Interreg
CENTRAL EUROPE

European Union
European Regional
Development Fund

LOW-CARB

TRANSNATIONAL PILOTS HANDBOOK

FOR LOW CARBON MOBILITY IN FUNCTIONAL URBAN AREAS

IMPRINT

Project Number:

CE1100 LOW-CARB

Capacity building for integrated low-carbon mobility planning in functional urban areas

Financed by:

Interreg Central Europe (http://interreg-central.eu/Content.Node/home.html)

Deliverable Title:

D.T.3.7.2. Transnational handbook on LOW-CARB's pilots for low carbon mobility in functional urban areas

Version 11/2020

Authors:

Wolfgang Backhaus, Marlene Damerau, Ana-Maria Baston, Kristin Tovaas (Rupprecht Consult GmbH)

Editing and Design:

Saydrina Govender (Rupprecht Consult GmbH)

Reviewed by Project Partners:

Carsten Schuldt (LVB, City of Leipzig, Germany)

Maciej Zacher (Municipality of Skawina, Poland)

Zoltán Ádám Németh (SZKT, Szeged, Hungary)

Małgorzata Jedynak and Lukasz Franek (ZTP, City of Kraków, Poland)

Nebojša Kalanj (City of Koprivnica, Croatia)

Laura Orsini and Davide Mezzadri (T.E.P., Parma, Italy)

For more info, visit the project website at:

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

TAKING
COOPERATION
FORWARD

Contents

Introduction to LOW-CARB's Pilots 5

REACHIE - Integrated Mobility Platform (Leipzig) 6
- Description of the pilot ---- 6
- Preparation and implementation of the pilot ---- 6
- Evaluation & results ---- 7
- Outlook – future usage and sustainability ---- 8
- Main take-aways/transferability ---- 8

Low-emission feeder bus line (Skawina) 10
- Context and objectives ---- 10
- Description of the pilot ---- 10
- Preparation and implementation of the pilot ---- 10
- Evaluation & results ---- 11
- Outlook - future usage and sustainability ---- 11
- Main take-aways/ transferability ---- 11

WiFi-based passenger counting system (Szeged) 14
- Context and objectives ---- 14
- Description of the pilot ---- 14
- Preparation and implementation of the pilot ---- 14
- Evaluation & results ---- 15
- Outlook - future usage and sustainability ---- 15
- Main take-aways/ transferability ---- 16

Park-e-Bike sharing service & CargoVelo e-cargo bike hub (Kraków) 19
- Context and objectives ---- 19
- Description of the pilot ---- 19
- Preparation and implementation of the pilot ---- 19
- Evaluation & results ---- 20
- Outlook - future usage and sustainability ---- 20
- Main take-aways/ transferability ---- 21

Multimodal electric mobility station (Koprivnica) 24
- Context and objectives ---- 24
- Description of the pilot ---- 24
- Preparation and implementation of the pilot ---- 24
- Evaluation & results ---- 25
- Outlook - future usage and sustainability ---- 25
- Main take-aways/ transferability ---- 25

Pilot action plan for implementing multipurpose charging infrastructure to integrate new e-mobility services into the existing electric PT infrastructure (Parma) 28
- Context and objectives ---- 28
- Description of the pilot action plan ---- 28
- Preparation of the pilot action plan ---- 29
- Evaluation & results ---- 31
- Outlook - future usage and sustainability ---- 31
- Main take-aways/ transferability ---- 31

Concluding Remarks 32

WHO WE ARE

CROATIA

- City of Koprivnica
- University North (UNIN)

CZECH REPUBLIC

- City of Brno

GERMANY

- Central German Transport Association (MDV)
- City of Leipzig
- Leipzig Transport Company (LVB)

HUNGARY

- Szeged Transport Ltd.(SZKT)

ITALY

- Electric Tramways Parma (TEP)

POLAND

- Municipality of Skawina
- Municipality of Krakow

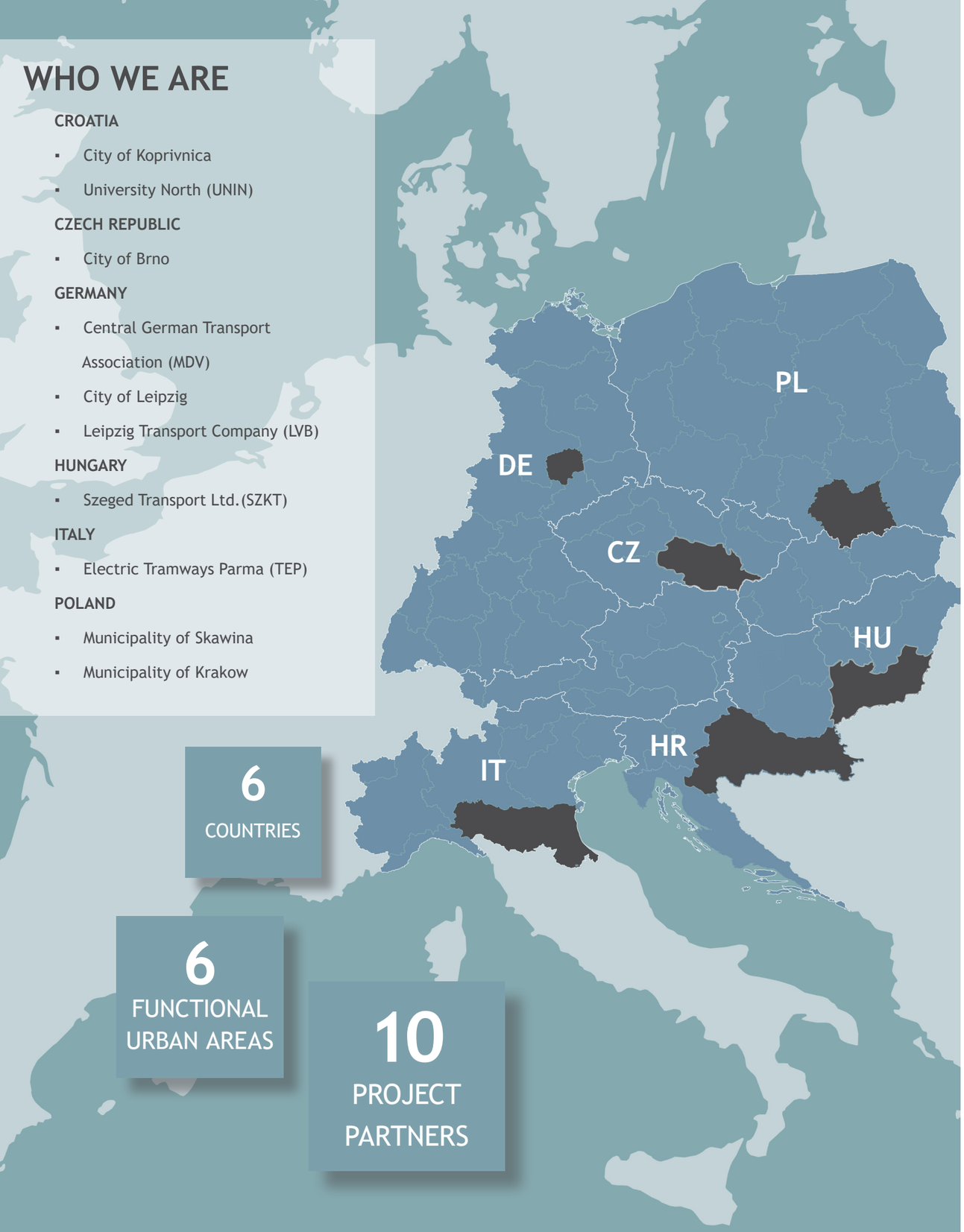


Figure 1:
LOW-CARB's pilots took place in the following Functional Urban Areas: Leipzig (Germany), City of Brno (Czech Republic), City of Parma (Italy), Krakow-Skawina FUA (Poland), City of Koprivnica (Croatia), and City of Szeged (Hungary).

