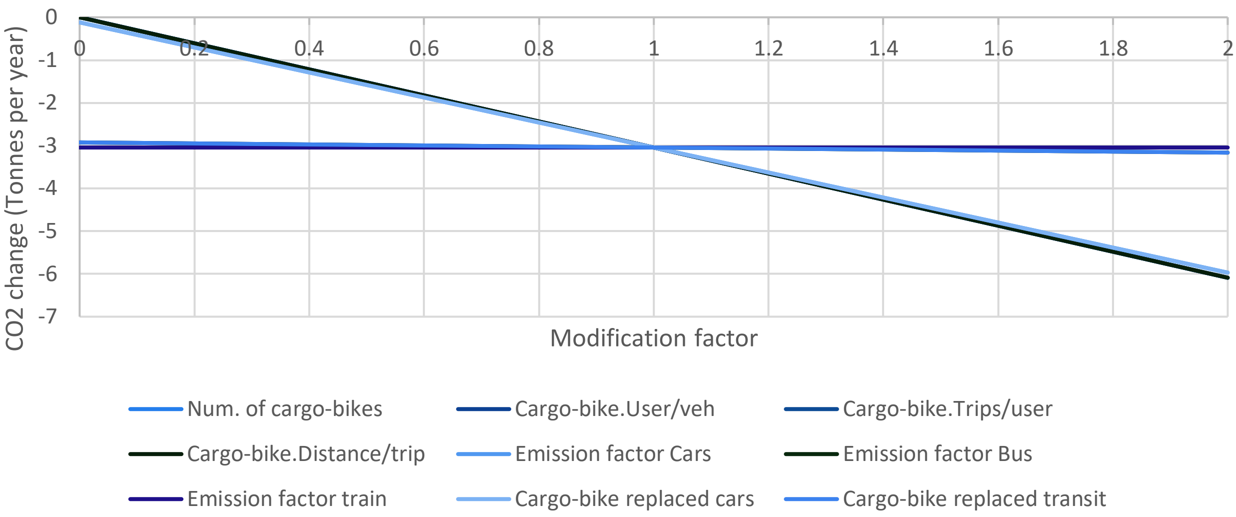
	Long-term	**Short-term**
$\Delta\boldsymbol{CO_2}$ (tn/year)	-586	-154
$\Delta\boldsymbol{CAR\ veh - km}$	-2.742.153	-747.074

MECHELEN

The exploratory analysis conducted for the cargo bikes pilot in Mechelen yields a potential carbon reduction of about 3 tonnes of CO_2 saved per year. We believe this estimate is relatively accurate and represents the potential impact of the pilot. This stems from the fact that the data inputs for its computation have been extracted from the dashboard of a couple of cargo bikes already deployed by the same operator in the city.

However, given the increase in the number of vehicles deployed and their location, it is useful to conduct a sensitivity analysis to assess how changes in the most relevant inputs can change the estimated carbon emission reductions, as the newly deployed vehicles might bring in more and/or different users (travel patterns). Figure 4 offers a graphical description of the impact of multiplying original input values by a modification factor on the pilot outcomes in terms of changes in carbon emissions. The sensitivity analysis suggests that the number of vehicles, users per vehicle, trips per user, and the distance per trip are the most sensitive factors. Increases by 1% in such factors imply an increase by an equivalent 1% in carbon emission savings. Other inputs like the impact factor that determines the number of replaced car trips, and the emission factor of cars are the most sensitive factors. They show sensitivities in a similar range, but slightly smaller, where a 1% increase in those inputs yields a 0.96% in carbon emission reduction. Other inputs, like the change factor from transit and the emission factor for buses, play almost no role at an aggregate level.

