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LOW-CARB

HANDBOOK ON MOBILITY STRATEGIES IN FUNCTIONAL URBAN AREAS

A guide for public authorities when planning mobility strategies in functional urban areas

CE1100

IMPRINT

About the LOW-CARB project

LOW-CARB - Capacity building for integrated low-carbon mobility planning in functional urban areas aimed at enhancing capacities for integrated low-carbon mobility planning for functional urban areas (FUAs). To achieve this, the project tackled the most important aspects of sustainable urban mobility planning (SUMP) and looked at how these can be adapted to the realities of the functional urban area: integrated coordination, institutional cooperation, and action plan implementation, including joint financing and public investments in low-carbon mobility systems in challenging times. Clean public transport services together with new combined mobility offers, like sharing services or multimodal information services, were placed at the core of the planning process.

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https://www.interreg-central.eu/Content.Node/LOW-CARB.

TAKING
COOPERATION
FORWARD

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Executive Summary

Source: LVB, 2019.

The handbook on mobility strategies in functional urban areas was developed within the framework of the LOW-CARB project [1], financed by Interreg Central Europe, with the scope of gathering essential information to public authorities or other decision-makers who are at the starting point of:

1. either developing a mobility strategy to cover areas outside the city borders, or
2. updating their existing mobility strategy by targeting a problematic area outside the city limits or expanding it to a broader geographical scope.

In either way, the handbook offers fundamental information, efficient methods and a variety of tools designed to optimize the process at different steps in the strategy development. Hand in hand with the existing collection of guides and briefings on the sustainable urban mobility planning (SUMP), the present handbook follows the validated stepwise methodology from the SUMP Guidelines 2019[2] – the basic mobility strategy guidance for public authorities across Europe.

1 https://www.interreg-central.eu/LOW-CARB
2 https://www.eltis.org/mobility-plans/sump-guidelines

1. Introduction

Planning for integrated and low-carbon mobility for public transport (PT) was at the heart of the LOW-CARB project. The main objective was to increase public transport accessibility in the functional urban area (FUA) [3] of cities in central Europe, thereby creating good planning practices, tools, and strategies with high take-up potential. To reach this objective, four LOW-CARB partners – city administrations, Public Transport (PT) planning authorities and companies in Leipzig (DE), Brno (CZ), Koprivnica (HR) and Szeged (HU) – developed highly innovative action plans for low-carbon mobility in their FUAs. In new vertical, horizontal, spatial, and inter-departmental governance arrangements, these partners defined joint visions, objectives, measures and monitoring arrangements for a more attractive, integrated low-carbon mobility system. Doing this, they stepped out of their comfort zone, and started joint planning cooperation beyond administrative and institutional boundaries. As these partnerships also aimed at assessing and analysing available data as evidence-base for joint planning, a range of methods and tools to assess and increase data availability were developed by the project, along with data-based planning applications and a strategy for data-governance. While PT usually plays an executing role in planning, it is important to mention that the partnerships were led by PT companies in two cities - Leipzig and Szeged - and played a major role in Brno and Koprivnica, due to the complex planning situation in the FUAs.

The goal of this handbook is to present these strategic approaches to governance and data-based planning to interested practitioners.

> *"LOW-CARB challenged us and our project partners to strategically rethink how we can better plan for sustainable mobility beyond city borders with local stakeholders and based on data. We at LVB are proud of our master plan that helps us to respond to the future mobility needs of commuters to the 'Nordraum', a rapidly growing industrial area at the periphery of Leipzig, in a responsible and innovative way."*

- Ronald Juhrs,
Managing Director Technology and Operations at Leipzig Transport Company (LVB)

2. Development of low-carbon mobility strategies for FUAs

Planning for sustainable mobility in the FUA means to go beyond administrative boundaries, and to consider the integrated area of daily flows of people and goods, rather than a confined municipal area. This entails communicating with a variety of "new" or additional institutional and organizational actors on a common vision, joint objectives, targets, and indicators. As such a procedure challenges the traditional planning approach, it requires to find new ways of cooperation and agreements on, e.g., joint objectives and data-sharing, with actors from other municipalities, regional planning institutions, public transport companies and authorities, or from the private and civic sector. For this reason, it was an essential part of the LOW-CARB project to develop new approaches for data-based planning in the FUAs.

2.1 The SUMP planning phases used for LOW-CARB action plan development

The SUMP[4] methodology served as general framework reference in the LOW-CARB process. Its main aim is to improve accessibility and to provide safe, clean, and equitable mobility for the entire FUA in a comprehensive and participative approach that helps taking all functional relations into account. SUMP supports fact-based decision making beyond administrative borders and is guided by a long-term vision shared by all involved stakeholders. It helps to assess the status quo and future trends, to develop strategic objectives, and an integrated set of measures from different policy areas, including regulation, promotion, financing, technology, and infrastructure. Emphasis is placed on citizen and stakeholder involvement, and on cooperation among actors in public administrations and with the private sector.

In LOW-CARB, Brno and Koprivnica explicitly updated their sustainable urban mobility plans with a FUA perspective, whereas the partners in Leipzig and Szeged developed targeted action plans to relieve the mobility situation in specific remote business districts within their FUAs. Doing this, all partners followed the general SUMP phases. These phases are: (1) Preparation and analysis, (2) Strategy development, (3) Measure planning, (4) Implementation and monitoring.[5] In the following, they are shortly explained.

(1) Preparation and analysis

In the inception phase, the LOW-CARB partners decided to prepare an action plan for a defined geographical scope, either covering the city and the entire FUA (Brno, Koprivnica) or targeted specific industrial and business districts that are not well served by PT (Leipzig, Szeged). Corresponding to the setting in their planning areas, the management and working structures (project manager, project core group and steering and technical committee) were set up, along with agreements on joint decision-taking. Also, mapping of stakeholders took place, and their involvement was planned. This first phase was finalized with a review of the planning capacities and planning situation, including analysis of data availability, regulatory and technical conditions for data-sharing, and summaries of the mobility problems and opportunities in the defined planning areas.

4 "A Sustainable Urban Mobility Plan is a strategic plan designed to satisfy the mobility needs of people and businesses in cities and their surroundings for a better quality of life. It builds on existing planning practices and takes due consideration of integration, participation, and evaluation principles." Rupprecht Consult (editor), Guidelines for Developing and Implementing a Sustainable Urban Mobility Plan, Second Edition, 2019, p.9. Find more information and SUMP guidance here: https://www.eltis.org/mobility-plans/sump-online-guidelines. In central European languages: https://sump-central.eu/

5 The need for flexibility is understood and planners are encouraged to make reasonable adaptations as required by their specific situation if the overall principles of SUMP are followed.

(2) Strategy development

In this phase, the partners developed future urban mobility visions, objectives, short and long-term targets, and actions for urban mobility together with planning organisations, and stakeholders in their FUAs. Based on the previous diagnosis work, they weighted and assessed different options for meeting the vision and objectives, e.g., using scenario and modelling techniques and data visualization, as basis for intense discussions with key stakeholders and citizens.

(3) Measure Planning

The partners leveraged the planning process from the strategic to the operational level. Accordingly, the focus was on the selected options or scenarios and prioritization of measures, as well as the description of monitoring arrangements. Measures were specified as concretely as possible to ensure that they are clearly defined, comprehensive, and well-coordinated. The measure-planning phase was concluded with the preparation of the implementation phase and submission of the action plan to the decision-makers of the competent political bodies, who then adopted the plan.

(4) Implementation and Monitoring

The LOW-CARB partners prepared for systematic monitoring, evaluation, and communication – all partners developed brochures and/or videos - during implementation of their measures, while applying for funding.

2.2 New approaches to governance and data-based planning for integrated planning in the FUA

The stakeholder constellation at a FUA level is more complex than at city level and requires engaging a higher number of institutions in the planning process. Therefore, all the following forms of cooperation were applied by the partners[6]:

- Vertical cooperation – organizations cooperate with other organizations to whom they are accountable in a hierarchical manner (e.g., a local authority and the local public transport authority)
- Horizontal cooperation – describes an autonomous relationship between different organizations (e.g. between local authority and private operators)
- Spatial cooperation - organizations representing different geographical areas and levels (e.g. a lead local authority working with neighbouring authorities)
- Inter-departmental cooperation - organizations and experts with different backgrounds, knowledge, and fields of expertise cooperate (e.g. from different departments of the local authority).