Introduction to LOW-CARB's Pilots

Planning for integrated and low-carbon mobility for public transport (PT) was at the heart of the LOW-CARB project. Thus, the main goal was to increase public transport accessibility in the functional urban area (FUA) of cities in central Europe. This could only be achieved when planners in municipalities, public transport authorities and companies join forces and cooperate beyond administrative, departmental, and organizational boundaries. With these objectives in mind, six LOW-CARB partner teams (in Leipzig, Szeged, Koprivnica, Kraków, Skawina and Parma) realized pilots to demonstrate innovative mobility services in selected areas within their FUAs. The preparation, implementation and evaluation of pilots were accompanied by SUMP[1] Action Plan developments in three FUAs: Leipzig, Szeged and Koprivnica, where the parallel development of pilots and action plans created enhanced synergies. For the pilots in Kraków and Skawina, who represent an urban core and a satellite municipality in a joint FUA, the cooperation of LOW-CARB catalysed the kick-off a metropolitan SUMP process; while in Parma, a pilot action plan for a multimodal public transport electrification measure was developed, ready to implement, but also to share with others for replication.

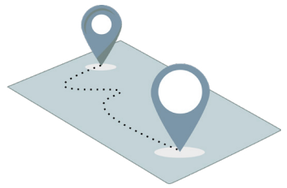
The realized pilots are diverse in nature but all respond to a need to increase accessibility in under-served areas at the outskirt of cities. In Germany, the Leipzig pilot, "Reachie" – an accessibility heatmap for the Leipzig Nordraum - was organized by the public transport company LVB, Lead partner of LOW-CARB, together with the regional transport association (MDV), and the City of Leipzig. In Poland, ZTP Kraków, PT transport authority, and the City of Skawina developed a shared (cargo-)e-bike hub at a train station in the joint FUA and tested a new hybrid-bus-line in Skawina. ZTP Kraków additionally realized an e-cargo-bike consolidation station in the centre of Kraków. In Hungary, the public transport company of Szeged, SZKT, created a new passenger counting method by installing Wi-Fi counting sensors in buses to monitor passenger movements more accurately and use this knowledge to plan new PT services for a newly established business district.. The Croatian City of Koprivnica realized a smart mobility station for e-bus and e-bikes at the local university. Finally, the Italian public transport company TEP planned an integration of charging infrastructure with public and private modes of transport.

As stand-alone measures, these pilot demonstrations have a high replication potential that cities and public transport authorities and companies in central Europe can "copy & paste" to enable higher PT usage and shift towards sustainable modes of transport for their FUAs. However, these solutions develop their full impact when they are integrated into a SUMP process with neighbouring municipalities and other planning organisations[2]. This LOW-CARB handbook will briefly describe all pilots and present key experiences in the implementation of these pilots and their potential for transferability.

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

1 Sustainable urban mobility planning (SUMP)

2 The Leipzig partners integrated their pilot into their Action Plan process, with concrete measures for developing a mobility hub in their remote business district "Nordraum". In Szeged, SZKT used the collected data to estimate future service needs for public transport infrastructure extension to a business district. And in the Koprvinca Action Plan, the pilot represents an important energy and mobility node for the extended future decarbonized public transport service area.



REACHIE - Integrated Mobility Platform (Leipzig)

REACHIE is available at: www.mdv.de/reachie

Context and objectives

Leipzig is home to one of the largest industrial areas in the German federal state of Saxony. Four industrial parks span an area of 50 km^2 and support 35,000 jobs – which are expected to double by 2030 – with companies such as DHL, Porsche and BMW. As a result, commuter traffic to the area is also steadily increasing. The objective of this pilot area is to inform and attract commuters to shift their modes of transport to sustainable PT offers and thereby reduce their CO_2 emissions. To achieve this, it became clear that there was a need to better communicate the region's complex PT network options of rapid transit lines and feeder bus systems as a single and more reliable service.

Description of the pilot

REACHIE is a powerful, multi- and intermodal online journey planner that aims to help commuters access the remote northern periphery of Leipzig by choosing the most accessible and sustainable mode of transport. It achieves this by visually communicating the integrated transit network on a multimodal information platform via reachability heatmaps (based on isochrone calculations), and by determining the user's carbon footprint and potential annual kg CO_2 savings across five modes of transport (PT, biking, walking, car or transit & bike).

Preparation and implementation of the pilot

REACHIE's development process included a feasibility assessment, detailed specifications on functions and user experience, identification of potential suppliers, a tendering process for the preparation of the heatmap, and a testing phase with corporate stakeholders (such as BMW and Porsche during the 2018 European Mobility Week). A complementary measure of ensuring the reliability of changeover connections is a follow-up project to increase the PT service quality.

The working structures included the following organisations and roles:

- **Central German Transport Association (MDV):** pilot lead and responsible for devising the concept and its implementation; IT project management; data analysis and digitalisation; communication and networking.
- **Leipzig Transport Company (LVB):** provided input on available data interfaces and operational experience of the local transit provider; contributed local marketing experience.
- **City of Leipzig:** financial accountability tendering of the information platform development; collaborated with the city's traffic management office; moderated the process of implementation and evaluation with stakeholders and customers.
- **Central Public Transport Agency of Sachsen-Anhalt (NASA - Nahverkehrsservice Sachsen-Anhalt GmbH):** provided open data needed to keep REACHIE updated on a weekly basis.
- **Targomo GmbH:** data consumer that provided state-of-the-art location-based services; made their developer API available for MDV.

Evaluation & results

REACHIE has had around 1,000 visitors within a year, since its official launch at the end of 2019. And the general feedback among stakeholders, experts and end-users was very positive during consultations, as it was made clear that there already is a sustainable transport service running that provides an alternative to private car use. However, it became obvious that the unsupervised usage of this web-app without prior training is slightly too difficult for the end-user. This feedback helped to refine its future applications: REACHIE is best applied in active consultation processes and shows high potential as a tool that could be used as an alternative planning instrument for mobility management of companies.