FIGURE 4. MECHELEN. SENSITIVITY ANALYSIS ON THE IMPACT OF THE CARGO BIKES PILOT PROGRAM ON CARBON EMISSIONS



Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

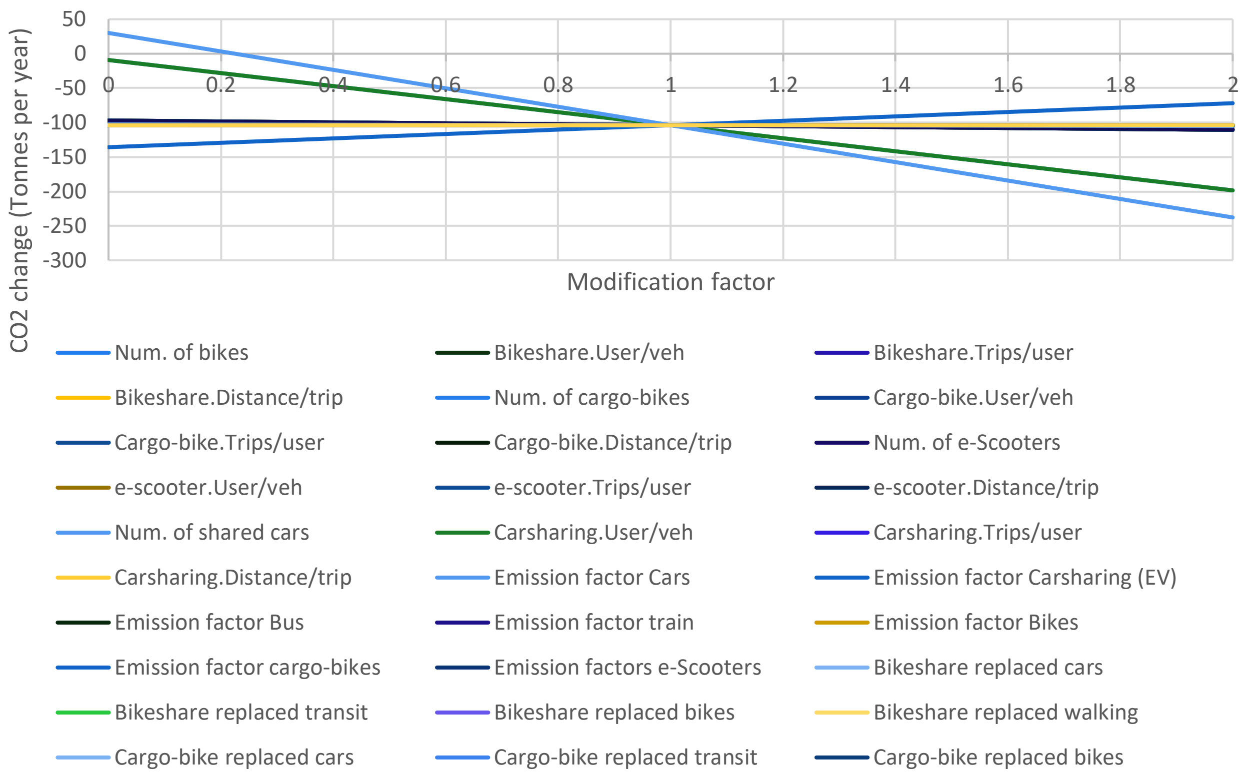
The exploratory analysis conducted for the '*Sharing neighbourhood*' pilot yields carbon emission savings of around 104 tonnes of CO_2 per year. However, this figure can be challenged from opposed perspectives. On the one hand, most of these savings derive from the impact of carsharing on car ownership. Especially in this specific pilot, with an extremely restricted time window, it is unlikely that such mid- to long-term behavioural adaptation can be achieved. The previous figure must be understood as the potential impact sharing neighbourhood's pilot might have if extended. If we disregard the car ownership impact, carbon emissions savings will be reduced to 10 tonnes of CO_2 per year. On the other hand, the assumed impacts might be higher due to our analysis not integrating the fact that shared mobility vehicles would be made available for free to residents in a specific area. We could not assess the impact of this specific pricing scheme due to the lack of available equivalent evidence in the impact repository. Additionally, given this pilot will be active for just 2 months, the share of the short-term impact that arises during this period would be about 1.6 tonnes of CO_2.

The uncertainty about the considerations included in our analysis makes it mandatory to conduct a sensitivity analysis, to check how changes in the original values of the inputs used might make carbon emission savings deviate. Figure offers a complete graphical exploration of the sensitivity of results to the changes in the relevant inputs. The analysis suggests that the most sensitive inputs are emission factor for cars, the number of shared cars, the number of users per carsharing vehicle, and the change factor in car ownership due to carsharing. These factors enter carbon emission computations both from a pure travel substitution effect and through car ownership reduction (the latter being the one with a larger impact). In particular, an increase in car emission factors by

1% implies an increase in carbon emission savings by 1.3%. For the other previously mentioned inputs, a 1% increase yields a 0.9% increase in carbon emission savings. Other factors show much smaller sensitivities, as described in the figure below.

