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Pilot action in FUAs: Poznan

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GRETA Project

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More information about GRETA can be found on https://www.interreg-central.eu/greta/

Abbreviation table	
Abbreviation	**Definition**
CE	Central Europe
CoP	City of Poznań
DC	Distribution Centre
FUA	Functional Urban Area
Łukasiewicz-PIT	Łukasiewicz Research Network – Poznań Institute of Technology
SUMP	Sustainable Urban Mobility Plan
SULP	Sustainable Urban Logistics Plan
ZEV	Zero Emission Vehicle
ZDM	Zarząd Dróg Miejskich (local City Roads Administration)

1. The GRETA project

GRETA project aims to decarbonise the last mile delivery in Functional Urban Areas (FUAs) in Central Europe (CE) and create liveable and accessible cities for all by 2030. The project seeks to implement joint sustainable solutions in CE FUAs using zero-emission vehicles and cargo bikes and reorganise urban spaces with curb management. The pilot actions in the cities of Maribor, Reggio Emilia, Verona, Poznan, and Budapest (with Berlin FUA as an observer) have the potential to quickly deploy as pop-up measures in combination with existing measures. GRETA provides capacity-building activities, strategies, action plans, and tools for public authorities, enterprises, and relevant organisations to ensure financial, environmental, and social sustainability beyond the project's lifetime.

Last-mile delivery generates negative impacts, including emissions, noise, and congestion. Due to the COVID-19 crisis, global parcel distribution volume nearly doubled, further increasing inefficiencies in the peripheral areas. GRETA's FUAs recognise the problems that generate pollution, nuisance, noise, congestion and have jointly recognised three main problems: the lack of use of green zero-emission last-mile vehicles, conflicts between freight and public vehicles, and the lack of knowledge and strategies for a flexible and shared use of the curb and public space. Despite having SUMPs/SULPs, FUAs struggle to activate fitting measures while keeping their centres attractive and alive for residents and tourists.

GRETA addresses the common challenges of all CE FUAs by creating the conditions to promote ZE logistics using micro-hubs, cargo bikes, light e-vehicles, and curb management strategies. Additionally, the project also focuses on paving the way to innovative concepts such as regional collaborative logistics, physical internet, and freight curb management. GRETA facilitates the dialogue towards the acceptance of a business and governance as a service model, where cities must equip themselves with a network of innovative services to guarantee seamless experiences for their users and a mobility plan considering different functions and priorities of the services.

GRETA's objective is to support the urban mobility transition in CE FUAs by jointly developing solutions and strategies with a huge potential for decarbonisation of the last mile in line with the EU Green Deal and the Urban Mobility Package, abating congestion, pollution, and nuisance. The project's success relies on capitalising on previous experiences, exploiting synergies with ongoing initiatives, testing innovative pilots, improving competences and knowledge among PPs and stakeholders.

2. Executive summary

Poznań, like many large cities, suffers from insufficiently clean air, noise and traffic congestion. One of the factors causing it are freight deliveries. They are particularly problematic in the historic city centre, which on the one hand is not suitable to freight traffic, and on the other is particularly burdened by it, due to the restaurant and tourist services provided there. Reducing delivery vehicle traffic on any scale is valuable, especially in view of the plans to create Clean Transport Zones in the centres of Polish cities, not only Poznań. The use of cargo bikes for parcel deliveries is one of the ways being considered to reduce the nuisance of urban deliveries.

As part of the implementation of pilot task 2 in Poznań, a living lab approach was used for implementation of a transhipment hub supporting last-mile deliveries by cargo bicycles.

City of Poznań (CoP) and Łukasiewicz-PIT (L-PIT), in cooperation with the Operator (GLS Poland), determined the location of the pilot project based on the availability of the site (municipal plot), its transport links and the Operator's needs. The final location was a plot on Pułaskiego Street, owned by City Roads Administration (ZDM) and intended for a future Park&Ride function.

After selecting the hub location, the service area was mapped out based on the operation of three cargo bikes from that site. Despite the availability of a fourth bike, it was not possible to fully utilise the hub's potential due to recruitment difficulties.

In consultation with the Operator, the assumed course of the process in the hub and the potential of the region were determined as assumptions for the preparation of the hub project and its subsequent operation. In addition, restrictions related to the location of the hub on the building plot were specified.

As part of the project, a tender was awarded, and a service provider was selected to design, deliver, operate and ultimately dismantle the transhipment hub. This followed the completion of procedures to obtain the necessary permits, secure a power supply, organise access, and fence off the car park area.

The actual pilot programme began in December 2024 and lasted six months, during which the Operator carried out (mainly) parcel deliveries in the designated area.

During the pilot programme, data on the parameters of the activities carried out were collected, including the use of dedicated GPS devices mounted on bicycles. Also data on typical deliveries in the hub's area of operation was collected by the Operator.

After the pilot project was completed and the data was collected and analysed, conclusions were drawn. Firstly, the use of cargo bicycles resulted in a reduction in emissions of less than 30% (approximately 2,57 t eCO_2 over 6 months in the case of minimising combustion engine vehicle traffic) and a similar reduction in delivery vehicle traffic. However, this was associated with an increase in delivery costs (depending on the calculation method, from 6% to 14%), resulting from slightly higher labour intensity and the need to operate a larger number of vehicles.

It should be emphasised that the hub's potential was utilised at 37%, which could theoretically be increased by sharing equipment or making deliveries throughout the working day, as opposed to 4 hours a day, which is typical for courier companies. Improving utilisation could result in improved financial efficiency.

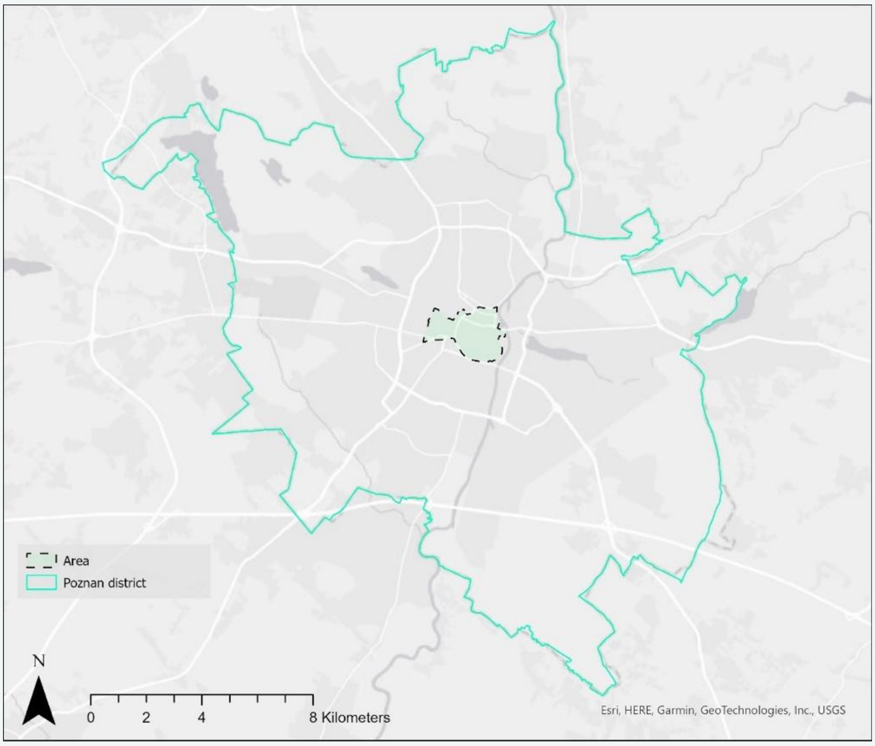
The pilot proved the significant environmental efficiency of the solution, its neutral impact on process efficiency and, at least in the pilot, its negative financial efficiency.