Outlook – future usage and sustainability

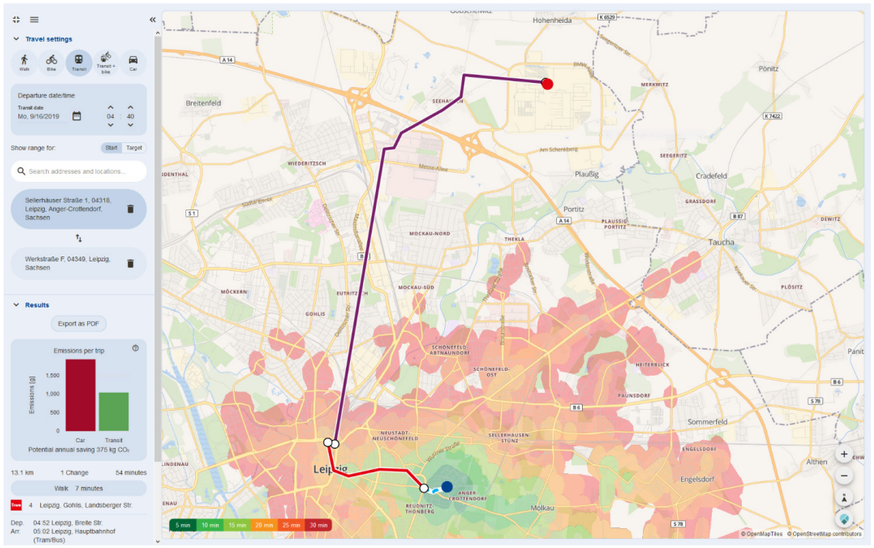
MDV will continue to maintain and update REACHIE in the future. REACHIE will continue to be promoted mainly to experts who can act as multipliers, such as mobility managers and human resources representatives at local companies of business districts. It could also help with the planning of new transport lines and scheduling adjustments. Therefore, the REACHIE pilot was a first step leading to a new way of thinking about planning instruments based on open data. REACHIE has generated interest among regional districts, transport associations and consulting firms to be applied as a spatial analysis tool for a variety of applications. In addition, other possible uses, such as the reachability of kindergartens by the City of Leipzig, or to utilize REACHIE to collect data on KPIs for controlling and reporting the quality of Leipzig's PT.

Main take-aways/transferability

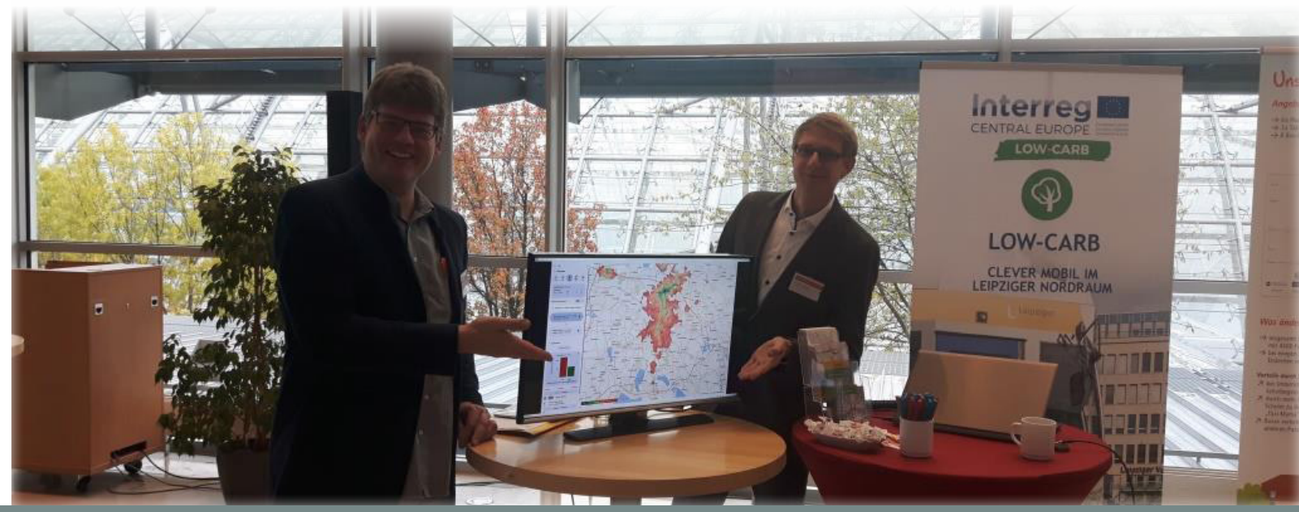
- REACHIE's heatmap tool shows high potential for transferability to central European PT operators, as it addresses the commonly faced challenge of increasing the access to PT services in industrial areas on the outskirts of FUAs.
- Industrial FUAs have the unique added advantage of important multipliers for adopting this tool, including company directors, recruiters, and mobility consultants who can leverage a considerable number of employees to opt for sustainable modes.
- The process of developing REACHIE has encouraged publishing data to open data portals, which has enabled transferability and integration into future tools.
- A standardised strategic approach is needed to maximise exploitation of open data for isochrone technologies.
- Building in a time buffer to account for development delay and bugs proved useful for keeping the project on-track.

The rapid transit, tram and feeder bus in Leipzig (2017, LVB).

> ***Our Leipzig pilot action, an innovative accessibility map REACHIE targeting commuters, is successful for communicating public transport modes in the project area. The technology behind REACHIE found applications beyond our initial ideas. Nowadays, it assists the City of Leipzig in the identification and assignment of sites for Kindergartens and helps the region to identify public transport friendly areas for future residential developments. It also provides data-based analysis for company-based mobility management [in business districts]. In LVB, another planning tool, based on the knowledge of this pilot action process, was submitted and approved for the [upcoming] project MONI. It will be acquired next year. In addition, other partners of Central Germany are considering the use of similar tools to improve their planning. Therefore, REACHIE became a first step towards new paths of a digital future in transport planning.***
>
> - Ronald Juhrs,
> Managing Director Technology and Operations at Leipzig Transport Company (LVB)



Above: Screenshot of the REACHIE integrated mobility plaform showing various modes of travel for a selected route and the associated CO_2 savings in a bar graph on the left margin (2019, MDV).



Right: *Tilman Schenk (City of Leipzig) and Chistian Jummerich (LVB) present the REACHIE tool at the pilot launch- a mobility brunch.*

Low-emission feeder bus line (Skawina)

Context and objectives

The Municipality of Skawina is one of 14 suburban municipalities located around the Kraków metropolitan city and is one of the largest communes, with around 43,000 inhabitants. The population is increasing as Kraków continues to develop. There is a large commuter flow coming into and going out of Skawina and the surrounding communities during the morning and evening rush hours.

Although Skawina is well-connected to Kraków by rail, many commuters travel by car, resulting in heavy traffic congestion as well as air and noise pollution. The main objective was therefore to reduce commuters' CO_2 emissions by improving last-mile PT connections to and from the rail station, thereby attracting more people to make use of the regional rail connections between Skawina and Kraków.

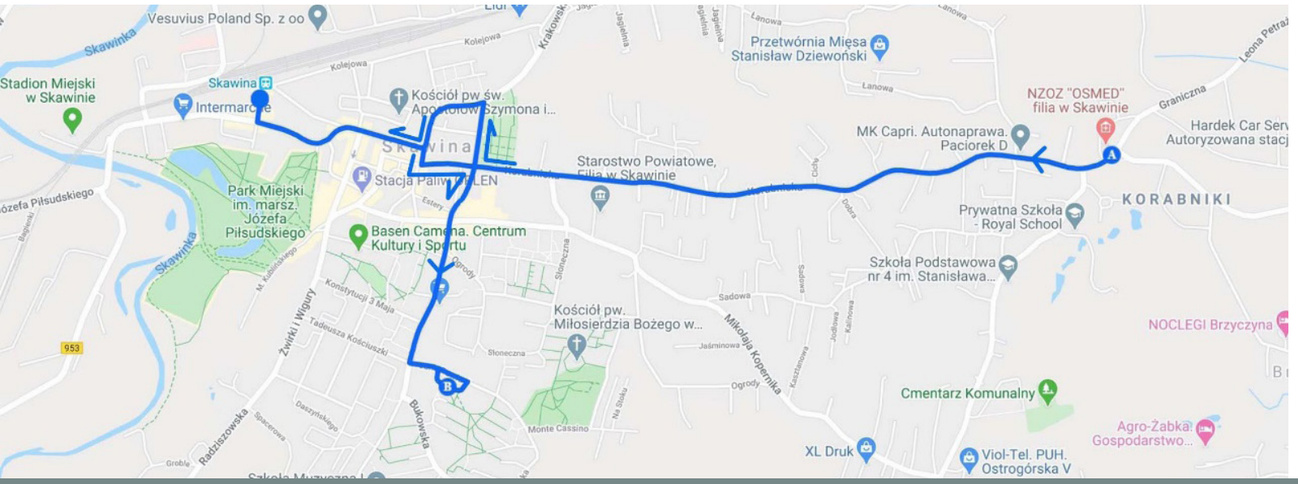
Description of the pilot

A new low-emission bus line was piloted in Skawina using two 12-metre hybrid diesel-electric buses, with the aim of providing school and work commuters with seamless connections to the regional PT network in the Kraków FUA. It serves as an internal feeder line, covering a 9.25 km route within Skawina, and making 42 runs on workdays and 22 runs on weekends. The pilot was developed by conducting a demand analysis, route-modelling and testing of the bus line. It was piloted over a duration of six months, and offered free of charge for all users throughout the pilot phase.