As a summary, Table 7 shows a comparison of the preliminary impact forecast for carbon emissions and car travel vehicle-km for both long-term and short-term approaches, where the short-term one disregards the effect associated with car ownership change.

FIGURE 5. MECHELEN. SENSITIVITY ANALYSIS ON THE IMPACT OF THE SHARING NEIGHBOURHOODS PILOT PROGRAM ON CARBON EMISSIONS (INCLUDING CAR OWNERSHIP EFFECT)



Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

TABLE 7. MECHELEN. SUMMARY OF SHORT- AND LONG-TERM PRELIMINARY IMPACTS FORECAST

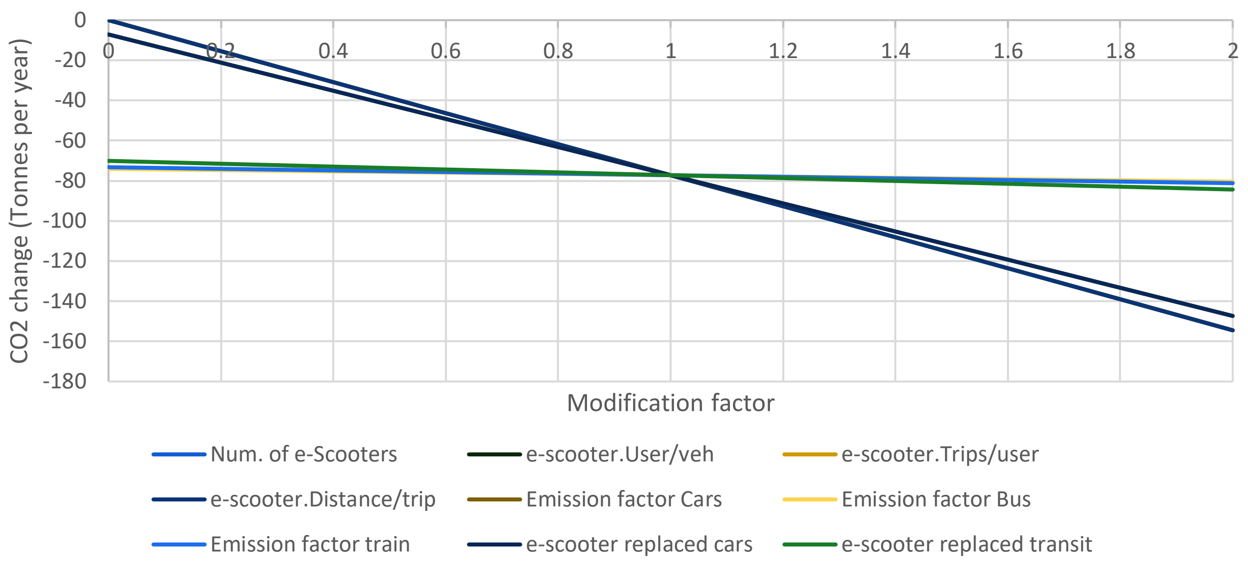
		Long-term	**Short-term**
Cargo bikes	$\Delta \boldsymbol{CO_2}$ (tn/year)		-3
	$\Delta \boldsymbol{CAR\ veh-km}$		-12.719
Sharing neighbourhoods	ΔCO_2 (tn/year)	-104	-10
	$\Delta \boldsymbol{CAR\ veh-km}$	-582.179	-40.124

NORFOLK

The exploratory analysis conducted for the e-scooter program pilot introduced in Norfolk yields a potential carbon reduction of about 77 tonnes of CO_2 per year. These results do not account for any additional effect that the training programmes associated with the e-scooter services might yield, as we expect them to have a higher impact on other dimensions (i.e.: road safety), rather than carbon emissions. Savings on carbon emissions might be observed in the long-term, as behaviour changes, yet it will be difficult to calculate precisely the role played by the training programmes.

Additionally, the uncertainty about the actual value for several of the inputs used in the calculations recommends we conduct a sensitivity analysis. Figure 6 graphically summarizes the effects on carbon emissions savings due to modifications in the original value of inputs used in the analysis. This shows how the most sensitive inputs are the number of e-scooters, the user per vehicle rate, trips per user and average distance travelled. For all of them, a 1% increase translates into a 1% increase in carbon emission savings. Additionally, a 1% increase in either car emission factor or the substitution percentage between cars and e-scooters (change factor) yield a 0.9% increase in carbon emission savings. Changes in the rest of the input factors appearing in Figure 6 have a marginal effect on the level of carbon emission savings on their own.

