

Activity Deliverable

21062 SMARTHUBS DEL11 Warsaw: feasibility study report

EIT Urban Mobility - Mobility for more liveable urban spaces

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Mobility hubs

A Feasibility Study on the implementation of mobility hubs in Warsaw*

*No time? No need to read the entire Study in order to learn what mobility hubs can do for your city and your neighbourhood. Just read the summary on this page.

So, mobility hubs...

- are a gateway to sustainable travel options as they promote multimodal journeys via the use of public and shared means of transport;
- bring a viable alternative to private car ownership closer to the citizens and their daily routes;
- address the same mobility needs while using less resources (e.g., space);
- reduce parking pressure and parking clutter in public realm;
- reclaim public street space and improve quality of urban landscape;
- reduce traffic congestion e.g., through effective use of shared vehicles;
- minimize negative environmental impact and reduce the air pollution generated by transport (even to zero!);
- help to achieve behavioural changes concerning transport choices;
- improve health and wellbeing (through active mobility);
- regenerate local communities by encouraging more social interactions;
- strengthen the local economy due to cooperation of multiple local partners;
- offer added value services, e.g., charging or logistics solutions.

Interested in bringing mobility hubs to your city and neighbourhood? **Enjoy your reading!**







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Name	Organisation	Contribution	
Adam Jędrzejewski	Mobile City Association (in Polish: Stowarzyszenie Mobilne Miasto)	Author	

About the author

Well, after many years of dealing with parking policies, public-private partnerships, and shared mobility, I've found something that connects all these areas: the mobility hubs. Designed both for public space in cities and private real estate, mobility hubs have a variety of advantages: they reduce the need for an excessive supply of parking spaces, provide excellent opportunities for cooperation between the public and the private sectors (each of which has its unique potential), and help to start thinking about moving around the cities in a different way, which is much more effective than the usage of private cars.



Mobility hubs also address a number of increasingly complex challenges that lie ahead of today's cities and societies: environmental concerns and climate action that must be taken, reclaiming public realm, traffic congestion, air and noise pollution coming from transport, ineffective urban mobility patterns, to name only a few.

All this makes me passionate about mobility hubs and I am sure that this Study will also convince some other people to take joint action in this area.

Adam Jędrzejewski

founder and CEO of the Mobile City Association in Poland

Definitions

Below you will find some of the abbreviations and/or phrases that are repeated throughout the Feasibility Study, along with their meaning. You will recognize these phrases by capital letters.

Feasibility Study or Study	this document which is also the result of the Project's task ID A2108		
Municipal Strategic Documents	a set of strategic documents adopted in Warsaw setting the directions for the city development, and comprising of: the Warsaw Strategy 2030, the Warsaw Transport Strategy, the Warsaw Parking Policy, and the Warsaw Spatial Policy		
PPZ or Paid Parking Zone	the Paid Parking Zone organized by municipalities on public roads according to the Act of 21.03.1985 on public roads with further amendments		
LEZ or Low Emission Zone	an area of a city organized by municipalities on public roads according to the Act of 11.01.2018 on electromobility and alternative fuels with further amendments		
Project	the SmartHubs project executed by a number of stakeholders, led by the Amsterdam Institute for Advanced Metropolitan Solutions and co-funded by EIT Urban Mobility		

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Feasibility Study on the implementation of mobility hubs in Warsaw Chapter 1. Executive summary

"The transport network seeks new and efficient ways of addressing the changing mobility needs"

1. Executive summary

The purpose of this Study is to assess the feasibility of implementing mobility hubs in Warsaw – a network of designated parking areas **which in one place combine multimodal shared mobility services with public collective transport** and other corresponding services, e.g., charging or logistics solutions. The Study is carried out as a part of the SmartHubs Project (co-financed by EIT Urban Mobility), whose ultimate aim is to develop and validate effective and economically viable mobility hub solutions.

Developing mobility hubs will bring a number of benefits for the city and its inhabitants, e.g., increase the efficiency of the transport system, decrease air and noise pollution from transport, reduce traffic congestion, reclaim public realm, and foster more sustainable mobility behaviour through creating an alternative to owning and using privately owned cars for urban travel.

Importantly, implementing mobility hubs is also very much **in line with Warsaw's Municipal Strategic Documents**, including direct support for nearly 40 of their strategic goals and activities, such as the "dissemination of shared mobility solutions" (Warsaw Strategy 2030) and the "support and promotion of car sharing" (Warsaw Transport Strategy). Moreover, the network of mobility hubs could be facilitated as an incentive for Warsaw's citizens to use the sustainable transport.

As with every endeavour, assessed must also be its regulatory environment. The regulatory framework that interferes with the Project, both on central level (generally applicable law) and local level (resolutions of the Warsaw City Council), does not prevent the implementation of mobility hubs. However, **there are legislative measures that could help promote shared mobility** both nationwide as well as in Warsaw, e.g.,

through introducing shared mobility as an official category of transport (preferably on central level, but also possible on municipal level), also resulting in defining shared vehicles and introducing appropriate road signs. This, in turn, could provide the possibility to grant shared mobility services a special status in the public realm, incl. inside Paid Parking Zones and Low Emission Zones.

When it comes to discussing the local transport network of Warsaw, which serves the population of at least 2 million people, it should be stressed that all elements needed for a successful implementation of a network of mobility hubs are already in place: a dense road system as well as a developing infrastructure for bike lanes, a widespread public collective transport system, **an extensive network of transport nodes** (e.g., rail/metro/tram/bus stations or P&R car parks) allowing to transfer between different modalities, a number of mobility stakeholders complementing each other, as well as a well-established market of shared mobility, including self-service shared vehicles (a total of more than 16,000 bikes, e-scooters, e-mopeds, and shared cars) and driver-based taxi/ride hailing services.

When considering mobility issues, one has to take into account the impact of the pandemic that cannot be ignored. **COVID-19 has brought major disruption** also into the sphere of urban mobility. In Warsaw, for example, 40% less passengers were noted in the public collective transport in the first COVID-year (2020), as well as a 40% decrease in bike sharing rentals (comparing 2019 and 2020). Interestingly, only a group of approx. 10% of respondents did not use public or shared transport specifically due to the pandemic, according to the New Mobility Barometer surveys.



* based on the CAWI quantitative survey conducted on a nationwide representative sample of respondents (n=327)

Important data on the mobility of the Polish society was also provided by the so-called mobility index that showed the difference in the mobility behaviour of Poles compared to the typical, pre-pandemic level. The values of this index were in the successive COVID-waves as follows:-55% in April 2020,-44% in December 2020,-34% in April 2021 and back to the pre-COVID levels as of May 2021.

Despite the fact that some areas of urban transport are starting to recover from this impact, the transport network urgently seeks **new and efficient ways of addressing the changing mobility needs**. One of the obvious solutions would be bringing shared mobility services closer to the transport nodes, in the form of mobility hubs, thus supplementing the public collective transport as well as contributing to a more sustainable mobility ecosystem in Warsaw.

In order to learn more about the mobility needs in relation to the Project, two surveys on a representative sample of respondents were carried out in 2021. The #1 survey of mobility hubs' user profile proved that **3/4 of Poles like the idea of mobility hubs** and constitute a suitable group for changing mobility behaviour from private car travels to more sustainable urban options: public, shared, and active mobility. At the same time, the #2 survey of Warsaw residents' mobility behaviour showed that there **is a huge group (54% of Varsovians) undecided whether to use shared mobility services or not**, constituting at the same time a significant target group for efforts to change transport habits into more sustainable. Another finding was that the entire category of shared mobility was rated higher than its individual modalities assessed separately (e.g., bike sharing, e-scooter sharing or car sharing). All this data proves that implementing

multimodal mobility hubs in Warsaw could be a real chance and opportunity to convince an essential part of the local community to choose more sustainable mobility options.

Interesting data on mobility was also provided by the New Mobility Barometer periodic surveys conducted in 2019-2021. One of their findings showed a decrease in associating car ownership with one's social status. In 2019, 50% of Poles believed these were unrelated, and two years later it is already 57%. This seems to confirm **the trend of moving away from owning things towards using them**, which also should favour the use of shared mobility services.

When aiming to conclude on the feasibility of implementing mobility hubs in Warsaw, it should be stressed that for **optimal impact, mobility hubs should be planned as an entire network of hubs**. The larger the scale of the project and the longer its durability, the greater also its value and the efficiency of investment per hub. The differences can vary from even as much as EUR 166,000per hub (in case of a 1-year project with just 1 hub) to as few as EUR 4,400 per hub (in case of 500 mobility hubs and a 15-years long project, which is also the maximum statutory length of a **services concession** in Poland, a PPP-type form of carrying out public tasks very much suitable for the concept of mobility hubs).

Approx. **750 potential locations for mobility hubs in Warsaw** have been identified in the Study, with the proposed locations in the proximity of: housing estates (27%), public utilities (25%), public transport nodes, metro/rail stations and car parks (22%), commercial real estate (21,5%), and large employers (4,5%). The greatest risk in the implementation of the project was considered not to be related to operational challenges (which are manageable) but rather to the internal ability of the city of Warsaw to **recognize the project's potential and importance**, and then to implement it efficiently.

Last but not least, mobility hubs are supporting the delivery of the **European Green Deal**⁽¹⁾ and its climate targets, which are to turn Europe into the world's first climate neutral continent by 2050. The most recently adopted proposals⁽²⁾ even literally indicate the "construction and modernization of multimodal hubs" as one of the priorities in the new Urban Mobility Framework, as well as propose funding options for local and regional authorities to implement these priorities.

This fact, as well as all the circumstances mentioned above and described in the Study, mean that the implementation of mobility hubs is **no longer a question of whether to do it at all but rather how to do it**.

¹ Source: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/delivering-european-green-deal_en

² Source: https://transport.ec.europa.eu/news/efficient-and-green-mobility-2021-12-14_en

Feasibility Study on the implementation of mobility hubs in Warsaw Chapter 2. Introduction

"Mobility hubs bundle together different mobility services in one place"

2. Introduction

The aim of this study is to assess the feasibility of introducing mobility hubs in Warsaw. But what are mobility hubs? This chapter will explain what they are and provide some basic characteristics regarding the city of Warsaw.

2.1 Introduction: What are mobility hubs?

Mobility hubs are specially designated and well-marked places (hot spots) in the urban space (public realm) where various mobility services are concentrated, provided by both public and private suppliers. Sometimes these may also be accompanied by other services and functionalities, e.g., charging electric vehicles, parcel delivery and collection points, as well as others. The ultimate goal of mobility hubs is to conveniently switch to various forms of urban travel, using multimodal combinations of collective and shared transport – all of these more sustainable than a private car.

Below presented are also other definitions of mobility hubs:

• Future mobility hubs⁽³⁾ will "form a **network of structures that cluster together a full suite of complementary transport modes**. They will be distributed throughout urban, suburban, and rural areas enabling access to, and interchange between, a choice of sustainable mobility options to suit

³ Source: https://www.arup.com/perspectives/publications/research/section/future-mobility-hubs

individual user needs. The ability to connect and move seamlessly between different transport services, including shared and micromobility, will make it easier for people to make better choices about what mode of transport they use. This will support our shift towards more sustainable travel patterns. Mobility hubs are a way of bringing together all of these transport services in a highly integrated and connected way".

- Mobility hubs are⁽⁴⁾ "areas where a variety of sustainable transportation modes connect seamlessly. As such, hubs present an opportunity to integrate mobility options that utilize new transportation technology to help enhance user experience and travel resiliency to help cover first and last mile travel. Based on these existing definitions, the core components of mobility hubs include being near a major transit station, providing a variety of sustainable transportation options, and being surrounded by areas with high residential and employment density".
- A mobility hub⁽⁵⁾ is a "recognizable place with an offer of different and connected transport modes supplemented with enhanced facilities and information features to both attract and benefit the traveller. A mobility hub is designed and is spatially organized in an optimal way so as to facilitate access to and transport between modes, including human-powered and shared modes, as well as provide extra transport-related and digital services".

Considering the above, this Study will discuss the possibility of implementing mobility hubs in Warsaw, **referring to the SmartHubs Project**. As per this Project's definition, SmartHubs are novel mobility hubs combining in a single spot a number and selection of different mobility services, and optionally some corresponding infrastructure, e.g., chargers for electric vehicles. One of the key elements of SmartHubs is their multimodality, meaning that these locations offer the citizens a variety of services in different modalities, e.g., a bike, a kick scooter, a moped, or a car, all bundled in digital shared mobility services available to citizens 24/7 through mobile apps provided by vendors of these services.

This assessment is the first step in the attempt of a wider implementation and adoption of multimodal mobility hubs in city space and public realm, as a **comprehensive and standardized urban mobility solution** fostering the use of shared means of transport and as a supplement to the public collective transport system. The ultimate goal would be to create an alternative to owning and using private cars for daily commute in cities, thus making the urban mobility ecosystem more sustainable.

This Study has been carried out under the SmartHubs Project, an initiative led by the Amsterdam Institute for Advanced Metropolitan Solution and co-funded by EIT Urban Mobility. The Study itself has been executed by the Mobile City Association, which is the new and shared mobility industry organization based in Poland.

2.2 Warsaw: basic facts

The below section of the Study will elaborate on basic facts and characteristics introducing Warsaw with regard to its functional structure, demography, selected socio-economic factors, and motorization rate.

⁴ Source: https://sustain.ubc.ca/about/resources/identifying-best-practices-mobility-hubs

⁵ Source: https://como.org.uk/shared-mobility/mobility-hubs/what/

Warsaw: functional structure

Warsaw's administrative area is 517 km², and according to the Warsaw Spatial Policy, it consists of areas dedicated (as visualized on the chart below) in 28% to housing (out of which 17% single-family housing and 11% multifamily housing), in 28% to green areas (incl. forests, parks, garden allotments and cemeteries), in 12% to agricultural use of land, in 11% to technical functions (incl. engineering and transportation services), in 7% to service areas, in 5% to production-service areas (incl. warehousing and storage).



Figure 1 Functional structure of Warsaw's total area according to Warsaw Spatial Policy

Warsaw: demography

The Project is to be carried out in the capital and the largest city in Poland with a population of almost **1,8 million inhabitants**, that can be extended to even close to 3 million inhabitants, taking into account the entire Warsaw Metropolitan Area (official name in Polish: "*Obszar Metropolitalny Warszawy*"). Warsaw is also the capital city of the Masovian Region (Voivodship) which has more than 5,4 million inhabitants.

Despite the pandemic year 2020, Warsaw's population is constantly increasing: by 0,25% comparing 2020 with 2019⁽⁶⁾, while in earlier years the growth's speed was about 0,7% comparing 2019 with 2018. This is against the general tendency observed in the country. Such result is achieved mainly due to interregional migration (in the search for a job), but also due to a continued surplus of births over deaths in the years 2006-2019 (in 2019 the birth rate in the metropolis showed a positive level of 1,28 for every 1,000 inhabitants), even with a disruption in this trend in the pandemic year 2020, when declines in the birth rate were reported – about 0,84 for every 1,000 inhabitants.

⁶ Soutce: https://warszawa.stat.gov.pl/opracowania-biezace/opracowania-sygnalne/ludnosc/stan-i-ruch-naturalny-ludnosci-w-wojewodztwie-mazowieckim-w-2020-r-,1,15.html

Warsaw: socio-economic factors

Warsaw's outlook is also promising in terms of the socio-economic perspective. The Warsaw Metropolitan Area is becoming an increasingly wealthy region, constantly improving its position in the GDP (gross domestic product) ranking expressed in PPS (purchasing power standards) per capita, which is an indicator allowing to compare the value of all the produced goods and services between different economies and regions⁽⁷⁾, Warsaw was placed ex aequo with Bucharest on the 13-14th position among all the EU's NUTS 2 regions with a **PPS of 160% of the annual EU27 average** for 2020. Historically looking, the Warsaw Metropolitan Area was ranked 18th in the year 2018 and 20th the year before (2017). That clearly shows that Warsaw – together with its surrounding municipalities – is on a path of rapid economic growth.

Another indicator proving this is the average income in Warsaw (expressed in PLN as a monthly gross salary⁽⁸⁾), which is growing year over year despite the disruptions – including even the COVID-19 pandemic. Over the past few years, Warsaw reported a **25% increase in the average income** of its citizens (please see the chart below for data from the period 2017-2021), which reached PLN 7,046 in August 2021, which is 20% above the country's average.



Figure 2 Average salary in Warsaw and Poland in the years 2017-2021, source: Warsaw Statistical Office

Moreover, the **unemployment rate**⁽⁹⁾ in Warsaw has been relatively low for years, and even reported a **17% decrease** over the past few years (please see the chart below for data from the period 2017-2021), reaching 1,9% in August 2021 – this is almost 4% below the country's average.



Figure 3 Average unemployment rate in Warsaw and Poland in the years 2017-2021, source: Warsaw Statistical Office

⁷ Source: https://ec.europa.eu/eurostat/databrowser/view/tgs00005/default/table?lang=en

⁸ Source: https://obserwujmazowsze.stat.gov.pl/wynagrodzenia.html

⁹ Source: https://obserwujmazowsze.stat.gov.pl/bezrobocie.html

Warsaw: motorization rate

Another type of indicator worth investigating for the Project is the number of passenger (personal) cars registered in Warsaw. According to the official data⁽¹⁰⁾ as of the end of 2020, the capital city of Poland had approx. **836 passenger cars registered for every 1,000 inhabitants**. This result gives Warsaw a pole position not only among all the Polish cities but also puts it in the forefront in the European context, considering that cities such as Berlin, London, Stockholm, Vienna, and Oslo have individual motorization rates of 300-400 cars per 1,000 inhabitants⁽¹¹⁾. Moreover, passenger car traffic is not the only traffic experienced in the city. Considerable traffic is also generated by other types of vehicles registered in Warsaw (all non-personal ones such as delivery vans and trucks amounting to a total of 435,000), adding another 243 vehicles per 1,000 inhabitants. Therefore, all types of cars in Warsaw amount to a total of **1,079 vehicles per 1,000 inhabitants**. Even if not all the vehicles registered here are commuting locally, such a high motorization rate is impressive, albeit causing a number of negative consequences for the city and its inhabitants, such as traffic congestion, air and noise pollution, decreased safety, lower quality of public space (e.g., wide streets, multiple areas dedicated to parking spaces, narrow sidewalks), to name only a few.

Moreover, the urban car traffic in Warsaw, mainly generated by the citizens driving personal cars (approx. 32% of the rides in Warsaw are made by passenger cars according to the Warsaw Traffic Study), as well as the businesses carrying out their activities, is substantially increased by the external car traffic of approx. **500,000 additional unique vehicles** entering and leaving the city every day⁽¹²⁾.

The above clearly shows that Warsaw must work on developing more sustainable ways of addressing mobility needs as it seems that there are **more vehicles than people in Warsaw**. The multimodal mobility hubs, offering a variety of shared transport modes in a single spot, can be part of the solution by bringing a more effective use of common assets related to urban mobility (e.g., number of vehicles, land allocated for parking), assuming that there will be a network allowing the citizens and other stakeholders to easily access the vehicle of their choice and to rely on the mobility services provided in such a way, therefore becoming less dependent on driving private cars or vehicles in individual use. This means that the Project has the potential to drive a positive change in the mobility behaviour among Warsaw's citizens and the way of addressing mobility needs by local businesses, in the long run decreasing the motorization rate in the city.

When comparing Poland to other EU member states in terms of the individuals' motorization rate (possible only with data for the year 2019⁽¹³⁾ as presented on the chart below), it becomes obvious that **Poles are among the European leaders in possessing personal cars**. And the trend is only stronger in such highly urbanized areas like the Warsaw Metropolitan Area. Compared to the EU30 average for 2019 (529 passenger cars per 1,000 inhabitants), Poland exceeds this value by 21% and together with Finland is the **number 2 in Europe in this infamous ranking**, assuming the exclusion of smaller countries hardly comparable with Poland: Liechtenstein, Luxembourg, and Cyprus.

¹⁰ Source: https://www.green-news.pl/1615-W-Warszawie-wiecej-samochodow-niz-ludzi-to-tylko-wycinek-problemu

¹¹ Source: http://polskaparkuje.pl/2019/04/27/spp-po-nowemu/

¹² Source: https://www.transport-publiczny.pl/mobile/warszawa-kazdego-dnia-do-miasta-wjezdza-milion-aut-54092.html

¹³ Source: https://ec.europa.eu/eurostat/databrowser/view/road_eqs_carhab/default/table?lang=en

	0 20	0 40)0 60	00 800	0 1,000
Liechtenstein					- 781
Luxemburg					- 681
Italy					- 663
Cyprus					— 645
Poland					- 642
Finland					- 642
Estonia					- 598
Malta		///////////////////////////////////////			— 597
Germany					— 574
Slovenia					— 556
Czechia					- 554
Switzerland					— 537
Lithuania					— 536
Portugal					- 530
(EU30 average)					- 529
Norway					- 522
Spain					— 519
Belgium					— 511
Greece					— 504
Netherlands					- 499
France			/////		- 482
Sweden			/////		— 473
Denmark					— 455
Ireland			////		— 454
Slovakia			<u> </u>		- 439
Croatia			Z		- 425
Bulgaria			1		- 407
Hungary					— 390
Latvia					- 381
Romania					- 357

Figure 4 Number of passenger cars per 1,000 inhabitants in 30 EU member states, 2019, source: Eurostat

2.3 Summary

This chapter of the Study has defined what mobility hubs are and their key aims. They are physically designated places in the city space, where **various means of shared transport are gathered together**, complementing the public collective transport network. Such a setup helps in fostering the use of more sustainable ways of urban travel, other than using a private car, which already is the least effective mean of city transport and is also becoming the least supported one.

Looking at Warsaw's fundamental characteristics and some key indicators describing Warsaw's current demographic and socio-economic situation, it should be noted that Warsaw has the greatest potential among the Polish cities to introduce shared mobility solutions of the Project. This is mainly due to the high number of inhabitants (1,8 million as a stand-alone city and 3 million as a metropolis) and a high concentration of different institutions: governmental (Warsaw is the capital city of Poland), educational, scientific, multilateral (e.g., various EU's bodies), and businesses (Warsaw is home to head offices or branches of many domestic and international companies). All this, resulting in a high demand for all possible urban functions (residential, office, education, services & retail, hotels, leisure, to only name a few), which in turns means higher needs **for seamless mobility** of its citizens.

It is also worth emphasizing that despite the relatively large share of public transit trips in the local modal split (47% back in 2015), there are a lot of private cars in Warsaw – not only those used by its citizens for urban transport, but also those used by people from outside the city who enter and leave its borders: driving to work, for school trips, or just commuting through Warsaw on their way to other destinations. The remarkable traffic congestion created by this situation is causing serious challenges. Calculations of the motorization rate prove that there are more vehicles in Warsaw than residents (1,079 vehicles per 1,000 inhabitants). For this (inglorious) reason, Warsaw might have a **considerable driver to seek an alternative to owning and using a private car for urban commute**, therefore fostering shared mobility solutions that are part of the Project.

"Implementing mobility hubs is very much in line with Warsaw's Municipal Strategic Documents"

3. Municipal Strategic Documents

There is a set of valid Municipal Strategic Documents impacting the feasibility of the Project, among which the following four are the most important ones and will be briefly described in the context of the Project: the Warsaw Strategy 2030 (adopted in 2018), the Warsaw Transport Strategy (2009), the Warsaw Parking Policy (2009) and the Warsaw Spatial Policy (2006). Regardless of the indicated past dates, these documents are the most recently available official documents determining the current state of mobility in Warsaw, as well as its future.

3.1 Warsaw Strategy 2030



The Warsaw Strategy 2030 (official name in Polish: *"Strategia #Warszawa2030"*) was adopted in 2018 as a document defining general principles and plans for the development of Warsaw with the development vision based on three dimensions: 1. active (and committed) citizens; 2. a friendly (and comfortable) place to live; 3. an open and creative mindset with an emphasis on cooperation.