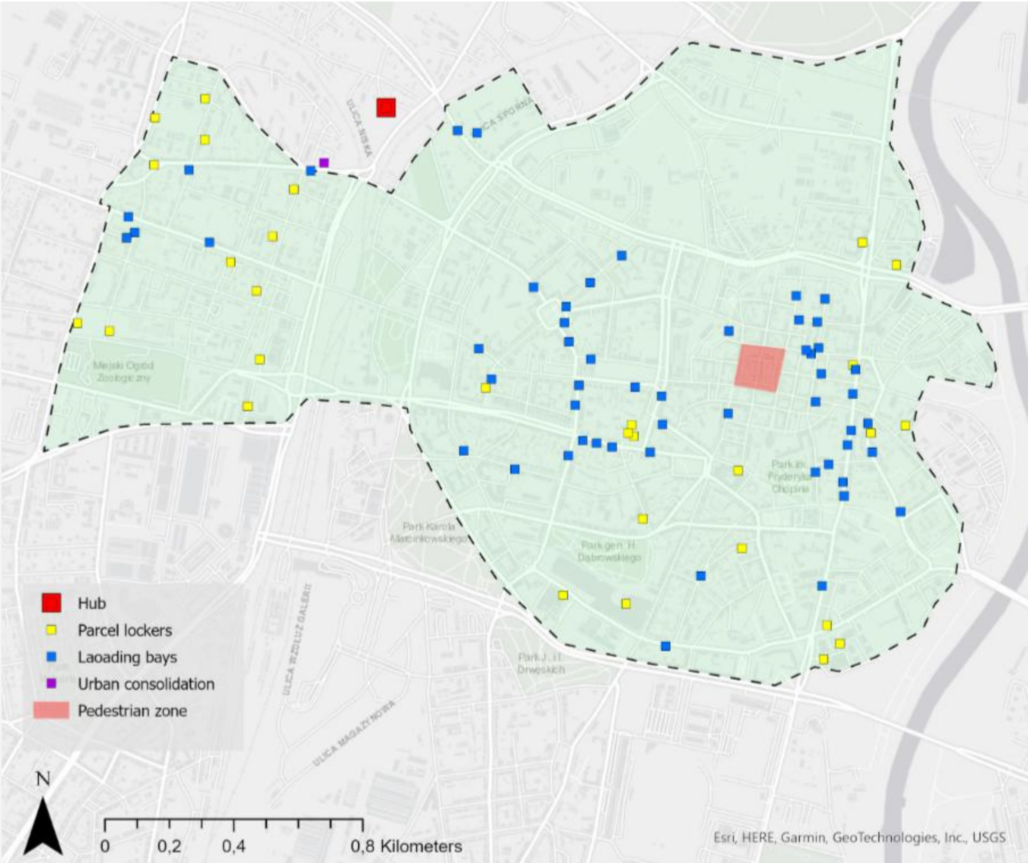
3. Pilot action set up

3.1. General information

Poznań is one of the most important academic and cultural centres in Poland, with a stable, modern economy, offering numerous knowledge-based services and a high quality of life. It is the fifth most populated city in the country, with more than 535,000 residents - about 1 million in the entire agglomeration. Among them are 104,000 students, who provide Poznań with an incredible dose of energy and contribute to its atmosphere.
The city is located in Central Europe, halfway between Berlin and Warsaw. Travel is easy, as the city is very well connected to major European and Polish cities, including Frankfurt, Munich, Copenhagen, Warsaw and London.
Poznan is a fast-growing, dynamic, compact and modern city that attaches great importance to its heritage. Its history, location, accessibility, high-quality urban and tourist infrastructure and services, as well as investment in cutting-edge solutions, make the city not only an unforgettable tourist destination, but also a place to live.

Table 1 General information

Location	Poznań, Poland
Map (general + detailed)	**General location map**  *Figure 1 General location map* *Source: GLS* **Detailed location map** The map shows the location of the expected reach of the hub in relation of its location.

	 *Figure 2 Detailed location map.* *Source: GLS*
Area characteristics	Reach area type: partly residential (North from the location), partly old city centre (South from the location) *Reach area size: 5.2 km*^{2} Access restriction: mostly without access restriction, apart from Old Market Square (pedestrian zone) Description of the area: there can be specified three types of areas: - mixed areas with historic buildings, mainly offices, hotels/hostels, restaurants and shops of various types, from groceries to exclusive goods, apartment buildings - single-family development, with detached house (flats and offices too) - residential areas (blocks of flats)

Challenges that the city faces include:

- reduction of traffic and usage of ZEV (Zero-Emission Vehicles);
- implementation of SUMP (Sustainable Urban Mobility Plan) in the city of Poznan in the last mile deliveries scope;
- using the principles of the Clean Transport Zone (under consideration) to implement ZEV solutions for deliveries.

Agreements with GLS on the size of the pilot area has been concluded. Once the administrative and formal issues have been verified, the exact site for locating the microhub was selected. The next steps in terms of exact arrangements was the tender procedure and selection of a contractor.

3.2. Vision, problems and needs to be addressed in GRETA

3.2.1 Pilot action objectives

- Identify process of last mile deliveries by cargo bikes with micro hub support.
- Model of cooperation between the City and Operator (with influence of other stakeholders).
- Test the solution for 6 months pilot in real condition to gain practical experience.
- Final design of the micro hub for shared use according to the requirements of City, Operator and experiences from the pilot.

3.2.2 Specific vision, ambition and the pilot action problems to be addressed by GRETA

Table 2 Problems addressed

Problem(s) addressed	Reduction of the GHG emissions, noise and congestion in the pilot area
Causes of the problem(s)	Poznań, like many large cities, suffers from insufficiently clean air, noise and traffic congestion. One of the factors causing it are freight deliveries. They are particularly problematic in the historic city centre, which on the one hand is not suitable to freight traffic, and on the other is particularly burdened by it, due to the restaurant and tourist services provided there.
Rationale for implementation	Reducing delivery vehicle traffic on any scale is valuable, especially in view of the plans to create Clean Transport Zones in the centres of Polish cities, not only Poznań. The use of cargo bikes for parcel deliveries is one of the ways being considered to reduce the nuisance of urban deliveries. Support of cargo bike deliveries with appropriate facilities, in the form of a transshipment hub, may multiply the beneficial effects of using this form of transport. Specific pilot needs and goals are: (i) confirmation of the justification for micro hubs implementation, (ii) verification that the solution will be a way to meet the conditions required in a potential Clean Transport Zone, (iii) verification of the efficiency and cost-effectiveness of cargo bike deliveries using the micro hub.
Future outlook	The pilot of the transshipment hub aims to prove its beneficial impact on city centre deliveries. The positive effects will, it is assumed, result in: (i) a change in the outlook of city authorities on city centre delivery hubs, (ii) the identification of environmentally and financially beneficial solutions for all city centre delivery companies, (iii) the creation of a transhipment hub project that meets the expectations of stakeholders and is ready for subsequent implementations.

3.2.3 Governance analysis

Local policies and regulations

The area is managed by the local government of the city of Poznań. The area where the micro hub was located belongs to the City Roads Administration (ZDM), also responsible for the city's road network. Within Poznań, a Parking Zone and a Downtown Parking Zone have been designated. Currently, there are more than 100 delivery reloading bays in the Paid Parking Zone and Downtown Paid Parking Zone. Delivery reloading bays are a solution aimed at businesses. Parking on them is time-limited, i.e. up to 15 minutes, and only possible with a purchased badge. In Poznań, there have been restrictions on the movement of trucks with a gross vehicle weight of more than 16 tons since 1997.
The documents setting the directions for sustainable mobility in Poznań, adopted in 2021, are the following. Sustainable Urban Mobility Plan (SUMP) for the City of Poznań and Transport Mobility Policy for the City of Poznań. Both documents include the most important scopes on logistics in the city and provisions from the Sustainable Urban Logistics Plan (SULP) developed in SULPiTER project. In addition, in 2023, the Sustainable Urban Mobility Plan for the Poznań Metropolis until 2040 was adopted, which includes guidelines for Poznań and neighbouring municipalities. In addition, in 2020, the Strategy for Electromobility Development for the City of Poznań until 2035 was adopted, which indicates the directions for moving towards electromobility.

In terms of the pilot involving the micro hub, the most relevant are the regulations on temporary construction facilities. According to Article 29, paragraph 1, item. 12 of the Construction Law, temporary construction facilities only require notification to the competent administrative authority. In the case of Poznań, this is the Poznań City Hall. Due to the above regulations, the pilot can be implemented for a maximum of 6 months. A longer pilot and micro hub location would require a building permit. In addition, national regulations limit the width of cargo bikes to 90 cm (10 cm less than in most European countries), which affects the availability of bike types.

National policies and regulations

The Road Transport Law [6] defines, among other things, the rules for undertaking and carrying out national and international road transport, as well as the conditions and procedure for obtaining certificates of professional competence.

The Road Traffic Law [3] specifies the rules of road traffic on public roads, as well as the terms and conditions that vehicles must meet in order to be admitted to traffic.

The Transportation Law [4] sets out rules for the transportation of passengers and goods.

The Electromobility and Alternative Fuels Law [5] the purpose is to define the rules for the development and operation of infrastructure for the use of alternative fuels in transportation. It aims to encourage drivers to choose electric cars and those powered by other alternative fuels. The law introduced the possibility of establishing Clean Transportation Zones in Polish cities, among other things.

EU policies and regulations

European Commission (2011), White Paper: Roadmap to a Single European Transport Area – Towards a competitive and resource-efficient transport system. The document sets the strategic vision for a 'carbon-free urban freight distribution', with zero direct CO_2 emissions by 2030. Cities also closely follow the proposed revision of the TEN-T Regulation, particularly the updated definition of Urban Nodes, and the EU's target of phasing out internal combustion engine vehicle sales by 2035.