Preparation and implementation of the pilot

The low-emission bus line was developed and implemented over a 16-month period, from March 2019 to June 2020. The project team consisted of the following organisations and roles:

- **Municipality of Skawina:** pilot leader and chiefly responsible for devising the concept and its implementation.
- **Via Vistula:** external research partner, responsible for the research phase, development of the concept of the line and project evaluation.
- **ZTP Kraków:** PT authority of the City of Kraków responsible for carrying out obligations according to the agreement between Skawina and Kraków.
- **MPK Kraków:** PT operator of the city of Kraków.



The Volvo 7900 Hybrid bus (2019, Municipality of Skawina).

Via Vistula conducted a demand analysis and market research to set a baseline of the current status of mobility and citizens' mobility behaviour in Skawina, to define the route and mode of the line and give an overall estimation of the expected impacts in terms of mobility and CO_2 reduction. MPK Kraków operated the line based on an agreement between the PT authority ZTP Kraków and the Municipality of Skawina. MPK Kraków also initially provided one 12-metre-long Solaris 12.9 hybrid bus to operate on the route every 20 minutes on weekdays and every 45 minutes on weekends. Shortly after the pilot launched, a second 12-metre-long Volvo 7900 hybrid bus was added to the service.

Evaluation & results

The evaluation consisted of onboard passenger surveys as well as online surveys (437 surveys were filled out and analysed). Based on ridership and demand analysis, the projected yearly demand for the feeder bus line was 119,667 passengers. This represents a reduction of 106,237 kg of CO_2 per year. The majority believed that the route and frequency were optimal and did not need to be changed. Of course, the fact that the bus could be used free of charge led to a high acceptance and must also be accounted for.

Outlook - future usage and sustainability

The continued operation of this low-emission feeder bus line is supported by Kraków's SUMP, which is currently being updated and aims to improve PT linkages with the SKA rapid metropolitan rail. The pilot project team therefore aims to relaunch the line with some alterations as a permanent service that connects the most densely inhabited neighbourhoods with rail service. The necessary charging infrastructure for electric buses will also be built in order to make full-electric bus service possible.

Main take-aways/ transferability

- The pilot has shown the possibility for rerouting the bus lines according to the "feeder" scheme as proposed in Kraków's SUMP. The pilot has also helped to define the needs, challenges and limitations regarding e-mobility and electric buses in Skawina.
- Find the right-sized vehicle: Although the research phase indicated that the vehicle should be max. 10 metres in length, practical matters implied to use MPK Kraków's 12-metre-long vehicles. This resulted in one of the main organisational challenges in this pilot.
- Low-emission feeder bus lines are highly transferable: This low-emission internal municipal feeder line was developed following processes and procedures that are common for opening a new bus line. It can therefore be replicated in other towns and communes in FUAs of Kraków and the rest of Europe.

Left: *Map showing low-emmision bus line's route after amendments were considered to avoid construction works (2019, Google Maps; Municipality of Skawina).*

> *The first pilot low-emission bus line organised in Skawina proved that there's a lot of potential for public transport for local travel in our community. It has also shown that our plans described in the Mobility Plan, with feeder lines supporting the spine of the system - The Rapid Metropolitan Rail - is a feasible and scalable solution. We have also made the first steps to electrify our public transport soon. In general, it was a great learning experience with much better results than anticipated.*
>
> - Maciej Zacher, project manager LOW-CARB in Skawina

The Volvo 7900 Hybrid bus on its route (2019, Municipality of Skawina).

WiFi-based passenger counting system (Szeged)

Context and objectives

The North area of Szeged is a growing remote business district that is not well served by public transport. To better define actual and future needs for mobility services in this area, the public transport company, SZKT, developed a Wi-Fi sensor passenger counting methodology and algorithm, and tested its accurateness against other methodologies of big data analyses. The objective is to integrate the collected data into the municipal open data platform, and to use them for mobility planning at the city-level.

Description of the pilot

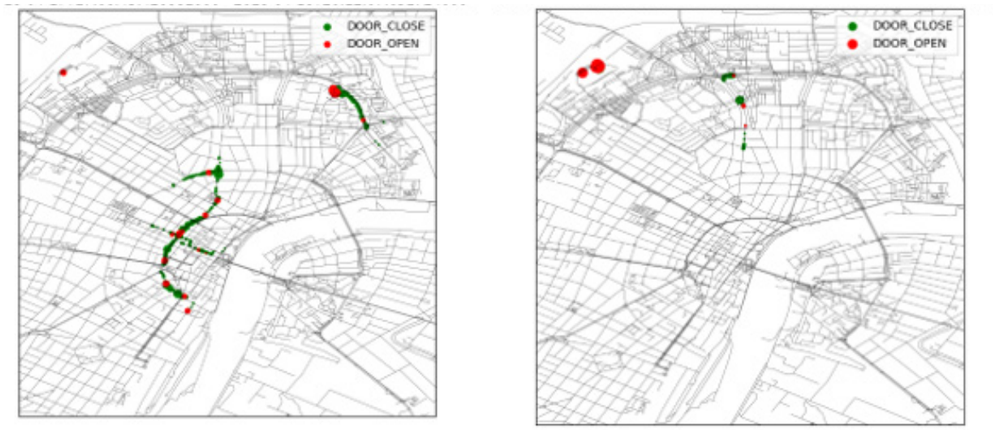
SZKT tested the precision of a new methodology to count PT passengers by a Wi-Fi based real passenger counting system on seventeen vehicles in the pilot area. The testing was based on a telemetry dataset and was validated by manual passenger counting (a method matching door openings with stops) by processing camera images and by calculating the vehicle passenger load based on axle load datasets. The resultant finding is that Wi-Fi data seem to be the most suitable for passenger counting among all sensor data. They ensure a wide range of options for improved transport planning, optimisation, and evaluation of the entire traffic network.

Preparation and implementation of the pilot

Key actors involved were:

- **SZKT:** providing the testing equipment, vehicles, data acquisition.
- **Institute of Informatics at Szeged University**: responsible for the software development.
- **City of Szeged**: Managing of user data incl. storage, access and interface formatting.

First, a preparatory research report was drafted, in which the research goals and methodology were defined. Data from the vehicles' black boxes and Wi-Fi technical parameters were analysed. Test equipment was installed on two vehicles while undertaking a manual traffic count. Based on the Wi-Fi sensor data collection and the manual passenger count, an algorithm was developed. For the software development, the theoretical measurement method had to be adapted to the real context based on collected data and data processing. Then, the measuring equipment was set up on fifteen vehicles for a final test. The collected data helped to finalize the algorithm and prepare the database structure for the software version.