The document also indicates the potential of Warsaw and the most important challenges it is facing. Taking into account the scope of this

Feasibility Study, we will pay attention to those provisions of the strategy that support the implementation of the Project.

The Warsaw Strategy 2030 presents a number of challenges faced by the city, including those that the **SmartHubs Project may have a positive impact on**, for example: too much traffic congestion; growing needs in terms of accessibility and quality of urban transport networks (incl. bike and pedestrian routes); not fully developed spatial order; frequent exceeding of air pollution standards. The Project, by promoting a city-friendly shared mobility and organizing shared mobility services into mobility hubs, has a real chance to respond to these challenges. Moreover, it provides a perfect area for cooperation of the local administration with non-governmental organizations (such as the Mobile City Association) during the implementation of municipal policies as indicated in the strategy.

The Warsaw Strategy 2030 sets out 13 **operational goals** within four strategic ones (1. a responsible community; 2. a local convenience; 3. a functional space; 4. a creative environment), among which the following ones are in line with the execution of the Project:

- 2.3 "We use services close to home" as mobility hubs have the potential (as a widespread network) to address local mobility needs, without the necessity of using a private car, through providing shared and micromobility services (good for covering short distances) close to residential areas and other destinations frequently used in daily commute;
- 3.1 "W use attractive public space" as mobility hubs have the potential to bring order to multiple scattered fleets of shared vehicles, often visible on the streets (a total of several thousand bikes, electric kick scooters, mopeds, car sharing), through providing specially designed designated parking spots for these vehicles and working with the fleets' operators on the execution of proper parking manners;
- 3.3 "We use a friendly transport system" as mobility hubs have the potential to supplement the public transit system of Warsaw, through providing citizens with multimodal shared mobility services located e.g., at public transport nodes, thus effectively addressing different mobility needs, enriching the offer of the local transport system and helping Warsaw to convince its citizens to live their lives in a more sustainable and less car-dependent way (within this operational goal the Warsaw Strategy 2030 literally indicates "dissemination of shared mobility solutions" as one of its aims);
- 4.2 "We **generate innovations**" as mobility hubs are designed to innovate within the spheres of urban mobility (e.g., mobility behaviour) and urban landscape (e.g., organized parking).

From the above, which is based on the most recent Municipal Strategic Document currently adopted in Warsaw, it is clear that promoting shared mobility solutions is one of the objectives inscribed in the future of Warsaw. For this reason, the **implementation of the Project has a strong justification**.

3.2 Warsaw Transport Strategy



The Warsaw Transport Strategy (official name in Polish: *"Strategia Zrównoważonego Rozwoju Systemu Transportowego Warszawy do 2015 roku i na lata kolejne, w tym Zrównoważony Plan Rozwoju Transportu Publicznego Warszawy"*) was adopted in 2009 by the Warsaw City Council and is another Municipal Strategic Document impacting the regulatory environment for mobility in Warsaw and therefore adequate to be analysed from the Project's perspective.

This document sets out a transport strategy oriented towards ensuring the balance between car travel and public transit trips, as well

as fostering active mobility (walking and cycling). All this is justified by the fact that the extensive and uncontrolled use of private cars has a too much negative impact on the quality of life in Warsaw, causing – among others – traffic congestion, lower quality of public space, decreased feeling of safety, or increased air and noise pollution. Therefore, the ultimate goal of the Warsaw Transport Strategy is **conditions for the efficient and safe movement of people and goods** while limiting the harmful effects on the natural environment and living conditions.

The strategy sets out a number of specific goals within the following six main goals: 1. ensuring accessibility of internal and external connections; 2. improving travel standards and accessibility of the transport system for people with disabilities; 3. stimulating economic development and spatial order; 4. improving the safety of traffic and the transport system users; 5. improving the condition of the natural environment and reducing the nuisance of the transport system for citizens; 6. improving the prestige and the image of Warsaw. Below indicated are those of the specific goals that are consistent with the implementation of the Project, proving at the same time that Warsaw can benefit from developing multimodal mobility hubs and that such turn of event is in line with the Warsaw Transport Strategy:

- I.1 "Ensuring high quality transport infrastructure" as mobility hubs have the potential of delivering high-class transport infrastructure through organizing well designed and well equipped mobility hubs next to, among others, public transport nodes, public facilities, commercial real estate, residential estates and/or other frequently visited places;
- I.4 "Improving accessibility of city areas without the necessity of using a private car" as mobility hubs offer a variety of sustainable mobility options in a single spot and in different modalities (according to the user's needs: e.g., bikes, scooters, mopeds, cars), which is (assuming a widespread network of mobility hubs) exactly an alternative to owning and using a private car for intra-city travel;
- I.8 "Improving accessibility of railway stations and stops" mobility hubs have the potential, if conveniently located next to railway transport nodes, of being the first/last mile solution supplementing the journeys carried out with trains;
- II.1 "Improving travel standards in public transit" as mobility hubs have the potential to provide a number of mobility services directly within public transport nodes, as well as to integrate different mobility offerings (both public and private) on digital platforms (e.g., timetables, multimodal journey planners, information about the available vehicles, etc.), thus to improve the accessibility and functionality of public transit, and its standard including general user experience of the passengers;

- III.1 "Rationalization of the **citizens' mobility behaviour**" as mobility hubs have the potential, by offering multimodal fleets of shared vehicles, to positively impact Warsaw's citizens in terms of their transport choice for commuting, other than a private car;
- III.2 "Bringing urban functions back to the streets" as mobility hubs have the potential to replace ineffective and space-consuming parking spaces (a statistical car in individual use is parked 96% of the time⁽¹⁴⁾) with mobility hubs serving a much larger group of citizens than only 1-2 people travelling in a private car (on average, there are 100 registered users for every shared vehicle in Poland⁽¹⁵⁾);
- III.3 "Improving the effectiveness of the transport system" as mobility hubs have the potential, based on the principles of shared economy implemented within the sphere of urban mobility (e.g., one car sharing vehicle car replace eight privately owned cars⁽¹⁶⁾), to provide mobility to a much wider group of citizens with the use of substantially less resources, such as the number of vehicles, the size of land allocated to parking lots and the costs actually incurred by the city and its citizens in order to move people and goods between different destinations, not speaking of the environmental costs resulting from too many ineffective trips made by private cars (this specific goal is literally indicated in the Warsaw Transport Strategy as "support and promotion of car sharing");
- III.4 "Rationalization of spatial development" as mobility hubs have the potential, through concentrating in designated spots different types of vehicles operating in highly-effective shared modes, to free up public space allocated to parking private vehicles and to intensify the transport functions around public transport nodes, as well as to contribute to the process of creating local district centres, given that mobility hubs will be implemented alongside the public transport infrastructure;
- III.5 "Mitigating the uneven access to public transit in some areas of the city" as mobility hubs have the potential to actually extend the reach of public collective transport into areas underserviced by the public transit network, through providing a selection of shared mobility solutions to be used as the mean of transport for the first/last mile of a multimodal journey – all of these in mobility hubs located around public transport nodes;
- III.6 "Reducing the **barrier effect** and cutting neighbourly ties" as mobility hubs have the potential to enrich the mobility offer within districts with new ways of commuting (e.g., shared vehicles available in mobility hubs), thus facilitating and relieving transport links between city districts as well as inside their areas;
- V.1 "Noise reduction" as mobility hubs have the potential to provide a variety of shared mobility fleets, which are in more than 90% driven by either muscle power or a noiseless electric engine⁽¹⁷⁾, thus heavily contributing to noise reduction in Warsaw;
- V.2 "Preventing pollution of air and water" as mobility hubs have the potential to provide shared mobility services that most often use (in >90% of cases as indicated above) zero emissions and climate friendly fleets of vehicles, thus contributing to the improvement of air quality in Warsaw;

¹⁴ Source: https://theconversation.com/end-of-the-road-why-it-might-be-time-to-ditch-your-car-72097

¹⁵ Source: https://www.magazyngalerie.pl/komentarze/eko-transport-przyszlosci-dla-klientow-handlu-i-uslug/

¹⁶ Source: https://www.autocar.co.uk/car-news/industry/analysis-will-car-sharing-replace-vehicle-ownership

¹⁷ Source: https://www.logistyka.net.pl/bank-wiedzy/item/92034-huby-mobilnosci-nowa-era-mobilnosci-miejskiej

- V.3 "Protection of **public health**" as mobility hubs have the potential to offer a variety of micromobility services (e.g., bikes, kick scooters) encouraging active mobility in the open air, contributing to well-being of the citizens and positively impacting their physical and mental health⁽¹⁸⁾;
- VI.2 "Improving the **quality of urban landscape**" as mobility hubs are specially designed spots gathering many shared vehicles in one place, in a visually attractive, functional and orderly manner, which also prevents from randomly/illegally parking these vehicles in public space.

Based on the above, it is more than clear that the Project exceptionally well fits with the goals of the Warsaw Transport Policy. There are as many as 14 specific goals the Project can contribute to, which is **another strong justification for implementing mobility hubs** in Warsaw.

3.3 Warsaw Parking Policy



The Warsaw Parking Policy (official name in Polish: "*Kierunki realizacji polityki parkingowej na obszarze m.st. Warszawy do roku 2035*") is a document published in 2009 – a set of guidelines and recommendations on organizing parking in Warsaw until the year 2035. The document indicates different actions supporting the execution of the Warsaw Parking Policy within 8 areas: 1. Paid Parking Zone; 2. Park & Ride (P&R) parking facilities; 3. on-street parking; 4. off-street parking; 5. parking in residential areas; 6. parking of trucks; 7. parking of coaches; 8. parking of bikes.

As the SmartHubs Project is about establishing designated parking spots for shared mobility fleets, it refers to the provisions of the Warsaw Parking Policy and at the same time either supports execution of particular activities outlined in the document or contributes to their fulfilment by proposing relevant actions in line with the very policy and/or other Municipal Strategic Documents:

- 1.3 "verification of the Paid Parking Zone regulations" (one of the priority-marked activities) because the vehicles parked inside mobility hubs (e.g., car sharing vehicles) are to coexist with the municipal Paid Parking Zone, which covers the entire central part of Warsaw, the proposed action assumes introduction of a new category of vehicles to the PPZ's regulations (shared vehicles provided by professional/certified vendors), which will be granted a separate classification and parking rules compared to private cars, due to the fact that shared mobility is an alternative to private cars and significantly contributes to the strategic goals of Warsaw, especially the above described Warsaw Strategy 2030 and the Warsaw Transport Strategy;
- 1.5 "organizing the method of designating parking spaces" because one of the strategic aims of the Warsaw Transport Strategy is improving the effectiveness of the transport system (incl. better utilization of land and vehicles), the proposed action assumes including multimodal mobility hubs in the official/formal process of designing and allocating parking spaces within the Paid Parking Zone

¹⁸ Source: https://media.ford.com/content/fordmedia/feu/gb/en/news/2021/10/08/Good-for-the-planet-good-for-the-mind.html

and beyond, similarly to the approach known from taxi parking bays (due to the changing habits of ordering taxis – now mainly functioning as door-to-door on-demand mobility services not requiring fixed parking locations – the current taxi bays in Warsaw can be used more effectively through sharing the available space between different shared mobility options, not just taxis);

- 2.5 "ensuring good access to P&R facilities" (one of the priority-marked activities) as mobility hubs have the potential, when present in a particular P&R location, to improve the convenience and ease of reaching it, through offering a variety of additional modes of transport other than the privately owned vehicles e.g., bikes, kick scooters, mopeds, and cars that are available directly on the real estate, thus not only facilitating access to the P&R facility but also opening it to a new group of users;
- 2.8 "developing new P&R functions" as the mobility hubs concept, when added to the existing P&R facilities, will constitute its new functionality through adding a variety of shared mobility vehicles and services (e.g., shared: bikes, kick scooters, mopeds, cars) as well as accompanying infrastructure (e.g., small architecture such as bike/kick scooter racks, chargers for electric micromobility, and/or other type of infrastructure providing services to citizens);
- 3.2 "limiting the number of parking spaces in areas, where parking worsens the quality of urban space" (one of the priority-marked activities) as one of the key features of mobility hubs is a reorganization of on-street parking in a way that the same mobility needs of the citizens can be met with fewer (shared) vehicles, thus requiring less land allocated for parking spaces;
- 3.3 "replacing on-street parking with off-street parking" as mobility hubs have the potential, through the efficiency of offered shared mobility solutions (e.g., one shared car replacing eight cars in individual use and shared micromobility replacing car trips), to decrease the demand for on-street parking spaces, thus making it easier for Warsaw to execute the program of eliminating parking spaces on public roads and sidewalks, and moving them to off-street parking lots;
- 3.9 "introducing **innovative solutions in designating parking spaces**" as mobility hubs are paving the road towards innovative use of common assets (such as public land allocated to parking) and have the potential to play a key role in reassessing the functional division of street space as well as in encouraging citizens to adopt innovative and more sustainable ways of commuting;
- 4.2 "cooperating with entities managing private car parks" because mobility hubs are a concept making urban mobility more sustainable regardless of whether the mobility hub is situated on public or on private land (e.g., in a commercial car park, next to an office building or next to a shopping mall), the proposed action is to involve Warsaw and its entities into joint creation of mobility hubs with institutional owners of commercial real estate;
- 4.5 "introducing innovative solutions increasing the functionality of off-street car parks" as mobility hubs have the potential, through adding new shared modes of transport to the traditional offer of an off-street car park (international example: a parking operator adds shared micromobility services to its garages⁽¹⁹⁾), to become an added value and added functionality to the vast majority of off-street car parks in the city, especially those that are in public hands and those being subject to awarding a public contract (Warsaw is in direct or indirect charge of hundreds of off-street parking

¹⁹ Source: https://www.parking-net.com/parking-news/apcoa/tier-launch-international-partnership

locations, both private and public , which can run multimodal mobility hubs, thus contributing to a more sustainable transport system);

- 5.2 "reduction of on-street parking in residential areas of the city centre" as mobility hubs have the potential, through offering a bundle of shared mobility services in front of people's houses, to serve much more residents (as indicated previously, for each shared vehicle in Poland, there is an average of 100 registered users), at the same time requiring less land and less vehicles compared to the situation, where most of the households have at least one privately owned car;
- 5.4 "running an educational program in residential areas aimed at giving up car ownership" as mobility hubs have the potential assuming a whole network will be created throughout Warsaw of being an alternative solution to car ownership, through offering different means of transport (incl. different types of shared cars) accessible all day and all year long, and therefore very much suiting a program aimed at encouraging Warsaw citizens to ditch their cars;
- 8.1-8.7 "increasing the number of bike parking spaces" (one of the priority-marked activities) as mobility hubs promote different means of shared micromobility (including bikes) and can also accommodate bike stands in a number of locations, e.g., next to P&R facilities (in form of a Bike & Ride parking), at transport network nodes, next to office and retail buildings, next to municipal buildings, in housing estates, etc.

The above clearly shows that the Project goals have very much in common with the Warsaw Parking Policy and parking management in general. It also creates a good potential and a reasonable **justification for the Warsaw Municipality to launch a number of initiatives** aimed at making urban mobility more sustainable and less dependent on private cars in individual use, for example, through creating separate parking rules for shared vehicles within the Paid Parking Zone and beyond, through designating multimodal mobility hubs as part of on-street (e.g., within the existing taxi parking bays) as well as off-street parking, or through encouraging private real estate owners to also create mobility hubs on their premises.

3.4 Warsaw Spatial Policy



The Warsaw Spatial Policy (official name in Polish: *"Studium uwarunkowań i kierunków zagospodarowania przestrzennego m.st. Warszawy"*) is a document adopted by the Warsaw City Council in 2006 (today with some further amendments), that divided Warsaw into 3 zones (I – downtown functional zone incl. the city centre, II – urban zone, III – suburban zone) and assigned them, among many other features, also diversified development guidelines and directions of change with regard to their transport and parking features (e.g., degree of privileged status of public transit, degree of restrictions on car and

truck traffic, or requirements for the number of parking spaces).

The document also emphasizes some general assumptions such as mixing of different urban functions (housing, offices, retail, recreation, industrial), the need for limiting commuter traffic in the city centre, or the aim of concentrating services in particular areas of the city, so that any place of residence can provide

a pleasant and comfortable quality of life, all of which also is very much in line with the assumptions behind the Project of multimodal mobility hubs providing local communities with easy and predictable access to diverse mobility options in designated spots, therefore heading towards a more liveable city.

The Warsaw Spatial Policy formulates, among others, the following conclusions, general assumptions and main directions of changes:

- "developing residential building construction in a manner maximizing utilization of existing and planned infrastructure" – here the Project could contribute through organizing mobility hubs in residential estates, that would offer highly-effective shared modes of transport concentrated in a compact (small) area;
- "protection against **noise caused by transportation** and industry" here the Project could contribute through offering a variety of mobility options, the vast majority of which (>90% as indicated previously) are noiseless due to the fact that they are powered either by muscle power (e.g., bikes) or an electric motor (e.g., e-scooters, e-mopeds or electrified parts of the car sharing fleets);
- "expansion of roads and parking areas in densely built-up areas of the city are condemned to failure" – here the Project could contribute through offering a comprehensive shared mobility solution allowing to maintain the same or even increased mobility needs, at the same using significantly less resources such as land wasted for storing private cars or the number of vehicles required for transport;
- "decrease in the need for traffic" here the Project could contribute through offering means of transport other than cars in individual use, which are an ineffective and space consuming intracity travel tool carrying on average as few as 1,3 persons in a 4/5-seated vehicle (according to the Warsaw Traffic Study⁽²⁰⁾), therefore promoting sustainable and highly-efficient mobility patterns that will allow reducing traffic congestion in Warsaw, which is also in line with European tendencies;
- "reinforcing the role and range of the operation of public transit" here the Project could contribute through providing shared modes of transport at the public transport nodes (e.g., metro, tram, and bus stations), which will have the potential of being the first/last mile mean of transport for people traversing the city mainly by collective vehicles, thus actually improving the reach and penetration of the public transit system in Warsaw;
- "integration of the mass rail transit system" also here, assuming creation of mobility hubs next to railway-based transport nodes (e.g., metro, urban rail and tram stops), the Project could contribute through adding more (shared) transit options connecting rail travel with a number of first/last mile mobility solutions;
- "construction of Park & Ride system parking areas" when adding the functionality of a mobility hub to the P&R parking facilities, the Project could increase the number of possible ways of reaching P&R destinations, thus attracting a new group of users who are using shared means of transport already;
- "construction, modernization and rebuilding of transfer nodes among the various types of transportations systems" – here the Project could contribute through adding a new category of

²⁰ Source: https://www.transport-publiczny.pl/mobile/ile-samochodow-w-autobusie-efektywna-warszawska-komunikacja-53076.html

urban transport (shared mobility services, e.g., concentrated in the mobility hubs) to the existing and new transport nodes, allowing the citizens to benefit from sustainable shared means of transit and allowing various transportation systems (mass and shared) to better complement each other.

Again, and similarly to the rest of Municipal Strategic Documents, the Warsaw Spatial Policy contains a number of guidelines and development directions that fit well with the implementation of the Project, creating **another justification for Warsaw's actual involvement** in the creation of mobility hubs.

An additional point to Warsaw's spatial planning is that as a result of getting involved in the process of creating a network of mobility hubs throughout the city, it could be lowering the required minimum number of parking spaces for cars (the so-called "parking indicator"), as established in the detailed local spatial development plans, which are often unnecessarily driving the demand for intra-city car travels through providing too many new parking spaces for vehicles in individual use. **Downward revision of the parking indicators** and adoption of such an approach citywide could lead to a favourable situation, in which both existing and new buildings would not need to generate so many new parking spaces, as part of the mobility needs of a certain building or object would be already addressed by shared mobility services of the mobility hub, without the necessity of incurring high investment costs. At the same time, this would contribute to making Warsaw's transport system more sustainable and allow the existing objects to win back space for other functions than simply being a car parking.

3.5 Summary

To sum up, all the above described Municipal Strategic Documents (the Warsaw Strategy 2030, the Warsaw Transport Strategy, the Warsaw Parking Policy, and the Warsaw Spatial Policy) have clear aims regarding the future of the Warsaw transport system. It should be more sustainable, promote active mobility, create attractive and safe public space, foster effective ways of commuting people and goods, and make the municipal mobility ecosystem less dependent on privately owned cars. All this comes with a special focus on the city centre, city districts, as well as on all transport nodes connecting citizens to the public transit network. And now, taking into account the Project's key features, which in general are about maximizing the effectiveness of urban commuting (through using shared means of transport) and minimizing the assets needed for this purpose (especially land allocated to parking and the required number of vehicles), **it is clear that implementation of SmartHubs in Warsaw is very much in line with the strategic aims of the city and therefore**, it is highly recommended for the Warsaw Municipality to seek ways of getting involved in the process of creating mobility hubs.

In Q4 2021, the Warsaw Municipality is also in the process of awarding a public contract for preparing an official Sustainable Urban Mobility Plan (**SUMP**, which usually is a planning concept applied by local and regional authorities for strategic mobility planning), however, this document is to be delivered during 2023, so it can't be subject of this Feasibility Study. Still, Warsaw's future SUMP should include and operationalize the concept of mobility hubs for many reasons indicated above.

Feasibility Study on the implementation of mobility hubs in Warsaw Chapter 4. Central regulatory framework

"The legal acts should reflect the changes undergoing in today's urban mobility"

4. Central regulatory framework

Apart from the Municipal Strategic Documents described in the chapter above and corresponding resolutions of the Warsaw City Council allowing the local regulations to enter into force, there is also a set of central-level legal acts (constituting the generally applicable law in Poland) in the area of transport and parking issues with a potential impact on the mobility hubs. The main ones will be discussed below, indicating not only their possible interference with the Project, but also the need to amend certain provisions in order to better **reflect the changes undergoing in today's urban mobility**, e.g., through introducing shared mobility as an official and acknowledged category of transport. The Warsaw Municipality could provide support for that by supporting the legislative initiative, the success of which would lead to better development of shared mobility in Poland, including Warsaw.

4.1 Act on public collective transport

The Act of 16.12.2010 on public collective transport with further amendments (official name in Polish: "*Ustawa z dnia 16 grudnia 2010 r. o publicznym transporcie zbiorowym*") is a legal act defining the rules for the organization and operation of regular passenger transport in Poland carried out in public collective transit systems. As the ultimate feature of collective transport is **public utility**, the role of its organizer has been assigned to the public administration (mainly local self-government units of various levels: communes/

municipalities, poviats/districts, and voivodships, or in some cases also the central administration), which has the statutory obligation of providing commonly available public transport services (including planning, organizing and running them) in order to meet the transit needs of the community in a given area – and what is important – in an ongoing and uninterrupted manner. For this reason, such passenger transport services cannot be operated on a commercial basis and are subject to **regulated competition** (as indicated in the Regulation (EC) No 1370/2007 of the European Parliament and the Council of 23.10.2007 on public passenger transport services by rail and by road), also guaranteeing transparency and performance of public passenger transport services, having regard to social, environmental and regional development factors, or to offer specific tariff conditions to certain categories of travellers, e.g., pensioners.

Moreover, the public collective transport system should also operate according to the principles of sustainable development (such as: taking into account the citizens' expectations, offering multimodality and promoting eco-friendly, and technically innovative means of transport) included in the locally adopted transport plan (in Warsaw: the Warsaw Transport Strategy). If we add the expectation that the public transport network should also incorporate integrated interchange nodes (enabling the passenger a convenient change of the means of transport in a place equipped with the necessary infrastructure, particularly parking spaces), it becomes clear that there is a **good justification for enriching public transport nodes with organized parking** in the form of multimodal mobility hubs.