Pilot project supports EU goals for sustainability, decarbonisation of transport, and improved urban mobility while contributing to environmental and public health objectives. By aligning with the EU's Green Deal, urban mobility frameworks, clean Vehicle directive [1], and vision zero for road safety [2], the project can help meet broader EU targets for a greener, safer, and more efficient transportation system.

3.2.4 Solution description and technical specifications

Solution description

The primary functions of the micro hub are: i) to serve as a backup facility for transshipment from delivery vehicles arriving from the distribution centre, equipped with cargo bikes, and ii) to provide temporary storage for parcels. Shipments delivered from the distribution centre are unloaded, sorted and then partially loaded into the cargo boxes of the bicycles. The remainder of the shipments, once sorted, are temporarily stored (optional) in the hub until couriers from subsequent rounds of deliveries arrive.

Once the deliveries are completed, the hub serves an additional function as a cargo bike garage space.

The location of the micro hub was strictly limited to available plots of City of Poznań. On the other hand, the location (see figure 2) directly next to the city centre with movement restrictions was very important. The final location is a compromise between available space and the requirements of the logistics operator.

Hub assumptions

Specific dimensions were decided: external (length x width x height): 6,058 x 5,800 x 2,591 mm, internal (length x width x height): 5,897 x 5,700 x 2,392 mm (see Figure 3). The hub was made of at least 90% recyclable materials. It was a temporary facility, not connected to the ground. It was equipped with a docking system for reloading vehicles, the ability to work with 4 cargo bikes transshipment modules simultaneously and the ability to simultaneously reload 4 cargo bike transport boxes and 1 cargo box of a delivery vehicle. The hub had a secure garage space for 4 cargo bicycles (off-hours of the hub). It provided protection from weather conditions, i.e. rain, snow and hail, to enable handling of shipments. It ensured compliance with relevant regulations (including health and safety) and ergonomics for couriers and drivers.

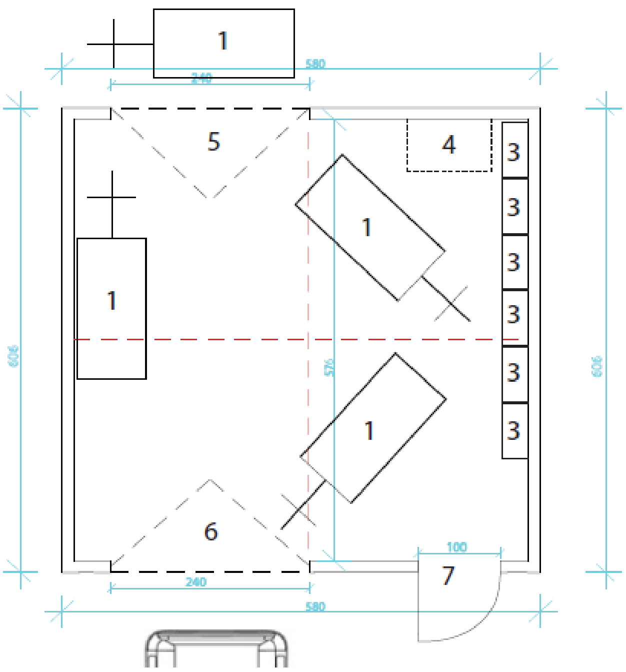


Figure 3 Microhub designed dimensions and main elements locations: 1. cargobike, 2. van (visible partially) 3. shelves, 4. charger location, 5. bike gate, 6. van gate, 7. doors (source: WCG design)

Bikes model description

Main parameters of the cargo bikes[1]:

- vehicle weight: approximately 120 kg,
- length: 2705 mm,
- width: 900 mm,
- height: 1994 mm,
- electric power steering: 5 gears,
- range: 40-100 km on a single charge,
- battery change time: about 30-50 seconds,
- driver's protection roof.

Figure 4 Cargobike during the pilot duration (source: L-PIT)

Process conducted

The logistical process of handling parcels in the micro hub was initiated by the arrival of employees (bicycle couriers) at work and with the confirmation of their working hours in the internal system. Next, bicycle couriers opened the micro hub, followed by positioning the parked bicycles at the designated loading stations. After all activities inside the micro hub have been completed, couriers waited for the arrival of the delivery of parcels from Distribution Centre DC Głuchowo. The parcels were delivered to the microhub using a delivery vehicle (van). The parcels inside the vehicle were already be sorted into individual sub-regions. Once the delivery vehicle arrives, the sub-routes were assigned, and courier terminals were handed over to individual couriers. The next step in the process was the unloading of shipments by couriers and the simultaneous sorting into individual rounds of shipments on a given route (based on the experience of couriers and markings on labels) with their simultaneous registration. Shipments were distributed in cargo bike boxes and in a warehouse like microhub (there will be no need to record this operation). At this stage the handling ended. The delivery vehicle that delivered the shipments can drive away. At the end of this part of the process, the hub were closed.

Activities during the day

Activities carried out during the day included the arrival of a courier from the next round of the sub-route and opening of the microhub. In addition, it was necessary to unload undelivered and (incidentally) shipped packages with simultaneous registration of operations in the terminal. Each day, the loading of parcels for the next turn (without registration) and the closing of the microhub were also performed.

[1] Details: https://www.maxpromobility.com/pl/ecocargoxl

Activities at the end of the day
At the end of the working day, bicycle couriers were returning from the last route of deliveries made. It was necessary to transfer cash from collections to commercial deposit machine (optional). After the couriers return from the route, there will be an opening of the micro hub and unloading of undelivered and (accidentally) shipped packages with simultaneous registration of the operation with the terminal. Once the tasks were completed and the operational processes finished the hub was closed. The bicycles will then be parked inside the microhub for garaging. Once all these steps were carried out, the work will be officially concluded.
In addition, the last of the terminating couriers was required to wait for the arrival of a delivery vehicle from DC (probably one of the couriers from nearby routes). The vehicle that arrives was taking the undelivered and posted packages and pick up the couriers' terminals. Once everything is done, the micro hub was closed.

3.2.5 Transnational Cooperation

The pilot was jointly developed with the support of Municipality of Reggio Emilia and the Municipality of Maribor. Three peer-review workshops have been organized to share issues, ideas and solutions among partners that face similar situations. Indeed, Reggio Emilia and Maribor were testing a similar solution to the one implemented in Poznan. The mutual exchange of experiences is aimed at comparing the results of all the pilots and developing lessons that can serve other cities.
All pilot partners face the problem of lack of data; logistic operators are not available to share their transport data due to their internal policies. This makes it very difficult for public entities to develop an effective city logistics planning based on real data. To cope with this issue, partners jointly developed a basic questionnaire to share among transport operators.
Moreover, partners share the need to implement and enforce access restrictions in pilot areas to boost the use of sustainable modes of transports. Indeed, the development of a rules system that limit the access to pollutant vehicles is the main requirement to encourage transport operators to change their delivery system. In the absence of restrictions, transport operators would not change their profitable system. At the same time, partners strongly agree on the need to build a collaborative approach with transport operators to support them in a fundamental change of transport behaviour.

Table 3 Information on joint development

Main implementor of the pilot action	City of Poznan
Contributor	Municipality of Maribor (SL) and Municipality of Reggio Emilia (IT) (country)
Process of joint development	The process of exchanging mutual experiences is based on the experience of each city. The peer - review workshops have been discussing the possibilities and experiences of the pilots in each city. In addition, during the regular online and cyclical project consortium meetings, each piloting partner will be able to learn about the progress of the pilots, ask questions and find out how these experiences can be applied to their pilot. Once the results of the microhub pilot in each city have been collected, the conclusions will be analysed and compared. All of the above will lead to the development of general conclusions on microhubs in cities.
Input received from contributor	Reggio Emilia and Municipality of Maribor provided useful examples of access restrictions enforcement and collaboration with transport operators. In addition, Poznan contacted the Italian offices of the international transport

	operator with which they are working (GLS). The cooperation helped to put Reggio Emilia in contact with this logistics operator.
Value of collaboration	Three pilot actions have been envisaged in slightly different scopes of usability and infrastructure access (dedicated and shared approaches). The variety of applications will make it possible to have a broad view of the solutions, tested and possible for further deployment in urban environments after the pilots. The cooperation was mainly based on the exchange of experiences concerning formal and technical aspects. The formal issues were similar in the case of solutions in Maribor and Poznań, due to the location of the hubs on municipal land. On the other hand, the process characteristics link the hubs in Emilia Romania and Poznań, where cross-dock solutions are to be created at the intersection of car transport and cargo bikes.

4. Stakeholders and their role

Stakeholders can be divided into three groups: i) municipal institutions, involved in the project as partners and at the same time interested in improving the situation of residents (as their representatives), ii) institutions involved in the implementation of the pilot, iii) institutions directly interested in improving the efficiency of parcel distribution within the city.