FIGURE 6. NORFOLK. SENSITIVITY ANALYSIS ON THE IMPACT OF THE E-SCOOTER PILOT PROGRAM ON CARBON EMISSIONS



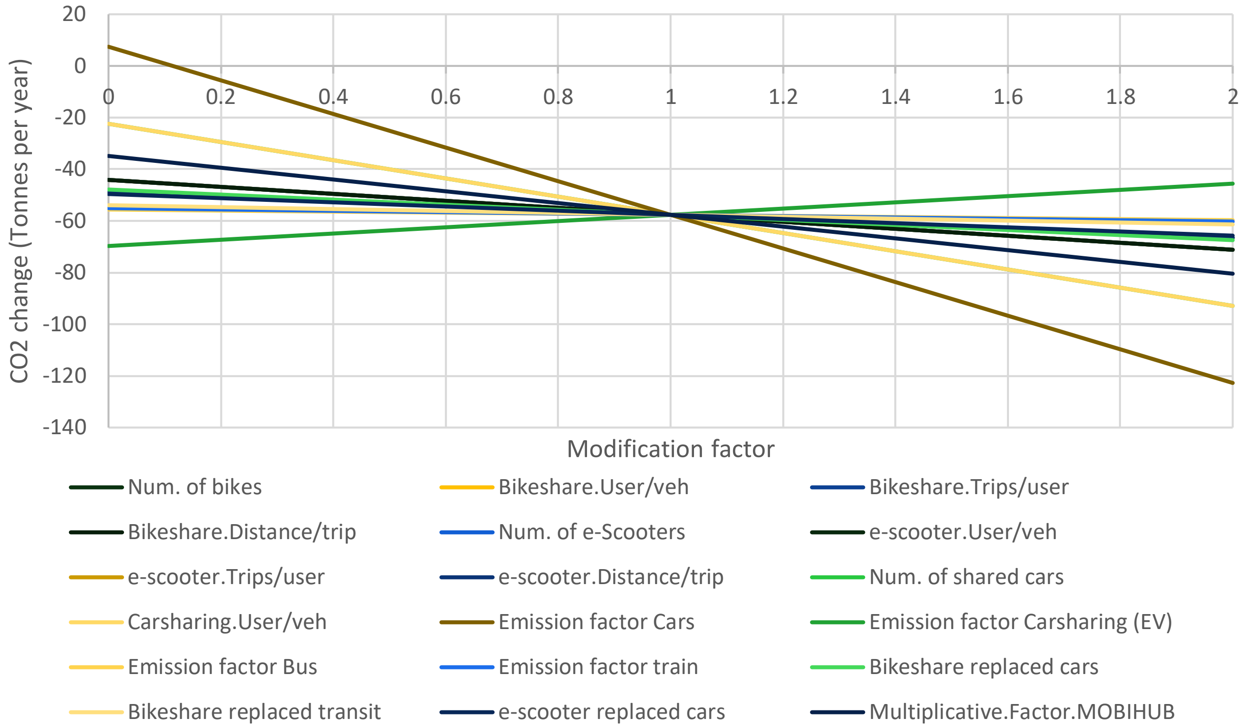
Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

The exploratory analysis conducted for the Mobihubs pilot in Norfolk yields a carbon emission savings of 58 tonnes of CO_2 per year.

The sensitivity analysis for this specific pilot suggests that results are most sensitive to car emission factors, as it affects both the contribution of modal shift and car ownership. A 1% increase in car emission factor implies a 1.13% increase in carbon emission savings. Slightly less sensitive are changes in the number of shared cars, the number of users per vehicle, where a 1% increase implies a 0.6% increase in emission savings. Along the same line, a 1% increase in the estimates of the carsharing effect on car ownership implies a 0.6% increase in carbon emission savings. Additionally, it is important to note that disregarding completely this effect, the carbon emission savings will lower down to just 23 tonnes of CO_2 per year, in a similar way as seen across the pilots previously discussed.

Other inputs do also have an impact on results sensitivity. An increase of 1% in the multiplicative factor assumed for physical integration (Mobihubs) implies a 0.4% increase in carbon emission savings. The number of shared bikes, users per bike, trips per user, distance per trip and carsharing fleet (EVs) emission factors all imply 0.2% increase in carbon emission savings per each 1% increase in those inputs. Similarly, the number of e-scooters, users per e-scooter, trips per user and distance per trip increase 0.15% emission savings per each 1% increase in the input values.