Due to the fact that shared mobility does not directly include the elements of the public collective transport, as defined in the legal framework, but only promotes its use in conjunction with shared means of transit, the impact of this law on mobility hubs is rather limited. However, it is in the best interest of the Project to have a well-functioning public transport network, which mobility hubs and the corresponding shared mobility services can complement, as well as it is in the best interest of the public collective transport to supplement its offer with shared mobility solutions.

4.2 Act on road transport

The Act of 6.09.2001 on road transport (official name in Polish: "Ustawa z dnia 6 września 2001 r. o transporcie drogowym") is a legal act defining the terms and conditions for conducting **business activity in terms of transporting people or goods** with the use of road vehicles (including platforms being an intermediary between the drivers and the passengers) and requiring the possession of a valid license to do so, issued by a relevant authority (GITD: the General Inspectorate of Road Transport or an appropriate body of the self-government).

The Act on road transport has a fairly limited impact on the Project, as most of the shared mobility services provided in mobility hubs are either based on fleets of self-service road vehicles (with the users being the drivers themselves, e.g., shared cars and mopeds with remote access to the vehicles) or other micromobility-type vehicles (e.g., bikes and electric kick scooters) not fulfilling the definition of a road vehicle. Of course, a mobility hub can also play the role of a stop within a regular communication line or a hop-on/drop-off location for mobility-on-demand services (such as ride- and taxi-hailing services, for instance). In such a situation, the Project would also have to take into account the provisions of the Act on road transport. With regard to taxi services, this legal act gives local city councils (for Warsaw: the Warsaw City Council) the right to set maximum tariffs as well as to set up the zones inside the service area, each of

them having diversified tariffs. According to the Resolution no XXIX/608/2011 of the Warsaw City Council of 15.12.2011 on setting official prices for passenger taxis in Warsaw, the maximum taxi tariffs in Warsaw are set as follows:

- starting fee: PLN 8.00 per trip
- daytime (from 6 AM to 10 PM): PLN 3.00 per 1 km inside zone I and PLN 6.00 per 1 km outside the zone;
- night-time (from 10 PM to 6 AM): PLN 4.50 per 1 km inside zone I and PLN 9.00 per 1 km outside the zone;
- waiting fee: PLN 40 per 1 hour when waiting for the passenger during the trip.

4.3 Traffic law

The Traffic Law of 20.06.1997 with further amendments (official name in Polish: "Ustawa z dnia 20 czerwca 1997 r. – Prawo o ruchu drogowym") is the legal act setting the traffic rules applicable on public roads (as well as in some other specially designated areas: the residential and/or traffic zones), the regulations on allowing different vehicle types for road traffic (incl. technical requirements of these vehicles), the requirements enforced on traffic participants other than drivers (e.g., pedestrians), as well as the rules on traffic law enforcement.

This legal document introduces a **typology of roads** (e.g., public, internal, express/highways, bike lanes, other) and outlines the road's key elements, including: a roadway (intended for road vehicle traffic) with optionally designated road lanes, a sidewalk (for pedestrian traffic), a trackway (for rail transport), a roadside, as well as other pedestrian and biking infrastructure.

The Traffic Law also enumerates different types of vehicles, e.g.:

- a road vehicle (official name in Polish: "*pojazd samochodowy*") a vehicle equipped with a drive allowing it to move with a speed of 25 km/h and more;
- a slow running vehicle (official name in Polish: "pojazd wolnobieżny") a vehicle equipped with a drive limiting its speed up to the maximum of 25 km/h;
- a privileged vehicle (official name in Polish: "*pojazd uprzywilejowany*") a vehicle equipped with blue flashing lights and sound sirens (e.g., emergency services);
- a historic vehicle (official name in Polish: "pojazd zabytkowy") a vehicle registered as a historic vehicle and entered into an adequate register;
- a passenger car (official name in Polish: *"samochód osobowy"*) a road vehicle with a construction intended for carrying up to 9 people including the driver and their luggage;
- a bus (official name in Polish: "*autobus*") a road vehicle allowing to carry more than 9 people, including the driver;
- a truck (official name in Polish: "samochód ciężarowy") a road vehicle with a construction intended for carrying freight, including also a passenger truck for carrying freight and 4-9 people;
- a quadricycle (official name in Polish: "czterokołowiec") a road vehicle other than passenger car, truck and motorcycle, with a maximum weight of 400 kg (when carrying people) or 550 kg (when carrying freight);

- a light quadricycle (official name in Polish: "czterokołowiec lekki") a quadricycle with a maximum weight of 350 kg and maximum speed of 45 km/h;
- a taxi (official name in Polish: "taksówka") a road vehicle, properly equipped and marked, intended for transporting up to 9 people – including the driver – and their hand luggage, driving according to the rules of service that have been described in the Act on road transport;
- a motorcycle (official name in Polish: "motocykl") a 2-wheel or 3-wheel road vehicle complying with the categories L3e/L4e/L5e outlined in the Regulation (EC) No 168/2013 of the European Parliament and of the Council of 15.01.2013 on the approval and market surveillance of two- or three-wheel vehicles and quadricycles;
- a moped (official name in Polish: "motorower") a 2-wheel or 3-wheel vehicle equipped with a combustion engine of a maximum displacement of 50 cm3 or with an electric drive of a maximum power of 4 kW limiting the vehicle's speed up to the maximum of 45 km/h;
- a bike (official name in Polish: "rower") a vehicle with a maximum width of 90 cm powered either purely by muscle power of the driver or with the support of an electric drive with a maximum power of 250 W and a maximum voltage of 48 V, activated by pressing on the pedals and deactivated after reaching the speed of 25 km/h;
- an electric kick scooter (official name in Polish: "hulajnoga elektryczna") a biaxial vehicle without saddle and pedals, with handlebars, powered by an electric drive and allowing to carry only one person (the driver);
- a personal transport device (official name in Polish: "urządzenie transport osobistego") a vehicle without saddle and pedals, powered by an electric drive and allowing to carry only one person (the driver), unless it's an electric kick scooter;
- a SAM-type vehicle (official name in Polish: "*pojazd marki SAM*") a vehicle build with the use of a body, a chassis, or a frame all of an own construction.

The intention of listing above a part of the vehicle types outlined in the Traffic Law is to show that this legal act is the appropriate place to define a certain type of a vehicle, including some new ones such as the electric kick scooter and the personal transport device (both introduced to the Polish legal system only in May 2021), as well as some well acknowledged ones and welcomed to the Traffic Law already a long time ago, such as taxis, for instance. **Defining a vehicle type in the Traffic Law** lays a foundation for all further actions related to it for example, allowing to introduce specific road signs and special traffic rules (sometimes constituting a new sub-category of transport), and, in consequence, to foster the dissemination of different vehicle types.

In order to make the existing transport systems in Polish cities more sustainable (mainly with regard to the ineffective use of individual means of transport), it would be required to welcome an additional type of a vehicle to the Traffic Law's vehicle typology, through introducing highly-effective shared means of individual transport. A newly established **"shared vehicle" type** could be defined as a vehicle, properly equipped and marked, intended for transporting people and their luggage based on a professionally available shared mobility service – not including the taxis and the means of public collective transit, which have been already defined in separate legal acts. Introducing shared vehicles into the Polish legal system would support fighting the transportation, spatial and climate issues resulting from ineffective use of individual means of moving around (personal cars particularly), thus ineffective use of common assets such as land

allocated to parking vehicles required to address the citizens' mobility needs. Such turn of events would be good not only for bringing more sustainable means of transport into the Polish cities, including Warsaw, contributing with a more climate-neutral approach towards mobility, but it would be also a step forward for the SmartHubs Project offering a variety of shared mobility services bundled in designated mobility hubs.

Taking into account the general traffic rules described in the Traffic Law, this Feasibility Study will provide an insight into its two aspects, which are most relevant for designating and operating mobility hubs on public roads These are the parking regulations for different types of vehicles, as well as the traffic rules applicable when arriving/leaving the mobility hub with a certain type of a vehicle. Speaking of **the parking regulations**, the general rule is that drivers should park the vehicles in a manner that does not pose a threat to safety (e.g., through limiting visibility for pedestrians or other road users) and – in most cases either – in designated places (e.g., found through official road signs in the form of horizontal and vertical markings) or according to specific rules – especially when parking road vehicles in the space closest to the edge/curb of the roadway or by parking bikes and electric kick scooters in a parallel to the edge/curb of the sidewalk away from the roadway (if there are no other designated areas). The abovementioned regulations, as well as a few more indicated in the Traffic Law (e.g., no parking in the distance less than 10 meters from an intersection or pedestrian/bike crossing, or in the distance less than 15 meters from the sign indicating a stop for public collective transport), are rules that must be taken into account when planning and designating multimodal mobility hubs on public roads.

With regard to the **traffic rules applicable when arriving and/or leaving the mobility hub**, it is important to stress that the designated parking spot should be situated in a way enabling simultaneous access for all modalities represented in the mobility hub: a roadway for road vehicles (e.g., for shared cars and mopeds), biking infrastructure for micromobility (e.g., bikes, electric kick scooters), and – of course – a sidewalk for pedestrians. Riding a bike or an electric kick scooter on sidewalks is allowed only in special circumstances, therefore offering access for these modalities to the mobility hub solely through pedestrian-type infrastructure will automatically force its users to violate the Traffic Law. This shows that access to each mobility hub situated on public roads or in other specially designated areas in which the regulations apply (the residential and/or traffic zones) should be properly planned in order to **enable legal access to the hub for all users**. Of course, mobility hubs situated outside of areas being subject to the Traffic Law regulations should also take into account the above rules in order not to violate the general regulations of using mobility hubs and publicly available infrastructure.

Finally, the Traffic Law also introduces **road signs** in order to legitimize its provisions in the physical environment (on streets, sidewalks, etc.). A detailed list of road signs and their technical requirements have been included in the Regulation of the Minister of Infrastructure and the Minister of Interior and Administration of 31.07.2002 on road signs and signals with further amendments. The aim of the legislative measures indicated in this Feasibility Study (a newly established "shared vehicle" type as described above) would be to introduce to the list of the road signs new ones, dedicated to shared vehicles, that would allow, for example, special separate parking rules, as well as introduce the restrictions on the access to selected areas of the city (e.g., the Low Emission Zones), by either limiting it to the low-emissions vehicles or entirely restricting the private cars from driving into these urban parts.

4.4 Act on public roads

The Act of 21.03.1985 on public roads with further amendments (official name in Polish: "Ustawa z dnia 21 marca 1985 r. o drogach publicznych") is the legal act determining, among others, the rules for Paid Parking Zones organized by municipalities on public roads. The statutory objectives of a Paid Parking Zone are increasing the rotation of vehicles (in Warsaw the PPZ rotation rate for a single on-street parking space between 6 AM and 6 PM equalled almost four cars, according to the Warsaw Road Authority and based on data from 2014-2015), executing the local transport policy and limiting the number of vehicles in certain areas of the city, thus giving the public transit system a more privileged position.

The act on public roads also determines a number of factors the municipalities must comply with when **designating and operating a Paid Parking Zone**, for example:

- the maximum applicable parking fee (up to PLN 4.52 for the first hour in the regular PPZ and up to PLN 13.55 in the downtown PPZ, according to the Poland's minimum monthly wage approved for 2022, equalling PLN 3,010⁽²¹⁾), which has only recently (2021) been raised in Warsaw from PLN 3.00 to PLN 3.90 for the first hour in the regular PPZ (Warsaw lacks a downtown PPZ, therefore the city centre is subject to a regular PPZ);
- the time when the parking fees apply (working days only for a regular PPZ and all year long for a downtown PPZ) – today the drivers are obligated to pay for parking during all working days between 8 AM and 8 PM;
- exemptions from the parking fee, which may be defined either by local or central regulations, as described in the paragraph below;
- penalties for not paying the parking fee, which cannot exceed 10% of the national minimum monthly wage, that is PLN 301 in 2022 (in Warsaw the penalty fee has been increased during 2021 from PLN 50 to PLN 250 with a possible reduction to PLN 170, if paid within 7 days);
- rules on designating downtown PPZ, which may only be introduced once duly justified and in case the regular PPZ is no longer fulfilling its statutory objectives.

The act on public roads is important from the Project's perspective as the mobility hubs may often be located within the PPZ's area and should have a **clearly defined status**, e.g., in terms of the necessity for the users of shared mobility vehicles (located either inside or outside the hub) to pay a regular PPZ parking fee, which today is applicable for all personal cars, including car sharing fleets, however, with some exceptions either defined by:

 local regulations (for Warsaw that would be the Resolution no XXXVI/1077/2008 of the Warsaw City Council of 26.06.2008 on the paid parking zone with further amendments, which sets out various groups of road users entitled to an amended parking fee, e.g., a reduced parking fee for residents of the PPZ and paid in the form of a monthly subscription or a completely waived charge, e.g., for people with disabilities, municipal services, motorcycles and 2-wheel vehicles, embassies, and some governmental institutions), or by

²¹ Source: https://www.gofin.pl/17,2,7,213883,placa-minimalna-w-2022-r.html

• central regulations, e.g., exemption from the PPZ parking fee for electric vehicles as defined in the Act of 11.01.2018 on electromobility and alternative fuels.

A clearly defined status of shared mobility vehicles on public roads, including their approach to the parking rules, including inside the specially designated mobility hubs, can be achieved through several actions, some of which may be fully addressed on local level (by the Warsaw Municipality alone):

- **central level:** defining shared mobility in the Traffic Law as a separate transport category (similarly to taxi services) and granting it some privileges in urban traffic, e.g., reduced/waived PPZ parking fees (similarly to electric vehicles), as well as creating dedicated road marking (horizontal and vertical signage) for shared mobility, allowing this category of transport to appear in public space and on public roads (similarly to what started happening in Germany⁽²²⁾);
- **local level:** defining shared mobility in the Resolution no XXXVI/1077/2008 of the Warsaw City Council of 26.06.2008 on the paid parking zone with further amendments and granting it some privileges in urban traffic, e.g., reduced/waived PPZ fees (similarly to other groups of road users).

Another aspect of the Act on public roads that may affect the process of designing and designating SmartHubs is the number of **parking spaces for people with disabilities** that the traffic operator must provide within parking spaces on public roads, and in the statutory residential and/or traffic zones. Here, the following calculation applies: at least one specially designated parking space for people with disabilities for car parks with the capacity of 6-15 spaces; two such parking spaces for car parks providing 16-40 spaces, three for car parks with 41-100 places, and 4% of the total number of parking spaces for car parks exceeding 100 parking spaces.

4.5 Act on electromobility and alternative fuels

The Act of 11.01.2018 on electromobility and alternative fuels (official name in Polish: "Ustawa z dnia 11 stycznia 2018 r. o elektromobilności i paliwach alternatywnych") is a legal act defining the rules for the use of primarily electric drives in the transport sector. Among its various provisions, there can be found such having a potential impact on the shared mobility sector, thus also on the mobility hubs that offer this type of service.

Moreover, mobility hubs may also offer additional services to the basic mobility offering. The electric vehicle charging services seem to be particularly complementary as 65% of the self-service shared mobility fleets – both in the entire Poland and in Warsaw only – have an electric drive (according to the research of the Mobile City Association as of the end of Q3 2021, as indicated on the chart below), among which shared kick scooters (46,200 units in Poland and 10,300 units in Warsaw) and shared mopeds (1,000 units in Poland and 200 units in Warsaw) are 100% electric, while car sharing (5,000 units in Poland and 1,200 units in Warsaw) and bike sharing (21,600 units in Poland and 4,950 units in Warsaw) fleets have a much smaller share of electric drive: 6% and 13,3% for car sharing (results for Poland and Warsaw respectively) as well as 1,4% and 2% for bike sharing (results for Poland and Warsaw respectively).

²² Source: https://carsharing.de/themen/politik-gesetze/stvo-novelle-verwaltungsvorschriften-werden-endlich-verabschiedet



Figure 5 Share of electric drives in shared fleets in Poland and in Warsaw as of end of Q3 2021, source: Mobile City Association

The Act on electromobility and alternative fuels also allows, after the amendment that has been processed at the end of 2021, the municipalities to establish an amended **Low Emission Zone** (official name in Polish: "Strefa Czystego Transportu"), which is an area designated on public roads with free access allowed only to cars powered by clean energy (electricity, hydrogen or natural gas), some special purpose vehicles indicated in the act (e.g., fleets of selected public institutions, school buses, cars for people with disabilities) or those approved by the city council, e.g., cars belonging to citizens, vehicles meeting specific emissions standard or automobiles from car sharing fleets. However, the catalogue of allowances will each time be specified by the city council in a relevant resolution and all cars allowed to enter LEZ free of charge will have to be marked with a special sticker.

All cars not complying with the above, thus not being eligible for entering a Low Emission Zone, will still be able to enter it, but only under the following conditions:

- after the adoption of such provision by the city council;
- within the first 3 years since establishing the LEZ in a city;
- only between 9 AM and 5 PM;
- after paying a LEZ entry fee of PLN 2,50 per every hour or a PLN 500 monthly subscription.

The introduction of a LEZ in Warsaw will most probably boost the utilization of zero-emissions vehicles, including those operated by shared mobility providers and located in mobility hubs. Additional support would be provided by the decision of the Warsaw City Council allowing car sharing vehicles to enter the local LEZ, regardless of the type of drive (electric, combustion, hybrid).

4.6 Summary

Summarizing the potential impact of the provisions of the above described central regulatory framework (the Act on public collective transport, the Act on road transport, the Traffic Law, the Act on public roads, and the Act on electromobility and alternative fuels) on mobility hubs, it should be emphasized that it does not pose a threat to the execution of the Project, although it requires that the mobility hubs comply with certain legal requirements. These concern mostly the process of designating parking spaces on public roads, the parking regulations for different vehicle types, as well as the traffic rules when arriving/leaving the hub with a certain vehicle type. **The legal acts at the central level do, however, have a great potential to foster the development of shared mobility**, thus contributing to making urban mobility more sustainable nationwide.

The recommendation of this Study with regard to the central regulatory framework is to undertake a legislative initiative with the aim of introducing shared mobility vehicles (and services) into the Polish legal system, thus creating the basis for regulating this category of transport in such a way as to encourage residents to use shared mobility instead of individual motorization. In Poland, the following parties are entitled to start a legislative initiative: the Parliament, the President of Poland, the Cabinet of Ministers, and a group of 100,000 citizens. Municipalities, such as Warsaw, are not on the list, but they can still be of great help in gaining endorsement among the abovementioned stakeholders.

Feasibility Study on the implementation of mobility hubs in Warsaw Chapter 5. Local transport network

"Transport nodes and P&R car parks create a good opportunity for establishing mobility hubs"

5. Local transport network

The aim of this chapter of the Study is to provide an insight into the local transport network serving the population of at least 2 million people living and/or visiting Warsaw, with all its complexity, that is, with a variety of transport/mobility services provided by different (public and private) stakeholders in varying modalities and via a diversity of infrastructure, the most important of which have been described below.

5.1 Local public transport network

The public collective transport in Warsaw is mainly organized by the Warsaw Transport Authority (ZTM) and carried out by a fleet of 1,500 buses, 417 trams, 52 metro trains, 20 urban rail trains (SKM), and a few tourist ferries on the Vistula river, operating of which is either contracted only to municipal companies (as in the case of tram, metro and urban rail services), or to both municipal and private companies (as in the case of bus and ferry services). In addition to ZTM, public collective transport services in Warsaw are also provided by the Polish State Railways (PKP), which are the national railway carrier, and two other public regional railway operators (KM and WKD) further in the Study also called suburban rail. A more detailed insight into different stakeholders of the Warsaw mobility market is provided later in this section.



Figure 6 Service area of the Warsaw Transport Authority, source: ZTM

When it comes to the **number of passengers** carried by the public transport network in Warsaw, in 2020 the Warsaw Transport Authority provided transport services to a total of 726 million passengers⁽²³⁾ (with a total annual driven mileage of the entire public transport fleet of 268 million km), including the combined ticket offer for urban and suburban rail within Warsaw (ZTM-KM-WKD). However, this result is 40% lower than the year before (compared to 1,200 million served passengers in the record-breaking year 2019). The huge decline is attributed to the COVID-19 pandemic and its impact on the residents' mobility behaviour (e.g., lockdowns, safety concerns, shift to remote work and education).

The 2020 trips **broken down by means of transport** and presented on the chart below show that slightly more than half of the trips (51%) were realized by railway (23% trams, 22% metro, 6% urban and suburban rail combined ZTM-KM-WKD) whereas 49% of the trips were completed via buses.



Figure 7 ZTM trips in 2020, broken down by means of transport

²³ Source: https://www.transport-publiczny.pl/wiadomosci/warszawa-trudny-rok-dla-komunikacji-pasazerow-o-40-mniej-68020.html

Between 2020 and 2019, there was also a 35% decrease in the revenues from tickets sold by ZTM. Below presented are the tariffs for using these services (presented as selected regular prices, although citizens have an access to a variety of discounts, e.g., young people pay only 50% of those prices):

- PLN 3.40 for a 20-minute ticket;
- PLN 4.40 for a 75-minute ticket;
- PLN 7.00 for a 90-minute ticket;
- PLN 15 for a 24-hour ticket;
- PLN 36 for a 3-day ticket;
- PLN 98-110 for a 30-day urban card (discount for Warsaw's citizens included);
- PLN 250-280 for a 90-day urban card (discount for Warsaw's citizens included).

5.2 Local shared mobility market

The shared mobility market in Warsaw is the largest market of such services in Poland, according to the data collected by the Mobile City Association by the end of Q3 2021. This market's definition usually takes into account all self-service shared mobility services such as **bikes**, **electric scooters**, **electric mopeds**, **and cars**. Everything is available in a B2C model and therefore publicly accessible by all people in Warsaw who meet certain criteria and requirements for registering for a particular shared mobility service, e.g., being at least 18 years old (which is the legal age), having a valid driving license for a certain type of vehicles, downloading the provider's mobile app, or validating a payment method. Sometimes taxi services are also included in the shared mobility market. However, this Study focuses primarily on the self-service shared means of transport where users are also drivers.

Looking into all four modalities of the Warsaw shared mobility market, at the end of Q3 2021, there were a **total of approx. 16,500** vehicles available on the streets, the vast majority of which (94%) were shared micromobility services⁽²⁴⁾. Moreover, a significant part of the local shared mobility market (except for the station-based bike sharing) consists of so-called free-floating systems that allow the users to start and end their trips in almost any location (no base or docking station required) within the service area specified by a given operator.



Figure 8 The Warsaw self-service B2C shared mobility market broken down by modality, source: Mobile City Association

24 Source: https://smartride.pl/strefa-danych/
The abovementioned fleet of shared vehicles is supplied by 9 different providers (1 bike sharing operator, 4 electric scooter operators, 1 electric moped operator, and 3 car sharing operators), the exact shares of which will be indicated further in the text below. Of course, there are also some peer-to-peer shared mobility systems (platforms for renting individually owned private vehicles), as well as small B2B sharing systems (e.g., several bikes or cars shared by the employees of a particular company or tenants of an office building) available in Warsaw, but these systems are of insignificant amounts in relation to the publicly accessible B2C shared mobility systems. The current state of the shared mobility systems in Warsaw has been described below.

Bike sharing

The bike sharing system in Warsaw is called Veturilo and is operated differently than the rest of the shared mobility market, as it is subject to a public tender, which is announced every few years and **awarded as a public contract**. The current agreement with Nextbike expires in November 2022 (bikes are available seasonally: every year for 9 months from March to November), and for this reason the Warsaw Road Authority (ZDM), which is in charge of the



municipal bike sharing system, is preparing a new tender to be released at the turn of 2021 and 2022. The existing system is station-based, with almost 400 docking stations scattered all over the city, including a few charging docks for a fleet of 100 e-bikes.

The system costs the Warsaw Municipality approx. PLN 14 million (EUR 3 million) per season, however, some of these incurred costs are compensated in the form of user fees (20 minutes of each ride is free of charge, but any excesses are paid extra: PLN 1.00 until 1st hour, PLN 3.00 for the 2nd hour, PLN 5.00 for the 3rd hour and PLN 7.00 for the 4th and every next hour). For example, in 2019 about PLN 3 million returned to the municipal budget in this way.