Process of involvement and engagement level:

- City and its offices were naturally engaged in the stakeholders' group while project was developed during FQP workshop organization
- The operator was engaged during the phase of assuring source of the parcels
- External advisor as answer to the need of process verification
- Container developer answering the tender procedure of L-PIT

Recommendations on engagement of stakeholders:

- Citizens / local companies' employees were engaged by living in the reach area and receiving packages, should not experience a change in the standard of delivery and at the same time be informed of an improvement in their operating environment through a reduction in greenhouse gas emissions and a reduction in congestion.

Table 4 Stakeholders' list

Organisation	Stakeholder type[2]	Role	Stakeholders' priority[3]	Engagement level[4]	Engagement activity		Feedback from stakeholder	Comments
					When	What		
City of Poznan	Public Institution	coordination of pilot conduction	high	1	Whole project		yes	-
Operator, including the one, involved in pilot GLS	Private sector companies	source of the parcel, supplier of bikes and bikers	high	1	Pilot preparation and conduction		yes	Delivering the sorted parcels, support in pilot conduction
ZDM - city roads operator	Local administration	landlord of the microhub site	middle	1	10.2024	03.2025	no	
Ł-PIT	Research institution	coordination of pilot conduction	high	1	04.2023	03.2026	yes	
WCG sp. z o. o.	Private sector company	microhub design supplier	high	1	08.2024	03.2025	yes	

[2] Public institutions and authorities, local administration, neighbouring municipalities, regional administration, national and state administration, association and intermediaries, Chamber of Commerce, business association, private sector, other members and representatives, educational institutions and research institutes, local media and general public.

[3] High, medium, low.

[4] Engagement level 1 or 2, as reported in the stakeholders' mapping file

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Organisation	Stakeholder type[2]	Role	Stakeholders' priority[3]	Engagement level[4]	Engagement activity		Feedback from stakeholder	Comments
					When	What		
(optional external advisor)	Private sector company	Practical advisor with experience in organizing bike deliveries in the cities and designing of the hub	middle	1	06.2024	03.2025	no	
Unidentified suppliers of technical equipment	Private sector company	Design, manufacture, supply and service of microhub	middle	1	06.2024	03.2025	no	

5. Pilot action implementation

5.1. Timeline

- Preparation of project documentation for the tender for the micro hub contractor - March 2024
- Checking formal and administrative matters – March/April 2024
- Tender procedure – May - August 2024
- Procedure for obtaining local permits and rules for cooperation of the stakeholders involved – August – December 2024
- Detailed design of the microhub - October 2024
- Construction and installation of the microhub in the identified location: November 2024
- Living Lab operations: December 2024 - May 2025
- Living lab data collection: December 2024 - June 2025
- Presentation of the solution to interested stakeholders with expected feedback from other Operators: September 2025
- Summary and analysis of the results: September 2025

Figure 5 Timeline of the pilot action implementation

5.2. Planning

Tasks planned for the period from the start of the project to the announcement of the tender procedure:

- Analysis of logistics solutions available on the market.
- Establishing cooperation with logistics operator GLS. The operator, as part of the implemented pilot, will engage its employees, cargo bikes and parcels that will be delivered in the selected area.
- The work of the working team under the FQP on the design arrangements for the entire pilot.
- Selecting a plot of land in the city for locating a microhub.
- Arrangements with the City Roads Authority on the possibility of using city land for a microhub.
- Arrangements for formal capabilities and legal requirements for the microhub as a temporary facility.

The macro activities performed were the following:

- Preparation of project documentation for the tender for the microhub contractor - March 2024.
- Checking formal and administrative matters – March/April 2024.
- Tender procedure - May 2024.
- Detailed design of the microhub - June 2024.

5.3. Implementation

- Construction and Installation of the microhub in the identified location: November 2024.
- Living Lab operations: December 2024 - May 2025.

5.4. Monitoring

- Living lab data collection: December 2024 - June 2025.
- Presentation of the solution to interested stakeholders with expected feedback from other. Operators: November 2025.
- Summary and analysis of the results: October 2025.

The set of required data from the operator was agreed in the form of an agreement to estimate financial and environmental differences in delivering by cargo bikes from micro hub in relation with direct truck deliveries and deliveries by cargo bikes without support of infrastructure (directly from the delivery van's load compartment).

6. Digital and physical infrastructure

To the pilot's digital and physical infrastructure can be included:

- innovative microhub, with photovoltaic (optional grid-off possibility), with green wall,
- cargo-bikes corresponding with the needs of the operator,
- own operator system (software, terminals) and procedures, modified for the utilization of the microhub,

The cross-dock operations were conducted in a safe and a weatherproof area, with ensured safety for both couriers and parcels.

Hub design

The designer and lessor (called here hub operator) of the hub was selected by means of a call for tenders. The experience of the hub operator, in cooperation with GLS and local project partners, influenced on the design of the hub. The area of hub was doubled in place of folding roof, planned in the beginning phase. Finally the dimensions of the hub were 6.1 x 5.8 x 3.2 m (built-up area - 34.8 sqm). Hub was equipped with two gates: one for bikes with dedicated ramp, the second one for reloading operation for van deliveries. The other assumptions (see 3.2.4) regarding the design of the hub have been kept.

One of the results regarding the hub equipment is that there is no need for heating (in fact, the couriers did not use it). It was only used to heat the charged batteries in case of low temperatures. It is therefore advisable to equip the hub with equipment that maintains the correct temperature of the batteries during charging in place of heating the entire hub area.

Figure 6 Microhub during the pilot phase (source: own photo)

Cargo bikes equipment

Lack of possibility to obtain detailed data on the location of the bike (courier terminals only transmitted location information in case of one of the activities) during the pilot, the bikes were equipped with a GPS-based location system with a wireless communication module (see Figure 7), sending detailed data at an interval of 5 seconds. This allows very accurate verification of the location of the bike. However, information on the location of the courier was missing.

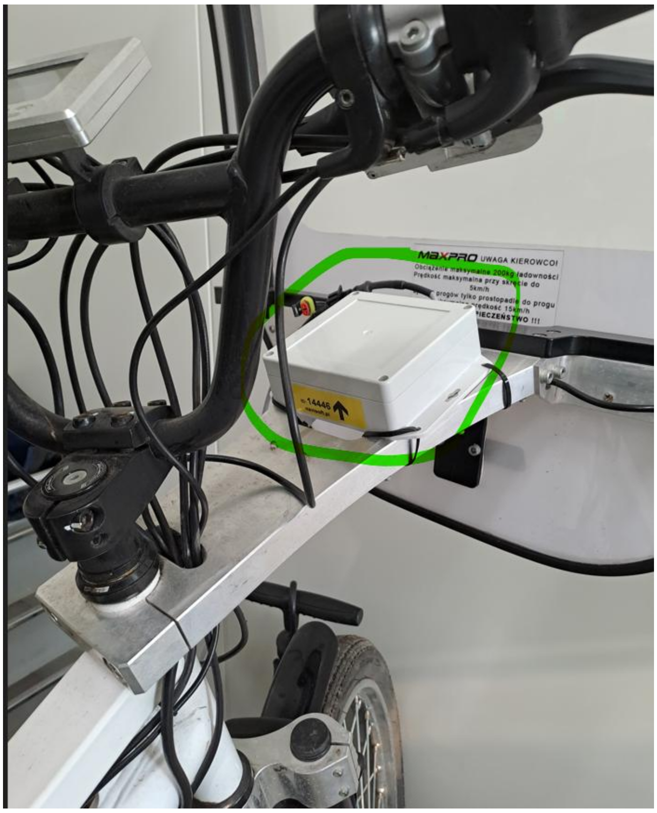

Figure 7 GPS sensor placed on bike construction (source: own photo)

7. Evaluation/Impact assessment and results of implementation

7.1. Primary and secondary quantitative and qualitative KPIs

Set of primary indicators:

- Available space - operational space
  - Indoor: 36 sqm
  - Outdoor: 264 sqm
- Utilization of public space: 300 sqm
- Investment costs – 0 €,
  the infrastructure of hub was rented, the investment was on the lessor side,
- Total cost of infrastructure rental about 71.000 € covered by project funds for a whole period of pilot's tests (on average 11 850 € monthly),
  the cost of infrastructure covered site preparation, installation, maintenance during testing, uninstallation, and restoration of the site to its original condition,
- Operational costs – 210 € over the estimated period of 6 months (on average 35 € monthly),
  the hub was located on city plot, free of charge during pilot action, only electricity was operational cost,
- Forecast on revenues – 0 € not expected in pilot phase
- Estimated Impact on carbon-emissions: 1,52 t eCO_2 (in the case of minimizing electric vehicle traffic) over the estimated period of 6 months.