FIGURE 7. NORFOLK. SENSITIVITY ANALYSIS ON THE IMPACT OF MOBIHUBS' PILOT ON CARBON EMISSIONS (INCLUDING CAR OWNERSHIP EFFECT)



Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

As a summary, Table 8 shows a comparison of the preliminary impact forecast for carbon emissions and car travel veh-km for both long-term and short-term approaches, where the short-term one disregards the effect associated with car ownership change.

TABLE 8. NORFOLK. SUMMARY OF SHORT- AND LONG-TERM PRELIMINARY IMPACTS FORECAST

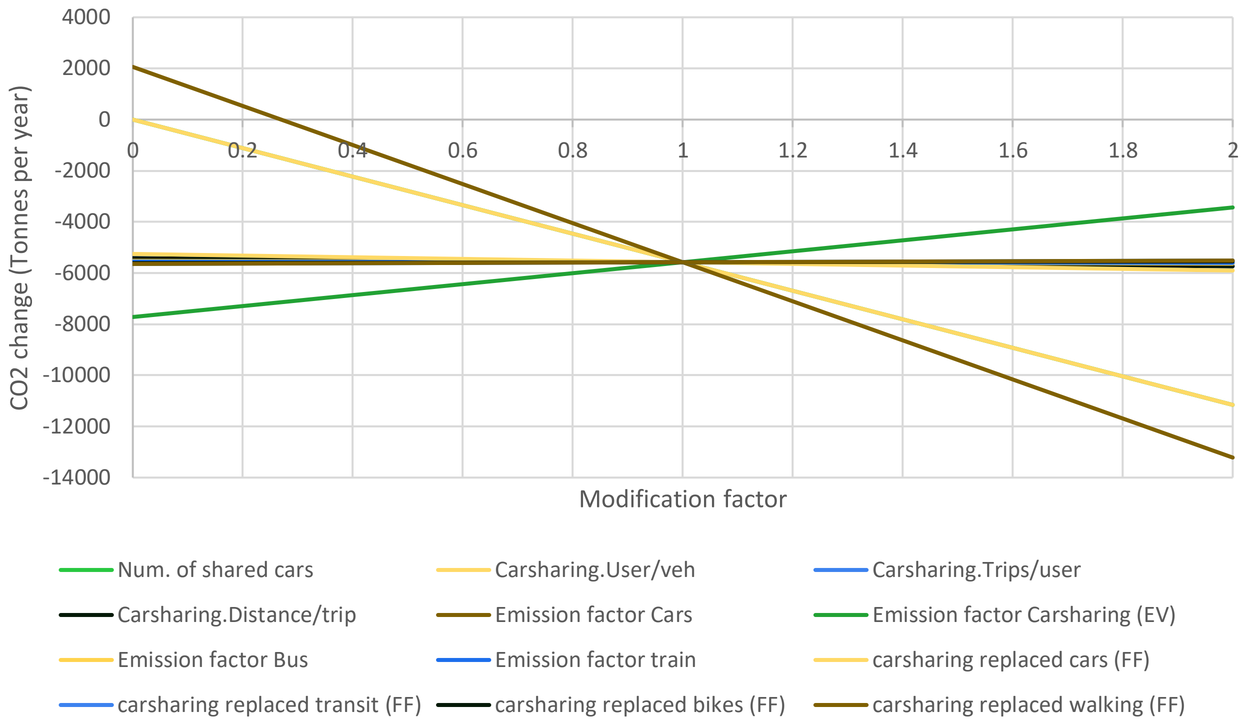
		Long-term	**Short-term**
e-Scooters	ΔCO_2 (tn/year)		-77
	$\Delta CAR\ veh - km$		-304.811
Mobihub	ΔCO_2 (tn/year)	-58	-23
	$\Delta CAR\ veh - km$	-359.544	-81.437

The exploratory analysis conducted for carsharing services operating under free-floating conditions yield a reduction in carbon emission of about 5579 tonnes of CO2 per year.

This figure is huge due to the large number of shared cars deployed and the substantial implicit reduction in car ownership levels considered in our analysis. If we completely disregard the effects of carsharing on car ownership, the figures will dramatically decrease to just 158 tonnes of carbon emission savings per year. It is important to highlight once more that the evidence gathered in our impact repository on the effect on car ownership reduction is slightly overoptimistic. No proper robust causal impact estimates are available in the literature, as most studies base their estimates on simple naïve before-after comparisons, do not properly control for confounding factors and self-selection bias. We expect to improve such estimation in the ex-post evaluation based on surveys, which will most likely reduce the carbon emission saving reported before.