The whole system consists of almost 5,000 bikes, and it is already its 10th season in a row. Looking at the last 4 seasons, however, the system has lost a lot of popularity (only 3,3 million rentals in 2021 compared to the record-breaking year 2018 with almost 6,5 million rentals, which is a decline of almost 50%), mainly due to COVID-19, but not only, as an 18% decline was already observed between 2019 and 2018⁽²⁵⁾. Comparing the pandemic year 2020 (3,2 million rentals) and the year 2021 (3,3 million rentals), the bike sharing system did only rebound by approx. 4%.

E-scooter sharing

The electric kick scooter sharing market in Warsaw is definitely on the rise. It is only 3 years old and has already achieved twice the size of the bike sharing market with a 10-year history. There are currently 4 providers of shared e-scooters in Warsaw, all well-known from the international landscape: Dott, Lime, Tier, and Bolt. This market is so far not regulated by any sort of public procurement (e.g., tenders or licensing), however, such a scenario cannot be

²⁵ Source: https://mobilne-miasto.org/raport-bikesharing-2019-2020/

excluded in the future since in May 2021 the regulations defining electric kick scooters in Poland came into force and some municipalities may be willing to regulate this market more than before. Still, such turn of event does not seem highly probable, as cities do not have to pay for rendering these services (unlike the bike sharing service). Moreover (as in the case of Warsaw), the providers are able to contribute financially to the city's budget in order to maintain access to the Warsaw market. A relevant **agreement between the operators and the Warsaw Road Authority** (ZDM) was concluded in November 2021.

Regarding the prices for renting e-scooters, these tariffs are completely different than in the case of bike sharing. The reason is obvious – the city does not contribute financially to these systems, which means that the users pay the full fees (usually an unlocking fee of approx. PLN 2.00 and then up to PLN 0.50 per minute, depending on the operator). Despite this, according to the estimates based on the providers' declarations, there are more shared e-scooter trips than shared bike trips in Warsaw – approx. 600,000 per month in a high season, which may result in 5-6 million journeys annually. Another difference in comparison to the bike sharing system is that the shared e-scooters work all year long, including the winter months.

E-moped sharing

The electric moped sharing market in Warsaw has the smallest share of the local self-service shared mobility marketplace – it makes up for only 1% of it with a fleet of almost 200 vehicles provided by only one operator (blinkee. city) with the following price plan: unlocking fee of PLN 2.50 and then PLN 0.69 per minute with a daily cap of PLN 69. The year 2021 has been the 5th consecutive year of the presence of shared electric mopeds in Warsaw, as



well as in Poland. Still, there is a year-on-year decline happening in the number of such vehicles available on the streets, including Warsaw, where the number of mopeds has decreased in 2 years by 55% from 430 mopeds of two operators in the end of Q3 2019 to 194 mopeds of only one operator in the end of Q3 2021. This trend, however, is not observed internationally, as at the same time the number of shared mopeds on the leading markets, e.g., in Western Europe (Netherlands, Germany, France) was growing⁽²⁶⁾.

Similarly to the electric kick scooter sharing market, in 2021 the shared e-mopeds were neither regulated nor supported by the local government. However, unlike the kick scooters, mopeds did not report any increases within their category. This may lead to a conclusion that this eco-friendly and effective form of moving around the city (up to two people on one noiseless e-moped) could be of larger interest to the local government, as it helps to relieve traffic jams. One of the ways to support the development of shared electric scooters in Warsaw could be designating multimodal mobility hubs, including shared e-mopeds, and running some marketing campaigns in order to **encourage Warsaw citizens to try out this modality**. Such action would be duly justified as a consumer survey⁽²⁷⁾ has shown that the users who tried e-moped sharing rated it even higher than enjoyers of other micromobility services (bike sharing and e-scooter sharing), and were also the most regular users. Last but not least, the Warsaw Strategy 2030 literally indicates **"dissemination of shared mobility solutions"** (operational goal 3.3: "We use a friendly transport system") as one of its aims.

²⁶ Source: https://mopedsharing.com/moped-sharing-report

²⁷ Source: https://smartride.pl/Strefa_Danych/skutery-to-dzis-najbardziej-niedowartosciowana-usluga-sharingowa-maja-szanse-na-duzo-wiecej-pisze-szef-mobilnego-miasta/

Car sharing

The car sharing market in Warsaw has, except for bike sharing, the longest history out of all such services, as it was first implemented in September 2016. At the end of 2021, Warsaw citizens could use approx. 1,000 shared cars in the B2C model provided by 3 operators: Panek, Traficar and 4Mobility, the exact shares of which have been indicated later in this section. In 2021, a peer-to-peer car sharing platform also appeared in Warsaw, allowing

individuals to share their own cars with other individuals (HoppyGo with approx. 200 cars available at the end of Q3 2021). Taking into account the population of Warsaw (1,8 million), on average there was approx. one shared car for every 1,700 inhabitants, which is rather a low ratio compared to the European cities leading the in the field of car sharing (such as Oslo, Milan, Berlin, Hamburg, or Paris), according to Fluctuo's Shared Mobility Index⁽²⁸⁾.

The pricing plans of car sharing services in Warsaw are quite varied and depend on the car model/class, but usually allow the users to choose between distance-based charging (e.g., PLN 1.50 for every km in the lowest price category) or time-based charging (e.g., PLN 1.00 for every minute for trips under 30 km), or a mix of both (e.g., PLN 0.55-0.90 for every minute + additional PLN 0.80-0.95 per every km driven). Some operators also have an unlocking fee of approx. 3.00 PLN. There are also many different packages available, for example, for a specific period of time counted in hours or days (e.g., PLN 60-90 per day + additional PLN 0.70 per every km driven). All car sharing operators also have the Paid Parking Zone fees already included in the price (payment for the actual parking time in the PPZ), which means that the users do not need to bother themselves with extra charges.

Similarly to scooter and moped sharing, car sharing is also not supported by the local government. In the past, there were attempts to select an official car sharing operator in Warsaw in the course of a tender, which was eventually cancelled. Afterwards, the Warsaw Road Authority withdrew from further plans in this regard. However, the effect of this unsuccessful proceeding is a car sharing clause, introduced into Resolution no XXXVI/1077/2008 of the Warsaw City Council of 26.06.2008 with further amendments on the Paid Parking Zone, allowing all car sharing operators to benefit from an annual fixed PPZ parking fee of PLN 360 per 1 vehicle, **after signing an agreement with the city**. Taking into account the increasing prices of the PPZ fees and the cyclical expansion of the zone, it would be worth considering using these already adopted provisions for the purpose of fostering the development of the car sharing market in Warsaw, thus contributing to sustainable urban mobility, as well as fulfilling one of the specific goals of the Warsaw Transport Strategy (III.3: "Improving the effectiveness of the transport system") literally indicating the "**support and promotion of car sharing**", which can also be achieved through designating mobility hubs on public roads.

It should also be mentioned that in the past, the supply of car sharing vehicles in Warsaw was higher, mainly due to the electric car sharing system closed at the beginning of 2021, consisting of over 400 cars (the innogyGO! system was closed after less than 2 years due to its economic unprofitability). At the end of Q3 2021, the share of electric vehicles in car sharing system in Warsaw was approx. 13%.

²⁸ Source: https://european-index.fluctuo.com/

To summarize the entire market of approx. 16,500 self-service shared vehicles in Warsaw (bikes, e-scooters, e-mopeds, and cars), on the chart below we indicate the shares of all of the 9 shared mobility providers operating in Warsaw in the B2C model at the end of 2021.



Figure 9 Warsaw's self-service B2C shared mobility vehicles as of end of Q3 2021 broken down by operators

5.3 Available transport infrastructure

The **road network** in Warsaw consists of a total of 2,856 km, 89% of which (2,530 km) are public roads, and 11% of which (326 km) are internal roads managed by third parties (mainly housing estates and other private entities). The public road network also has a variety of entities that are in charge of its parts, the city districts particularly, as indicated on the chart below. Two-thirds (67%) of the public roads in Warsaw are under the management of 18 city districts . Approx. 31% (almost 800 km) are managed by the Warsaw Road Authority (ZDM) and approx. 2% (the expressways and highways) are controlled by the General Directorate of National Roads and Highways (official name in Polish: *"Generalna Dyrekcja Dróg Krajowych i Autostrad"*, abbreviated to GDDKiA).



Figure 10 Public roads in Warsaw broken down by type of managing entity

Within the administrative boundaries of Warsaw, there are also **11 bridges over the Vistula river**, 9 of which are road bridges (incl. tram railway in some cases), the other 2 being railway bridges. According to

the Warsaw Road Authority, the average daily car traffic on the bridges in summer 2021 amounted to more than 625,000 vehicles⁽²⁹⁾, which is only 2% less in comparison to the pre-COVID summer of 2019, when 639,000 vehicles per day were noted.

Other important parts of the road network include specially designated lanes dedicated for certain modalities and/or types of vehicles, such as bus lanes ensuring privileged commute of buses through the city, or bike lanes giving the possibility of comfortable and safe commuting with the use of a bike or an electric scooter. In Warsaw, in 2021 there were a total of **68,5 km of bus lanes**⁽³⁰⁾ (with another 9 bus lanes stretching for a total length of 38 km being planned) and a total of approx. **700 km of bike lanes**⁽³¹⁾ (an increase from 275 km in 2010, with plans to build at least another 200 km of bike lanes according to the Warsaw Spatial Policy). According to the Warsaw Bike Report, in 2020 the bike users were using the specially designated infrastructure in almost 92% of the cases, provided that it was available. It is also estimated that there are about 18,000 bike stands (racks) in Warsaw ⁽³²⁾, of which 15,000 are public ones. Interestingly, according to the official measurements of the Warsaw bike traffic from summer of 2020, it increased by 17,4% compared to summer of 2019. This increase was caused by the COVID-19 pandemic, which encouraged many Warsaw residents to choose the bike as a transport option – similar trends were also observed in many other cities in Europe and worldwide. Out of the entire micromobility traffic in Warsaw, 6,2% of it were municipal shared bikes and 4,1% - kick scooters.

Warsaw also has a **rail network** of different categories: metro (underground), trams (separate on-ground network), and the railway network serving urban, suburban, and national railway services. With regard to the metro network, the completion of the 2nd metro line (currently, 8 stations are missing with estimated deadline for commissioning the final stations in 2024) will result in Warsaw having an underground network comprising of 40 stations with the distance between them adding up to the length of 53 km. Additionally, there are design works underway aiming to increase the density of the 1st metro line in the city centre (by building 2 new stations), as well as projects to construct a completely new 3rd metro line. The tram network, on the other hand, consists of routes extending over a total length of 376 km, and there are further plans to expand it in the coming years. And the railway network in Warsaw utilized by the urban, suburban, and national services has a length of 93 km with a total of 8 train stations and 40 stops.

A very important feature of this transit network are **transport nodes** allowing passengers a convenient transfer between different modes of carriage. Apart from the largest transport node in Warsaw, which is the Chopin Airport located within the city's borders and only 9 km away from the very centre, the most important nodes are those allowing transfer from rail transport (metro, urban, and suburban rail particularly, often connected with long-distance bus terminals) to other means of transit, e.g., buses, trams or shared mobility. Some other important transport nodes include P&R facilities connecting mainly car drivers with public collective transport services. Last but not least, there are also 6,500 smaller nodes (regular bus and tram stops), out of which 4,000 are roof-covered through installed shelters. Again, all types of transport nodes in Warsaw have the potential to offer the opportunity to transfer to shared mobility services, and that is what the mobility hubs have been designed for.

²⁹ Source: https://inzynieria.com/mosty/rankingi/62409,to-ulubiony-most-drogowy-warszawiakow

³⁰ Source: https://um.warszawa.pl/-/powstanie-jeszcze-38-km-nowych-buspasow

³¹ Source: https://um.warszawa.pl/waw/rowery/-/wrr2020

³² Source: https://um.warszawa.pl/waw/rowery/-/stawiamy-na-stojaki

5.4 Park & Ride parking facilities

Park & Ride parking facilities can be considered the original mobility hubs, because they have already been used for a long time as a sort of an interchange station allowing to switch from one modality (mainly from a private car, but sometimes also a private bike) to another (e.g., to public transport).

At the end of 2021, there were 15 Park & Ride parking facilities in Warsaw (located **at 12 transport nodes**) with a total supply of approx. 4,400 parking spaces for passenger cars and approx. 800 parking spaces for bikes⁽³³⁾, and soon to by increased by another 358 parking spaces for cars and 150 roofed parking spaces for bikes, through opening 2 more P&R locations. All these car parks are under the management of the Warsaw Transport Authority (ZTM), and some of them are equipped with chargers for electric cars (with a total of 26 charging points as of the end of 2020). One more P&R parking facility is also in the designing phase, with the expected supply of 475 parking spaces for cars and 116 parking spaces for bikes. The P&R locations being currently in operations (15) and construction (2) have been indicated on the map below and described in more detail in the following table.



Figure 11 Location of P&R parking facilities in Warsaw

³³ Source: https://www.wtp.waw.pl/parkingi/#ParkujP+R

Number	Derking name (leastion	Status	Number of parking spaces			
on map	Parking name / location	Status	for cars	for bikes		
1	Metro Młociny		1,010	208		
2	Metro Młociny II		72	0		
3	Metro Młociny III		157	24		
4	Metro Młociny IV		254	0		
8	Metro Wawrzyszew		80	0		
6	Metro Marymont		405	28		
7	Połczyńska		500	20		
8	Ursus Niedźwiadek	in operation	345	24		
9	Al. Krakowska		415	100		
10	Metro Wilanowska		280	40		
11	Metro Ursynów		166	100		
12	Metro Stokłosy		393	20		
13	Warszawa Stadion		110	0		
14	Wawer SKM		149	144		
15	Anin SKM		83	100		
16	Żerań PKP	under construction	220	110		
17	Jeziorki PKP		138	40		
		TOTAL:	4,777	958		

Figure 12 Description of P&R parking facilities in Warsaw

In Warsaw, there are also 10 so-called **Kiss & Ride zones**, which are sets of designated parking spaces next to selected transport nodes (e.g., metro stations, tram stations, P&R facilities), intended only for the purpose of a quick (maximum stopover of 2 minutes) pick-up and drop-off of passengers.

Apart from P&R-type off-street car parks (with approx. 4,400 parking spaces) and PPZ-type on-street parking (with the current supply of approx. 52,000 parking spaces and further plans of expansion), there are also other off-street car parks under the management of the Warsaw Municipality, which can be used to combine a private car trip with other mobility options, such as public collective transport or shared mobility services, for example:

- 13 on-ground car parks in downtown managed by the Public Areas Administration with a total capacity of approx. 1,000 parking spaces;
- 3 underground car parks next to Metro Politechnika, Plac Defilad and Plac Krasińskiego with a total capacity of approx. 800 parking spaces;
- all other off-street car parks of public institutions and entities, e.g., city district halls, public utility buildings, recreational facilities, or plots under management of ZMSP, to name only a few.

Finally, Warsaw is also able to handle the deals with owners of private parking facilities to develop P&R-type cooperation, which is even one of the actions outlined in the Warsaw Parking Strategy (action 2.3).

5.5 Stakeholders on the local mobility market

The following part of the Study will indicate the key stakeholders of the Warsaw mobility market broken down into those representing the public and the private sector.

Public sector mobility stakeholders

Public sector's key mobility stakeholders in Warsaw:

- The **Warsaw Transport Authority** (official name in Polish: *"Zarząd Transportu Miejskiego w Warszawie"*, abbreviated to ZTM) is a unit of the Warsaw Municipality and the statutory entity organizing and managing public collective transport in Warsaw, including running all of the Park & Ride parking facilities. ZTM provides transit to 2 million citizens in the 3-million Warsaw Metropolitan Area.
- The **Warsaw Road Authority** (official name in Polish: "Zarząd Dróg Miejskich w Warszawie", abbreviated to ZDM) is a unit of the Warsaw Municipality and the statutory entity managing and maintaining approx. 800 km public roads in Warsaw (except for expressways and highways, as well as roads managed by city districts), including, among others, the Paid Parking Zone, some city-centre municipal underground car parks, street lighting, small architecture, but also dealing with shared mobility providers, incl. running the official bike sharing system and dealing with the shared e-scooter market.
- The 18 **city districts** of Warsaw are very important stakeholders of the mobility market as they manage approx. Two-thirds of the entire public roads network in Warsaw (the downtown district even has a specially designated body for this purpose: ZTP).
- The **Public Areas Administration** (official name in Polish: *"Zarząd Terenów Publicznych"*, abbreviated to ZTP) is a unit of the Warsaw Municipality administrating the downtown city district and also running 13 paid guarded off-street car parks.
- The **State Property Administration** (official name in Polish: *"Zarząd Mienia Skarbu Państwa"*, abbreviated to ZMSP) is a unit of the Warsaw Municipality administrating property belonging to the State Treasury, incl. some parking plots for temporary lease.
- **Polish State Railways** (official name in Polish: *"Polskie Koleje Państwowe"*, abbreviated to PKP) is Poland's national railway carrier, a 100% state-owned enterprise.
- **Masovian Railways** (official name in Polish: *"Koleje Mazowieckie"*, abbreviated to KM) is a public regional railway operator, a joint venture of the Masovian Voivodeship (51% shares) and the Polish State Railways (49%).
- The **Warsaw Commuter Railway** (official name in Polish: "*Warszawska Kolej Dojazdowa*", abbreviated to WKD) is a public regional railway operator owned by the Masovian Voivodeship (98% shares) and 6 municipalities located along the railway line (2%).
- The **Urban Rail** (official name in Polish: "Szybka Kolej Miejska", abbreviated to SKM) is the Warsaw's municipal urban rail operator.
- The **Warsaw Metro** (official name in Polish: "*Metro Warszawskie*") is the Warsaw's municipal metro operator.

- The **Warsaw Trams** (official name in Polish: *"Tramwaje Warszawskie"*, abbreviated to TW) is the Warsaw's municipal tram operator.
- The **Municipal Busworks** (official name in Polish: "*Miejskie Zakłady Autobusowe*", abbreviated to MZA) is the Warsaw's municipal bus operator. It has the 3rd largest fleet of electric buses in Europe (after London and Moscow) with roughly 160 e-buses in operations⁽³⁴⁾ in 2021.
- Public entities providing **long-distance bus (coach)** services (e.g., the state-owned and Warsaw-based Polonus).

Private sector mobility stakeholders

Private sector's key mobility stakeholders in Warsaw:

- There is one **bike sharing** operator running the municipal Veturilo system (Nextbike until 2022), as well as some minor B2B bike sharing systems providing dedicated fleets of bikes for tenants of particular buildings (e.g., The Bike Company) or for particular companies (e.g., Hop.City for the last-mile delivery companies).
- There are four operators of electric kick **scooter sharing** providing their service directly to Warsaw citizens in the B2C model (Dott, Lime, Tier, Bolt). All of them are acting freely, without any tender or licensing procedure, but in accordance with an agreement with the Warsaw Road Authority (ZDM), which regulates, among others, the kick scooters' parking.
- There is only one B2C **moped sharing** operator (blinkee.city) providing a fleet of shared electric mopeds directly to Warsaw citizens. Besides, shared e-mopeds are also provided for particular companies or entrepreneurs (e.g., Hop.City for the last-mile delivery companies).
- There are three **car sharing providers** in Warsaw operating in the B2C model (Traficar, Panek, 4Mobility), as well as one P2P car sharing platform (HoppyGo) matching individual owners willing to commercially share their vehicles with other individuals. Some companies have also developed in-house car sharing platforms (e.g., Orange Polska).
- There are five major **ride- and taxi-hailing** platforms in Warsaw (FREE NOW, Bolt, Uber, iTaxi, Taxi Polska), providing mobility-on-demand services through affiliated parties (only iTaxi and partners of Taxi Polska own their own taxi fleets in addition to the external resources).
- There are (still) typical **taxi companies** in Warsaw (e.g., Ele, Sawa, City, Super, Wawa, Volfra, Glob Cab, Plus and approx. 20 others⁽³⁵⁾), however, this market is quickly evolving into the direction of ride- and taxi-hailing platforms based on the gig economy (a labour market characterized by the prevalence of short-term contracts or freelance work, as opposed to permanent jobs).
- There is also a well-known community-based P2P **ride-pooling** platform (BlaBlaCar), allowing individuals to match with other persons travelling in the same or similar direction or destination, however, this option is used for transit between cities rather than intra-city commute. Some firms and buildings in Warsaw have also developed their internal ride- or car-pooling platforms (e.g., Eurocentrum Carpooling).

³⁴ Source: https://moto.rp.pl/tu-i-teraz/art17366531-tabor-autobusow-elektrycznych-warszawe-wyprzedza-jedynie-londyn-i-moskwa 35 Source: https://taxiways.pl/warszawa/

- There are private entities providing **bus services** in Warsaw's public collective transport as a result of a tender (as of 2020, these include the following four companies: Mobilis, Arriva, Michalczewski and PKS Grodzisk Mazowiecki).
- Other private entities specialize in providing long-distance bus (coach) services (e.g., Flixbus).
- Another stakeholder are MaaS-type (Mobility-as-a-Service) platforms one-stop-shop digital services integrating various means of transport, and allowing booking and paying for all mobility options integrated within one app (e.g., Vooom, FREE NOW).

5.6 Available mobility mix offerings

When discussing the mobility offer provided in Warsaw by both the public and the private transport providers, it should be noted that so far, there have been very few offers combining different mobility services. Among these few endeavours, those outlined below are the most significant.

- Vooom One App to ride the City is a Polish start-up founded in 2019 with the aim of becoming the first Polish MaaS platform. Still, in the face of the industry's resistance to mutual data sharing, this plan did not work out as well as expected, but the entire system architecture remained and is waiting for the industry to become more mature in terms of cooperation. Another Vooom's feature in continuous development is the AI-based predictive multimodal route planner allowing real-time planning of routes combining different modalities from both public and shared transport providers.
- **FREE NOW** is a European multi-platform, allowing not only ride- and taxi-hailing but also car sharing, as well as utilizing further sustainable micromobility options such as e-scooters, e-mopeds, and e-bikes, by partnering with external operators. In Poland, the platform offers the shared kick scooters from Tier and Dott. The aim is to integrate more modalities into the app in 2022.
- **Bolt** is an international platform that originally allowed only ride-hailing, but since 2020, it has been extending its portfolio with the micromobility services (shared scooters). In the nearest future, it aims to introduce car sharing to more markets, besides Estonian one.
- **Mobility Hubs** (original name in Polish "Huby Mobilności") is the first, and so far the only entity in Poland specialized in organizing multimodal mobility hubs for cities and real estate as an independent intermediary as well as offering a selection of shared mobility services along with other accompanying services (e.g., electric vehicle charging) in a single spot. The pilot launched in May 2021 in Warsaw involved kick scooters, e-mopeds and car sharing.
- Another example of industry cooperation are brand partnerships, which consist of displaying vehicles of one brand (service) in the mobile app of another brand, established for example between e-moped sharing (blinkee.city) and car sharing (4Mobility), as well as between ride-hailing (Uber) and e-scooter sharing (Lime).
- Arval Mobility Hub is a new concept of integrating different shared means of transport (e.g., e-bikes, e-quadricycles, e-cars) developed by Arval, the leading car fleet management company in Poland. However, it works purely in a B2B model by offering so-called mobility budgets to its existing customers, that include access to a fleet of shared vehicles located in multimodal mobility hubs. Plans are made to introduce a MaaS-type platform in the future.

5.7 Incentives for using sustainable transport

Analysing the incentives for using sustainable transport available in Warsaw, the following few aspects should be considered.