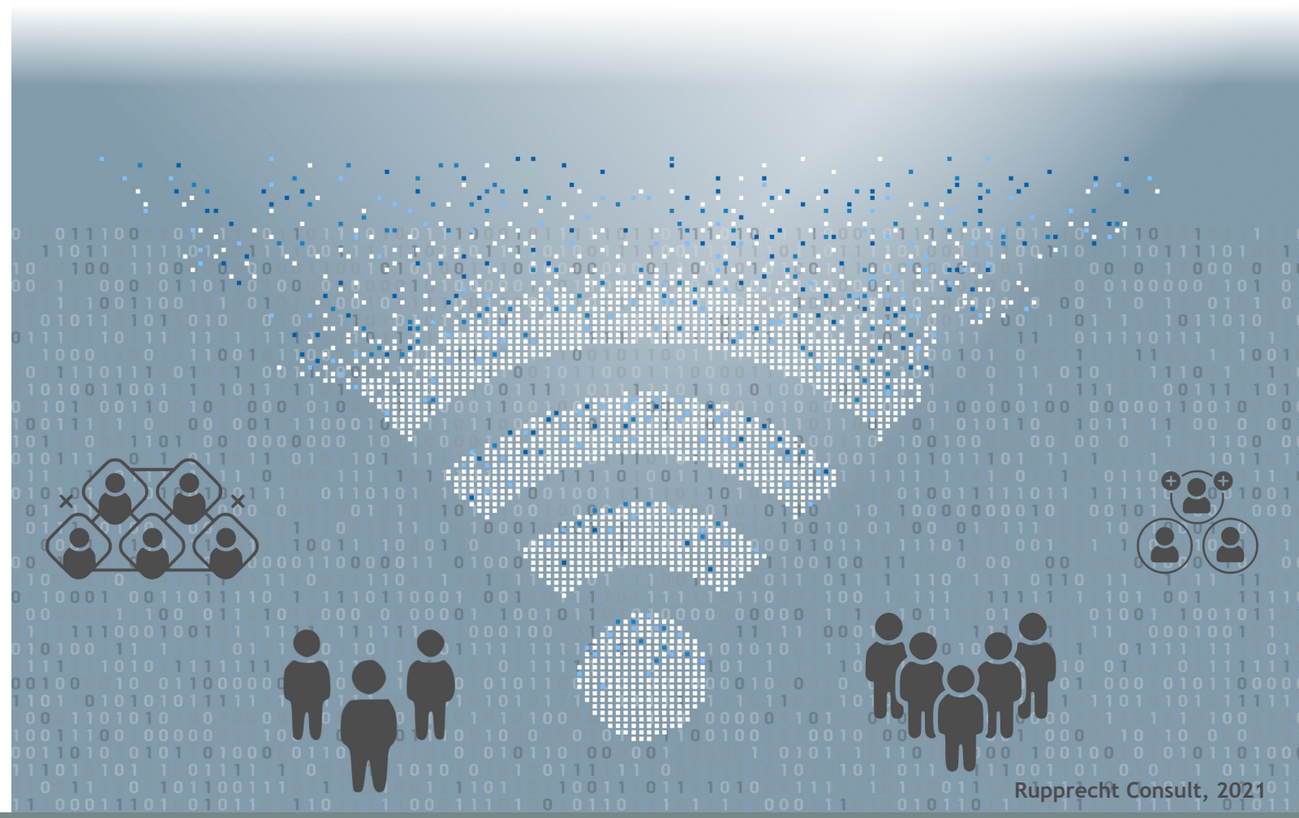
Real-time monitoring of passenger counting system showing which vehicles have opening and closing doors allowing passengers to enter and alight (SZKT, 2020)

Evaluation & results

The database necessary for running the algorithm to estimate passenger numbers was developed. Validation was undertaken in different ways: First, by deducting the load from the vehicle's own weight to get the total weight of the passengers, which was divided by the average weight of passengers for the passengers on the vehicle. Second, by matching the GPS data about door openings and closings with the stop information in the passenger count database. Third, by processing camera images using artificial intelligence. As a result, among all sensor data, Wi-Fi data seem to be the most suitable for passenger counting.

Outlook - future usage and sustainability

The passenger counting results are integrated in Szeged's municipal open data platform and will be taken up for mobility and transport planning, also by other municipal companies and researchers. A next step will be to examine whether the system is appropriate for the functional performance and interface requirements. In addition, further development of the interface and more detailed analysis of the data could become necessary.



Rupprecht Consult, 2021

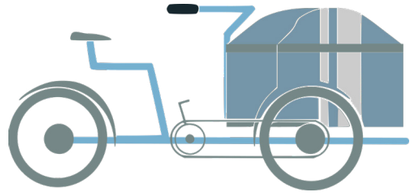
Main take-aways/ transferability

- As data modelling is both demanding and expensive, industry experts are advocating an open-source design standard. For this reason, the database scheme structure is described by a simple asset written in MySQL to allow high replicability.
- These data are extremely important not only for SZKT but also for Szeged Municipality. This type of passenger counting can be easily implemented in other cities as well since it can be used with existing Wi-Fi devices/routers with a suitable software and algorithm. Cities must consider if they have enough devices because this is the only way to achieve full coverage and results for accurate data.
- Close cooperation with researchers is very important in the development phase of the counting system, as well consideration of the timing of the project, because researching may need to be elaborated and extended.

> ***"We are dealing with a part of the city where we have existing transport links, well-established mobility habits, public transport, cycle ways and car traffic. But the northern segment of the city is a developing part too, […] therefore, we need to better understand the needs of those who will travel there daily and to see if we can ease their commute by co-operating with their employers."***
>
> - Szeged's Vice Mayor, Sándor Nagy.

Stills from live video feed showing real-time passender counting (SZKT, 2020)

Park-e-Bike sharing service & CargoVelo e-cargo bike hub (Kraków)



Context and objectives

Kraków is the capital of the Malopolskie voivodship (Lesser Poland Province) and the second largest city in Poland, with 1.4 million inhabitants in the metropolitan area, which includes the 14 surrounding communes. Kraków experiences traffic congestion from commuters and visitors. These trips are increasingly done by car and decreasingly by PT. The objective of this pilot is to implement an e-bike and e-cargo bike sharing service that provides more convenient sustainable mobility options in internal and external connections for cargo and passengers, in line with Kraków transport policy goals for sustainable mobility.

Description of the pilot

ZTP Kraków, the transport authority of the city of Kraków, implemented two e-bike sharing services: The Park-e-Bike sharing service that serves the Kraków and Skawina commune, and the CargoVelo e-cargo bike reloading hub. The sharing Park-e-Bike station was opened with 43 e-bikes and 2 CargoVelo e-cargo bikes in the Park & Ride Czerwone Maki, located in a densely populated residential area where the Kraków and Skawina communes meet, which is also home to clusters of commercial or office buildings. This location was chosen to encourage users to switch from their cars to a bicycle. Users can rent a bike free of charge via the Park-e-Bike app for the entire day, Monday to Friday from 8am to 8pm, for use in the Kraków and Skawina communes and return the bike to the station. The CargoVelo reloading hub in the Kraków city centre offers a solution for suppliers to reload goods from a van to a cargo bike so that they can be delivered to local shops and restaurants in the Old Town a dedicated urban vehicle access restricted (UVAR) zone. The hub consists of two van parking spaces (10m x 2.5m) exclusively for the system users and two cargo bike parking spaces (2m x 2.5m) that are secured with flexible posts. Parking is allowed only during loading and unloading of goods. The pilot uses 5 "Long-John" e-cargo bikes that have a load capacity of 80 kg and are equipped with electronic o-locks that can be opened via the app. Users must first be pre-verified by ZTP Kraków by filling in a form with their data and the planned date of the e-cargo bike rental, after which they may rent an e-cargo bike for up to 60 minutes and use one of the dedicated reloading parking spaces.