Due to this limitation, and the fact the high uncertainty arises concerning other inputs used in our analysis, we conduct a sensitivity test to check how changes in the original values of the different relevant inputs affect the carbon emission savings estimated for this pilot. Figure 8 offers a graphical plot of such analysis. It suggests that the most sensitive inputs are the cars emission factor, the number of shared cars, the number of users per car and the effect on car ownership. A 1% increase in car emission factor increases the carbon emission savings by 1.4%; while a 1% change in the other mentioned inputs implies an equivalent 1% increase in emission savings. The emission factor for carsharing vehicles (EVs) is also relevant, and a 1% increase leads to a 0.4% reduction in carbon emission savings. The rest of the input variables have a comparatively marginal effect on the sensitivity of the results, given the large weight of the emission reduction associated with car ownership with respect to the reduction due to modal shift.

FIGURE 8. ROTTERDAM. SENSITIVITY ANALYSIS ON THE IMPACT OF CARSHARING (FREE-FLOATING) PILOT ON CARBON EMISSIONS (INCLUDING CAR OWNERSHIP EFFECT)

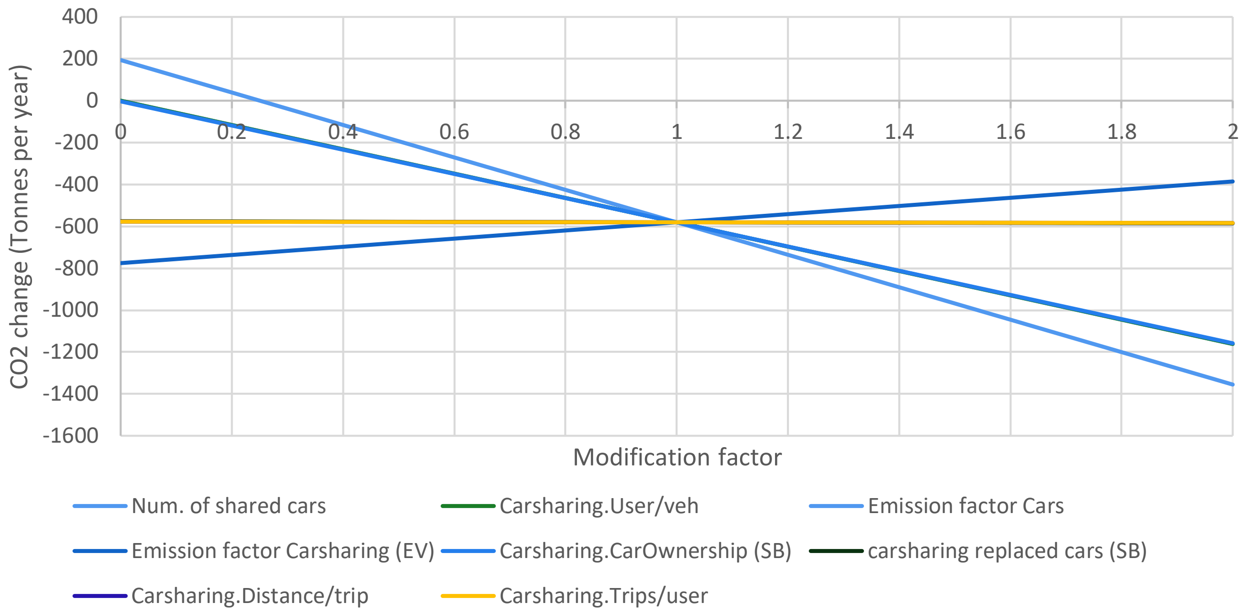


Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

The exploratory analysis conducted for carsharing services operating under a station-based scheme yields carbon emission savings of around 581 tonnes of CO_2 per year. Here too, the effect that dominates is car ownership induced savings, rather than modal shift.

The sensitivity analysis suggests that, as before, results are dependent on a few relevant inputs. Figure 9 shows that a 1% increase in car emission factor implies a 1.3% increase in carbon emission savings. Similarly, a 1% increase in the number of shared cars, users per shared car, and the effect on car ownership yields a 1% increase in emission savings. A 1% increase in carsharing fleet emission factor (EVs) yields an increase of 0.3% in emission savings.