- Electric cars have a waived (reduced to zero) PPZ parking fee and are also allowed to use bus-• lanes, however, these privileges are a result of central legislation (the Act on Electromobility and alternative fuels), not of the resolutions made by the Warsaw City Council. It is also questionable, whether the electric drive alone makes a privately owned passenger car sustainable enough, particularly in densely populated urban environment, as private cars (carrying 1,3 people on average and being unused 96% of the time) are an ineffective mean of urban transport, regardless of the drive employed in those. The electrification of fleets is the right direction, as it helps to fight air pollution, however, it should not be used as a sole mechanism, since the key to transport sustainability lies in the efficiency of the use of common assets such as land designated for roads and parking, and the number of vehicles needed to address local mobility needs. For this reason, the modes of transit deserving to be fostered are public collective transport and shared mobility. However, at this very moment we are observing something entirely opposite in Warsaw and in the entirety of Poland – the privileged position of individual motorization is being maintained. There is hope that this troubling trend may begin to change, though, e.g., for example, thanks to fostering car sharing and other modes of shared mobility.
- **Taxis** don't have to pay for parking in the Warsaw PPZ (provided that they are carrying/waiting for a passenger) and are also allowed to use bus –lanes. All of these privileges are a result of local regulations adopted by the Warsaw City Council. Still, it is questionable whether taxis alone should be perceived as a sustainable mode of transport every time they are being used. Growth of ride-and taxi-hailing services can lead to increased traffic congestion, a study⁽³⁶⁾ says. Moreover, today giving an access to the taxi bays only to taxis is no longer an effective way of using public land. On the other hand, taxi-sharing (multiple passengers per every vehicle) is able to reduce the number of cars on roads by 75%, another study⁽³⁷⁾ has suggested. Such a taxi-sharing mechanism is even available in Warsaw within a limited zone⁽³⁸⁾ via the FREE NOW platform.
- Discounted fares in public collective transport (ZTM) for selected group of users, e.g., free rides for people with disabilities, honorary city citizens, primary school children, or people over 70 years of age, rides discounted by 50% for students, retired persons, or pensioners, and discounts of approx. 10% for 30- or 90-day urban card that can be used by registered Warsaw's citizens, who pay taxes in the city;
- A **free 20-minute** ride with the municipal bike sharing system (in operations for 9 months between March and November).

37 Source: https://www.bbc.com/news/technology-38496175

³⁶ Source: https://www.npr.org/2018/08/01/634506179/ride-hailing-services-add-to-traffic-congestion-study-says?t=1637663133910

³⁸ Source: https://free-now.com/pl/match-pas/

The above incentives for the use of sustainable transport are not much for a city with 1,8 million inhabitants and a very high individual motorization rate (more cars than inhabitants as of the end of 2020 – a recordbreaking total of 1,079 vehicles per 1,000 inhabitants), especially as car owners have multiple privileges when using the common spaces in Warsaw, e.g.:

- almost free parking for residents (the monthly subscription to park a car inside the Paid Parking Zone costs as little as PLN 30 per year);
- low regular parking fees within the Paid Parking Zone (significantly lower than in other Polish as well as European cities, for example, 44% cheaper than in Poznan, 35% cheaper than in Krakow, 29% cheaper than in Gdansk);
- lack of Low Emission Zone (the existing regulations did not facilitate the introduction of LEZ, but did not exclude it either);
- barely any zones with traffic restrictions (only a small number of streets with no car traffic);
- lack of congestion charge;
- insufficient enforcement of the rules against the illegal parking by the Municipal Police and the national Police.

In the light of the above, it seems obvious that the actions proposed in this Study, that is, granting in Warsaw some privileges to shared means of transport, e.g., through fostering the mobility hubs' concept, should be perceived as very reasonable and even necessary next step for the decision makers in Warsaw, leading to both fulfilling the goals of the Municipal Strategic Documents as well as making the local transport system more sustainable. In conclusion, incentives for using sustainable means of transport are still a matter of the future, which means that there is a large area where positive impact on the city can be made.

5.8 Summary

Warsaw is a city with a **highly developed transport network**, where most modalities remain important and are utilized often. There are almost 3,000 km of roads (with 9 bridges and 68,5 km of bus lanes), approx. 500 km of railway (both on-ground and underground) and an international airport within the city boundaries. There are also approx. 700 km of bike lanes in Warsaw, however, they do not constitute a coherent network – much should be improved in this regard in order to foster micromobility and contribute to a more sustainable transport ecosystem in Warsaw.

With regard to public collective transport, it is being organized by the Warsaw Transport Authority (ZTM) and provided by a fleet of 1,500 buses (incl. 160 electric ones), 417 trams, 52 metro trains, and 20 urban rail trains. This network contains 6,500 transport nodes (bus and tram stops). In 2020 a total of 726 million passengers used these services (40% less compared to the year before due to COVID-19), out of which 49% utilized the buses, and 51% were travelling by railway.

Warsaw also has a pretty **well-developed market of shared mobility** with a total of 16,500 self-service vehicles available on the streets: a municipal bike sharing system (with almost 5,000 bikes) and commercial operators of e-scooters (over 10,000 vehicles provided by four operators), e-mopeds (only approx. 200 vehicles from 1 operator), as well as car sharing (slightly above 1,000 vehicles supplied by three B2C operators).

Another piece of infrastructure contributing to the transport network in Warsaw are parking facilities, including 16 Park & Ride parking facilities in 12 locations with a total capacity of 4,400 parking spaces for cars, 800 parking spaces for bikes, and 26 charging points for electric cars. Both the **transport nodes and P&R facilities create a good opportunity for establishing multimodal mobility hubs** that combine the offer of public collective transport with shared modes of transit. Other potentially good locations for mobility hubs include a variety of parking facilities located across Warsaw, both publicly and privately owned/managed.

Despite quite a number of different mobility stakeholders on the Warsaw market, both public (e.g., ZTM, ZDM, city districts and others) and private ones (e.g., shared mobility operators, ride- and taxihailing platforms), so far, only a few mobility mix offerings have been made available to the public, e.g., the multimodal route planner developed by Vooom, some MaaS-type platforms such as FREE NOW and Bolt, as well as some mobility hubs' pilots.

To sum up, Warsaw has a great chance and potential of creating more incentives for its citizens for the use of sustainable transport, e.g., through fostering the development of multimodal mobility hubs helping to boost the utilization of shared modes of transport in Warsaw instead of a far too frequent use of private cars for the intra-city commute.

Feasibility Study on the implementation of mobility hubs in Warsaw Chapter 6. Local mobility needs

"54% of undecided Varsovians is an important target group for efforts to change transport habits"

6. Local mobility needs

The aim of this section of the Study is to provide a better understanding of local mobility needs from the users' perspective, that is, people using the transport system network, especially with regard to sustainable modes of transit (such as public collective transport, active mobility and shared mobility), but also to assess the perception of other, rather ineffective modes of transport, such as privately owned cars. A number of sources have been investigated: the Warsaw Traffic Study, the Warsaw Bike Report, the New Mobility Barometer, and some other sources related to the impact of COVID-19 on the mobility landscape.

For the purpose of this Study, two separate consumer surveys on a representative sample of respondents have also been carried out. These surveys, the results of which have not been previously published, provide exclusive insight and unique knowledge in the following two areas:

- the perception of the concept of concentrating shared mobility services in multimodal mobility hubs (survey conducted on a representative nationwide group of respondents);
- the mobility behaviours of Warsaw citizens and their perception of different means of transport, incl. shared mobility (survey conducted on a representative group of respondents from Warsaw).



6.1 Warsaw Traffic Study

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The Warsaw Traffic Study in 2015 along with the development of a traffic model Synthesis								
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The Warsaw Traffic Study⁽³⁹⁾ (official name in Polish: "*Warszawskie Badanie Ruchu*") is a study concluded in 2015, which is currently the most recent available official study on mobility behaviour in Warsaw.

According to the findings of the Warsaw Traffic Study, the **overall mobility rate** of Warsaw residents was 1,99 trips on a usual business/ working day, with nearly 3,35 million trips being performed every such day. The most common motivation of undertaking these was to travel between home and work.

The Warsaw Traffic Study also gives insight into the local mobility patterns through examining the travel habits: the preferred way of reaching Warsaw from outside the city as well as the preferred way of getting around within the intra-city commute. The **modal split** was established as follows: most of the trips were performed with use of public collective transport (nearly 47%), followed by journeys undertaken with personal cars (32%), on foot (18%), and with the use of a bike (3%). Other means of transport accounted for 0,5% of all trips, which shows that there is also a huge growth potential for all shared means of transit such as bike sharing systems, fleets of shared e-micromobility vehicles (kick scooters and mopeds), car sharing schemes, and mobility on-demand services such as taxi-hailing for instance, all together creating an alternative to owning a private car in a city.



Figure 13 Modal split in Warsaw in 2015, source: Warsaw Traffic Study

With regard to the tourists visiting Warsaw, the study found that the most popular means of transport among them were train (chosen by 45% of domestic tourists) and car (preferred by 35% of domestic tourists).

Looking at the finding of the Warsaw Traffic Study we must, however, take into account additional circumstances. Firstly, more than 5 years have already passed since the study was carried out, during which the car traffic, as well as the number of vehicles in Warsaw, were constantly growing year over year. Secondly, the COVID-19 pandemic caused an enormous decline in public transit ridership (40% less passengers used public transit in Warsaw in 2020 compared to 2019⁽⁴⁰⁾). Therefore, it is very doubtful that the current (the

39 Source: https://transport.um.warszawa.pl/-/wbr-2015

40 Source: https://www.transport-publiczny.pl/wiadomosci/warszawa-trudny-rok-dla-komunikacji-pasazerow-o-40-mniej-68020.html

turn of 2021 and 2022) modal split is as it was back in the year 2015, when public transit accounted for almost 47% of all trips made in the city. But this might be even a larger driver for Warsaw, which needs to undertake a whole range of **measures aimed at re-balancing the urban mobility** and heading towards a more sustainable transport ecosystem. Naturally, mobility hubs are suitable to become an essential part of the offer for more sustainable mobility in Warsaw.

6.2 Warsaw Bike Report



The Warsaw Bike Report⁽⁴¹⁾ (official name in Polish: "*Warszawski Raport Rowerowy*") is a study released in 2021, providing an insight into the state of development of bike transport in Warsaw. It also provides interesting data on the **bike user profile**, indicating, for example, that 40% of people riding a bike in Warsaw are women and 60% are men, that 85% are wearing normal clothes and 20% sports clothes, or that 75% of Warsaw bike users wear a helmet, while 25% do not.

Some other interesting findings of the Warsaw Bike Report are related to **bike traffic**, which reported significant growth of 17,4%

between summer of 2019 and summer of 2020, most likely as an effect of COVID-19 that caused more people to start using their own bikes. Out of the total bike traffic in Warsaw in the same assessed period, approx. 6% were users of the Veturilo bike sharing system (drop by 20% year over year from 7,8% in 2019 to 6,2% in 2020) and approx. 4% were users of electric kick scooters (both privately owned and shared; a drop by 24% year over year from 5,4% in 2019 to 4,1% in 2020). An important remark here is that all of the municipal bike sharing systems in Poland remained closed for approx. 6 weeks in April and May 2020 due to the government's decision, as one of many nationwide measures to prevent the spread of the pandemic. This decision was widely criticized as not duly justified, as biking allowed to keep social distancing and ensured individual transport in the open air. This was also one of the factors that contributed to causing a huge decline in the usage of the Warsaw bike sharing system between seasons of 2019 and 2020 (a 40% decline in ridership from approx. 5,3 million trips in 2019 to approx. 3,2 million trips in 2020, which is also exactly the same rate of decline as in the case of the number of passengers of the public collective transport system organized by ZTM). With regard to the way of accessing the bike sharing system in Warsaw in 2020, 92% of the users rented the bikes through a mobile app.

Another interesting change in the mobility behaviour, most probably resulting from the change in our work style (much less of office commute), was the decrease of the bike traffic by about 25% in the morning peak hours, although at the same time the increase of the same value was noted in the afternoon peak hours. The highest observed values for the bike traffic included 450 bikes per hour in the morning peak (on one of the streets leading to the city centre from the west) and 860 bikes per hour in the afternoon peak (on one of the bridges).

⁴¹ Source: https://um.warszawa.pl/waw/rowery/-/wrr2020

6.3 New Mobility Barometer



The New Mobility Barometer (official name in Polish: "Barometr Nowej Mobilności") is a cyclical study, carried out by the Polish Alternative Fuels Association⁽⁴²⁾, that examines various aspects of the development of the electromobility market in Poland on an annual basis. It also partly includes the new mobility market (shared mobility and MaaS: Mobility-as-a-Service) as well as some general trends and attitudes, e.g., on car ownership or public collective transport. For the purpose of this Study, results from the last 3 surveys were analysed, all based on a nationwide representative sample of respondents and conducted in May 2019 (pre-

COVID), September 2020 (first year of COVID), and October/November 2021 (second year of COVID). The issues analysed below concern private cars (and the readiness to replace them with other forms of transport), the use of public collective transport, alternative ways of urban commute (other than private car and collective transport), the use of shared mobility (broken down into 3 categories: bike sharing, scooter/ moped sharing and car sharing), as well as some aspects of MaaS.

A remarkable finding of the study is that **car ownership** is not as much considered to be a proof of one's social status. In 2019, 50% of Poles believed these were unrelated, and two years later it is already 57%. This seems to confirm the trend of moving away from owning things towards using them, which also should favour the use of shared mobility services. In 2019, as many as 64% of respondents were ready to consider giving up using their own vehicle and replacing it with other efficient and affordable ways of getting around the city, in this case: public collective transport, shared mobility, and ride/taxi-hailing. This readiness weakened in the pandemic year of 2020, when much fewer people (41%) were ready to consider replacing their own car with other means of transport, and it increased again in 2021 to the level of 50% – still significantly less than before the pandemic. However, the latest study (2021) shows a large group of undecided people (as much as 34%) and a relatively small group of opponents (only 16% compared to 36% in 2019), which may suggest that a better offer of shared mobility services has the potential to attract more users.

The respondents were also asked what other forms of transport could encourage them to **substitute using** a private car for urban travel. And in recent years, the preferences of Poles have also been changing in terms of the form of transport that could replace travelling with a private car. In 2019, as much as 44% of respondents indicated public collective transport, 36% shared mobility (which consisted of 19% car sharing, 10% bike sharing, and 7% scooter/moped sharing), and 20% ride-/taxi-hailing. More than two years later, a large group of undecided respondents appeared (23%), public collective transport reported a clear decline (from 44% to 27%), and ride-/taxi-hailing also lost in popularity (from 20% to 16%). Shared mobility recorded a slight decrease in this comparison (from 36% to 34%), with some changes observed in several modalities. As an alternative to private car travels, car sharing clearly weakened (drop from 19% to 8%) while the entire category of shared micromobility increased (from 17% to 26%), with none of the analysed modalities (bikes, e-scooters, e-mopeds) declining.

⁴² Source: https://pspa.com.pl/

The New Mobility Barometer also provides data on the **usage of public collective transport**, helping to understand the changes in the mobility behaviour caused by COVID-19 pandemic. When comparing the data from 2019 and 2021, there is a noticeable trend of a decrease in the use of public collective transport (by 5%, from 62% down to 57%). However, among people who do not use public transit at all (43% of Poles), only 10% indicate the pandemic as the reason for such a behaviour. Much more respondents indicate quite different reasons for not using public collective transport: 43% simply choose to use their own car for urban travel, and a total of 39% assess public collective transport as poorly developed, inconvenient, or too time-consuming. This may lead to the conclusion that city car travel in Poland is still too convenient for many. It is also difficult to draw the far-reaching conclusions from the negative opinion on public collective transport from this survey, particularly for Warsaw, where the most recent public transit passenger satisfaction survey (the **Warsaw Barometer**⁽⁴³⁾), conducted in September 2020, showed a satisfaction level of 93%, with the following key findings: 45% of respondents use the Warsaw public collective transport every day or almost every day, and additional 20% does that at least once a week.

The study conducted by the Polish Alternative Fuels Association also explored **other ways of intracity commute**, other than using a private car or public collective transport. In 2019, as much as 62% of Poles indicated that they use such other forms of travelling around the city (with the following breakdown: 48% ride-/taxi-hailing, 28% shared mobility, and 24% others, incl. active mobility), but in 2021 – just 50% (a decrease of 12%). Those who use the other ways of intra-city commute have also noticeably reoriented their choices: as many as 51% of respondents indicated in 2021 shared mobility (with an impressive increase of 134% in micromobility, but also a very significant decrease in car sharing of approx. 70%), 40% chose ride-/taxi-hailing and only 9% other ways of commuting, incl. active mobility. Still, according to the study and in absolute terms, the increase in the category of self-service shared mobility between 2019 and 2021 was very significant, with a growth of 46%, while other categories recorded significant declines – other ways of commuting (incl. active mobility) went down by almost 69% and ride/taxi-hailing by 33%.

The New Mobility Barometer also investigated the **use of some modalities within shared mobility**, namely: bike sharing, e-scooter/moped sharing (all of these were included in a joint category, which made interpretation a bit ambiguous), and car sharing. This part of the study led to partially different conclusions that those indicated above, that is, a huge increase in micromobility and a serious drop in car sharing usage, with a much better performance of the car sharing services. Comparing figures in 2019 and 2021, the following conclusions can be made:

- bike sharing: there is clearly less interest in bike sharing schemes (both factual and declaratively regarding future preferences); before, most people used bike sharing (> 50%) and/or wanted to use it (> 60%); currently the minority uses bike sharing (> 40%) and/or want to use it (< 40%); the main reason for not using many people already own a bike and/or bought one, hence no need for sharing; approx. 10% of Poles do not use and/or do not want to use bike sharing due to COVID-19;
- **e-scooter/moped sharing:** when the service is available in the city, it is used by 1/3 of the population (no change between 2019 and 2021); when the service is not available in the city, 2/3 of the population declares willingness to use it; 2 times more people (and even 4 times in the case of e-mopeds) declare their willingness to use e-scooter/moped sharing in comparison to the

⁴³ Source: https://www.ztm.waw.pl/informacje-prasowe/2020/10/16/barometr-warszawski-mieszkancy-dobrze-oceniaja-komunikacje/

numbers that actually use them later; the main reason for not using – currently, lack of such need (indicated by approx. 30%), while previously it was mostly about concerns and not being convinced enough; approx. 10% of Poles do not use and/or do not want to use e-scooter/moped sharing due to COVID-19;

car sharing: there is currently more interest in car sharing, with a decline only in the pandemic year 2020; when the service is available in the city, its usage increases, except for the pandemic year 2020 (usage: 25% in 2019, 18% in 2020, 31% in 2021); when the service is not available in the city, the willingness to use car sharing decreases from year to year (50% willingness in 2019, 39% in 2020, 33% in 2021); the main reason for not using – every year more and more people choose to have their own car (41% in 2019, 43% in 2020, 45% in 2021).

With regard to car sharing, the results of the study in 2020 also indicated that the use of car sharing is most often (71%) determined by the availability of the vehicles in a given place, then (58%) by the price, and only later and with a large difference (22%), by the operator's brand. This c might be showing that predictable availability of (any) car sharing vehicles in a given location favours **greater use of car sharing as a category**. This conclusion clearly encourages the mobility hubs' concept of gathering different vendors/brands of various modes of shared mobility in one place, e.g., car sharing. By the way, the 2019 survey indicated that municipalities intend to support the following modes of shared mobility: 74% bike sharing, 45% car sharing, and only 16% e-scooter/moped sharing.

The last aspect of the New Mobility Barometer to be covered in this Study will be **MaaS** (Mobility-as-a-Service), though often equated more generally with shared mobility and/or apps, rather than the ultimate multimodal MaaS platform combining public collective transport with other travel options, shared mobility and mobility on-demand in particular. In 2019, 84% of respondents did not know the term MaaS, and those who knew it most often (36%) associated it with car sharing, then (28%) with bike sharing, only later (12%) with scooter/moped sharing. More enthusiasm came from the 2020 survey, in which "only" 77% of Poles indicated that they do not know the term MaaS, while 74% would like to use it. Unfortunately, the results from 2021 (82,5% of respondents do not know the term MaaS) indicate that the idea (whatever the definition) has not been popularized. Still, this indicates a greater need to develop awareness around shared mobility and digital integration of these services with public collective transport, and this may be achieved, for example, by the implementation of the mobility hubs.

Another important aspect of MaaS investigated by the study concerned the **price for a MaaS solution** Poles would be willing to pay instead of travelling by private car. In 2019, nearly two-thirds of Poles (65%) indicated a price range of PLN 100-300 per month (with an average of PLN 175), while 24% of Poles wanted to pay below PLN 100, and 11% were ready to pay over PLN 300 per month. However, the results from the 2021 study showed a clear change and a large flow of indications (as much as 25% of Poles) to the lowest price range (that is below PLN 100 per month). This flow was mainly from the middle price range of PLN 100-300 (decline by 23%), and only to a small extent from the top price range of over PLN 300 per month (drop by 2%). This clearly shows the current expectations of Poles that wish to spend less (almost 20% down from the average of nearly PLN 200 in 2019 per month to only PLN 160 in 2021) when switching from private car travels to alternative solutions (incl. different mobility services available on integrated platforms). This change may also be caused by economic reasons, stemming from the pandemic, which is challenging not only for public or corporate budgets but also for individual and household budgets.

6.4 COVID-19 impact on mobility

When discussing local mobility needs, we must take into account the changes in our lifestyles (e.g., working habits, ways of commuting, remote work/education, safety concerns) brought by the COVID-19 pandemic and causing a significant disruption in the world as we used to know it before. Some aspects are indicated in the relevant chapters of the Study, but here they will be repeated and further discussed.

The key issue analysed during the pandemic was the **mobility of individuals**. In 2020, the mobility of Poles, measured on the basis of data from the location of mobile phones, recorded two major moments of decreases compared to the typical level recorded before the pandemic (indicated as 0% on the charts below): by 55% in the spring (the so-called first wave of COVID-19) and by 44% at the end of year 2020⁽⁴⁴⁾ (the second wave). This had an obvious impact on the use of different transport and mobility services in Warsaw, e.g., the **public collective transport**, which carried 40% less passengers in 2020 (compared to 2019), and the municipal bike sharing system, which recorded 40% less rentals (year 2020 compared to 2019).



Figure 14 Year 2020: Individual mobility of Poles in the pandemic, data based on the activity of mobile phones

Still, not all modalities have been affected in the same way. The individual road traffic in Warsaw, for example, already in 2020 returned to similar pre-COVID levels. According to ZDM's official measurements, the **road traffic** on one of Warsaw's bridges in summer of 2020 was only 2% smaller than in summer of 2019. Still, this trend does not apply to car sharing, or to ride- and taxi-hailing services, which were reporting even a 40-60% decline in ridership in 2020 (no official data for Warsaw and Poland is available as the companies did not disclose any information concerning these but⁽⁴⁵⁾).

There are also mobility categories that have increased significantly in 2020, in all likelihood because of the pandemic, as people were seeking an alternative to crowded public collective transport and were exploring ways to have a secure and quick commute on short distances, resulting in a boom in bikes and micromobility, also observed in other areas of the world⁽⁴⁶⁾ (almost 70% of respondents were willing to use micromobility vehicles for their commute, a recent global study⁽⁴⁷⁾ found). The **bike traffic** in Warsaw increased by 17,4% comparing summer of 2019 to summer of 2020 according to ZDM's official

⁴⁴ Source: https://covid19.healthdata.org/

⁴⁵ Source: https://www.frontiersin.org/articles/10.3389/fpsyg.2021.646593/full

⁴⁶ Source: https://www.bbc.com/future/bespoke/made-on-earth/the-great-bicycle-boom-of-2020.html

⁴⁷ Source: https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/why-micromobility-is-here-to-stay

measurements. It is an unprecedented increase, however and again, as in the case of road traffic, it applies only to private bike usage and not to the publicly available bike sharing system. Another interesting change with regard to the bike traffic in Warsaw was a 25% drop in the morning peak hours and a 25% increase in the afternoon' peak hours.