Figure 8 Microhub and cargobike during pilot (source: own photo)

Secondary quantitative indicators:

- Number of vehicles using the hub per day: 3 cargo bikes (with potential for 4)
- Fermi-estimation on number of deliveries / number of possible deliveries: 53 parcels delivered daily (on average) by one cargo bike,
- Additionally created job: 0,3 FTE
- Number of operators (n.): 1 operator

Qualitative indicators:
Based on interviews the following qualitative indicators will be ascertained:

- Impact on neighborhoods quality of life
  - the reduction of 31% of vans travels (replaced with silent and clean cargo bikes) and adequate reduction of emissions have meaningful influence on environmental factors of the cite center, limited by the scale of the pilot,
- Benefits for shops and other retail businesses – recipients did not report any changes in the efficiency of deliveries made by bicycle compared to traditional deliveries; in fact, most recipients were unaware of the method of delivery,
- Satisfaction of the service users - couriers reported:
  - positive interest from bystanders who, in addition to friendly comments, expressed a desire to be employed as couriers or to purchase ice cream (both cases authentic), which further emphasizes the positive connotations of cargo bikes,
  - some difficulties related to overcoming architectural barriers, which are often less significant for traditional bicycles but hinder the comfortable ride of cargo bikes, which are assumed to be much heavier and slightly less maneuverable.

7.2. Results

For calculation the sources of data have been used:

- data directly from the infrastructure, such as camera recordings, electricity consumption data etc.,
- data provided by the Operator in accordance with the signed agreement, also feedback from couriers,
- data obtained from GPS sensors placed on bikes based on the GPS system.

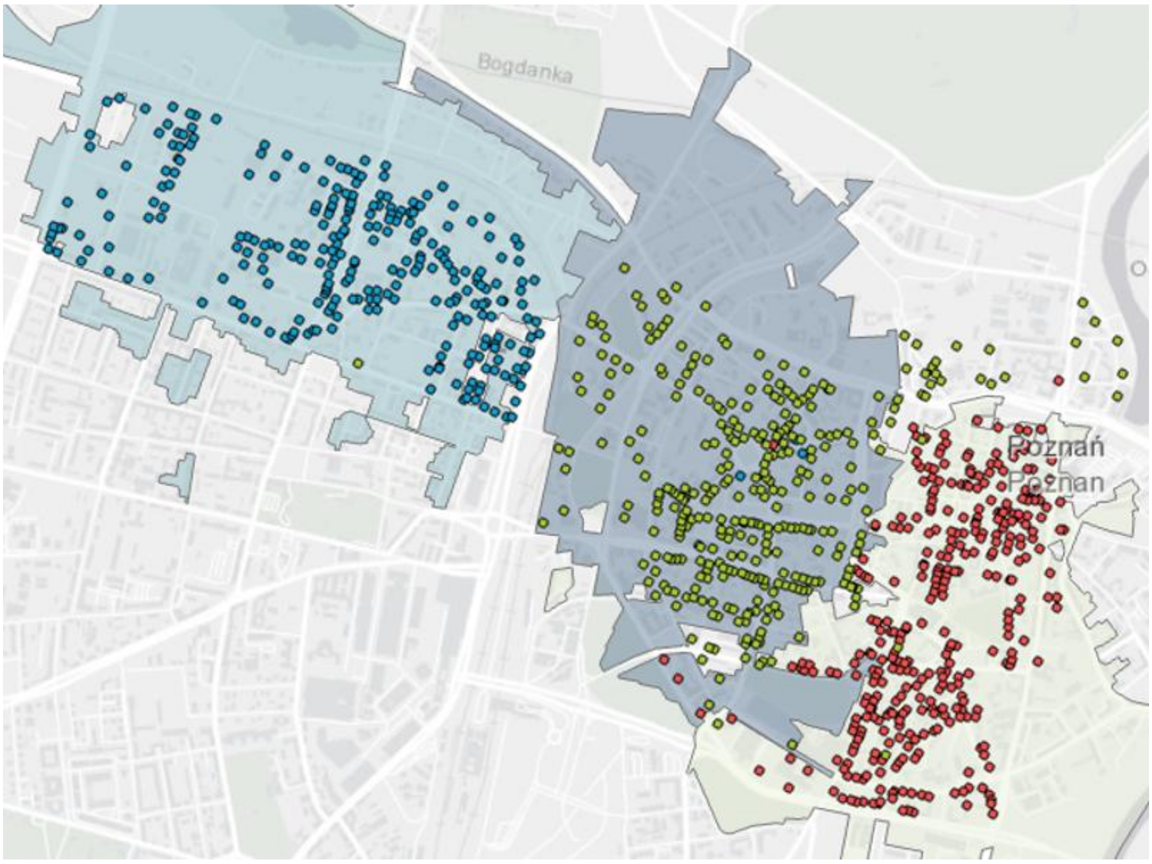

Figure 9 Operator data accuracy – events only, divided by three delivery regions, marked different colors (Operator data)

Operator data included:

- data on deliveries handled by bicycles (noting events only),
- data on shipments handled by vans,
- number of stops,
- distance covered (approximated),
- working time,
- general information about costs.

Due to their nature, the Operator's data allowed for determining the occurrence of events (location, time), but did not allow for determining the exact route, places where the bicycle stopped, or the speed of movement. For this purpose, dedicated sensors were used in the during pilot, enabling their ongoing location.

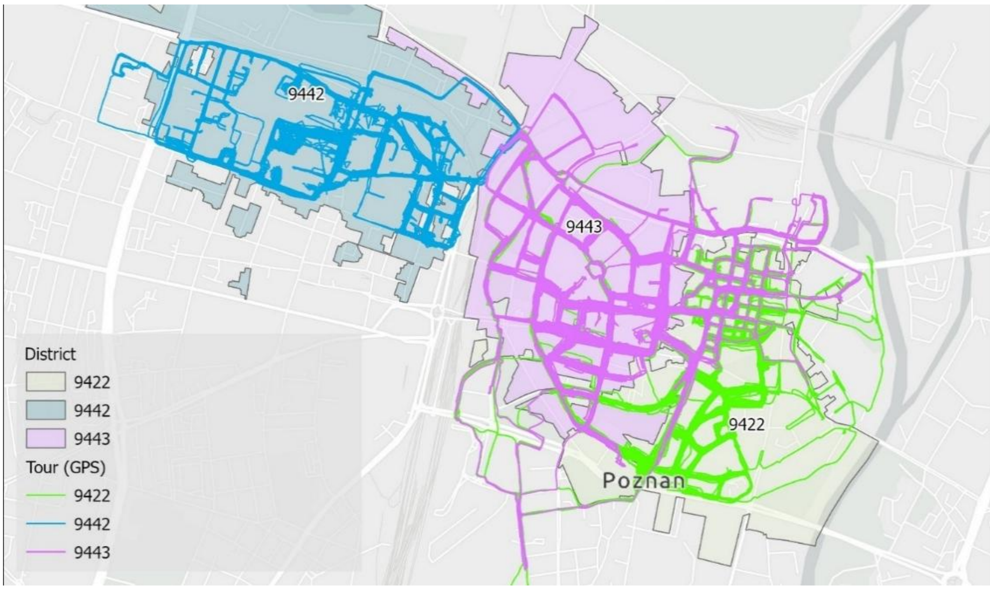

Figure 10 GPS data accuracy (GPS data)

GPS sensors were dedicated rechargeable devices mounted on bicycles, suppling information every 5 seconds, connected online trough the server with availability of sensor status data. Data from sensors allowed to calculate:

- location of the bike (every 5 seconds),
- exact distance covered,
- speed of travel,
- detailed time of daily activities.

Figure 11 GPS data accuracy example on Old Market Square (GPS data)

The accuracy of GPS sensors gave possibility to identify routes, not possible to cross by van, for example in Old Markt Square (Figure 11).

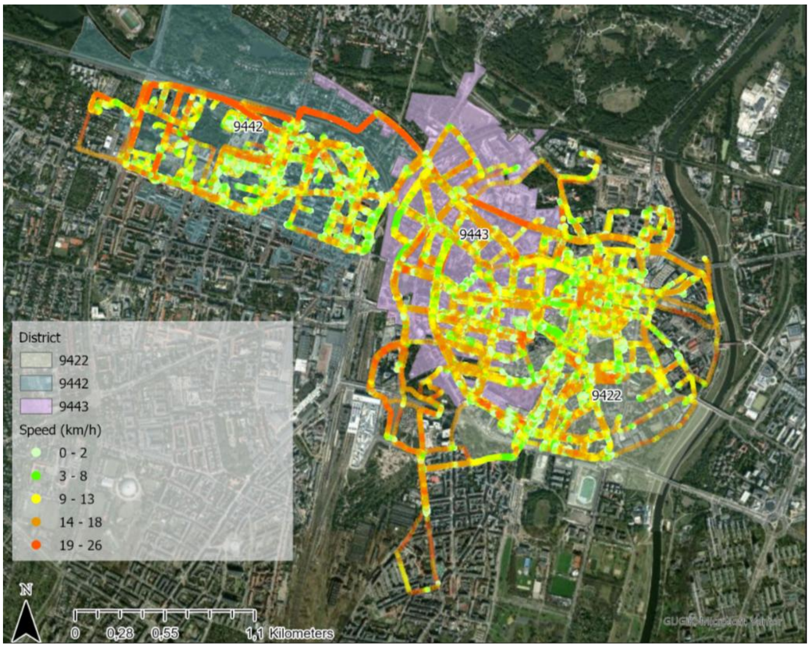

Figure 12 Average speed "zones" of cargobikes (GPS data)

Additionally GPS data was base for calculation of the bikes speed (Figure 12).
Small differences between Operator and GPS data were identified. Operator data combine the distance travelled by bike and on foot, hence the average distance in this case is slightly longer. In scope of average operating time Operator data is counted from the first to the last delivery point, so it does not take into account the time consumed during travels to and from the hub and is shorter in total.