FIGURE 9. ROTTERDAM. SENSITIVITY ANALYSIS ON THE IMPACT OF CARSHARING (STATION-BASED) PILOT ON CARBON EMISSIONS (INCLUDING CAR OWNERSHIP EFFECT)



Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

Taking advantage of the differentiated pilot schemes deployed in Rotterdam, we make a comparative analysis of the impacts associated with free-floating and station-based carsharing options. In this case, we use an equivalent number of cars deployed in the station-based pilot (22) to compute the carbon emission savings of the same amount of free-floating shared cars. This yields a saving of 267 tonnes of CO_2 per year. Comparing previous results, we get that the carbon emission saving rate lays around 12 tonnes/car in the case of free-floating and 26 tonnes/car for station-based schemes. The difference in emission savings is mostly driven by the differential effect on car ownership in favour of station-based options (threefold larger car ownership reduction). Free-floating schemes seem able to attract a larger number of users with more veh-km travelled. However, given the assumed equivalent substitution effect with sustainable mobility modes, those extra savings can not compensate for the big difference in car ownership change.

In this regard, given the over-optimistic estimates of carsharing impact on car ownership, it is likely that updates of the analysis based on ex-post evaluation are likely to yield shorter differentials between both carsharing options. Exemplification of this is the fact that completely removing car ownership effects (and holding everything else as assumed) yields an annual 7 tonnes of CO2 saving for the free-floating option and just 3 tonnes for the station-based option. We believe that these figures are the most credible impact estimates that can be expected within the short time framework of the pilots. The true mid- to long-term impact (if pilots are maintained) would lay somewhere in between the figures reported for both extreme scenarios (with and without car ownership effects).

As a summary, Table 9 shows a comparison of the preliminary impact forecast for carbon emissions and car travel veh-km for both long-term and short-term approaches, where the short-term one disregards the effect associated with car ownership change.

TABLE 9. ROTTERDAM. SUMMARY OF SHORT- AND LONG-TERM PRELIMINARY IMPACTS FORECAST

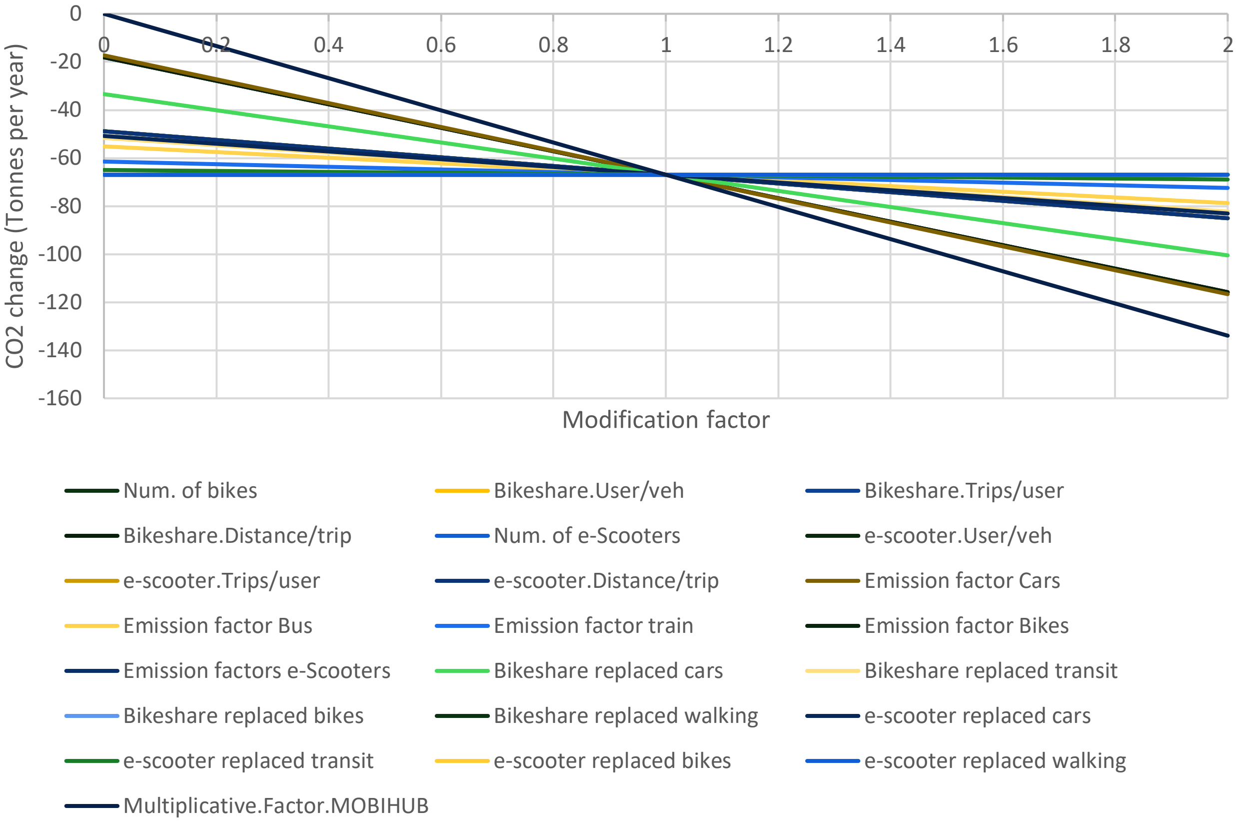
		Long-term	**Short-term**
Carsharing (free-floating)	$\Delta \boldsymbol{CO_2}$ (tn/year)	-5.579	-158
	$\Delta \boldsymbol{CAR\ veh-km}$	-33.210.765	-1.877.605
Carsharing (station-based)	$\Delta \boldsymbol{CO_2}$ (tn/year)	-581	-3
	$\Delta \boldsymbol{CAR\ veh-km}$	-3.368.049	-30.103