Now, when looking closely at the year 2021, the mobility of Poles, measured with the same methodology as in 2020, was slowly recovering during the first four months of the year with one noticeable fall compared to the typical level of mobility noted throughout last years: a drop by 34% in the first days of April (the so-called third wave of COVID-19). As of May 2021, the mobility index has returned to pre-COVID level and remains well above the typical level of individual mobility, as visualized on the below chart.



Figure 15 Year 2021: Individual mobility of Poles in the pandemic, data based on the activity of mobile phones

Again, the above indicator for individual mobility does not directly infer the demand for shared mobility services, however, according to **Fluctuo's European Shared Mobility Index** for Q3 2021⁽⁴⁸⁾, the industry is among those recovering well. The chart below presents the evolution of ridership since July 2020 for all shared self-service modalities (bikes, electric kick scooters, electric mopeds, and car sharing) across 16 European cities, including Warsaw. Still, not all the modalities were recovering equally quickly, and some did not note any revival at all, namely the station-based bike sharing, whose popularity decreased in 2021 by approx. 20% compared to last year (the downward trend does not apply to free-floating bike sharing schemes, meaning systems without docking stations), as well as car sharing, whose popularity was about 5% below the level from the year before. Among the outperforming modalities, the kick scooters returned to the last year's levels in the fastest way, achieving these already in April 2021, and during the following summer, the ridership tripled in comparison to the same period a year ago. However, it took a little longer to return to the level of July 2020 in case of shared e-mopeds, but they did so in the course of summer of 2021, beating the last year's levels of ridership by approx. 15%.

⁴⁸ Source: https://european-index.fluctuo.com/



Figure 16 Shared mobility ridership in 16 European cities incl. Warsaw, source: Fluctuo's European Shared Mobility Index

Interesting data about the impact of COVID-19 on the use of different means of transport was also provided by the previously described **New Mobility Barometer**, which made it possible to compare the data from the pre-COVID year 2019 with the data from the COVID-year 2020, as well as with the most recent data from Q4 2021, when the world is still facing the pandemic. In the light of the collected data, it was confirmed, among others, that Poles use public collective transport less frequently (62% in 2019 compared to 57% in 2021). Still, only 10% of those not using it indicate the pandemic as the reason. And even a lower percentage (7%) indicates COVID-19 as the main reason for not using other means of transport in the city, such as shared mobility and ride-/taxi-hailing. Very similar results are also noted in the survey's insight into each modalities of shared mobility: bike sharing and e-scooter/moped sharing (no data on car sharing in the study in this regard). Another effect of the pandemic may also be the fact that Poles are less willing to spend money on travelling in other ways than by a private car. Within over two years, as many as 25% of Poles indicated that they are ready to pay significantly less (below PLN 100 per month instead of PLN 100-300) for MaaS-type services that are to replace their urban travels carried out with a private car, with an average decrease of almost 20% (down from almost PLN 200 per month in 2019 to only PLN 160 in 2021).

6.5 Dedicated surveys 2021

In order to learn more about the mobility needs related to the subject of the SmartHubs Project (multimodal mobility hubs) two separate surveys have been conducted in the course of 2021⁽⁴⁹⁾, each on a representative sample of respondents.

⁴⁹ The quantitative research was carried out for the purposes of the doctoral dissertation- the author of the research and analysis is Grzegorz Młynarski, PhD student at the Department of Innovative City at the Warsaw School of Economics

Survey #1: mobility hubs' user profile

During the first survey conducted in July and August 2021, a nationwide group of respondents was asked (n=327 with a maximum measurement error of 6% at the confidence level of 95%), among others, about the **concept of mobility hubs**, and more precisely, how they evaluate the idea of concentrating many different shared mobility vehicles (cars, bikes, scooters, etc. available for immediate rent by minutes/hours) at specially created for this purpose permanent parking points (so-called mobility hubs). The responses were marked on a 7-point scale, where 7 meant "I like the concept very much" and 1 "I don't like the concept at all". All the positive answers (top-3-box; answers marked 7, 6, and 5) accounted for a total of 74,6% replies provided by a group of n=245 (with an average answer of 5,33). That means that as many as **3/4 of Poles like the idea of mobility hubs** and using shared mobility solutions in such places. As for the remaining responses, 16,5% of respondents were neutral to the concept of mobility hubs (answer marked 4), and only as few as 8,9% had a negative attitude (bottom-3-box; answers marked 3, 2, and 1).

	Avg.	1	2	3	4	5	6	7	top-3- box
How do you assess the idea of concentrating many different shared mobility vehicles (cars, bikes, scooters, etc. available for immediate rent by minutes/hours) at specially created for this purpose permanent parking points (so-called mobility hubs)?	5,33	0,9%	2,8%	5,2%	16,5%	26,9%	23,2%	24,5%	74,6%

Table 1 Evaluation of the mobility hubs concept, based on the CAWI quantitative survey (n=327)

The isolated group of respondents, who like the idea of mobility hub (n=245), further in this section also called the supporters of mobility hubs, was then crossed with other selected 11 questions of the survey, which allowed drafting the **user profile of a potential mobility hub user** with a positive attitude to the concept. The following aspects were analysed:

- city size (place of residence);
- types of owned vehicles;
- monthly transportation expenses;
- types of shared mobility vehicles used;
- impact of the following 8 factors on the use of shared mobility services: convenience of using the vehicle; price per minute; price per km; diversified fleet of vehicles, quality of vehicles; distance to the nearest vehicle, environmental impact; trip safety;
- use of public collective transport;
- use of ride- and taxi-hailing;
- intention to use bike sharing services in the future;
- intention to use e-scooter sharing services in the future;
- intention to use e-moped sharing services in the future;
- intention to use car sharing services in the future.

With regard to the city size, the supporters of mobility hubs live mainly in the **most populated cities**. Over half (52%) of them live in Poland's top 5 cities by population (>500,000 citizens): Warsaw, Krakow, Lodz, Wroclaw, and Poznan, and a further 26% of them in the next 6 most populated cities (250,000-500,000 citizens): Gdansk, Szczecin, Bydgoszcz, Lublin, Katowice, and Bialystok.

In terms of the **type of owned vehicles**, only 7% of the respondents do not own any vehicle, while among the rest, 81% own a car, 74% a bike, 18% a kick scooter, 7% a motorcycle, and 6% a moped. What is encouraging, among the surveyed group, the percentage of people using **public collective transport** (81,3%) is as high as the percentage of car owners. Also, a high rate of ride-/taxi-hailing users was observed (62,6%).

Interesting data was also obtained on **monthly transportation expenses**. Most of the respondents (41%) indicated the top price range of PLN > 300 per month (with an average of PLN 543), while 35% chose the middle range of PLN 100-300 per month (with an average of PLN 188), and 25% pointed to the lowest range of PLN < 100 per month (with an average of PLN 58). When comparing the general transportation expenses indicated in this survey (with a monthly average of exactly PLN 300) with those related to the expected price of MaaS solutions indicated in the New Mobility Barometer (with a monthly average of PLN 160), it can be concluded that Poles would like to save almost 47% on transportation expenses if they were to use only MaaS solutions.

With regard to the **types of shared mobility vehicles** used by the supporters of mobility hubs, the following three aspects were investigated: usage during the last year, usage during lifetime, and usage as the very first shared mobility system. The outcome has been presented in the table below.

	used at least once in the last year	used at least once in a lifetime	used as the very first shared mobility system
shared bike	53%	69%	56%
shared e-scooter	44%	54%	15%
shared e-moped	7%	10%	1%
shared car	25%	40%	18%

Table 2 Types of shared mobility vehicles used by mobility hubs supporters, based on the CAWI quantitative survey (n=245)

The above shows the hierarchy of shared mobility modalities used by the supporters of the mobility hubs concept. The greatest percentage of indications concern **bike sharing**, which is not surprising as this category has been present in Poland already for over 12 years with such type of services spreading at the end of Q3 2021 across almost 100 Polish cities⁽⁵⁰⁾. However, it is important to stress that offering station-based bike sharing in mobility hubs would be the most expensive among all of the abovementioned types of self-service shared mobility modalities, mainly due to the fact that practically all bike sharing systems in Poland operate on the basis of an agreement concluded by the bike sharing operator with the local self-government as a result of a tender proceeding. This means that the establishment of additional bike sharing stations (e.g., inside mobility hubs) is always associated with a significant infrastructural and/or contractual cost, unlike in the case of free-floating bike sharing systems not bounded by a public contract, which seem much easier and cheaper in terms of service that could be offered in mobility hubs. Still, there are currently

⁵⁰ Source: https://smartride.pl/Strefa_Danych/rowery-bikesharing-polska-trzeci-kwartal-2021-roku/

no such free-floating bike sharing systems available in Poland, but looking at the redevelopment of such systems in Europe gives hope that such services (e.g., based on e-bikes) will also be available in Poland in the coming seasons.

Speaking of other types of shared vehicles indicated by the supporters of mobility hubs, the **shared electric kick scooters** came second with 44% of the respondents, who used them at least once in the last year, and even 54% of respondents who used them at least once in their lifetime. The entire category of shared e-scooters is the youngest in Poland because at the end of 2021, they have noted only 3 years of their presence on the city streets. But in such a short time, they were able to grow in terms of vehicle supply to 2,5 times the number of shared bikes⁽⁵¹⁾, however, disseminated across approx. 60 cities nationwide at the end of Q3 2021, which is still about 40% less than in the case of bike sharing systems. An important aspect that should also be taken into account when making shared e-scooters available in mobility hubs is the possibility of charging them, either through plugging into special chargers or through swapping batteries. As of today, this process alone is quite an operational challenge for most of the micromobility operators⁽⁵²⁾, mainly due to non-standardized charging technologies and the lack of such chargers in the urban space.

Looking at the type of shared micromobility vehicles indicated by the supporters of mobility hubs, **shared e-mopeds** gained the least attention with only 7% of respondents, who used them at least once during the last 12 months, and as few as 10% of respondents, who used them at least once in their lifetime. These are not the only data indicating the so far undiscovered potential of this form of travelling around the city, similarly to the insights from the New Mobility Barometer study in 2021, in which only approx. 6-7% of Poles indicated e-mopeds as an alternative to travelling by private car and/or by public collective transport. Moreover, the offer of B2C shared e-mopeds in Poland is shrinking⁽⁵³⁾, with a decrease of 38% comparing Q3 2021 to Q3 2020, and also with the shared e-mopeds in Warsaw constituting only as few as 1% of the entire shared mobility B2C landscape in Warsaw.

The last but not least important shared mobility category analysed in the survey was **car sharing**. And here, 25% of the supporters of the mobility hubs concept indicated to have used car sharing at least once within the last year, and 40% of them to have used car sharing at least once in their lifetime. Taking into account that 81% of the surveyed respondents own a car and even more have a driving license, there is a huge potential for growth of the car sharing modality in Poland, however, fostering the development of this modality is essential. The data just cited is also very much in line with the data obtained by the New Mobility Barometer survey, which showed that a similar share of people was using car sharing services if they were available in a city: 25% in 2019, 18% in 2020 (decline due to the pandemic) and a rebound to the level of 31% in Q4 2021.

The respondents of survey #1 (the supporters of mobility hubs, n=245) were also asked, what factors they would potentially take into account when making a **decision to use a shared vehicle**. The table below presents the answers, incl. the average value for every of the investigated eight factors as well as accumulated indications of the most and least supportive answers (top-2-box and bottom-2-box). The responses were marked on a 7-point scale, where 7 meant "I definitely take this into account" and 1 "I definitely don't take it into account".

⁵¹ Source: https://smartride.pl/Strefa_Danych/e-hulajnogi-sharing-polska-trzeci-kwartal-2021-roku/

⁵² Source: https://www.linkedin.com/pulse/how-feed-hungry-scooter-fluctuo/?trackingId=ZTI9S0xKRL2rXIXOk%2By5Ug%3D%3D

⁵³ Source: https://smartride.pl/Strefa_Danych/e-skutery-sharing-polska-trzeci-kwartal-2021-roku/

Factor	Avg.	1	2	3	4	5	6	7	top-2- box	bottom- 2-box
distance to the nearest vehicle	6,26	1,2%	0,4%	0,4%	2,8%	13,4%	28,0%	53,7%	82%	2%
price per minute	6,18	1,6%	0,4%	0,8%	6,1%	11,8%	25,2%	54,1%	79%	2%
trip safety	6,07	1,2%	0,8%	0,8%	6,5%	12,2%	35,0%	43,5%	79%	2%
convenience of using the vehicle	6,01	1,6%	0,8%	0,8%	4,9%	20,7%	25,6%	45,5%	71%	2%
quality of vehicles	5,94	1,6%	0,0%	0,4%	9,3%	19,1%	28,0%	41,5%	70%	2%
price per km	5,91	3,3%	0,4%	1,6%	10,6%	12,6%	24,4%	47,2%	72%	4%
environmental impact	5,03	8,1%	3,3%	8,9%	11,4%	21,5%	19,1%	27,6%	47%	11%
diversified fleet of vehicles	4,85	3,4%	5,9%	8,5%	22,9%	20,3%	21,6%	17,4%	39%	9%

Table 3 Importance of factors when deciding on the use of shared mobility, based on the CAWI quantitative survey (n=245)

The above clearly shows that the supporters of mobility hubs are very pragmatic. The most important factors for them when deciding about the use of shared mobility services are **the proximity to the rented vehicle** (with an average score of 6,26 out of 7 and top-2-box result of 82%) and the price per minute they have to pay when using this vehicle (average score: 6,18 out of 7; top-2-box: 79%). On the other hand, among the least important factors for using shared vehicles, the respondents indicated environmental impact (average score: 5,03; top-2-box: 47%) and the diversified fleet of shared vehicles (average score: 4,85; top-2-box: 39%). Still, both of these achieving the lowest results does not mean that they were irrelevant to the decision-making process whether to use a shared vehicle or not, as their weight of approx. 5 out of the score of 7 clearly indicate that these factors were also at some point taken into account.

Another observation is, that despite the willingness to organize shared mobility vehicles in designated locations (mobility hubs), the supporters of this concept also want to have the very same vehicles as close to them as possible. Moreover, and among all of the analysed factors, they also attach the least importance to the diversification of the fleet offered. Both responses can be interpreted in some contradiction to the concept of mobility hubs, which by their nature cannot be designated everywhere and in a too dense way. Moreover, one of the core aims of multimodal mobility hubs is to provide the local society with a wide range of different shared vehicles and modalities in order to meet the mobility needs of the majority of the potential users.

The analysis of the factors impacting the decision on the use of shared mobility shows a very **utilitarian approach** of the respondents, who are being driven by instrumental motives, which are dominated by economic considerations and convenience. It also indicates that Polish shared mobility users are much less incentivized by normative motives (mainly sustainable development, but also altruism) – what's more, such factors impact them to a much lesser extent than in the case of users in other European countries⁽⁵⁴⁾.

The last aspect of the survey of the mobility hubs' user profile was their **intention to use shared mobility services** in the future, which they marked on a 7-point scale, where 7 meant "I'm definitely going to use" and 1 "I'm not going to use at all". The values of the strongest attitudes, both for and against the use of shared mobility, are shown in the table below.

⁵⁴ Source: https://www.researchgate.net/publication/316597244_Participation_in_the_Sharing_Economy

	Respondents with a strong attitude to the use of shared mobility (top-2-box)	Respondents with a clear reluctance to the use of shared mobility (bottom-2-box)
shared bike	52%	13%
shared e-scooter	33%	29%
shared e-moped	7%	37%
shared car	31%	18%

Table 4 Intention to use shared mobility services in the future, based on the CAWI quantitative survey (n=245)

The above can be interpreted in such a way that the shared mode desired the most by the supporters of the mobility hubs concept are shared bikes (52% of respondents with a strong attitude to use them), which also have the fewest negative indications (only 13% of respondents not willing to use). Then, e-scooter sharing and car sharing services are at a similar level of desire, respectively 33% and 31% of top-2-box responses, still with clearly fewer negative indications for car sharing (only 18%) compared to e-scooter sharing (29% of bottom-2-box responses). The shared modality, which Polish supporters of mobility hubs want to use the least, is e-moped sharing. This category of shared mobility gathered the fewest supporters (only 7% of the top-2-box responses) as well as the most opponents (as much as 37% bottom-2-box responses).

Survey #2: The mobility behaviour of Warsaw residents

The second survey for the purpose of this Study was conducted in December 2021 with the aim to examine the **mobility behaviour of Warsaw residents** (hereinafter also referred to as Varsovians) and their opinions on shared mobility solutions (a representative sample of n=302 with a maximum measurement error of 6% at the confidence level of 95% assuming a total of 1,5 million adults live in Warsaw, as indicated by the Central Statistical Office, and all of them are potential shared mobility users). The 23 aspects outlined below were analysed, apart from basic demographic, social and economic characteristics:

- types of owned vehicles;
- monthly transportation expenses;
- types of shared mobility vehicles used;
- travel time used for different modalities;
- assessment of the following 7 features of a privately owned car: distance to the vehicle from home; availability at the time needed; trip safety; ease of use; comfortable feel in the vehicle; travel time; annual costs;
- tendency of car owners to give up their cars and replace them with car sharing;
- assessment of the following 8 features of car sharing services that would convince car owners to give up their cars and start using car sharing instead: high availability of vehicles; proximity of the vehicle to the place of residence/work; electric drive of the vehicle; free parking in the city; ability to book a vehicle for a specific time; various vehicle sizes (also more spacious models); always a modern fleet of vehicles; discounts for economical and accident-free driving;
- tendency of people not owning a car to use car sharing instead of buying their own vehicle;
- assessment of the same abovementioned 8 features of car sharing services that would convince people not owning a car to use car sharing instead of buying their own vehicle;

- perception of the following 2 actions as environmentally friendly: using public collective transport and riding electric cars;
- belief that the choice of a particular mode of transport for city commute has an impact on the environment;
- belief that choosing a passenger car for daily commute may have a negative impact on the environment;
- assessment of the idea of concentrating different shared mobility solutions in mobility hubs;
- impact of the following 8 factors on the use of shared mobility services: convenience of using the vehicle; price per minute; price per km; diversified fleet of vehicles, quality of vehicles; distance to the nearest vehicle, environmental impact; trip safety;
- intention to use shared mobility in the future (any mode);
- intention to use bike sharing services in the future;
- belief that using bike sharing reduces negative impact of transport on the environment;
- intention to use e-scooter sharing services in the future;
- belief that using e-scooter sharing reduces negative impact of transport on the environment;
- intention to use e-moped sharing services in the future;
- belief that using e-moped sharing reduces negative impact of transport on the environment;
- intention to use car sharing services in the future;
- belief that using car sharing reduces negative impact of transport on the environment.

The group of surveyed respondents was characterized by the following basic features:

- use of shared mobility services: 55% were users of shared mobility services and 45% non-users (in accordance with the survey's assumptions);
- sex: 51% were women, 49% men (in accordance with the structure of the population);
- age: 20% were people aged 18-30, 45% people aged 31-50, and 35% people above 50 years of age (in accordance with the structure of the population);
- education: 65% had higher education, 33% secondary education, and 2% basic education;
- neighbourhood of residence: 13% lived in city centre, 60% lived in a city district adjacent to the city centre, 26% in the suburbs, and 1% out of town;
- type of residence building: 84,5% in multifamily housing and 15,5% in single-family housing;
- number of people in the household: 16% live alone, 30% live in a 2-people household, 26% in a 3-people household, 19% in a 4-people household, and 9% live with more people;
- average monthly disposable income: 17% earned less than PLN 2,000, 27,5% had earnings in the range of PLN 2,001-3,000, 37% in the range of PLN 3,001-4,000, 8% in the range of PLN 4,001-5,000, 5% in the range of PLN 5,001-6,000 and 5,5% earned more than PLN 6,000.

Looking close at the **types of vehicles owned** by Varsovians, it can be discovered that 16% of them do not own any, while among the rest, 70% own a car, 61% a bike, 17% a kick scooter, 6% a motorcycle, and 4% a moped. These figures are noticeably lower compared to the nationwide sample of mobility hubs' supporters (for example, lower by 11% in terms of car ownership and by 13% in terms of bike ownership), which may indicate less dependence on private vehicles in Warsaw compared to a nationwide benchmark.

Speaking of privately owned cars, those of the residents of Warsaw, who own one (n=211), have **assessed different features of their cars**. The responses were marked on a 7-point scale, where 7 meant that a given feature is "very attractive" and 1 "very unattractive". The outcome has been summarized and presented in the below table.

Feature	Avg.	1	2	3	4	5	6	7	top-2- box	bottom- 2-box
distance to the vehicle from home	6,46	0,5%	0,0%	0,0%	1,0%	11,4%	25,2%	61,9%	87%	1%
availability at the time needed	6,37	0,0%	0,0%	0,0%	3,3%	15,6%	21,8%	59,2%	81%	0%
trip safety	6,18	0,5%	0,0%	0,9%	4,3%	17,5%	27,0%	49,8%	77%	1%
ease of use	6,14	0,0%	0,5%	1,4%	4,3%	19,4%	26,5%	47,9%	74%	1%
comfortable feel in the vehicle	6,10	0,0%	0,9%	1,9%	4,7%	16,1%	30,8%	45,5%	76%	1%
travel time	5,71	0,0%	1,4%	1,4%	7,6%	31,0%	31,0%	27,6%	59%	1%
annual costs	5,02	1,9%	4,7%	6,6%	19,4%	28,9%	20,4%	18,0%	38%	7%

Table 5 Assessment of private car's features among Varsovians who own a car (n=211)

A general observation is that car owners present their cars in a positive light. This is not a surprise, especially in the context of the mere ownership effect, which is "the observation that people who own a good tend to evaluate it more positively than people who do not"⁽⁵⁵⁾. Ownership can therefore increase the perceived value of a good and the phenomenon is further strengthened when an emotional bond is formed with the object. Nevertheless, car owners point to the annual costs and travel time as the least attractive features of their assets. Among the highest rated features, there are **very practical (utilitarian) aspects**: proximity to the car in relation to the place of residence and the car's availability exactly at the time when it is needed.

⁵⁵ Source: https://en.wikipedia.org/wiki/Mere_ownership_effect

The survey also examined the **tendency of Varsovians either to give up their cars and replace them with car sharing** (in case of car owners) or to use car sharing instead of buying an own vehicle (in case of people not owning one). The outcome here is rather clear and not in favour of shared mobility: only 14% of car owners (and even less people not owning a car – barely 10%) are ready to choose car sharing over car ownership (top-2-box responses), while a lot more (38% of car owners and 30% of people not owning a car) strongly reject such idea (bottom-2-box responses). The analysis of different features of car sharing services that could eventually convince Varsovians to choose car sharing instead of a privately owned car has been presented in the table below:

Feature	car owners (top-2-box)	people not owning a car (top-2-box)	weighted avg.
free parking in the city	45%	46%	45,3%
proximity of the vehicle to the place of residence/work	41%	41%	41,0%
discounts for economical and accident-free driving	40%	42%	40,6%
high availability of vehicles	39%	44%	40,5%
ability to book a vehicle for a specific time	37%	39%	37,6%
various vehicle sizes (also more spacious models)	30%	32%	30,6%
always a modern fleet of vehicles	30%	29%	29,7%
electric drive of the vehicle	29%	25%	27,8%

Table 6 Car sharing services' features and their impact on choosing car sharing over car ownership

From the above, we can see that financial incentives have a strong influence on convincing Varsovians to the use of car sharing, especially **free parking in the city being the key driver**. The other strong stimulants are further pragmatic aspects, such as the density and proximity of shared cars in a neighbourhood, as well as discounts that can be gained by car sharing users for economical and accident-free driving. On the other hand, features purely related to the car sharing fleet (vehicle's size, modernity, and eco-friendliness) are of least importance among the examined car sharing features.