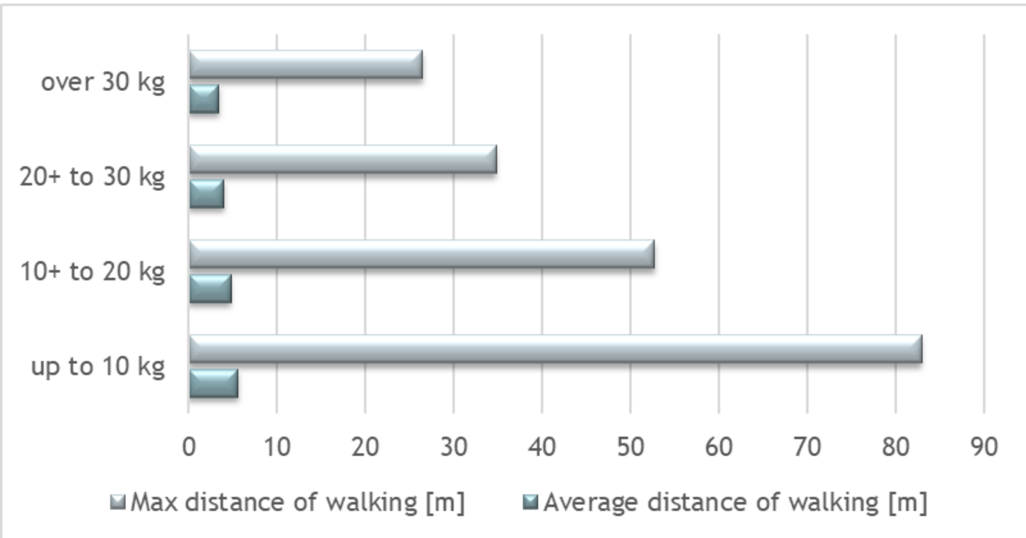

Figure 13 Average distance of walking related with weight of the parcel (Operator and GPS data combination)

The combination of Operator and GPS data allowed approximation of walking distance, which is related with weight of the parcels - the heavier the parcel, the closer to the delivery address the cargobike-stop is located (details: Figure 13). It should be emphasised that the identified walking distance does not take into account any floors that couriers may have to climb.
All the data obtained allowed for the determination of process, environmental and financial efficiency.

It should be noted that the results presented below take into account aggregation of data for the purpose of maintaining the confidentiality of the Company/Operator. Even aggregated and anonymized data required consent each time for the publication.

The assumptions of calculation include:

1. The basic calculations were based on data from the pilot period, i.e. from December 2024 to May 2025.
2. The reference period was set as December 2021 to May 2022, as suggested by Operator representatives (hereinafter: reference data).
3. It should be emphasised that due to the different regionalisation of deliveries by cargo bikes and delivery vehicles, they were "assigned" to "bike" regions based on the location of the delivery/collection point (commonly referred to as "geostamp"), hence it is impossible to determine the actual number of routes and the distance travelled by vehicles in the area, which have been approximated on the basis of reference data.
4. Financial efficiency was determined in two ways:
    - based on the rates for collection/delivery of parcels that Operator pays to the carrier (outsourcing of last mile deliveries), together with a surcharge related to deliveries by cargo bike, i.e. 'from the point of view' of the Operator,
    - based on generally available data related to the leasing and operation of delivery vehicles, salary levels (data from May 2025) in two options: the use of only electric vehicles or the exclusion of vehicles with combustion engines (diesel), i.e. from the Carrier's point of view.
5. For greater comparability, the specified number of vehicle routes and the appropriate number of employees were used in percentages, assuming that the remaining parts are used to perform work outside the cargo bike delivery areas.
6. The distance travelled in delivery areas was added to the distance travelled to and from the distribution centre (assumption: 30 kilometres per day) for each vehicle.
7. The emissions from each means of transport were determined using generally available emission indicators for combustion engine and electric vehicles, assuming that emissions related to electricity consumption result from the 'energy mix' in Poland in 2025.

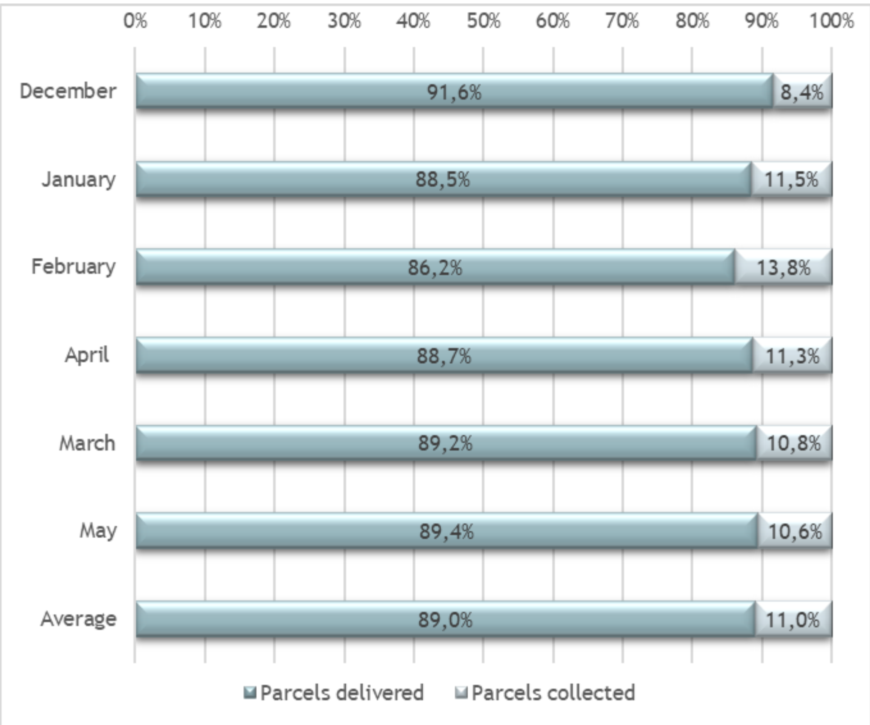

Figure 14 Parcel delivered in collected on area of interest (source: Łukasiewicz-PIT)

On average, parcels collected in the area accounted for just over 11% of all parcels handled (delivered and received), including deliveries by all vehicles combined (Figure 14).

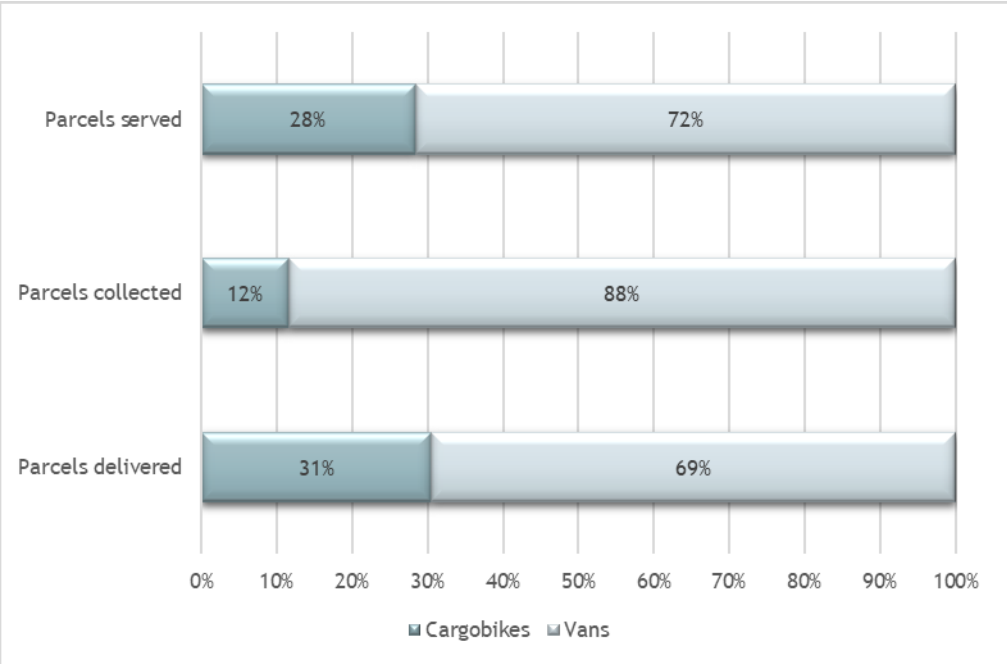

Figure 15 Cargobikes versus vans (source: Łukasiewicz-PIT)

Cargobikes served an average of 28% of parcels, this value results indirectly from the Operator's process, which assumes the implementation of collections using vans (Figure 15). Cargobikes are only supposed to collect parcels incidentally, although this included an average of 12% of shipments picked up in the cargo bike delivery region. On average, 31% of parcels were delivered using cargo bikes.