To identify stakeholders who should be involved in the FUA-planning process, criteria depicted in the following table were applied.

6 More information on the governance strategies in the four LOW-CARB FUAs can be found on the project website in the Publications section (deliverable D.T1.1.3): https://www.interreg-central.eu/LOW-CARB

Table 1: Stakeholders by key assets for collaborative planning in functional urban areas. Source: Rupprecht Consult, 2021.

Competence	Relevance	Stakeholders	Key assets
Political support	Who can assure political support and resources within the transport sector and cross-sectoral?	Mayors of cities planning a low-carbon mobility strategy, city councillors (both majority and opposition)	Vision Leadership Power Resources
		Representatives of district town halls	
		Mayors and representatives of neighbouring cities part of the functional urban area	
		Heads of metropolitan areas, provinces, counties, regions	
		Politicians from different local authorities in FUA	
Transport network competence	Who manages the respective transport networks?	Public transport companies (municipal, regional)	Technical feasibility
		Public transport authorities	
		Owners of public transport infrastructure (roads, parking, mobility hubs etc.)	
		National railway companies	
		Providers of new mobility services (e.g. bike sharing, car sharing)	
		Public transport associations	

Technical expertise	Who has the data and relevant skills to deliver a technically sound plan?	Departments of public authorities from FUA	Technically sound planning
		Regional transport authorities	
		Universities and research centres	
		Independent experts, private companies	
		Specialised agencies	
		Qualified NGOs and associations	
Public participation	Who understands public and stakeholder opinions?	Communication departments from public authorities in functional urban area	Values Sense of urgency Sense of ownership
		Communication departments in district town halls	
		Local and regional NGOs and influencers	
		Representatives of companies located in business and industrial areas in the city outskirts	
		Representatives of logistic centres located in the city outskirts	

Source: Rupprecht Consult, 2019.

Setting up vertical, horizontal, spatial, and inter-departmental cooperation structures in the FUA goes along with identifying and analyzing which data are available for mobility planning. Here, different types of data from, e.g., automated measurements, geodata, public transport schedules, quantitative and qualitative survey results, transport modelling, etc., were identified as possible data-sources.

However, to use them for planning, the project identified the following needs, for which it developed methods, tools, and strategies[7]:

- Need to increase data availability (identify needs and methods for data collection)
- Need for applications based on data, incl. big data
- Need for data-governance

To assess data availability and gaps also in terms of data quality and exchange, the project co-developed the SUMP-Self-Assessment Tool[8] that helps mobility planners within and between organizations to undertake a stocktaking of available data, and to agree on targets, indicators and methodologies for monitoring and evaluation. Besides, the tool also guides users in their native languages through the entire SUMP planning process and provides tailored feedback. It can be used alone or in workshop settings, and, thus, facilitates communication between stakeholders. It is ideally used when starting or evaluating a SUMP process (in phase 1 – preparation and analysis, or after phase 4 – implementation and monitoring).

In Szeged, the public transport company SZKT developed a holistic approach towards making data available for planning. Aggregated traffic flows were derived from both public transport data and road traffic measurements. In this process, various data were collected in the first planning phase (analysis and preparation), such as on-board diagnostics from public transport, and data from quantitative surveys, and interfaced on the municipal open-data platform[9] (see more p. 25).

7 More information on LOW-CARB approaches to data-based planning can be found on the project website in the Publications section (deliverable D.T1.3.3): https://www.interreg-central.eu/LOW-CARB

8 https://www.sump-assessment.eu/English/start

9 More information can be found on the project website in the Publications section (deliverable D.T3.2.4, Output Fact Sheet O.T3.1 and The LOW-CARB pilots handbook): https://www.interreg-central.eu/LOW-CARB

In Leipzig, the REACHIE tool[10] was developed to analyze the accessibility of remote areas by low-carbon modes as a new application of available open data. It is a powerful online journey planner for commuters based on static, weekly updated PT schedule data, that can be applied as a planning tool in the 1st and 4th planning phase (for analysis or for performance monitoring). It illustrates modes per trip by isochrones and visualizes routes according to its level of accessibility with respect to the starting point (see *fig*. 1 below). REACHIE also increases environmental awareness of suitable services through a CO_2 savings' comparison between trips.

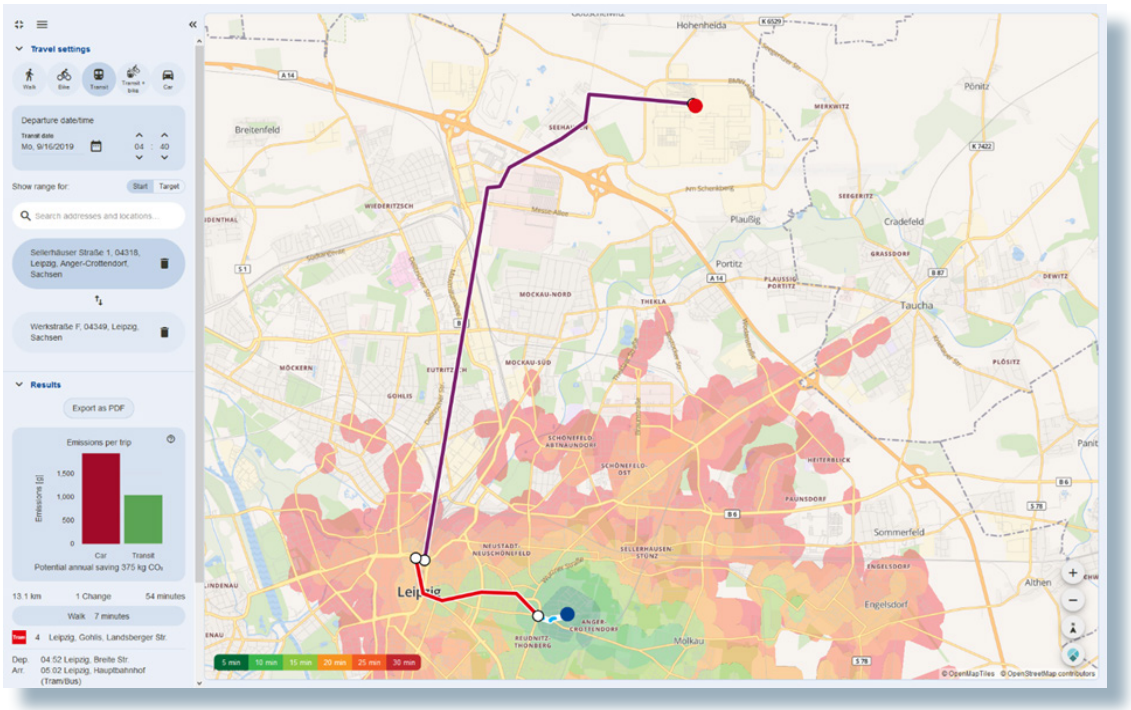


Figure 1: REACHIE screenshot – demonstrating accessibility (in time and per mode) of sites by multimodal mobility (source: LVB/MDV, LOW-CARB final conference, 2020).

Brno developed, as another data application, the SUMP monitoring tool,[11] that synthesizes data in a GIS application, to support planners monitoring the implementation and financing of measures, while assigning clear responsibilities for all stakeholders involved. This tool can be applied in the 4th planning phase (implementation and monitoring).

To enable data availability and application in all four phases of the planning process, the city of Leipzig developed a municipal strategy for data-governance.[12] It analyes potential barriers to implementation and provides concrete guidance on key actions to enhance data collection. Furthermore, it takes a strategic outlook towards the deployment of innovative mobility solutions, following major trends such as vehicle-sharing services and the transformation of urban mobility through decarbonisation, automated driving and "Mobility as a Service" (also see p.14).