Preparation and implementation of the pilot

Both measures were developed and implemented over a 20-month period from January 2019 to October 2020. The pilot project team consisted of the following organisations and roles:

- **ZTP Kraków:** the transport authority of the City of Kraków responsible for public transportation and active mobility
- **Municipality of Skawina:** Local and project partner
- **International Management Services sp. z o.o.:** external expert contracted as research partner, responsible for the research phase of the e-bikes sharing system and loading hubs and both pilot projects' evaluation.
- **NEUTENO:** Supplier of e-cargo bikes
- **Freebike s.r.o.:** Supplier of e-bikes

An external expert, International Management Services sp. z o.o., was contracted via a public procurement procedure to conduct a feasibility study and evaluation of both services. A tendering procedure was then launched to purchase the e-bike systems. Freebike s.r.o. supplied the e-bikes

Left: E-bike parking point (ZTP Krakow, 2020)

Stakeholder meeting with local businesses to discuss the functioning of the e-cargo bike reloading point (ZTP Krakow, 2020)

and NEUTENO supplied the e-cargo bikes. Finally, the CargoVelo reloading hub was launched on 6 December 2019 and the Park-e-Bike system was launched on 26 October 2020.

Evaluation & results

Survey results showed that the quality of the e-bikes and the service predominantly met user expectations. Nearly all indicated that they were very satisfied with the services which achieved extremely high ratings ranging between 4.5 - 4.8 out of 5. This provides convincing evidence of a high demand for this type of public transport service and confirms that the introduction of the public electric bicycle system is an important and desirable mobility option for those who have thus far chosen the car as a means of urban mobility. For the CargoVelo hub, qualitative feedback from users shows the need to integrate reservation of cargo bikes also with parking space reservation.

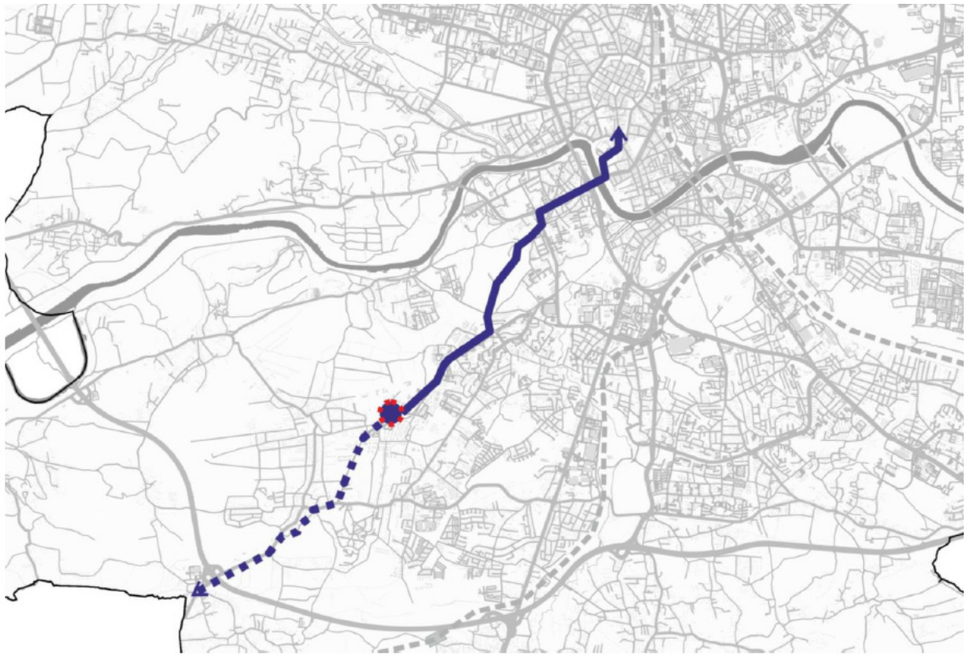
Outlook - future usage and sustainability

The City of Kraków will continue to operate and extend the Park-e-Bike sharing service for the foreseeable future. Feedback received from local suppliers regarding the CargoVelo reloading hub will also be considered for future improvements on this service. It is also planned to integrate both systems (CargoVelo and Park-e-Bike) with Kraków's new large public bicycle system that is planned to be launched in 2021, by making it possible to rent bicycles from these three services in one mobile app. These pilot measures therefore allowed the Kraków Transport Authority to test possible solutions for this new service.

Main take-aways/ transferability

- Electrically assisted public bicycle sharing systems are effective for attracting people who have previously travelled by car in the Kraków FUA.
- The process of developing the Park-e-Bike sharing system has strengthened institutional cooperation between the Municipality of Skawina and Metropolia Krakówska (an Association of Local Governments)
- Implementing an e-bike sharing system at a Park&Ride facility that connected well with a bicycle path, offers people a convenient means for modal shift from car to e-bike by offering a comfortable trail of the new mode.

Cargo-bike parking point (ZTP Krakow, 2020)



Location of the Park-e-Bike station on the border between Krakow and Skawina municipality, with direct routes through each area highlighted (ZTP Krakow, 2020).

Park-e-Bike at the Park&Ride Czerwone Maki on the border between Krakow and Skawina municipality (Google maps, 2020).

The accession by Krakow to the LOW-CARB- Capacity building project for integrated low-emission mobility planning in functional urban areas, co-financed by the transnational program Interreg Central Europe (Interreg Central Europe) for 2014-2020, allowed to attempt to test a number of tools used within modern transport policies based on sustainable city development.

The pilot implementation of the municipal electric bike rental service contributed to the improvement of the quality of services in the field of cycling, e.g. by increasing the comfort of travel and shortening the travel time, while increasing the share of environmentally friendly bicycle transport.

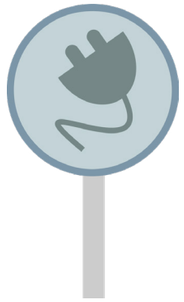
The test implementation of the Park-e-Bike system provided convincing evidence of the huge demand for this type of public transport service and (thanks to the results of the survey) confirmed once again that the introduction of the electrically assisted public bicycle system is an important and desirable utility alternative for people who have so far chosen passenger car as a means of urban mobility.

Therefore, the activities started under the project will be continued or even extended after the formal end of the project.

Where the full scope of implementations has not been achieved, it can be expected that their implementation is only a matter of time. Kraków, among others thanks to participation in the Dynaxibility4CE project, wants to continue to actively participate in the discussion about the future of urban transport, a field that is perceived by the inhabitants of European cities as one of the most important for ensuring the desired comfort of living in a metropolis.

- Andrzej Kulig - Deputy Mayor of Krakow

ZTP Krakow, 2020



Multimodal electric mobility station (Koprivnica)

Context and objectives

The pilot area - city of Koprivnica has around 31,000 inhabitants and an area of around 90km^2. The small Croatian city is the largest economic, educational, medical, and sports centre, not only for the neighbouring communities but for the entire Koprivnicko-krizevacka county. It is characterized by a large inequality in infrastructure accessibility between rural and urban areas. The commuting flows into and out of the city are therefore dynamic and generate challenges related to traffic congestion associated with increased car traffic and a high level of air pollution; poor public transport connectivity; and a decrease in the overall quality of life for the functional urban area.