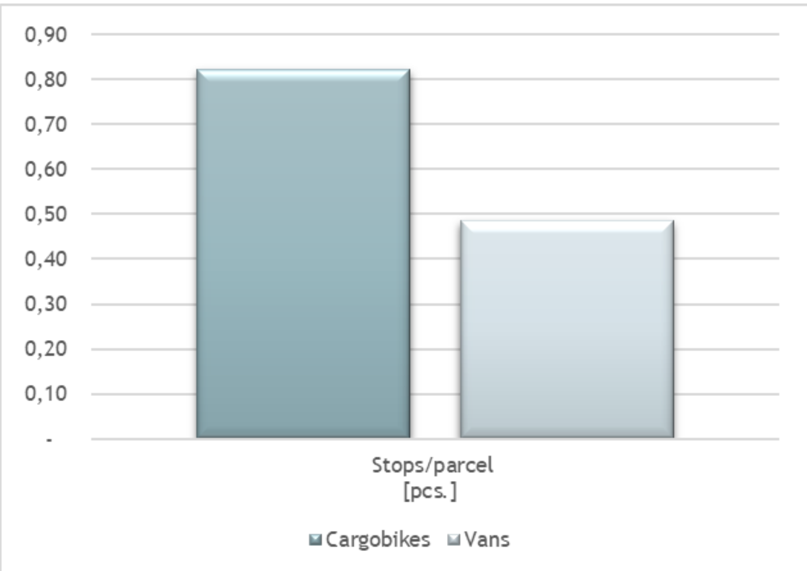

Figure 16 Stops per parcel and cargobikes versus vans (source: Łukasiewicz-PIT)

The number of "stops" (the stopover of a vehicle for manual delivery/collection of shipments in the immediate vicinity) per shipment handled (Figure 16) - the higher number of stops per shipment for bicycles is due to the greater flexibility of getting and parking near the required addresses and the shorter walking distance between the vehicle and the delivery/pick-up point.

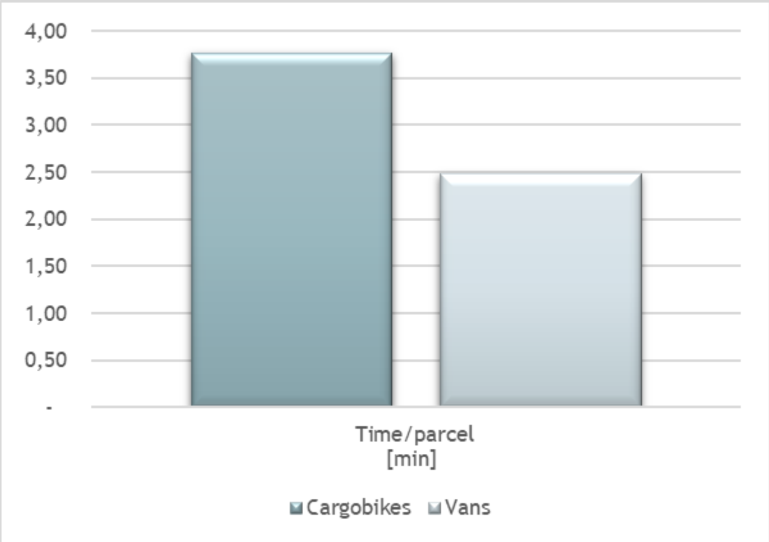

Figure 17 Working time in the area served (source: Łukasiewicz-PIT)

Longer working time of cyclists per shipment (see Figure 17) results from a lower speed of movement (with a similar distance per shipment) and from a greater number of bicycle parking activities, due to a larger number of stops. In general, this leads to an increase in labour intensity when using cargo bikes.

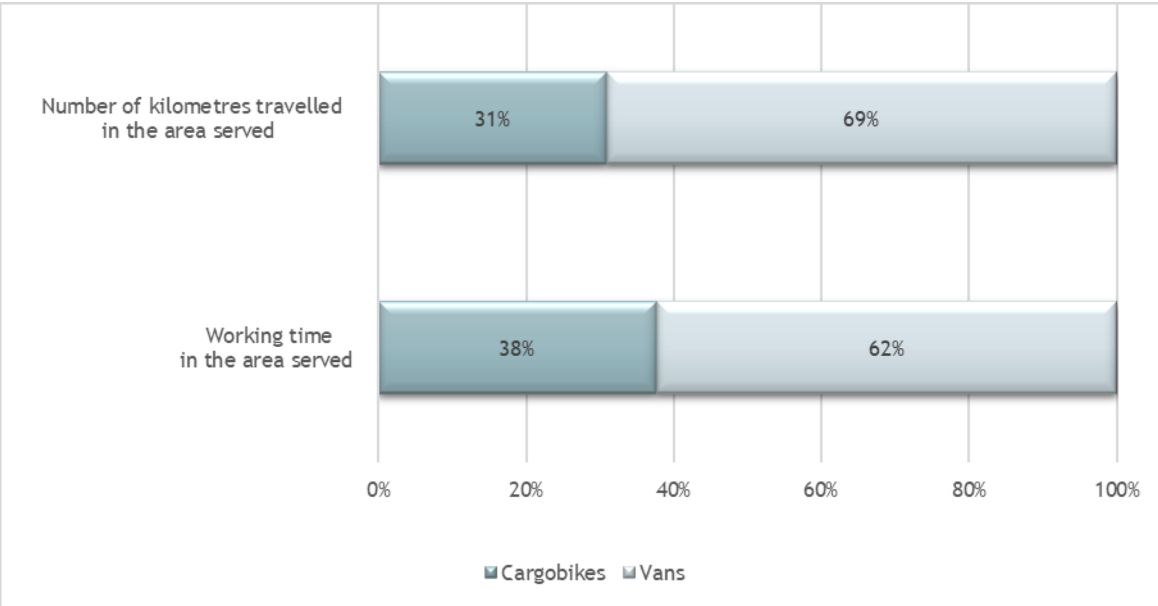

Figure 18 Distance and working time in the area served (source: Łukasiewicz-PIT)

Cargo bikes travelled 31% of the distance travelled by vehicles in the region is show on Figure 18. This value is higher than the share of handled shipments due to the need to travel from the hub to the region and less "saturation" of the region with "feet" (fewer pickups).
The working time in the cargo bike region is 38% of the working time of all couriers. Apart from getting to the region, this is due to the lower speed of bicycles (compared to vans) and more stops (more "parking" per shipment).

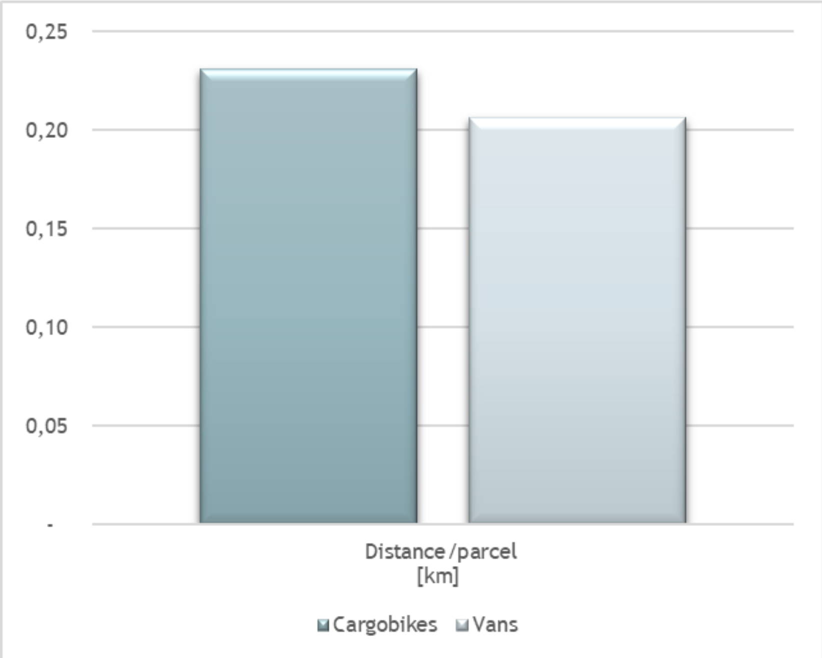

Figure 19 Distance and working time in the area served (source: Łukasiewicz-PIT)

The greater saturation of the region with delivery/collection addresses, due to the vast majority of pick-up operations carried out by cars, affects the shorter distance they travel per shipment.