10 Find more information on REACHIE here: https://www.interreg-central.eu/Content.Node/LOW-CARB--Reachie-Tool-Factsheet.pdf
11 https://www.interreg-central.eu/Content.Node/LOW-CARB-SUMP-monitoring-tool-brochure-EN.pdf
12 More information on Leipzig data governance approach can be found on the project website in the Publications section (Output O.T1.1): https://www.interreg-central.eu/LOW-CARB

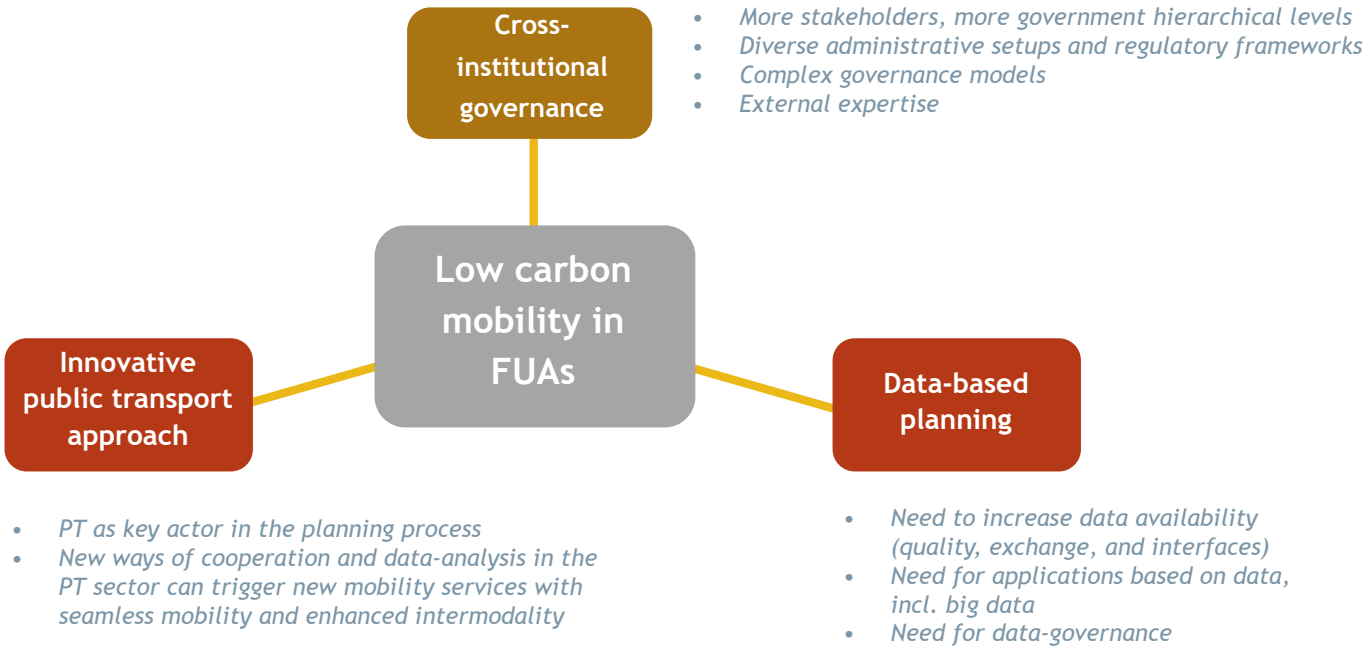
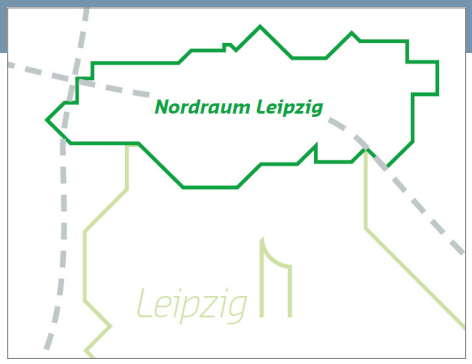


Figure 2: Strategic approaches on low-carbon mobility in FUAs (source: Rupprecht Consult, 2021).

Source: LVB, 2019.

Use case 1: Cooperation among the key stakeholders with jointly developed working structures in Leipzig



FUA Leipzig (Germany): Achieve low-carbon workplace mobility to a remote district

Planning area description: The Leipzig northern industrial area (Nordraum) is one of the largest and most important economic hubs of the Saxony region in Germany and Leipzig's primary industrial site. The area spans over about 50km² and features around 35,000 jobs.

Mobility problems: The rapid development of the industrial area initiated a new flow of traffic with a dynamic perspective. A massive increase of employees is expected until year 2030. The private car is the main transportation mode in the area for employees and suppliers.

Collaborative approach between stakeholders:

Action Plan development: The Leipzig Public Transport Company (LVB), the central German Transport Association (MDV) and the City of Leipzig cooperated with clear roles and assignments. Further consulted regional stakeholders were the district of North Saxony, the Regional Rail Association (ZVNL), the City of Schkeuditz, the public transport organisation of Northern Saxony, other affected surrounding communities and companies located in the planning area. A local Steering Group formed of all three partners led the process and endorsed the Action Plan. An external expert in traffic modelling cooperated closely with the stakeholders in the data processing and scenario building phase.

Open-data strategy: The City of Leipzig involved stakeholders from city administration (transport planning, data handling, statistics, and the digital city unit), an external expert (Open Knowledge Foundation) and public transport, LVB. The external expert drafted the strategy document.

Action Plan in a nutshell:

Objective: Starting from the process of developing the first mobility strategy for the area, Nordraumkonzept 2025+, the LOW-CARB partners in FUA Leipzig[13] developed the Masterplan Mobilität Nordraum Leipzig (Mobility Action Plan Leipzig North Area) aiming at a strong increase of environmentally friendly transport offers, to reach ambitious municipal aims. The Action Plan has been prepared for adoption by the City of Leipzig and the FUA public authorities. A set of 86 measures is clustered in 14 packages focusing on horizontal measures (e.g., stakeholder cooperation, communication, company-based mobility management), rail (e.g., improvement of the regional rail infrastructure), local public transport (e.g., enhancement of the bus and tram offer, on-demand services) and last mile (e.g., mobility hubs, new cycle paths, Bike/ Park and Ride). Their implementation will require a joined financial effort among all the key stakeholders, compensated by governmental funds.

Vision: By 2030, Nordraum will set an example for sustainable industry and attractive and eco-friendly mobility. 44% of up to 70,000 commuters are envisioned to use public transport and environmentally friendly transport modes.

13 The LOW-CARB project team in Leipzig consists of City of Leipzig (LEI), Leipzig Transport Company (LVB) and Central German Transport Association (MDV).

Open-data strategy in a nutshell:

Objective: Create conditions for availability and application of data in mobility planning.

The strategy analyses potential and barriers to data-sharing, and to achieve political support, and provides concrete guidance on key actions to enhance data collection. It takes a strategic outlook towards the deployment of innovative mobility solutions, following major trends such as vehicle-sharing services and the transformation of urban mobility through decarbonisation, automated driving and "Mobility as a Service". Locally available traffic data is essential to enable the optimal deployment of these innovative solutions. Thus, Leipzig aims to create a 'conductive' ecosystem of open data, nourished by the public sector as well as by private businesses, the academic community and civil society, thus facilitating the further research and development of new mobility services.

Vision: The city is responsible for digital infrastructure and data. It builds discrimination-free open-data networks for efficient use of resources and facilitates business cases, such as Mobility as a Service (MaaS) by, e.g., real-time data and service information.

Preparation and Analysis

The **governance and organizational structure** created between LVB, MDV and the City of Leipzig included the following levels:

- On a *steering group level* with the heads of units of the three institutions, decision making on milestones, content and framework of actions took place.
- In all participating institutions, project leaders were appointed, responsible for preparing the decisions, and consulting the practical work of the operational team in weekly meetings.
- The operational team members, employed in public transport departments of the respective institutions, communicated daily, and met weekly. One person was specialized in data-driven analysis, one in networking and communication and one in strategic planning.

All ongoing mobility projects in the planning area were clustered, and a traffic model was developed (based on PTV VISUM with modal split data, actual and expected economic and workforce development until 2030). In parallel, the companies located in the planning area were interviewed in relation to their mobility needs.

From the beginning and throughout the process, regional stakeholders were involved in defining the planning area and context, based on already existing informal planning instruments, industrial and residential settlements, and analysis of daily commuter flows.

To prepare the ground for the data governance strategy, the City of Leipzig identified key stakeholders, analyzed regulatory conditions and the strategic value of data to determine privacy limitations towards an open-data strategy.

Strategy development

Before the LOW-CARB project started, the Leipzig municipality conducted a scenario process to decide on a common vision and objectives for their mobility planning until 2030. In this city-wide participative stakeholder process, a political decision was taken to follow the ambitious "sustainability scenario", aiming at a maximum increase of environmentally friendly modes with no additional increase of motorized individual traffic. Based on this scenario, and on the analysis of problems and opportunities, a vision for the Nordraum area was developed with stakeholders.