The survey #2 of Warsaw residents' mobility behaviour (n=302) investigated also the **monthly transportation expenses** of Varsovians. Almost half of the respondents (47%) indicated the top price range of PLN > 300 per month (with an average of PLN 585), while 33% chose the middle range of PLN 100-300 per month (with an average of PLN 193), and 20% pointed to the lowest range of PLN < 100. Meanwhile, the general average of the monthly transportation expenses of the residents of Warsaw amounted to PLN 348, which was also 16% higher compared to the nationwide sample of mobility hubs' supporters (average of PLN 300), in line with the expectations that the people inhabiting the capital city would spend more on this purpose.

During the investigation of the preferences of Varsovians as to different modalities used for the daily commute, the respondents were asked to evaluate their **travel time used for different modalities** (expressed as the average weekly number of hours spent moving in a certain way), additionally indicating data for two periods separated by two years: during the pandemic (mid-2021) and before the pandemic (mid-2019). The intention was also to check the impact of COVID-19 on the mobility behaviour of Warsaw residents. The table below summarizes these results.

	ļ	verage travel t	ime per week		increase/decrease			
	mid-2021 (d	uring COVID)	mid-2019 (pre-COVID)	pre-COVID)			
	hours % share		hours	% share	%	% share		
On foot (walking)	12,2	25,8%	11,7	26,4%	4,3%	-0,6%		
Own car	11,3	23,8%	11,6	26,1%	-2,6%	-2,3%		
Public collective transport	10,9	23,1%	9,0	20,2%	22,1%	2,9%		
Own bike	5,5	11,5%	5,1	11,4%	8,1%	0,2%		
Bike sharing	2,2	4,6%	2,2	4,8%	0,9%	-0,3%		
Taking a lift	1,8	3,8%	1,3	2,8%	43,7%	1,0%		
Scooter sharing	1,0	2,1%	1,4	3,1%	-26,3%	-1,0%		
Taxi/ride-hailing	0,9	1,9%	1,0	2,3%	-12,5%	-0,4%		
Car sharing	0,8	1,7%	0,6	1,3%	39,0%	0,4%		
Own motorcycle or moped	0,8	1,6%	0,7	1,6%	5,6%	0,0%		
Total:	47,4	100,0%	44,5	100,0 %	6,6%	0,0		

Table 7 Time spent by Varsovians on commuting using different modalities, based on the CAWI quantitative survey (n=302)

It is debatable whether the respondents' above evaluation of the travel time indications is accurate or maybe overestimated, but it reflects the genuine values indicated by them, thus also showing their **preferences in terms of various modalities**. The results of the survey clearly reveal that the most popular (and time consuming) ways of getting around the city (amounting to nearly 73% in terms of the travel time) did not change much during the last two years. These are: walking (26% share in 2021), driving a private car (24%) and travelling by public collective transport (23%). When analysing the largest increases in the travel time of different modalities, public collective transport gains the most attention with almost 2 hours more travel time consumed every week. This shouldn't be attributed to the rising popularity of the urban transport or it winning more passengers, as it was exactly the opposite due to COVID-19. The more likely interpretation is that less short trips were performed because public transport was more often used for longer journeys or simply that commuting now takes longer, e.g., due to frequency or capacity constraints. Other modalities with a noticeable increase in travel time (by approx. 30 minutes more weekly) were taking a lift and walking.

The above set of data also constitute Warsaw's **modal split**, defined as the percentage share of each mode of transport. However, it is quite different from the modal split established during the Warsaw Traffic Study (2015) as different methodologies have been applied. The percentage breakdown for the 2021/2019 modal splits is based on the total travel time of certain modes of transport, while the 2015 modal split was based on the number of trips performed, regardless of their duration. All discussed modal splits have been presented on the chart below.



Figure 17 Comparison of Warsaw modal splits from survey #2 (2021/2019) and Warsaw Traffic Study (2015)

If we were to slightly recategorize the 2021 modal split of Varsovians based on travel time, we could also present the following figures: 28% private car, 26% on foot, 23% public collective transport, 13% private micromobility, and 10% shared and new mobility solutions, or alternatively: 42% active mobility, 31% passenger car travel, 23% public collective transport and 4% other micromobility. In each configuration, **car journeys are ahead of public collective transport**, not to mention shared mobility, which shows that despite the increasing trend of uptaking active mobility and micromobility, there is still a lot to be done in the context of increasing the efficiency of the urban transport system in Warsaw.

The subject of the survey was also to **examine a set of beliefs** of Warsaw residents regarding specific attitudes and mobility behaviour. A bit surprising was the fact that only 54% of the respondents were clearly convinced (top-2-box responses on a 7-point scale, where 7 meant "I definitely agree" and "I don't agree at all") that the choice of a particular mode of transport for city commute can have an impact on the environment. On the other hand, approx. half of Varsovians (49% top-2-box-responses) clearly agreed that choosing a passenger car for daily commute may have a negative impact on the environment, while at the same time admitting that riding electric cars is environmentally friendly (52% top-2-box responses). A stronger belief in a positive impact on the environment was measured for public collective transport, which is clearly perceived as eco-friendly by 62% of the Warsaw residents (top-2-box responses).

What is important for the Project, assessed was also the **attitude of Varsovians to the concept of mobility hubs** and concentrating a selection of multimodal shared mobility services in such places. The responses were marked on a 7-point scale, where 7 meant "I like the concept very much" and 1 "I don't like the concept at all". As a result, 61% of Warsaw residents like the idea of mobility hubs (top-3-box responses), and only as few as 13% find it unattractive (bottom-3-box). These figures are slightly less supportive towards the mobility hubs concept compared to the nationwide sample of respondents (75% of Poles are positive about mobility hubs and only 9% negative, similarly based on top-3-box and bottom-3-box responses), however, still clearly positive. The difference observed between these samples (Warsaw vs Poland) may be due to the expected greater comfort for the user, which is mainly related to the proximity of the shared vehicle to be rented but can be also attributed to the fact that the free-floating model is currently widely popularized in Warsaw, allowing users to park the shared vehicles almost everywhere, not necessarily in designated spots.

The last part of this section's analysis of the Warsaw residents' mobility behaviour will concern the **use** of shared mobility services. The following popularity of shared modes in Warsaw has been established, according to survey #2:

	used at least once in the last year	used at least once in a lifetime
shared bike	40%	51%
shared e-scooter	23%	33%
shared e-moped	4%	5%
shared car	18%	26%

 Table 8 Types of shared mobility vehicles used by Varsovians, based on CAWI quantitative survey (n=302)

The above figures show the popularity of different self-service shared mobility modalities, as declared by Varsovians, with bike sharing leading the way (with 40% respondents who used it at least once during the last year), followed by e-scooter sharing (23%), car sharing (18%), and e-moped sharing gaining the least interest (4%). The most important observation, however, is that the nationwide group of mobility hubs' supporters (from survey #1) recorded even 25-50% higher popularity levels (depending on particular modality), which means that increasing the number of mobility hubs' supporters in a city (e.g., through implementing a network of mobility hubs and fostering its development) has a great potential to popularize the entire category of shared transport, thus contributing to an increased sustainability of the urban mobility ecosystem.

Another issue examined in the survey was to what extent Warsaw residents intend to use shared mobility services in the future and what factors support its utilization the most. With regards to the **intention of using shared mobility**, the answers were marked on a 7-point scale, where 7 meant "I am definitely going to use" and 1 "I am not going to use at all". The result was an average score of 4,36 out of 7, which shows a rather neutral attitude of Varsovians to the use of shared mobility solutions. Still, comparing the top-2-box responses (28%) with the bottom-2-box ones (18%), it can be stated that there are more strong supporters of shared mobility in Warsaw than its opponents. Also, taking into account the very **large number of undecided respondents** (54% of answers marked 3, 4 and 5), now it is the right moment to undertake actions in order to popularize shared mobility in Warsaw, especially as these activities concern a large group of the local population, thus having a real chance to achieve a measurable effect.

The Warsaw residents (n=302) were also asked, what factors they would potentially take into account when making a decision to use a shared vehicle. The table shown below presents the answers, incl. the average for every of the investigated 8 factors as well as accumulated indications of the most and least supportive answers (top-2-box and bottom-2-box). The responses were marked on a 7-point scale, where 7 meant "I definitely take this into account" and 1 "I definitely don't take it into account".

Factor	Avg.	1	2	3	4	5	6	7	top-2- box	bottom- 2-box
distance to the nearest vehicle	5,94	4,0%	0,0%	1,0%	7,0%	15,9%	25,2%	47,0%	72%	4%
price per minute	5,89	4,6%	0,0%	2,0%	8,9%	13,9%	20,2%	50,3%	71%	5%
price per km	5 <i>,</i> 88	4,0%	0,0%	1,3%	11,6%	12,9%	22,2%	48,0%	70%	4%
trip safety	5,77	3,6%	1,0%	2,6%	9,3%	15,6%	26,8%	41,1%	68%	5%
convenience of using the vehicle	5,57	4,6%	0,7%	2,6%	11,3%	19,5%	28,5%	32,8%	61%	5%
quality of vehicles	5,53	4,3%	0,3%	3,0%	14,9%	19,9%	23,5%	34,1%	58%	5%
diversified fleet of vehicles	4,86	6,0%	3,3%	8,9%	20,5%	22,5%	19,5%	19,2%	39%	9%
environmental impact	4,72	8,6%	6,6%	7,9%	17,9%	19,9%	18,2%	20,9%	39%	15%

Table 9 Importance of factors when deciding on the use of shared mobility by Varsovians, based on the CAWI quantitative survey (n=302)

As in the case of the nationwide sample of respondents in survey #1, the Warsaw residents are also **very pragmatic in their motivations** when deciding on the use of shared mobility. The most important factors for them that impact the decision whether to use a shared mobility service or not, are the proximity to the rented vehicle (with average score of 5,94 out of 7 and top-2-box result of 72%), and the pricing per minute and km (average score: 5,88-5,89; top-2-box: 70-71%). On the other hand, the potential customers of shared mobility in Warsaw care the least about factors such as environmental impact (average score: 4,72; top-2-box: 39%) and diversified fleet of vehicles (average score: 4,86; top-2-box: 39%).

The last two aspects investigated by survey #2 were the Warsaw residents' **intentions to use particular modes of shared mobility** in the future (marked on a 7-point scale, where 7 meant "I'm definitely going to use" and 1 "I'm not going to use at all") as well as their beliefs that using a particular shared modality reduces the negative impact of transport on the environment (marked on a 7-point scale, where 7 meant "I definitely agree" and 1 "I strongly disagree"). The results have been compiled in the table below.

		intension	reduces the negative impact of transport on the environment				
	Avg.	Avg. top-2-box (strong middle-3-box bottom-2-box (clear reluctance)		bottom-2-box (clear reluctance)	Avg.	top-2-box (strongly	
shared mobility	4,36	28%	54%	18%	-	agree)	
bike sharing	4,07	29%	42%	29%	5,10	45%	
car sharing	3,81	19%	54%	27%	4,81	34%	
e-scooter sharing	3,27	16%	38%	46%	4,65	34%	
e-moped sharing	2,79	10%	36%	54%	4,34	28%	

Table 10 Varsovians' attitude to particular modes of shared transport, based on CAWI quantitative survey (n=302)

From the above, it can be observed that the intention to use a particular modality of shared mobility ranks in the same order as its perception as a remedy for the negative effects of transport on the environment. However, the indications for the willingness to use shared modalities are fairly lower (with the majority of Varsovians being rather their opponents than supporters, but only when asked about particular modalities) than those related to the environmental beliefs (which are more positive). This is consistent with previous findings of both surveys #1 and #2, which showed that **environmental considerations are a weak motivator to use shared mobility** (both for Poles and for Varsovians).

Now, taking a closer look at particular modalities of shared transport:

- **bike sharing** took the top position in the above ranking, with better indicators than the other modalities, e.g., with the largest group of strong supporters (29% of top-2-box responses) and the strongest belief that it helps to address environmental issues caused by transport (45% of top-2-box responses);
- **car sharing** ranked 2, with the largest group of undecided respondents (54% of middle-3-box responses) and approx. one third (34%) of them strongly agreeing that car sharing reduces the negative impact of transport on the environment;
- **e-scooter sharing** ranked in the lower part of the ranking, with the indicators noticeably lower compared to the shared mobility's average, e.g., a large group of opponents (46% of bottom-2-boxes responses) and a rather small group of supporters (16% of top-2-box responses);
- e-moped sharing traditionally with the weakest indicators among all shared modalities, e.g., with only 10% of supporters and the largest group (54% of bottom-2-box responses) of those who are not thinking of using this modality.

The above outlined figures can be interpreted in the way that the entire category of shared mobility is rated higher as a comprehensive multimodal solution than in case of individual modalities being assessed separately. Also, there are approx. 40-50% of undecided respondents, who have the potential to become supporters of shared mobility, still, this would require undertaking efforts in order to popularize shared mobility in Warsaw. An obvious way to achieve it would be the implementation of the network of multimodal mobility hubs.

6.5 Summary

The above chapter on local mobility needs mainly discusses what has been found in research on mobility behaviour and user preferences in terms of urban transport, where available – based on the example of Warsaw. One of the most important findings of the Warsaw Traffic Study was the modal split, although the data obtained over 5 years ago, particularly in the context of the impact of COVID-19 on mobility, require treating these findings with an appropriate dose of distance. At that time, the modal split in Warsaw was as follows: 47% travel by public collective transport, 32% travelling by passenger car, 18% on foot, and 3% by bike. Another interesting finding was, for example, that a statistical resident of Warsaw made about 2 trips on each regular business/working day.

This had to change as the **pandemic has had a significant impact on urban mobility**, but its effects are still not clearly explored. What we do know, however, is that in 2020 the number of passengers in public transport in Warsaw decreased by 40%. The number of bike sharing trips fell by exactly the same percentage between 2019 and 2020. On the other hand, the road transport in Warsaw in summer of 2020

was only 2% smaller than in summer of 2019. Also, a significant growth of 17,4% in bike traffic was reported between summer of 2019 and summer of 2020, as revealed by the Warsaw Bike Report, most likely as an effect of COVID-19 that caused more people to start using their own bikes.

A broader context on the mobility behaviour of Poles has been provided by the New Mobility Barometer, a survey carried out annually by the Polish Alternative Fuels Association. For the purpose of this Study, data from the years 2019-2021 have been analysed. The opening finding shows a decrease in associating car ownership with one's social status. In 2019, 50% of Poles believed these were unrelated, and two years later it is already 57%. This seems to confirm the **trend of moving away from owning things towards using them**, which also should favour the use of shared mobility services, although no data has been obtained that would directly confirm this thesis. The most recent study (2021) unveiled that as many as a third of Poles are undecided whether they would be ready to consider giving up using their own car and replacing it with other efficient and affordable ways of getting around the city (public collective transport, shared mobility, and ride/taxi-hailing).

Other findings of the New Mobility Barometer included, for example, a drop in shared mobility usage between 2019 and 2021 as an alternative to private car travels, but only by 2% (down from 36% to 34%). Moreover, a decline by 5% in the usage of public collective transport has been reported in the same period (down from 62% to 57%). Interestingly, **only a group of approx. 10% of respondents did not use public or shared transport due to the pandem**ic. An increase in the popularity of shared mobility, however, has been noted among those who make their intra-city commute in other ways than private car or public collective transport. In this group, the popularity of self-service shared mobility services increased by as much as 46% in over two years.

The New Mobility Barometer also investigated the **use of particular modalities within shared mobility**. When comparing 2019 and 2021 figures, the following conclusions can be made:

- there is clearly less interest in bike sharing as many people already own a bike and/or bought one;
- approx. 1/3 of the population uses e-scooter/moped sharing when such service is available in a city (no change between 2019 and 2021), while the main reason for not using it is the lack of such need;
- there is currently more interest in car sharing, with a decline only in the pandemic year 2020 (usage: 25% in 2019, 18% in 2020, 31% in 2021), while the main reason for not using it is that every year an increasing number of people choose to have their own car (41% in 2019, 43% in 2020, 45% in 2021).

Another interesting finding of this study (2020) with regard to car sharing was that the **use of car sharing is most often (71%) determined by the availability of the vehicles in a given place**, then (58%) by the price, and only later and with a large difference (22%), by the operator's brand, which can be interpreted in the way that predictable availability of (any) car sharing vehicles in a given location (e.g., in a mobility hub) favours greater use of car sharing as a category.

The last aspect from the New Mobility Barometer surveys described in this Study was the Poles' **attitude towards MaaS** (Mobility-as-a-Service). This term, however, did not gain in popularity between 2019 and 2021. with more than 80% of the respondents not knowing it. Investigated was also the price for a MaaS solution Poles would be willing to pay instead of travelling by private car. The current expectations of Poles
are, however, to spend less on such type of mobility (down by almost 20% from an average of almost PLN 200 in 2019 to only PLN 160 in 2021).

Based on other sources, when comparing both COVID-years (2020 and 2021) in terms of the **mobility index** (data based on the activity of mobile phones), which examined the differences between current situation and the typical mobility level of the society, steady growth in the mobility of Poles was reported during the successive COVID-waves, with the following growing values of the mobility indicator:-55% in April 2020,-44% in December 2020,-34% in April 2021, and back to the pre-COVID levels as of May 2021. This indicator for individual mobility does not directly infer the demand for shared mobility services, however, according to Fluctuo's European Shared Mobility Index for Q3 2021, this industry is among those recovering. Still, **not all the modalities were recovering equally quickly, and some did not note any revival at all**. The following results have been obtained within a year until July 2021: station-based bike sharing went down by 20%, car sharing fell by 5%, e-moped sharing went up by 15% and e-scooter sharing was up by an almost 200%. The explanation for the boom for e-micromobility, which excludes the shared docked bikes, could be that people were seeking an alternative to crowded public collective transport, as well as exploring ways of secure and quick commute on short distances.

In order to learn more about the mobility needs in relation to the Project, two surveys on a representative sample of respondents were carried out in 2021: the #1 survey of mobility hubs' user profile and the #2 survey of Warsaw residents' mobility behaviour. This Study presents the results of both surveys to the public for the first time. The #1 survey of mobility hubs' user profile proved that **3/4 of Poles like the idea of mobility hubs** and offering shared mobility services in such places, and that there are only as few as 9% of respondents with a negative attitude towards this concept. Also, it turned out that the surveyed group has a high potential to use diversified transport modes (as 81% of the respondents own a car, 81% also use public collective transport and 74% own a bike), therefore might be open to switching from private car travels to more sustainable urban mobility options (public, shared and active mobility). With regard to the most preferred mode of self-service shared mobility, both in terms of the actual usage (at least once in the last year) and the intention to use in the future, the survey indicated the following values: bike sharing (53% use it, 52% intend to use it), e-scooter sharing (44% use it, 33% intend to use it), e-moped sharing (7% use it, 7% intend to use it), car sharing (25% use it, 31% intend to use it). The respondents also specified which **factors are the strongest motivators to use shared mobility services**, and these are utilitarian aspects: the distance (proximity) to the nearest vehicle and the price per minute.

And now going into the #2 survey of Warsaw residents' mobility behaviour, it turned out that, compared to the nationwide sample of respondents, there were a bit fewer supporters of the mobility hubs concept among Varsovians (61% of supporters, 26% undecided, 13% opponents), as well as that there was a larger group of respondents undecided whether to use shared mobility services or not (28% of clear supporters, 54% undecided, 18% clear opponents). Such a large number of undecided Varsovians constitute a **very important target group for efforts to change transport habits** into more sustainable ones, e.g., through developing a network of mobility hubs in Warsaw, especially as the mobility hubs user profile (from survey #1) indicated higher utilization levels of shared mobility services (depending on a particular modality), from 25% to even 50%.

The survey also examined the tendency of Varsovians either to give up their cars and replace them with car sharing (in case of car owners) or to use car sharing instead of buying their own vehicle (in case of people not owning a car). The outcome was not in favour of car sharing: only 14% of car owners (and 10%

of people not owning a car) were ready to choose car sharing over car ownership, while a lot more (38% of car owners and 30% of people not owning a car) strongly rejected such idea. At the same time, **free parking in the city has been identified as the strongest incentive** to encourage Varsovians to use car sharing, alongside other pragmatic drivers such as the density and proximity of shared cars.

As for the modal split in Warsaw based on the travel time, there have been three core (and most time consuming) modalities established by the survey respondents: walking (26%), a private car (24%), and public collective transport (23%). The remaining modalities were as follows: a private bike (almost 12%), self-service shared mobility (8%), being given a lift (4%), taxi-/ride-hailing (almost 2%), and a private motorcycle/moped (approx. 1,5%).

One more finding of survey #2 indicated also that the **entire category of shared mobility is rated higher as a comprehensive multimodal solution** than in the case when individual modalities of shared mobility are assessed separately. This conclusion favours the concept of mobility hubs concentrating a multimodal offer of shared mobility services in one place.

Feasibility Study on the implementation of mobility hubs in Warsaw Chapter 7. Feasibility of mobility hubs

"For optimal impact, mobility hubs should be planned as an entire network of hubs"

7. Feasibility of mobility hubs

The final chapter of this Study will focus on the assessment of the feasibility of implementing the mobility hubs concept in Warsaw. In addition to describing the concept of mobility hubs itself and recalling other examples of implementation of multimodal mobility hubs from Poland and abroad, the following issues will be discussed: fitting mobility hubs into the local transport network of Warsaw, mobility hubs' requirements, cost assessment, possible forms of implementation, possible business models, potential risks, appropriate locations for mobility hubs as well as the assessment of mobility hubs' performance (KPI) in the future.

7.1 The concept of mobility hubs

The information on the mobility hubs' concept presented below was taken from the SmartHubs Project's proposal and will cover the following aspects of the activity: introductory description, the purpose of the activity, as well as the expected outcome of the Project.

In a world with increasing pressure on urban space's economy and climate fight, there is a clear need for new and effective mobility solutions such as shared mobility. Its adoption rates are rising, but not yet at a level that would significantly change the way people move around the cities. Therefore, the reduction in the pressure on the transport network and public space is still limited. Findings show that these new means of transit are not being unlocked in the right manner for mode transfer. Novel mobility hubs in the outskirts

of the city, neighbourhoods or city centres could be a robust solution for this challenge while providing other interesting side services. This Project aims to **develop and validate effective and economically viable mobility hub solutions** by doing pilots in several European cities (Amsterdam, Eindhoven and Helmond in the Netherlands, Lisbon/Setúbal in Portugal, Barcelona/Sant Cugat in Spain as well as Warsaw in Poland) and provide answers to three important questions: where, how and what size should the mobility hubs be, what business models are the best to make the mobility hubs scale and what procurement methods are the most suited?

Mobility hubs offer an integrated product-service solution to the urban scarcity of space by physically and geographically clustering new shared modes and existing (public) transport services or parking solutions. Mobility is strategically located in urban areas in places where it is beneficial to supply the transportation alternatives to the use of individually owned cars or motorcycles, by aggregating several shared modes, plus existing public transport, in the same cluster to improve the level of service from a multimodal perspective. The typical modes are normal/electric bikes, scooters and mopeds, electric cars, and microcars which can contribute to decreasing space needs and emissions in urban areas. Clustering in this way provides easier access to the shareable modes and shows the customer a broader perspective, potentially influencing their choice of modality. If one mode is missing, an alternative should be found in the same SmartHub. Nevertheless, the concept has not been properly tested yet. Previous projects and research show its potential, but proper planning tools and piloting are in great need. SmartHubs will bridge this gap by putting together a unique consortium of cities, companies, and universities, who have been working on shared mobility for increasing transport sustainability. The project is complementary to EIT projects SOUL (Smart mObility hUb pLatform⁽⁵⁶⁾) and UMOS (Urban Mobility Operating System⁽⁵⁷⁾), which are respectively focused on developing a theoretical DSS tool (decision support system) and the digital integration of mobility access/standardisation. The SmartHubs Project gathers the engagement of several sites in Europe for operational delivery of mobility hubs. Within the Project, cities provide different contexts and mobility hub needs', allowing to design proper blueprints for SmartHubs that wouldn't fit only a specific hub, but instead could be utilized across a variety of these. Universities will unify knowledge and convert it into a decision-support planning tool for cities intended to support them in positioning and optimizing the created mobility hubs. Companies aim to develop a business side of the mobility hubs together with the cities of the consortium.