The urban public transport system in the city consists of two pillars: a bus operation (2 electric buses) and a public bike-sharing scheme (6 stations with 60 conventional bikes and 1 station with 10 e-bikes). The pilot's main goal was to integrate the different modes (conventional bike, e-bike and e-bus) into one single charging point. This required updating and harmonizing the existing charging infrastructure's technology and software.

Description of the pilot

The city-owned public transport operator MUC Komunalac Koprivnica, Kampus ltd. Koprivnica together with the city of Koprivnica and energy provider HEP Elen, installed a multimodal electric mobility station equipped with Photo Voltaic (PV) technology at the premises of a new campus at University North. The station was created with up-to-date software and locally produced renewable energy to power the e-buses and e-bikes. A parallel objective of the pilot was to set up a sound basis for the further electrification of the entire PT system and the e-service expansion at the FUA level.

Preparation and implementation of the pilot

The modern station is based on a PV system and storage facility and has urban furniture beside an e-bike terminal for 5 e-bikes. It provides passengers with information about charging statuses and saved CO_2 emissions. The investment funded the construction of the charging station, the PV panels, battery, and the e-kiosk and included connecting the power supplies from the PV and "conventional" grid.

The multimodal station system offers:

- Full integration of all existing PT services by the operator.
- Independent (in-house) charging facilities for electric buses (2 AC chargers for e-buses).
- Photovoltaic panels as the renewable energy solution for charging the entire station.
- Expanded number of charging facilities for e-bikes (5 new charging points for e-bikes).
- Data monitoring of PT usage, incl. cost tracking of the consumption of electricity and all other PT related costs.

Evaluation & results

The pilot evaluation was conducted over three months and consisted of a technical analysis of the compatibility of the integrated charging and storage systems, data gathering and cost management. It was found that after finetuning technical issues experienced during the implementation phase, the equipment successfully and reliably maintained all functionalities without incurring any further problems. In addition, all requirements needed for expansion of the system into other potential FUAs of Koprivnica were met. Finally, software updates allowing new capabilities for data gathering and cost monitoring were fully operational.

Outlook - future usage and sustainability

The PT operator *MUC Komunalac Koprivnica* will be responsible for the multimodal electric mobility station as they will continue to operate the whole PT system and since they will endevour to expand the system throughout Koprivnica's FUA.

They plan to maintain and expand functions and capabilities of the station incl.: regular software upgrades, preparation of MaaS activities, expansion of the battery storage system and the photovoltaics (integral to systems operation). They will also continue to showcase the functionalities of this type of system to other similar PT operators, to promote the city of Koprivnica as an innovative leader in the field of sustainable mobility, thereby demonstrating the potential of this type of system for e-mobility take-up. It is planned to use the station for increasing PT for the City of Koprivnica (as laid out in the Koprivnica FUA Action Plan). This will be achieved by expanding the public e-bike and bike system and other PT operations; optimizing PT processes and organisations; and improving data monitoring for the evaluation of PT usage and operation.

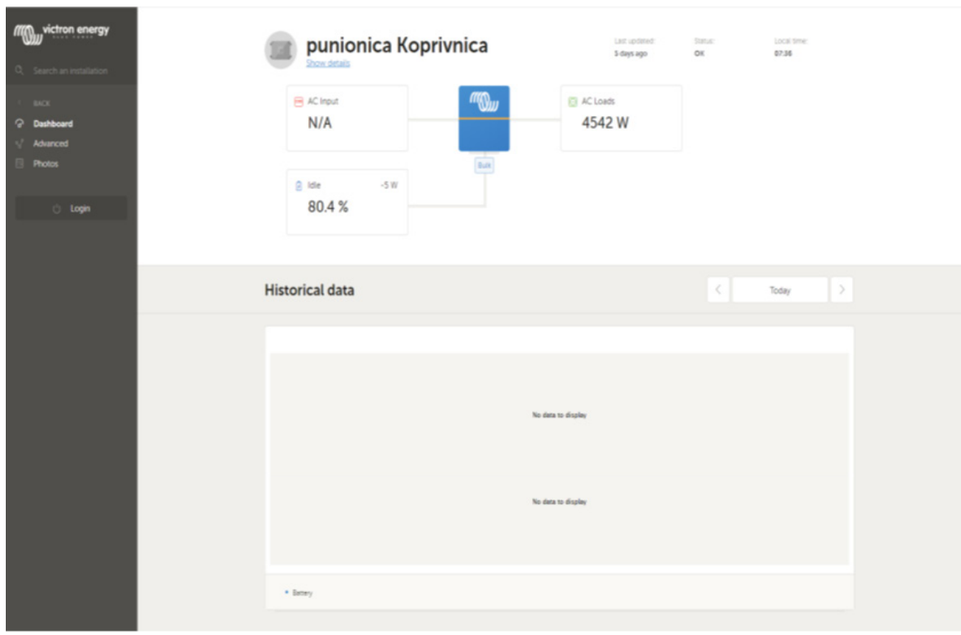
Main take-aways/ transferability

- The implementation and evaluation of innovative technical solutions are especially difficult for small municipalities to overcome due to limited funds and human resources in public transport operations. It is therefore recommended that strong political support is secured and recruiting people with the necessary technical competences before starting the project.
- Requirements for the expansion of the system into potential FUA Koprivnica have been meet.

The challenging year 2020, seemed to largely disturb the progress in the pilot implementation phase, but in fact it urged the team to streamline the decision-making process and to really focus on the main aspects of the implementation."

- Nebojša Kalanj,
associate expert for sustainable development, City of Koprivnica

Below and right:
Photo montage of pilot infrastructure set up (City of Koprivnica, 2020).



Pilot action plan for implementing multipurpose charging infrastructure to integrate new e-mobility services into the existing electric PT infrastructure (Parma)

Context and objectives

Parma is a medium-sized University city of nearly 200,000 inhabitants, and the second-largest city in the Emilia-Romagna region of northern Italy. The Integrated Regional Air Plan for Emilia-Romagna envisages "promoting and optimising the use of local and regional PT", while Parma's SUMP further supports substantial investment in PT and a significant boost to the development of electric mobility. The main interventions foreseen in Parma's SUMP related to the PT network and services include those that make the services more attractive through the introduction of new fast-charging electric vehicles, as well as supporting the development of electric mobility by drafting a municipal electric mobility plan. The objective of this pilot action plan[1] was to therefore achieve a modal shift from private car usage towards low-carbon mobility services by allowing for seamless, multimodal, and local zero-emission mobility in Parma.

Description of the pilot action plan

Parma's PT operator, TEP, in cooperation with the City of Parma, developed an action plan for the implementation of multi-purpose charging infrastructure for a multi-modal electric mobility service that combines electric bus services with shared electric car services. A key asset in this plan is the existing trolleybus network, which could become a backbone for electric charging infrastructure to introduce a new electric bus line and linked electromobility services. The existing trolleybus network consists of 21 vehicles that operate on 4 lines along 20 km of overhead catenary wires.

The plan foresees the implementation of an energy recovery system that includes a three-step energy flow: 1) recharging at the bus stop, 2) recharging at the bus depot, and 3) a kinetic energy recovery system. To this end, the following measures will be implemented: converting an existing diesel bus line to an electric bus line, building a recharge system hub, and building a depot for overnight recharging. By switching from diesel buses to electric buses, Parma will benefit from an estimated annual emissions reduction of 639.85 kg of CO_2, 3,986.57 kg of NOx and 36.85 kg of PM10.