It comprises the following main elements:

- Up to 70,000 employees work in the Northern Area of Leipzig in 2030.

- 44% use environmentally friendly transport modes, just 65% the car
- Most employees have access to trains or trams, meaning fast connections to the main interchanges.
- For the last mile, different transport modes and options can be used: buses, transport on-demand (partly autonomous), ride pooling, improved pedestrian and cycling infrastructure; bike-sharing and bike stands; easy booking and information through Apps, LOW-CARB accessibility map REACHIE[14], and place-based information.

For the open data strategy, the City of Leipzig developed a vision and goals with stakeholders to discuss the use and added value of open data (such as parking data, P&R, e-scooter usage, etc.), requirements for harmonization, and application potential of data from transport planning modelling or geodata infrastructures. Then, the vision for open data was developed.

The external expert drafted the open data strategy document, with the main recommendations to establish, following an iterative path:

- An 'Open-by-default' approach, where Leipzig will publish all data, documents, and data services free of charge and machine readable – unless confidentiality requirements state otherwise.
- "Mobility Data as a Service", by publishing data from traffic count systems to facilitate cooperation and steering the development of new services.
- "open-data culture" and "culture of experiments" by providing creative space for citizen science.

Measure selection

With a vision for the Action Plan in place, the Steering group developed a set of ca. 90 draft actions, which were discussed and prioritized with project leaders, administrative and political decision-takers, and external experts. Regional and FUA stakeholders, followed by the companies in the planning area, were consulted. The discussion showed that the actions met the specific needs of companies dealing with changing shift times, need for direct connections and high-quality transport systems. The actions were adjusted, and a detailed financial planning and adaption, especially of the actions with short time perspective until 2024, took place in close cooperation of the Leipzig city administration, and the public transport operator, LVB.

14 Find out more about REACHIE on the tool website www.mdv.de/reachie

Public transport measures in a nutshell

✓ Challenge:

The PT offer at the industrial plant and in the surrounding areas is confusing for users. The last mile mobility offer (by means of active travel or sharing services) is lacking. Tram and local train connections are poor and not well interconnected.

✓ Selection of innovative measures:

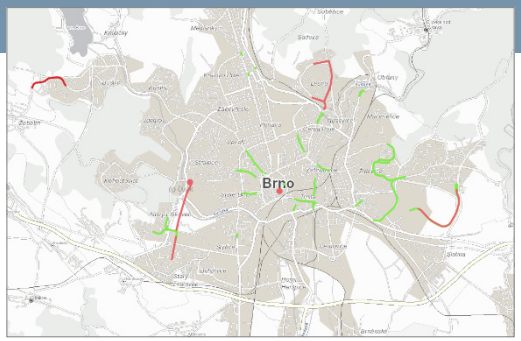
Measure	Impact
REACHIE -accessibility map	Applicable as trip-planner for commuters and as planning tool to analyse and monitor accessibility by PT.
Introduction of an automated on-demand bus shuttle service between the fair center railway station, the surrounding localities, and the industrial park.	On-demand service as a supplement to the regular offer at times of low demand and on less demanded routes.
Construction of mobility hubs combine a Bike & Ride parking and additional sharing services at the railway station.	Better connected travel options through sharing offers and comfortable parking facilities and increase the level of comfort at PT stations
Extension of tram line and interconnectivity with the bus network.	Increased attractivity and safety of clean public transport modes
Construction of the cycle expressway Halle-Leipzig	Cover the last mile offer, supplement the PT with new sharing offers, increase safety on cycle paths

Implementation and monitoring

To ensure implementation, a 'governance strategy for the implementation' was developed including a working structure for the upcoming years, and a new decision-making process. The Leipzig partners acquired national funding to adapt the established working and decision-taking structures, and to apply for further funding to finance the measures implementation[15], and to organize for political legitimation. The steering group decided to use a structure like the one used during the Action Plan development but broaden the staff responsibility for implementation in mid-term perspective by project management, marketing, stakeholder involvement including administrations and companies, preparation of actions and financing. The involvement of companies and stakeholders remains key during implementation. Different legal institutional forms and financing models – also based on the number of employees - have been analysed. The recommendation was to institutionalize the cooperation among the different groups and a timeframe for implementation. For the implementation of several actions a communication strategy will be developed by the marketing team. The implementation will be monitored by the coordination team, using the pilot action accessibility map REACHIE as adapted planning tool which measures the effects of actions based on increased accessibility and further data. Additional further studies are planned by the city to measure the possible effects of actions of the masterplan towards the use of road infrastructure for commercial and motorized indivual transport.

15 Such as for the realization of short-term actions in the national funding programme "public transport model projects".

Use Case 2: A city-led validated process of scaling up the mobility strategy at the FUA level in Brno



FUA Brno (Czech Republic) – Increase the (high) share of low-carbon modes usage in the FUA

Planning area description:
The FUA of Brno, or the Brno Metropolitan Area, is an organic functional unit. The City of Brno, the second largest city in the Czech Republic, is situated in its centre, with a dense network of surrounding mid-sized towns and villages, connected to the urban core by intensive daily commuting flows, mainly for work and education purposes. The entire South Moravian Region is serviced by an integrated public transport network managed by the regional coordinator of transport services KORDIS JMK.

Mobility problems:
The daily movement of people and goods is increasing, exhausting the traffic network. A share of 25 – 50% of commuters to work and 50 – 70% of commuters to school are using PT services, and around 25% of commuters integrate PT with private car. Strategic aims at both FUA and region levels are the enhancement of PT services, and the increase of intermodal offers (P+R, K+R, B+R) at mobility nodes

Vision and strategic objectives:
To increase the share of PT and active modes in the modal split by an improved and more efficient public transport system and enhanced inter-modality in the entire functional urban area. To increase the share of use of public transportation by 1% compared to the current state (from 53% to 54%) by the year 2030, to stop the outflow of passengers from public transportation

Action Plan in a nutshell:
The newly adopted SUMP Action Plan[16] reflects the recommendations included in the Regional Transport Plan. The measures were selected based on setup goals and policy fields, and their prioritisation is revised on a yearly basis. A new SUMP monitoring tool[17] developed in the framework of the LOW-CARB project by the City of Brno has been used by all involved stakeholders for overseeing the implementation process

Preparation and analysis

In Brno, the working structures for updating the previous version of the city SUMP were already set up in the framework of the CH4LLENGE project[18], during which the first SUMP was developed. Based on the lesson learnt in CH4LLENGE, and on the existing collaboration of main stakeholders at city and FUA levels, the institutional cooperation framework was defined. It focused on strengthening and continuing regular collaboration among the different levels of government – local, regional, and national - through exchange in meetings and workshops. The stakeholders involved are:

16 www.mobilitabrno.cz
17 https://gis.brno.cz
18 http://www.sump-challenges.eu/

Stakeholder	*Level of influence*
City of Brno (SMB)	Key
Integrated Transport System Coordinator of the South Moravian Region (KORDIS JMK)	high
Transport authority of the South Moravian Region (JMK)	
Regional roads authority (SÚS JMK)	
Public transport operator (DPMB)	medium
Public infrastructure owner (BKOM)	
Public authorities in FUA	
Czech Railways (ČD)	
Railway Infrastructure Authority (SŽDC)	
Other PT (bus) operators in the region of South Moravia	
National road infrastructure (ŘSD)	
Transport Research Centre (CDV)	low

Building on the SUMP set of targets and proposed measures, the updated SUMP Action Plan started from strengthening the cooperation with municipalities in the FUA and the South Moravian Region. Under the coordination of the City of Brno, the stakeholders defined a mobility vision for the entire FUA to tackle the commuting flows to and out of the city. Experts from different fields and politicians (members of City Council and members of the opposition too) have been involved in this process, and the vision was approved by the City Council in 2018.

Strategy development

In the Action Plan development process, the successful participation process started in 2015 was strongly emphasized and continued. With support by an external communication and engagement expert, more than 2500 comments from citizens were analysed, and more than 500 participants were involved in about 30 events. Several workshops with citizens, experts, city districts and municipalities, as well as politicians, were organised. Based on public input, the vision, and strategic objectives for the entire FUA were selected and validated by the Brno City Council. In the following six months, the referring measures were selected. The Action Plan was then approved by the City Council, and it is planned to be updated yearly.