The informal interviews with bicycle couriers is summarized as follows:

1. Recipients did not report any changes in the efficiency of deliveries made by bicycle compared to traditional deliveries; in fact, most recipients were unaware of the method of delivery.
2. Couriers reported positive interest from bystanders who, in addition to friendly comments, expressed a desire to be employed as couriers or to purchase ice cream (both cases authentic), which further emphasises the positive connotations of cargo bikes.
3. Couriers reported some difficulties related to overcoming architectural barriers, which are often less significant for traditional bicycles but hinder the comfortable ride of cargo bikes, which are assumed to be much heavier and slightly less manoeuvrable.

7.3. Summary of the environmental and social impact assessment of GRETA pilot actions and solutions

Based on the assumptions made, the estimated reduction of GHG emission is on the 30% level. A reduction of about 30% means a decrease in GHG emissions by:

- 2,57 t eCO2 (in the case of minimising combustion engine vehicle traffic),
- 1,52 t eCO2 (in the case of minimising electric vehicle traffic),

over the estimated period of 6 months. However, the indicated reduction requires expenditures on the part of the operator. This has been estimated in three ways:

- taking into account the Operators rates, paid for each delivery,
- minimising traffic of electric delivery van,
- minimising traffic of diesel delivery van.

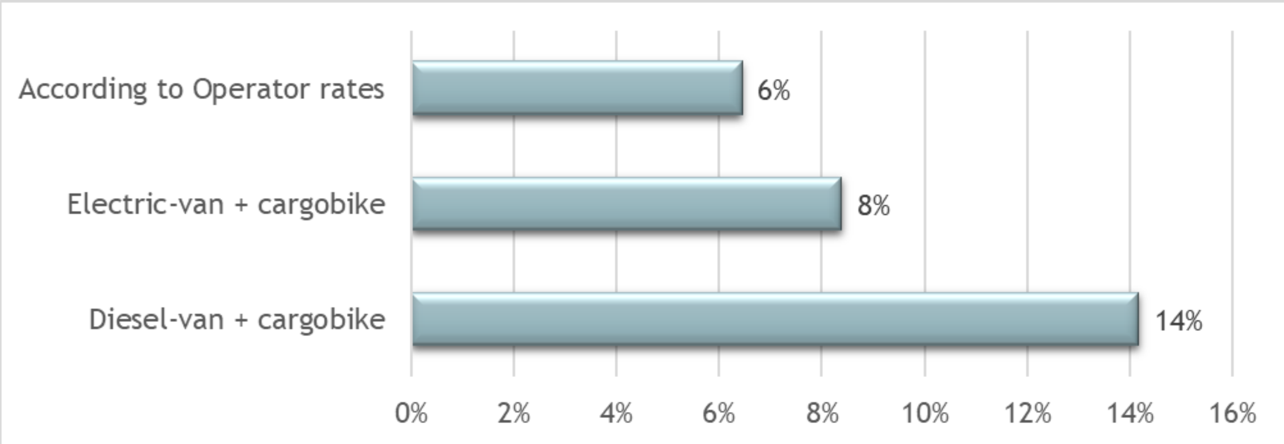

Figure 16 Increase in costs for cargobikes deliveries (source: Łukasiewicz-PIT)

Depending on the calculation method, the introduction of deliveries by cargo bikes involves additional costs of different levels.

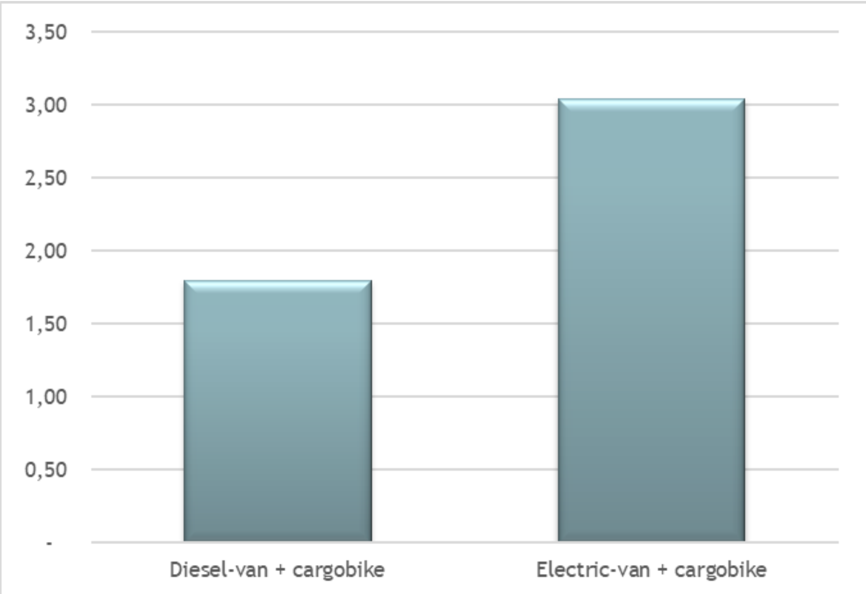

Figure 16 Cost of emissions reduction (source: Łukasiewicz-PIT)

Base on above stated data approximate cost of reducing GHG emissions by minimizing the use of cars amounts to:

- combustion engines EUR 1,80 / kg $eCO_{2,}$
- electric EUR 3,04 / kg $eCO_{2.}$

8. Lessons learnt

The lessons learned are the following:

- Complicated process of preparing the micro hub concept from design proposal to final design of the hub provider,
- Strict municipal regulations minimising the possibility of building a hub in the form of a container in the city centre,
- Complicated procedure for obtaining a standard building permit lasting usually minimum 6 months.
- Complicated procedure for obtaining a permit for a temporary facility,
- Basically, impossible to implement the pilot without the participation of the City, except for the use of commercial and, in the case of pilots, already existing infrastructure,
- One operator (courier company) utilizes only part of the supply potential due to delivery hours and the effective range of cargo bikes; it is advisable for operators with different delivery characteristics to share the hub (and cargo bikes) in order to make better use of the available infrastructure.

In scope of hub design:

- No need for hub interior heating (in fact, the couriers did not use it).
- It is therefore advisable to equip the hub with equipment that maintains the correct temperature of the batteries during wintertime charging in place of heating the entire hub area.
- Couriers prefer to overload their cargo bikes rather than return to the hub for the second part of their deliveries, the storage space was used rarely.

However, the most important conclusion from the pilot project is the need to bear the costs of reducing emissions - the solution used, which involves utilising the potential of cargo bikes by less than 40%, leads to the need to incur expenditure in order to achieve a positive environmental effect in the form of a 30% reduction in harmful emissions.

9. Conclusions

The implementation of the project allowed for the introduction and operation of a transhipment hub (urban consolidation centre) serviced by cargo bicycles. The agreement with the Operator made it possible to reduce the cost of purchasing bicycles and, at the same time, to use a hub with a larger area than originally planned and ready to serve up-to 4 cargo bikes.

The implementation of the solution proved its environmental effectiveness and lack of impact on process efficiency. However, achieving this result involves costs on the part of the operator or carrier, depending on the method of calculation. It should be emphasised, however, that cooperation with one type of operator (courier deliveries only) limits the use of the hub to approximately 4 hours per working day, leaving significant potential for sharing the hub and cargo bikes.

A nearly 30% reduction in emissions without affecting efficiency seems to be a very favourable result, especially given the positive public reception. In turn, the hub design, which is intended to be relocatable and transferable to other urban environments facing similar urban logistics problems to Poznań, creates opportunities to disseminate the solution and reduce emissions not only on the scale of one city and one operator, but at least in the cities of the project partners. The positive results of the pilot project in terms of process and environmental efficiency justify scaling up similar solutions.

There are also positive signals from the host of the implementation, the City of Poznań. The meetings with representatives of other large Polish cities and NGOs, which took place during the project and attracted considerable interest, confirm the interest in transferring similar solutions in a country scale.

Cooperation between the Operator, the hub lessor, the City and the car park Operator proceeded without any major disruptions, apart from the considerable complexity of obtaining the relevant permits for the hub's foundation and the launch of the service. It is worth emphasising the commitment of the City, which, through the Municipal Roads Authority and the Car Park Operator, enabled the free use (in fact, as part of a project in which the City is also a partner) of a very well-located plot of land for the purposes of the hub.

10. References

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[3] Prawo o ruchu drogowym, Dz.U. 1997 nr 98 poz. 602 / Road Traffic Act, Journal of Laws 1997 No. 98 item 602

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