VALENCIENNES

The exploratory analysis for the deployment of Mobihubs in Valenciennes yields a carbon emission reduction of 67 tonnes per year.

In this case, the estimates are not affected by over-optimism as no car ownership effects are included given only shared bikes and e-scooters will be deployed. However, a sensitivity analysis is used to investigate the effect of changes in inputs, as reported in Figure 10. This figure shows that the most sensitive input is the multiplicative factor used to account for the physical integration of shared mobility services. In this case, a 1% increase in the value of the multiplicative factor implies an equivalent 1% increase in carbon emission savings. Car emission factor, the number of shared bikes, users per bike, trips per user and distance per trip produce a 0.7% increase per each 1% increase in their value. The substitution factor between car travel and both shared bikes and e-scooters yield a 0.5% increase in carbon emission savings for each 1% increase in their value. As shown in Figure 10, other variables do also have an impact, even it is much smaller.

FIGURE 10. VALENCIENNES. SENSITIVITY ANALYSIS ON THE IMPACT OF MOBIHUBS PILOTS ON CARBON EMISSIONS



Note: The horizontal axis shows the modification factor for each specific variable. A modification factor equal to one keeps the input value unchanged. Figures below one reduce it (0.8 is equivalent to a 20% reduction) while figures above one increase it (1.2 is equivalent to a 20% increase). The vertical axis shows the total change in carbon emissions per year by each change in input values.

As a summary, Table 10 shows a comparison of the preliminary impact forecast for carbon emissions and car travel veh-km for both long-term and short-term approaches, where the short-term one disregards the effect associated with car ownership change.

TABLE 10. VALENCIENNES. SUMMARY OF SHORT- AND LONG-TERM PRELIMINARY IMPACTS FORECAST

	Long-term	**Short-term**
ΔCO_2 (tn/year)		-67
$\Delta CAR\ veh-km$		-215.987

MOBI-MIX PROJECT RESULTS SUMMARY

In this section, we aggregate the preliminary forecast results showed before for the different pilots to give a rough estimate of the joint impact within the MOBI-MIX project.

TABLE 11. MOBI-MIX PROJECT RESULTS

TOTALS	Long-term	Short-term	Target
ΔCO_2 (tn/year)	-6.695	-495	-365
$\Delta CAR\ veh-km$	-39.534.069	-3.309.860	-2.600.000

Based on previous computations, we assess that all pilots combined are expected to yield a 495 CO_2 equivalent tonnes/year reduction around their implementation date (short-run) with a reduction of 3,3M vehicle-km travelled by car. Such figures are higher than the initial target of the project (as shown in last column of Table 11). Additionally, once expected car ownership reductions arise, such impact could increase up to 6.695 CO_2 equivalent tonnes/year (long run) with a reduction of 39,5M vehicle-km travelled by car, exclusively driven by pilots involving carsharing solutions (being the only ones with available evidence on car ownership reductions).

In any case, given the sensitivity of results and the limitations of case studies reviewed, the exploratory analysis results will be re-evaluated after pilots' implementation (WP3), following the methodological path described before.