The core part of the Action Plan relates to the policies and measures that allow reaching the strategic objectives. Stakeholders agreed on a set of strategic objectives for the following four ‘areas of change’:

1. Modal split between sustainable modes of transport (public transportation, cycling and pedestrian traffic
2. Road network of the city and quality of public spaces
3. Organisation and monitoring of traffic control system and traffic demand
4. Protection of inhabitants against the negative impacts of traffic, and the reduction of energy consumption from traffic

According to the strategic objectives, indicators were selected and clustered. Some are:

1. Share of clean buses in mass public transportation
2. Number of environmentally friendly vehicles
3. Inhabitants affected by traffic noise
4. Users of mass public transportation (modal split)
5. Change in perception of public transportation
6. Kilometres of segregated routes for mass public transportation.

Measure selection

Based on the four defined 'areas of change' and on the strategic objectives, a set of 66 measures were included in the Action Plan for short- (until 2023), medium- (until 2030) and long-term (until 2050) implementation timeframes. Particular attention was given to improving the quality and service of public transport at the FUA level. The largest investments planned in the next years tackle improvements in the tram infrastructure (e.g., three extensions of existing tram lines, modernization of a tram depot). Accompanying measures aim at improving passengers' comfort and safety, better connectivity, seamless ticketing, and modes integration at intermodal nodes.

Public transport measures in a nutshell

- ✓ Challenge:

The existing public transport system in FUA Brno and in the entire region is a functional and well-developed system, but the mobility dynamics show that investments are needed to keep the PT current share in the modal split, and to encourage active mobility and make room for sharing services. The PT system can maintain its share only through measures that cover different topics such as the quality of service, integration at nodes, ticketing, safety and intermodality.

- ✓ Selection of innovative measures:

Measure	***Impact***
A seamless PT information system in FUA Brno	number of stops equipped with an intelligent information system > 70% (rail transport > 98%) number of passengers satisfied with the information system >90% increase in the number of users of web applications and information portals > 60%
New interchange hubs, upgrade of the existing ones	upgrading of interchange hubs > 90% increase in the share of PT > 54% of modal split
Increase the accessibility of PT by building train stops for interchange	increase in the number of train stops > 95% respecting the distances from journey source / destination to the nearest mass public transportation stop (according to the standards set out in the SUMP)

Multimodal hubs (P+R) in FUA Brno in connection with high-capacity PT	increase in the share of passengers in PT > 54% of modal split increase in the use of P+R to 98% of capacity (on workdays) reduction of car traffic in the city by 10 % improvement of air quality

Implementation and monitoring

The measure evaluation was realized with the SUMP GIS monitoring tool developed by the City of Brno in the framework of the Brno Action plan development. The tool monitors the progress of measure implementation, financing, and responsibilities of SUMP stakeholders, and is regularly updated. It is used by all stakeholders involved in SUMP development within the municipality. For public consultation and information, a public version of the tool was made available, first for online consultation during the SUMP update process, and for collecting public feedback on the approved SUMP Action Plan (more details on the LOW-CARB website[19] in the Publications section, and on the tool website[20]). Moreover, the City of Brno used the SUMP Self-Assessment Tool[21] in the process of updating their SUMP Action Plan and validating the compliance of their selected measures with the SUMP principles and preparing the new mobility projects in the city. Given the experience the municipality already gathered while developing the SUMP in 2015, the results of the self-assessment showed that the city understands the SUMP methodology well, and that the measures selected are sustainable, but more efforts need to be invested in enhancing the cooperation at the FUA level.

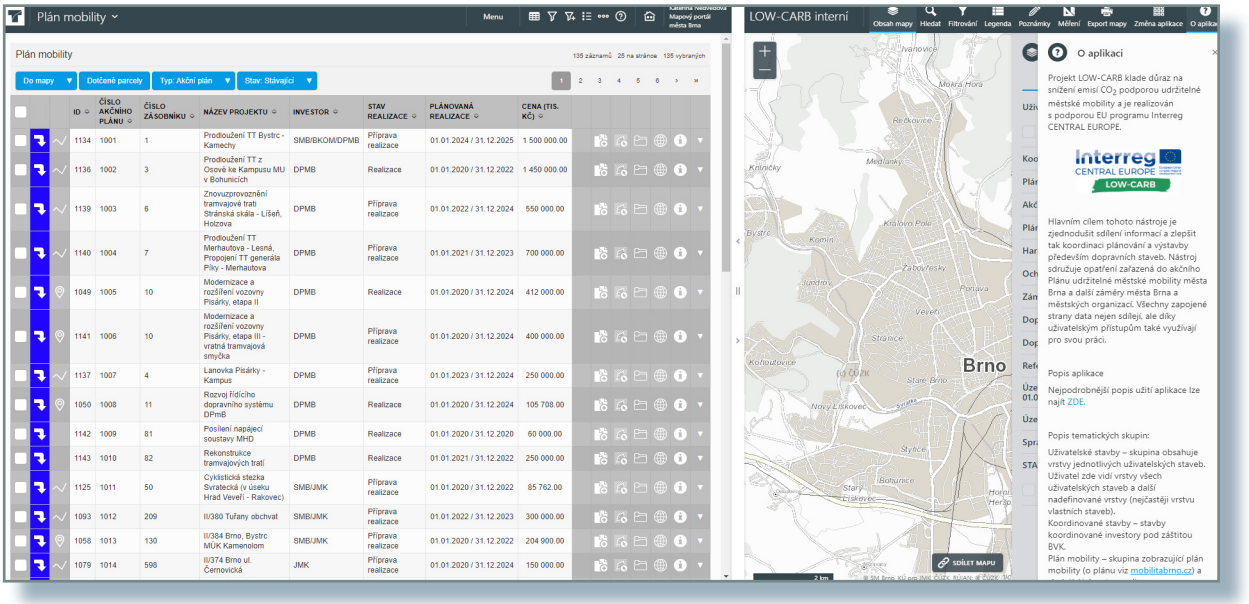


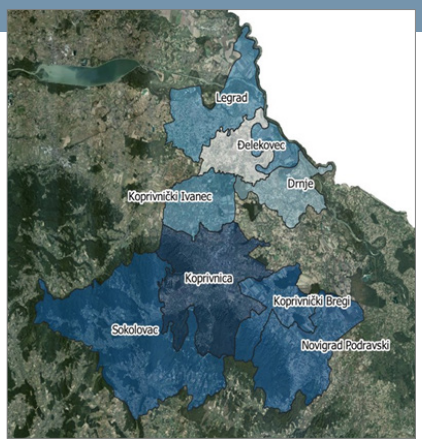
Figure 3: The SUMP monitoring tool developed by the City of Brno (source: City of Brno, 2020).

19 https://www.interreg-central.eu/LOW-CARB
20 https://gis.brno.cz/portal
21 https://www.sump-assessment.eu

Figures 4 and **5**: Visualization of planned tram lines from Osová to Kampus, in process of realization in Brno. It is planned to be in operation in 2022. Photo credits: salinounakampus.dpmb.cz

Figure 6: Vizualization of tram lines Plotní in Brno. The tram lines were moved to another street to enhance accesibility in the area. The project is currently under construction and should be finalised in 2020. Source: FB - Tramvaj Plotní

Figure 7: Visualization of reconstruction of tram lines Nové sady in Brno, where the “green belt” - meadow lawn with flowers - will be built for less noise and dust. Source:



Use case 3: Pioneering and consolidating a new model of mobility planning - the first Croatian functional urban area in Koprivnica

FUA Koprivnica (Croatia): Create one single public transport zone in the FUA

Area description: FUA Koprivnica is a newly established administrative layout formed by the City of Koprivnica and the 11 surrounding municipalities that have functional relations with the urban core. The City of Koprivnica is the economic centre of both FUA and of the entire Koprivnicko-krizevacka county.

Mobility challenge: As a clear regional centre in terms of number of inhabitants, the city is also the economic, administrative, and cultural centre of the entire region, leading to a constant daily commuting flow between the city and the surrounding municipalities. This leads to problems caused by traffic. The main challenge related to public transport and mobility at the FUA level are, thus, the large disparities between the quality of infrastructure in the urban core and the rest of the communities. Koprivnica has more advanced infrastructure in comparison, in terms of bus services, built cycling/ pedestrian tracks, bus stops, safety features for pedestrians and cyclists. Even if there are certain points in the FUA where the quality of infrastructure is great, these are not inter-linked to form a viable and integrated public transport system.