The action plan also includes:

- Identification of a new electrical line and transportation system program
- Technical overview and battery charging
- Definition of the characteristics of the system
- Analysis of the energy consumption of different scenarios
- Reorganisation and design of the terminus
- Authorisations required for the new charging point
- Analysis of the system at the bus depot for overnight recharging
- Economic analysis of costs and benefits

1 The full pilot action plan is available on the LOW-CARB website: https://www.interreg-central.eu/Content.Node/LOW-CARB.html

Preparation of the pilot action plan

Based on the plan to introduce new electric bus lines in Parma's FUA, TEP – supported by the City of Parma – analysed the potential for the multipurpose use of charging infrastructure for electric vehicles. Within the development of the action plan, a survey was conducted to gather information on users' acceptance in terms of electric PT and shared e-car services. To decide which bus model should be deployed, two different battery/ charging versions were analysed, and one bus model was tested under real conditions. Layouts of routes and charging stations were also developed. A bus line was identified that would be feasible for introducing an e-bus service. Finally, next steps for stakeholder engagement were defined and the energy market conditions, as well as their effect on implementation, were investigated.

The e-buses will be equipped with a pantograph for overhead charging, which will be conducted in the evening at a designated recharging depot so that they can go into service in the morning fully charged. The recharging stations will also be equipped with three docking stations for electric cars, so that it acts as a hub for both PT and individual electric mobility.

The coordination team for the implementation of this pilot action plan consisted of TEP and the City of Parma, responsible for overseeing all activities related to the detailed planning and authorisation of the new bus line and the recharge modules and civil works for the recharging system at the hub and the depot. In terms of resources, the bus line required input from a PT planner, recruitment of a driver, and procurement of the electric buses. The recharge system hub and depot required input from external experts as well as PT and infrastructure planners.

New test bus designed by BYD Group, (TEP, 2020)

Evaluation & results

The results of a survey of 221 potential users indicated that there is significant support for combining e-car charging and e-bus usage. In total, 95.9 % of respondents stated that they are in favour of such a project, while 74.2 % said that if they would have access to an electric vehicle, they would be keen on parking and using multimodal recharging stations to reach the city centre by bus. In line with this were the results that 7.7 % would still try to reach the city by car, while 18.1 % would reach the city centre by bus only if it were fuelled by clean or renewable fuels.

Outlook - future usage and sustainability

The next steps will be to conduct an analysis of trolleybus and e-bus systems to identify best practices for multipurpose charging infrastructure. The coordination team of TEP and the City of Parma will also work to align the implementation of the Action Plan closely with Parma's Mobility Strategy.

The implementation of this action plan reveals the potential for new complementary e-mobility services in the future, which will provide residents and visitors in Parma with a wider range of attractive sustainable mobility options. The action plan therefore supports a continuous expansion of multimodal electromobility services in Parma's FUA.

Main take-aways/ transferability

- Experimenting with vehicles and technologies allowed TEP to gather useful data for future investment decisions.
- Joint planning of TEP and the City of Parma for electric mobility charging infrastructure and electric vehicles increased the perception of TEP as a company committed to sustainability.
- Cooperation with the municipality and with citizens increased the quality and acceptance of the action plan.

> *"We are supporting the Municipality of Parma in building the future of clean, low-impact mobility in Parma. TEP is committed in renewing its fleet and exploring new technical opportunities, such as recharging facilities made available at the terminal both for buses and for private cars. Our aim is to provide new solutions to make mobility easier for people commuting every day."*
>
> - Roberto Prada, Chairman of TEP.

Left: Pilot test bus from BYD Group and its designated route (TEP, 2020)

Concluding Remarks

LOW-CARB's project pilots present innovative public transport solutions that aim at increasing service quality and users' satisfaction, for both current users and new customers. In addition, the pilots 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 increases in population.

All pilots 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[2].

The LOW-CARB partners' main take-aways along the realisation path of the pilots, in the preparation, demonstration and evaluation phases are summarised below.

- Participation in a funded project of the Central Europe Interreg Programme for the realisation of these pilots provided scope for taking risks associated with innovative measures for new services and engaging in such exploratory, transnational, and innovative environments. Furthermore, as innovations in public transport are always subject to the balancing act of ensuring that public expenditure delivers value to citizens on the one hand, and developing new innovative services, for which the value for the public is initially uncertain on the other hand, the participation in funded projects could be considered as a mitigation strategy to minimise innovation risk for new services through pilots.

- For all pilots the responsible local authorities, public transport providers and other relevant actors teamed-up to jointly develop, test, and deliver their pilots. Linked to a common vision, the local partnerships demonstrated their common intention for innovative low-carbon mobility solutions as part of the wider integrated urban mobility system.

- All pilots demonstrated contribution to the implementation of the functional urban areas' Sustainable Urban Mobility Plans (SUMPs) or Mobility Master Plans. Being embedded in a local policy framework for public transport fostered clear commitments from the relevant authorities to implement those plans.

- The LOW-CARB pilots included new approaches such as data-based public transport planning or sharing and new technologies such as electrification. Being integrated into SUMP / Mobility Master Plans' action plans. The pilots were therefor part of complementary and reinforcing packages of urban mobility measures including:

    - technological innovations (e.g., electric buses, integration of renewable energy in charging infrastructure).

    - non-technological innovations (e.g., coordination with alternative mobility services, integrated PT, and bike-sharing).

    - marketing, information, and awareness raising campaigns and co-creation of user-oriented solutions.

    - policy-based measures (e.g., urban vehicle access restriction (UVAR), free public transport) to improve the public transport offer in the functional urban areas.

Realising technical innovation and service innovation in the LOW-CARB pilots promoted competence development for the involved project partners and relevant stakeholders. Developing, implementing, exploring, testing and evaluating these low-carbon mobility solutions supported both competence development in the process of pilot realisation and identifying competence and knowledge gaps in the public transport area (e.g., data management and analysis, innovation procurement), which should become part of future capacity building strategies.

A thorough evaluation of the LOW-CARB pilots in terms of their effectiveness in achieving local, regional, and transnational mobility objectives as well as the identification of possible barriers to their take-up and further deployment, together with recommendations on how to overcome them, was part of LOW-CARB's joint lessons learning programme. To facilitate a common lesson drawn at the European level, the pilots' results are analysed and disseminated as best practices through the project's various communication channels, i.e., as fact sheets and further publications which are available on the LOW-CARB project's website[3] and the newly established Central Europe SUMP Competence Centre[4].

2 See more on the priorities at: Green New Deal

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

4 https://sump-central.eu/

DISCOVER MORE ABOUT LOW-CARB

Visit our website:
www.interreg-central.eu/LOW-CARB

Contact Us

+49 341 492 2012

Project managers:

Carsten Schuldt
c.schuldt@L.de

Marlene Damerau
m.damerau@rupprecht-consult.eu

www.linkedin.com/company/lowcarbonplanning

www.facebook.com/lowcarbplanning

@lowcarbplanning

TAKING COOPERATION FORWARD

Stadt Leipzig

MDV

Leipziger Verkehrsbetriebe

Zarząd Transportu Publicznego w Krakowie

Grad Koprivnica
Za život.

SZEGEDI KÖZLEKEDÉSI TÁRSASÁG

B R N O

tep S.p.A.

Skawina
Miasto i Gmina

University North
Sveučilište Sjever

RUPPRECHT CONSULT
Forschung & Beratung GmbH