Institutional cooperation approach: Since the FUA concept is still new in Croatia, the municipality defined it based on the administrative layout and on the functional PT relations between city and the interurban area, designed to optimize connectivity. To achieve this, the neighbouring communities were involved in a data and needs analysis. Analyses of traffic flows resulted in a new spatial delineation of the FUA. The main challenge was to set up a good basis for collaboration among the different many public authorities, and to harmonize the mobility vision for the entire FUA.

Action Plan in a nutshell: Koprivnica was the first Croatian city to develop a SUMP in 2014, and now went a step further by referring to the FUA as planning area for the SUMP. Stakeholders from all public authorities and communities in the FUA were included in the Action Plan development. The main goal is to create one single overarching public transport system that covers the commuting flows between all localities surrounding the city, and to increase the share of sustainable transport modes (especially cycling) by creating a framework for infrastructure investments. The measures are grouped in three main areas of interventions:

1. development of the cycling/pedestrian infrastructure in the surrounding areas
2. interconnectivity between city-level and FUA-level infrastructure
3. expansion of the public bike system and the bus system of the City of Koprivnica into the FUA area.

Vision: A comprehensive and flexible public transport and bike-sharing system covering all commuting flows among localities in the newly created FUA Koprivnica, based on energy-efficiency and on-demand concepts. A flexible model consisting of creating a mix between public transport and bike-sharing services, contextualised to address the specific needs in the FUA.

Preparation and analysis

The first part of the planning process was to define the geographical scope of the FUA and to get all key actors onboard the Action Plan development. In bilateral discussions with its neighbouring communities, the city gathered data on the individual mobility patterns and challenges at local level. Besides Koprivnica SUMP, regional and national strategic plans were taken into consideration (e.g. the regional masterplan covering a wider area, the national transport masterplan). The city also involved a team of external mobility experts with enough experience to guide the team through the SUMP development process. With their support, the city conducted a status analysis and a baseline traffic survey.

Strategy development

The aim of the SUMP Action Plan was to create a clear set of integrated measures and identify the funding sources needed for implementation (e.g., national funds). The data and needs analysis led to redefining the geographical zone of the actual functional area, based on traffic flows. With the identified need for a stronger PT interconnectivity, it was quickly decided to expand the existing municipal PT company Komunalac Koprivnica, based in Koprivnica, to cover the wider catchment area. In a next step, a common mobility vision based on enhanced PT services at the FUA level and their integration with a wider network of cycling infrastructure was embraced by all municipalities in the new FUAs.

Measure selection

The Action Plan contains a set of measures that are linked with the expansion and upscaling of sustainable mobility services from the city to the FUA. Thus, the set of measures was defined to enhance the level of sustainability in transport at the FUA level, lying on the expansion of the PT system in the FUA, bike and e-bike system, organisational set-up of the PT system, cost projections and running costs of the investments. All defined measures are linked with estimated costs and possible funding sources with the plan to access funds in 2021-2027. The approval of the measures and the Plan will not be formal, as in the case of the 1st generation SUMP of Koprivnica. The responsibility for the measure implementation and monitoring lies with the City of Koprivnica.

Public transport measures in a nutshell

- ✓ Challenge:

The key challenge for the SUMP Action Plan development was to define a strategy for a financially and economically sustainable integrated public transport service that also addresses the needs of residents in Koprivnica's low-density, rural, FUA.

- ✓ Selection of innovative measures:

Measure	*Impact*
Completion of the cycling-pedestrian infrastructure in the FUA Koprivnica area	The implementation of this measure is set to be the most important one, since it will, most notably, increase the safety of pedestrians and cyclists in the FUA, and set the basis for the implementation of the expansion of the public bike system
Expansion of the electric public transport system on FUA area	The implementation of this measure is important due to the large number of transit passengers that commute within the FUA every day.
Expansion of the public bike system on FUA area	Leading to an increase in use of active modes when commuting to Koprivnica and in the FUA area.

Implementation and monitoring

In Koprivnica, the measure monitoring will be managed by the municipality together with the involved stakeholders from the surrounding communities. The results will be visible through evaluation indicators that are set in the Action Plan (e.g., the changes in the number of public bikes available, number of additional public transport lines). New infrastructures like cycling and pedestrian paths that connect the main nodes in the FUA will form a functional unit that would increase the active travel modal share in the entire area.

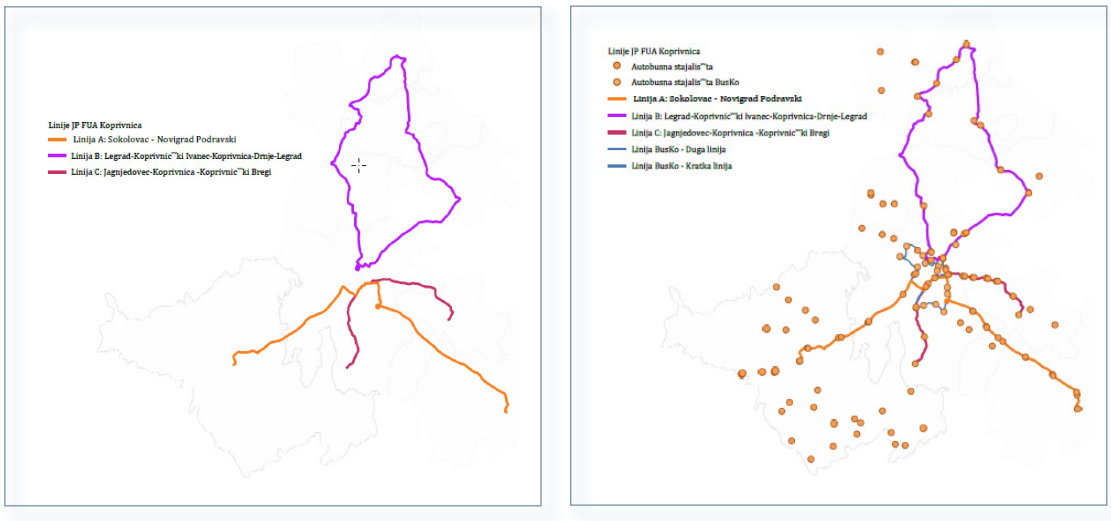


Figure 8: Left: Scenarios for the expansion of public bus transport in the Koprivnica FUA with new lines; Right: Public transport network in FUA Koprivnica (existing and planned routes). Sources: QGIS tool (City of Koprivnica, 2020).

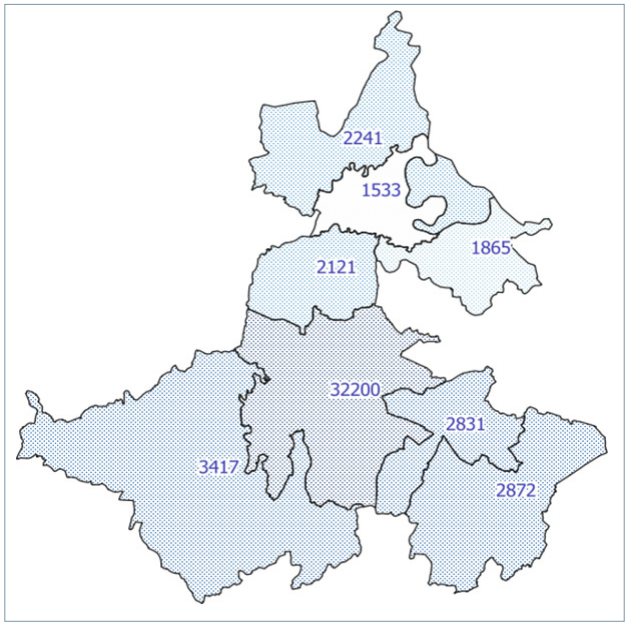
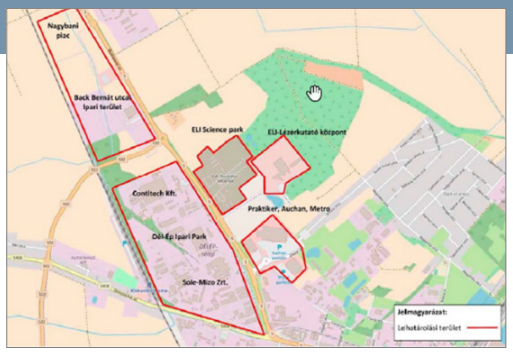


Figure 9: FUA of Koprivnica (source: City of Koprivnica, 2020).

Use case 4: Data-based planning for mobility in Szeged



FUA Szeged (Hungary): Understand mobility needs and tailor the PT offer

Area description: Szeged's Industrial Logistics Centre is a dynamically developing area, situated in the Northwest of the city close to the motorways M5-M43. There are 2500-3000 employees that work here, with more than 2000 employees working for 100 different employers.

Mobility problems: Most employees commute to the planning area every day by car from outside of Szeged. The city section of road nr. 5 (Budapesti út area) is congested in the peak hours. Proximity to motorways M5 and M43 makes the area easy to reach by car. Also, the current PT offer in this area has a bottleneck of schedule and longer tracking time of PT vehicles (currently diesel buses) with a relatively longer time to travel into this area. There is a need to increase accessibility for cyclists and PT from the northern residential area of Szeged, for clean bus services, more flexible schedules, and line operations, and for combined and multimodal offers, e.g., sharing offers for last and first mile.

Institutional and intersectoral cooperation approach: Employers, employees, PT operators (DAKK Zrt., SZKT), and the Municipality were involved in workshops and surveys. An external expert conducted the surveys and analysed the data. To increase data availability for mobility planning, SZKT developed a data-collection method and application based on big data analysis - the Wi-Fi-based passenger counting data methodology. For this, SZKT provided the testing equipment, vehicles, data acquisition. The Institute of Informatics at Szeged University was responsible for the software development, and the City of Szeged managed the user data incl. storage, access, and interface formatting. The cooperation and stakeholder process laid the foundation for regular formal and informal communication between the municipality, PT operators and the companies in the planning area.

For legal and technical requirements to integrate the data from the Wi-Fi passenger counting into the municipal data-platform, stakeholders involved were: politicians, scientific partners (e.g., University of Szeged), public transport authorities (SZKT) and service providers (e.g., DAKK Zrt), IT and traffic specialists, and legal advisors. Also, the local IT company of Szeged, RITEK Zrt, as a developer of the database, participated, or New Line Systems Kft, who has the exclusive right of ownership of the firmware functioning in data-collecting devices in SZKT's fleet

Action Plan in a nutshell: All in all, 10 groups of measures with 60 targeted measures around public transport, cycling, improved road connections, car-sharing, green mobility promotion have been developed.

Some priority actions are:

- trolleybus network development,
- new (trolley-) bus stop,
- scheduling harmonization/synchronization,
- building bike paths,
- new bicycle storages,
- increasing awareness for shared mobility and
- developing passenger information system.

Vision: Achieve a more effective and environmentally friendly organisation of public transport in Szeged's north-western area, by reducing car usage and development of zero-emission transport methods that could promote this process. Improve the general well-being and health of the workers.

Preparation and analysis

A thorough analysis of the mobility behaviour and needs of commuters in the planning area was conducted and assessed against the predicted economic growth and land use development in the area. An external expert interviewed employees and employers and aggregated the results in an evaluation report. In addition, a Wi-Fi sensor passenger counting methodology and algorithm[22] was developed to gain data on PT transport usage in the planning area. For consistency with the SUMP and planning objectives set for the region, the political and planning context was analysed to see which other measures would affect the planning area.

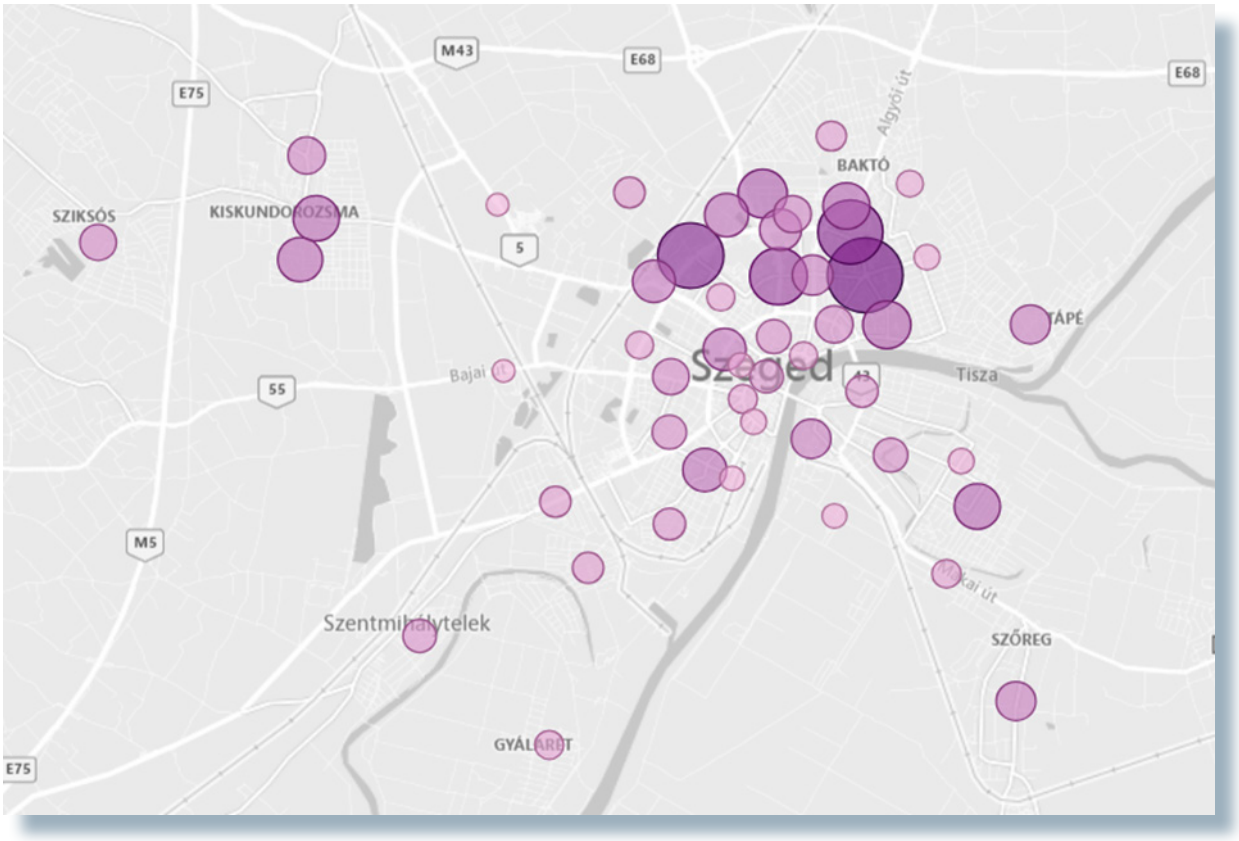


Figure 10: Place of departure of responders living in Szeged, by district n=1.106 (source: SZKT, 2019).

Strategy development

Based on the collected data and analysis results, smart targets to increase the share of sustainable modes of transport usage by commuters and indicators to measure performance were discussed and set at management level at SZKT. They were reviewed several times and discussed with the Szeged municipality to make sure that national or regional projects and developments affecting the planning area are included into the strategy development.

Developing and testing its methodology for passenger counting based on Wi-Fi data, SZKT closely cooperated with many stakeholders. The aim was to identify technical and legal requirements to integrate the data into the municipal urban data platform. The advanced discussions allowed Szeged to identify challenges and opportunities regarding the storage and handling of collected data. The negotiation involved addressing uncertainties on how to make data available for mobility planning, what type of data can be stored, referring to legal constraints to comply with data management- and privacy-related decrees.

22 More information can be found on the project website in the Publications section (Output Fact Sheet O.T3.1): https://www.interreg-central.eu/LOW-CARB

Measure selection

After technical consultations, a set of 60 measures clustered into 10 packages, grouped by responsible institutions (local government, state, companies) and by level of complexity were adopted. Funding streams other than the local funds were identified, especially for the most cost-intense measures (e.g. tram-train connection, introducing a new trolleybus line).

Public transport measures in a nutshell

- ✓ Challenge:

Increase use of sustainable modes for workplace mobility in a remote business district that is very accessible by car.

- ✓ Selection of innovative measures:

Measure	*Impact*
Introduction of e-tickets	Makes it very easy to buy tickets. One main goal of Szeged is to encourage contactless payment, which also promoted by this measure.
Datawarehouse: Construction of a city-wide database with traffic information. Collect accurate data, plan the data transfer, provide hardware.	This large urban database allows for easy data access, facilitates communication and collaboration with companies in the FUA, to better analyse mobility needs.
Develop a new trolleybus line: Analyse public transport lines in the area, develop infrastructure, provide new trolleybuses.	The action provides a direct zero-emission connection with the city centre and the most frequent areas (Rókus, Makkosház) by battery hybrid trolleybuses with in-motion charging – reducing infrastructure costs significantly.
Tram train project	The tram-train will connect Szeged and Hódmezővásárhely, enabling commuting by train.

Implementation and monitoring

For monitoring, renewed data collection by surveys and measurements is planned. Data collection and analysis will require external experts for mobility analysis, as well as mobility managers in the participating companies. For performance monitoring, it is planned to monitor the performance of implemented actions using the Wi-Fi based passenger counting system. Indicators will be, e.g.: travelling time (passenger hours / year); passenger number in FUA (million passengers / year).

3. Lessons learned and conclusions for low-carbon mobility planning and sustainable development of public transport in functional urban areas

Developing low-carbon mobility strategies and new approaches to data-based planning in the four functional urban areas made the partners invent new strategic ways for mobility planning at the functional urban area level. Their main recommendation is - given the specific characteristics – that new governance structures, more elaborated and more complex, need to be set up when developing a mobility strategy for the FUA, with a clear focus on public transport, last-mile mobility, intermodality, and new (sharing) mobility services.

The LOW-CARB project strategies present innovative public transport solutions that aim at increasing service quality and user satisfaction, for current users and new customers. In addition, the strategies support the ambitious decarbonisation targets for mobility in the involved functional urban areas. All partners supported the objective of public transport remaining the backbone of urban mobility in their functional urban areas, as well as to increase accessibility despite the challenges of urban sprawl and increase in population. Thus, the LOW-CARB strategies contribute to the priorities of the European Green Deal, which stresses that mobility should become drastically less polluting through a combination of measures addressing emissions, urban congestion, and improved public transport.

In the four presented cases, a multitude of stakeholders contributed to the success of the Action Plan development. Public transport companies and transport authorities at local and regional levels were deeply involved in the decision-making process, or even leading it. Moreover, a high effort was invested by all stakeholders in conducting thorough needs analysis on the level of the planning area, but also on the regional level, considering, e.g., commuting flows, and predictions for land-use. The business sector - that also generates the major commuting flows - became an important stakeholder in the process of data collection, scenario building, and measure development for company-based mobility management. Public-private partnerships between public authorities and private companies helped in creating a financial basis for project implementation. All available funding opportunities at local, regional, and national levels, and private sources have been integrated in the investment plans. Especially small and medium-sized cities strive for higher-level approval and endorsement of their strategies, a key factor to ensure sustainability and funding for their larger investments.

Furthermore, to respond to new, complex, planning requirements in the FUA, the partners developed a strategy for data-governance, and universally applicable and replicable tools and methodologies to increase the availability of different types of data for planning, also as a basis for developing planning applications based on open and big data.

Thus, the EU-funded research and collaboration project LOW-CARB provided opportunities to reflect and strategically plan the implementation of measures, and to provide stakeholders on local and regional level with best practices and learnings from other functional urban areas and from experts in the field.

Lessons learned by the project partners are:

- “The flexibility offered in the strategy development process - based on the SUMP approach - allowed to look beyond borders and to consider new mobility solutions and innovative service integration.”
- “Following the SUMP approach worked well and led to a higher acceptance and willingness for the measure implementation.”
- “In the beginning, think big. An ambitious vision can only be created when we shift the focus away from financial feasibility towards people’s needs.”

- “The process showed that all stakeholders need a willingness for change and a strategic perspective beyond the transport sector (e.g. economic and social needs).”
- “The close inter-departmental and cross-institutional cooperation among stakeholders and private companies is key for a successful implementation. A well-developed governance strategy is a first step towards sound planning and implementation of measures on the long run.”
- “The cooperation established during the strategy development helps not only the implementation of measures but also their evaluation, at which step the SUMP monitoring tool was the key instrument, keeping stakeholders together and structuring their ongoing collaboration.”
- “Focus on public transport as the backbone of the mobility system at the functional urban area level.”

Planning mobility at the functional urban area level is fundamentally about collaboration within a wide network of stakeholders, and about overcoming the geographical barriers and the traditional administrative setups. This type of process creates a base line for long-term cooperation among local, regional, and private stakeholders. The adapted SUMP methodology, enhanced also through the testing of the SUMP Self-Assessment tool, was a success factor in creating sustainable mobility strategies and paving the road to more efficient, innovative, and reliable transport systems in functional urban areas.

4. Check list for low-carbon mobility strategy development in functional urban areas

Preparation and analysis

- ✓ Clearly define the geographical area of your mobility strategy to follow the rationale of the functional urban area and the travel-to-work traffic flows.
- ✓ Ensure broad input from all key stakeholders, public and private, in different setups. The public (citizens, commuters, visitors) should be involved as they can very often provide expert advice and valuable data based on their personal mobility experience.
- ✓ Engage multiple types of stakeholders - ranging from public authorities, spatial planners, transport providers over other sectors and community leaders to the urban population and commuters as main beneficiaries of the transport infrastructure in a functional urban area. The development of effective urban mobility and spatial planning policies requires participatory decision-making processes.
- ✓ Work together with institutions representing other sectors (e.g. land-use planning). This can be challenging if no land-use strategy at the FUA or regional level is available, but can be overcome by extending the working group to a larger pool of stakeholders (e.g. other departments in the municipalities in an FUA that are in charge of collecting land-use data).
- ✓ Delays and uncertainties can be avoided through the timely identification of data gaps and alternative data sources. Cities are encouraged to consider solutions such as open-data sources and low-cost collection methods, but also real-time data to deploy traffic management solutions that consider all modes.
- ✓ Enable collaborative data collection strategies, with direct input from mobility users and co-creation efforts. Through public-private cooperation towards data-sharing and participatory planning, synergies can be exploited, and efforts aligned for the improvement of mobility services.

Strategy development

- ✓ Invest time and resources into vision - co-creation pays back in long-term engagement of stakeholders outside the municipality, measure selection performance and smoother implementation.
- ✓ Set clear goals and strategic objectives at the FUA level but understand local needs and expectations.
- ✓ Invest in public engagement opportunities to bring credibility to the planning process. The steering group should spend considerable time providing the public and key stakeholders with a variety of opportunities for input for visioning, goals, and objectives process.
- ✓ Define key performance indicators used to measure the level of achievement and the impact of projects. They need to be clearly understood by decision makers and by the public.

Measure implementation

- ✓ Give priority to public transport system improvements, as the main transportation mode at the functional urban area level. Public transport measures must be given priority in the mobility strategy and have sufficient finance allocated to them. Developing good quality public transport and infrastructure supporting active mobility is good practice in making functional cities more accessible, liveable, and safe.

- ✓ Develop an action plan for measure implementation once the list of measures is approved by the City Council(s). The action plan should be developed two-folded: a general overview of measures and packages, and a detailed description of each measure. The measures should be described with the following characteristics:
    - Measure description
    - Responsibility for implementation
    - Activities within a measure
    - Timeline for implementation
    - Cost
    - Funding sources
    - Indicators for monitoring and evaluation
    - Stakeholders involvement
    - Alignment with complementary measures from other policy sectors
- ✓ Assurance of data quality during implementation requires specific attention. Defining standards for the data utilised and developing capacities and tools can significantly facilitate this analysis and evaluation.

Implementation and monitoring

- ✓ Provide the framework to enable a high-quality public transport system, active mobility infrastructure, intermodality, sharing services and new mobility services.
- ✓ Encourage a better coordination between public transport companies and operators in the FUA. The mobility measures covering commuting flows should create a framework for a better coordination between all PT companies who have a share in covering operations in the area.
- ✓ Evaluate transportation alternatives, scaled to the size and complexity of the functional urban area, to the nature of its transportation system challenges, and to the realistically available options.
- ✓ Enhance interconnectivity of the different modes between FUA and the region's transportation system.
- ✓ Use an integrated measure monitoring and evaluation tool that can be equally accessed and used by all stakeholders in FUA.
- ✓ Successful monitoring requires timely access to the relevant data. A continuous and systematic data collection effort is of key importance. Alternative and innovative collection mechanisms should be considered, and cooperation strategies developed to involve private actors and civil society.

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