The main outcomes of the two-year Project and corresponding impacts are listed as follows:

- The Project will deliver **ready go-to-market smart mobility hubs concepts** with validated propositions in several different cities and contexts and a strong set of (international) commercial partners to move forward. These concepts are designed to have primarily a positive impact on urban accessibility by supplying sustainable multimodal options for people to travel. In the long term, emissions are expected to be reduced significantly, and citizens should own fewer cars, freeing up scarce urban space for other functions and usage as well. Based on the value proposition, cities can customize the mobility hubs for their locations and policy needs.
- The Project will deliver a validated list of criteria and a process for the **public procurement of smart mobility hubs in public** space. This is specified in terms of architectural, urban design,

⁵⁶ Source: https://www.eiturbanmobility.eu/projects/smart-mobility-hub-platform/

⁵⁷ Source: https://www.eiturbanmobility.eu/projects/umos-urban-mobility-operating-system/

urban planning, services offered, financial aspects, as well as governance and ownership aspects of the mobility hubs. The Project delivers knowledge on which factors will determine the success of a mobility hub and possible business study cases for cities and companies. The deliverables have an impact on the speed of adopting these solutions in European cities and will empower European companies in developing businesses internationally in supplying these solutions.

• The Project will deliver a decision-support tool for cities (e.g., transport/urban planners) to plan and decide on the type, location, and offered mobility services of smart mobility hubs at the street, district, city, and metropolitan levels. There is urgent demand from planning departments of cities and public transport authorities for this kind of tool. The DSS tool will be able to accelerate the successful implementation of the mobility hubs, maximizing citizens' accessibility and inclusion, as well as emissions reduction.

The results of the SmartHubs pilots will be used to accelerate the implementation of mobility hubs in the partner cities (Lisbon, Barcelona, Warsaw, Amsterdam, Helmond, and Eindhoven) in the next three years. It will enable **faster adoption of mobility hubs and shared mobility services in EU cities** and regions due to effective procurement. Foreseen is also supporting the scaling up of smart mobility hub services in other cities through EIT CityClub and Factory. The validated SmartHubs business models and mobility hub services will be used by the involved mobility/hub providers to improve and scale their service offerings to other cities and customer groups. This will strengthen and accelerate the EU smart mobility hub market. The decision support tool for cities and mobility providers to identify optimal hub locations, hub type, and service mix will be developed and validated in collaboration with the launching customers in this project (cities, mobility providers). A feasible business model will be defined too.

The deployment of smart mobility hubs in cities aims to enable **a faster transition to more shared and sustainable mobility in cities** while improving accessibility and affordability. At this moment, shared mobility services (shared bikes, micromobility and shared cars) are being used by a variety of commuters, tourists and residents in the city. However, most of the current shared mobility services are located near public transport nodes and in popular inner-city areas, thus focusing on particular user groups like commuters and tourists. This Project wants to test and validate mobility hub concepts (and shared mobility services) also in areas/contexts closer to residents themselves – more local, neighbourhood levels, other than the commuter mobility hubs. The SmartHubs (and shared services) tested in this Project will be inclusive to all user groups that are relevant to the context of the location.

7.2 Existing examples of mobility hubs

When analysing the area of multimodal mobility hubs, it is worth pointing to some solutions that have already appeared in European cities in this field, including two pilot implementations in Poland (however, with a different approach and a different outcome as well). Some of them will be presented below, but at the same time the proposed selection does not intend to bring together all of the existing mobility hub type projects in Europe, instead aiming to highlight the most adequate ones and relevant for the Study and the SmartHubs Project.



In Warsaw, a multimodal mobility hub was launched in May 2021 by a company⁽⁵⁸⁾ that in Poland is the first **specialized mobility hub provider for cities (B2G) and real estate owners (B2B)**, particularly office buildings, retail, hotels and housing estates. This pilot mobility hub is the only multimodal mobility hub in Warsaw and is based on contracts concluded with the real estate (an office park: Adgar Plaza) on the one hand and with several providers of shared mobility services on the other. In the course of 2021, it offered 3 shared modalities (e-scooters, e-mopeds and car sharing, including e-cars) and also extended its range of services by concluding an agreement for installing chargers for privately owned e-bikes and e-scooters.

Importantly, this particular mobility hub has been acquired for the purpose of the SmartHubs Project, which was done to take advantage of the unique market opportunity – having a ready-to-go multimodal mobility hub available in the Project's pilot city of Warsaw. In the period between May and November 2021, the acquired mobility hub reported a traffic (utilization) of more than 1,200 rentals of different shared mobility vehicles that either started or ended the trip in this place. 53% of these trips accounted for car sharing, 28% for e-scooter sharing, and 19% for e-moped sharing, as shown in a monthly breakdown on the chart below. Almost two-thirds (66%) of the shared mobility trips were rentals starting in the mobility hub and slightly above one-third (34%) were rentals that ended their voyage there.



Figure 18 Number of rentals and returns of shared mobility vehicles from/to the Adgar Plaza Mobility Hub in Warsaw

⁵⁸ Source: https://hubymobilnosci.pl/



In Gdansk, a multimodal mobility hub called City Hub was launched in summer of 2020 by a well-known office real estate developer: Skanska Property Poland. The City Hub has been located next to an office building and offered in the course of 2020⁽⁵⁹⁾. 3 shared modalities: e-scooters, e-mopeds, and car sharing (e-mopeds were no longer available in 2021 as the provider ceased providing B2C services in Gdansk), chargers for privately owned e-bikes and e-scooters as well as some additional mobility solutions available exclusively for the tenants of the office building (e.g., carpooling). The City Hub also includes parking spaces for taxis and deliveries of goods, as well as a self-service repair point for bikes.

The formula for implementing and managing the City Hub is fundamentally different from the Warsawbased model described above. First of all, the property has prepared the entire mobility hub solution on its own and also bore all the costs of creating the mobility hub, unlike in Warsaw, where, in return for a fixed setup fee, the external mobility hub provider created the hub as a turnkey solution. Another vital difference between those two mobility hubs is that the City Hub is also **managed in-house**, directly by the real estate. Again, unlike in Warsaw, where the daily operations are outsourced to the mobility hub provider, whose responsibility is, among others, to conclude and manage the contracts with the suppliers of shared mobility services (or any other types of services), to take care of the daily supply of shared vehicles, to make some repairs in the mobility hub if required, to provide support for the possible events in the mobility hub as well as to promote the services available in the mobility hub and the entire hub itself. All this for a fixed monthly fee, providing the real estate with a comfort that it has a provider who will comprehensively manage the mobility hub and further develop it (e.g., by adding new services, replacing non-performing services, addressing any issues related to the hub, etc.). Moreover, stand-alone mobility hub projects such as the City Hub have a limited potential to create a coherent network of mobility hubs in a given city, and only such a solution will have a chance to convince more users to use shared mobility services.

⁵⁹ Source: https://www.skanska.pl/o-skanska/media/informacje-prasowe/246896/City-Hub-przy-Wave-od-Skanska-wystartowal



In Berlin, a network of multimodal mobility hubs was launched under the pilot program called Jelbi, which is led by the provider of public collective transport services in Berlin (BVG: "Berliner Verkehrsbetriebe") in cooperation with a dozen of mobility providers. The program is primarily about digital integration of public and shared means of transport on a single MaaS-platform (**the BVG Jelbi app**⁽⁶⁰⁾ launched in September 2019 and enables route planning, booking, and payments for both public collective transport as well as a total of approx. 45,000 different shared mobility vehicles), but part of it is also about the physical designation of mobility hubs in urban space, often located close to public transport nodes (e.g., urban rail stations) and sometimes also equipped with micromobility chargers.

In the end of 2021, there were a total of 14 of such multimodal mobility hubs active in Berlin, allowing to either rent or return a shared vehicle (within different modalities: bikes, e-scooters, e-mopeds, car sharing), use a ride-sharing or a taxi-hailing service (with the hub being a pick-up or drop-off location), or charge electric vehicles. In addition, there were also 7 smaller mobility hubs designated on the streets of Berlin, for shared micromobility services only (bikes, e-scooters, and e-mopeds).

In the end of 2021, BVG has successfully concluded a tender⁽⁶¹⁾ for further operations of the Jelbi MaaSplatform for the years 2022-2025, with the option to extend the contract duration even up to 2035 with the same provider. The success of the project is evidenced by the fact that the Jelbi-app is used by about 8% of the local population. What's interesting, the average multimodal journey in Berlin takes 36 minutes.

⁶⁰ Source: https://www.jelbi.de/en/jelbi-app-2/

⁶¹ Source: https://www.trafi.com/jelbi-tender/



In Bremen, a network of more than 40⁽⁶²⁾ mobility hubs (called mobil.punkte⁽⁶³⁾) has been established. Those are most probably the oldest existing mobility hubs in Europe as Bremen began setting up these already in 2003 (almost 20 years ago). These mobility hubs have been **established by the municipality in cooperation with car sharing providers** and are designated parking spaces for shared cars encouraging the local citizens to use private cars rather occasionally, and use shared cars instead, thus contributing to a more sustainable transport system with less private cars on the roads, less traffic congestion, and less air pollution. These mobility hubs, although linked to the local public collective transport (e.g., proximity of bus or tram stops) and equipped with bike stands, and sometimes also with chargers for electric cars, are not really multimodal as they offer only one mode of shared transport: car sharing.

Out of the available mobil.punkte in the city of Bremen, 10 are larger ones (located in strategic points of the city, each with 4-12 parking spaces reserved for car sharing) and the rest are smaller ones, located in local neighbourhoods, each with 2-3 parking spaces reserved for car sharing. All of the mobility hubs in Bremen have very **clear objectives**: they are a way to reduce the dependency on owning a private car (through bringing a viable alternative to private car ownership closer to the citizens as one shared car eliminates 16 private cars from roads, according to a local study), to reduce parking pressure in the public realm and to reclaim public street space. Mobility hubs similar to Bremen's one also popped up in some other German cities: in and around Nürnberg⁽⁶⁴⁾.

⁶² Source: https://share-north.eu/2019/12/42-mobil-punkte-and-growing/

⁶³ Source: https://mobilpunkt-bremen.de/mobil-punkte/

⁶⁴ Source: https://www.nordbayern.de/region/fuerth/mobilpunkte-furth-hat-neue-carsharing-stationen-1.9601173



In Stuttgart, there is a good example of implementing the concept of mobility hubs by the national railway operator⁽⁶⁵⁾. In the very front of the railway station, a mobility hub has been designated, allowing to conveniently switch between railway transport and a wide selection of shared mobility offerings: bikes, e-scooters, e-mopeds, and car sharing. This enhances intermodal mobility and allows much more effective communication with the railway station , therefore with the railway services as well. Such an approach is very suitable for the concept of mobility hubs as it is located at an important transport node that enables many users to benefit from the proposed shared mobility solution.

Interestingly, similar approach can also be observed in Poland, where at three different railway stations in Tri-City, parking places have been designated for an electric car sharing service developed jointly by PKP Polish Railway and a company from the IoT industry⁽⁶⁶⁾.



Vienna can be seen as the forerunner of the approach that was later implemented in Berlin, namely a MaaStype app launched by the local provider of public collective transport services (Wiener Linien) combing the offers of both public and shared mobility options digitally in a single app (called WienMobil), allowing multimodal route planning as well as paying for public transit tickets. As for the payments for services other than public transport, these are not fully integrated into the MaaS app and take place in a manner separately regulated between the user and the service in question. Still, the WienMobil app offers a full

65 Source: https://smartcity.db.de/en/mobility-hub 66 Source: https://easyshare.pl/pkpmobility/

range of different mobility services, including bike sharing, e-scooter sharing, e-moped sharing, car sharing, taxi services, and even car rental.

In Vienna – followed later by the example of Berlin – several multimodal mobility hubs (called WienMobil Stationen) have been created since 2018, all located in the vicinity of public transport nodes and offering a selection of different shared mobility services, similar to those available in the WienMobil MaaS-app, e.g., shared micromobility (bikes, scooters, mopeds), cargo bikes, car sharing, but also some other transport-related services such as a secure and roofed bike parking or charging electric vehicles. The network of the Vienna mobility hubs is expected to be dynamically developed in the coming years as per the 15 million EUR funding secured by the end of 2021⁽⁶⁷⁾ and with the following targets for the number of WienMobil Stationen: 16 mobility hubs until the end of 2021 (an increase from the number of 9 in October 2021) and even up to 100 mobility hubs until 2025 with the ultimate goal of supporting climate action and climate neutrality of the last mile transport.



In Austria, more concepts of mobility hubs have been launched by providers of public collective transport⁽⁶⁸⁾, in Linz (a service of Linz AG Linien) as well as in and around Graz (a service of Holding Graz – Kommunale Dienstleistungen GmbH), all under a common brand: tim and the mobility hubs called tim-Mobilitätsknoten. These mobility hubs (10 in Linz, 11 in Graz, and an additional 10 around Graz), **located in the proximity of public transport nodes** (bus/tram stops and/or railway stations), allow to use a selection of the following functionalities: car sharing (both e-cars and conventional drive), car rental, charging of private e-cars, bike parking, hop on and drop-off locations for taxis (incl. taxi-sharing service in Linz) and cargo bike sharing (only available in selected mobility hubs in Graz). Tim stands for "täglich, intelligent, mobil", which translates into "daily, intelligent, mobile" and is an innovative form of mobility bundling different transport modalities.

⁶⁷ Source: https://www.smartertogether.at/15-millionen-euro/ 68 Source: https://www.tim-oesterreich.at/



France Dreux

© M Ta Ville

In France, the city of Dreux has launched its first three mobility hubs (locally branded as Mobipoints) at the beginning of 2021. They have been created as part of a much wider project of implementing mobility hubs across several European cities (Amsterdam and Arnhem in the Netherlands, Leuven in Flanders and four cities in Wallonia, all in Belgium, Manchester in England, Inverness in Scotland, Kempten/Allgäu in Germany and Dreux in France), namely the 2019-2022 EU project eHUBS⁽⁶⁹⁾, whose aim is to offer users of these mobility hubs a wide range of electric vehicles, thus fostering the adoption of shared and electric mobility services.

Each Mobipoint in Dreux was designed as a **multimodal mobility hub located in the vicinity of a public transport node** (e.g., the railway station) and offered the following modes of shared transport: e-bikes, electric cargo bikes, and electric car sharing (the last modality in 2 locations out of 3). Regarding the utilization of the shared vehicles offered in Mobipoints, since they were launched, e-bikes were rented on average 15 times a day, while the shared e-cars had only a dozen regular users.



Netherlands Amsterdam, Rotterdam, Utrecht, Amstelveen

© Mobian

In the Netherlands, a network of 14 mobility hubs located at the outskirts of city centres was created, allowing to park a private car and switch to different services, mainly bikes in different varieties: city bikes, e-bikes and, cargo bikes. These mobility hubs (called MobiHubs⁽⁷⁰⁾) **operate in a Park & Ride manner** and enable private car users to park their cars for free if they book another mode of transport (a bike) in

⁶⁹ Source: https://www.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/#tab-1 70 Source: https://www.mobian.global/en/what-is-a-hub

advance. One of the main aims of the Dutch MobiHubs is reducing the car traffic in the city centre while offering a sustainable and efficient mobility option (a bike). The MobiHubs are available 24/7 and have the entire process automated and digitalized (through a dedicated mobile app): starting from reserving a parking space for the car, entering the car park (license plate recognition cameras opening the barriers), renting and returning the bike as well as processing the payment.



In the Netherlands, a network of 13 mobility hubs intended for electric shared mobility has been created as a part of the eHUBS project⁽⁷¹⁾ (10 hubs in Nijmegen and 3 hubs in Arnhem). These hubs offer the following modalities, all supplied by different shared mobility providers: e-bikes, electric cargo bikes, and e-cars (in most but not all locations).

Some initial difficulties in eHUBS' activities, apart from the negative impact of COVID-19 on the usage of mobility services in general, were related to electric bikes and vandalism/theft, as well as difficulties in charging the e-bikes. These issues have been sorted out through implementing another type of shared e-bikes (with docking stations preventing theft) as well as switching to the process of swapping empty batteries instead of re-charging them. With regard to the utilization of the vehicles offered in the Nijmegen-Arnhem eHUBS, a steady increase in use is being observed, however, no specific data is being disclosed, and the performance of mobility hubs is being further investigated.

⁷¹ Source: https://www.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/news/ arnhem-and-nijmegen-share-the-insights-of-its-research-on-behaviour-and-the-use-of-ehubs/



Belgium

© Groen

In Belgium, a network of over 40 mobility hubs has been created under the eHUBS project⁽⁷²⁾ in the City of Leuven. It is at the same time the currently most numerous known mobility hub project in Europe, with 25% of its users demanding more stations. The shared modalities available at Leuven's eHUBS contain a different combination out of the following modes: almost 40 e-bikes (concentrated at 6 major locations instead of multiple neighbourhoods as the battery swapping process turned out not to work well), electric cargo bikes, and more than 120 car sharing vehicles, including a minor share of 15 electric cars, which is to be extended by another 30 shared e-cars in the future based on a tender proceeding. The mobility hubs are also **located close to public transport nodes** (e.g., railway stations, bus stops) in order to enable a seamless shift from one transport mode to another. They sometimes also contain drop-off zones as well as parking infrastructure for private bikes.



In Bergen, several mobility hubs have been introduced since May 2018 as a result of the SHARE-north project⁽⁷³⁾ and with the primary aim to **make car sharing services more visible**, thus increasing their **accessibilit for citizens**, all this in order to increase the uptake of this effective mode of shared transport as an alternative to owning a private car. The mobility hubs in Bergen offer the following functionalities: public parking spaces reserved for car sharing vehicles (including electric shared cars), charging of privately

⁷² Source: https://www.nweurope.eu/projects/project-search/ehubs-smart-shared-green-mobility-hubs/news/ the-city-of-leuven-analyses-the-results-of-its-survey-for-ehubs-users-and-much-more/

⁷³ Source: https://share-north.eu/topics/mobility-hubs/

owned electric cars, bike sharing, bike parking incl. secured and roofed bike parking in some locations and, of course, the proximity to public collective transport. Both the concept and the design of mobility hubs in Bergen (called mobilpunkt) have been directly inspired by the mobil.punkte from Bremen, Germany. In 2021, the city of Bergen opened some new mobility hubs⁽⁷⁴⁾ proving that it is a vital and continuously supported way of promoting sustainable mobility.



The only not yet existing mobility hub example in this section of the Study comes from Great Britain, and more specifically, from Plymouth in the very south of England. It is being presented as a good example of **understanding the concept of multimodal mobility hubs**⁽⁷⁵⁾ **at the self-government level** and how it can benefit the local society in several dimensions (e.g., more sustainable mobility, reduced carbon footprint, and improved social bonds) as well as at the central-government level that has prepared measures supporting the implementation of eco-friendly solutions in the field of urban transport. Until 2023, Plymouth is intending to use the three-year grant period of the Transforming Cities Fund to facilitate 50 mobility hubs offering charging infrastructure for electric cars (300 charging points), 400 shared e-bikes, car sharing services, and some accompanying infrastructure such as solar car ports and secure bike parking, with all hubs planned to be strategically integrated into the public transport network.

⁷⁴ Source: https://www.bergen.kommune.no/hvaskjer/tema/vi-bygger-bergen/veier-byrom-og-parker/gronn-mobilitet/ her-bygger-vi-nye-mobilpunkt-i-2021

⁷⁵ Source: https://www.plymouth.gov.uk/parkingandtravel/transportplansandprojects/transportplans/transformingcitiesfund/mobilityhubs

7.3 Scope of services

When considering the scope of services to be included in mobility hubs, the focus should be on mobilityrelated services, that is, the movement of people and goods. There should be neither too few nor too many of them. Moreover, there doesn't seem to be just one format (and scope of services) suiting all possible mobility hub types and locations. Primarily, however, we would like to distinguish the below three key functional areas of mobility hubs:

- transport solutions:
 - shared mobility solutions (self-service) for both consumers (B2C) and businesses (B2B) incl. the emerging area of mobility services for gig workers;
 - public collective transport (nodes: stops/stations/P&R/parking);
 - MoD (Mobility-on-Demand): taxi/ride-hailing and/or ride-sharing pick-up and drop-off locations;
 - parking for privately owned micromobility (e.g., bike racks, bike repair station/tools, roofed shelters, secured boxes);
- **charging solutions** (hubs provide a natural home for publicly available charging infrastructure):
 - micromobility (plug-in or battery swap);
 - electric cars (plug-in) incl. parking space during the charging process;
- logistics solutions (adding freight/goods delivery functions to the mobility hub):
 - parcel delivery/collection points (for such vendors like InPost, Allegro, Amazon, courier companies, or the national provider of postal services);
 - parking spaces for couriers and delivery to/from parcel lockers.

Some other city-genic solutions, such as air quality monitoring or unified/standardized outdoor information/ media display, may also be perceived as a mobility hub enhancement, however, they should be considered optional and complementary to the core scope of mobility hubs. CoMoUK, for example, is outlining the following components of mobility hubs in its guidance:

- public transport & other pick up/drop off (e.g., bus/tram stop, taxi/ride-sharing);
- non-public transport, which is about shared mobility and its different modalities, e.g., bikes, cargo bikes, other micromobility (scooters, mopeds), and car sharing;
- mobility related components (e.g., chargers, parking infrastructure, signage/pillar);
- non-mobility & urban realm improvement (e.g., parcel delivery lockers).

Of course, they may also be other functions added to the mobility hubs, but would they then still remain mobility hubs? Therefore, the recommendation of this Study is to limit the range of services offered in mobility hubs to mobility-related services outlined above.

7.4 Mobility hubs' requirements

Creating mobility hubs and the entire networks of such will require fulfilling certain requirements, in particular with regards to the location of the mobility hubs and their functions. These requirements, partially inspired by the CoMoUK's set of guidelines on establishing mobility hubs, and broken down by

essential, recommended, and optional, have been presented in the table below, which also highlights some good practices for mobility hubs as well as selected must-have and good-to-have features.

Essential requirements	Recommended requirements	Optional requirement
 sufficient flow of users (due to sufficient density of residents, businesses and employers, universities, shops, tourists, and also passenger flows); 	 proximity to public collective transport node (a good link to existing modes of transport or gap filling); 	 additional services, e.g., logistics solutions;
 sufficient space (pragmatic assessment of what can be included, may be necessary to scale down to fit an area); 	 multiple self-service shared mobility services available, in different modalities; 	 additional street furniture;
 all day long (24/7) and all year long availability, if possible; 	guaranteed supply of shared vehicles;	 proximity to other neighbourhood functions;
 at least one self-service shared mobility service available in one modality; 	• easy and public availability with accessibility for all;	 parking spaces for corporate carpooling;
 periodically replenished fleet of shared vehicles; 	 remove barriers to encourage all users to interact with shared mobility, incl. people with disabilities; 	• a meeting point;
• a clearly designated space in the public realm;	digital access to the mobility services offered;	 parking spaces for private cars (applicable on P&R parking facilities);
• good visibility;	 integration of mobility hubs into route planners and maps; 	 mobile food units or vending machines.
appropriate branding;	 parking spaces for car sharing services; 	
• lighting;	 parking spaces for pick-up and drop-off of taxi/ride- hailing or ride-sharing services; 	
convenience;	• high-quality parking spaces for private micromobility;	
 compliant with the spatial plan; 	 power supply (access to electricity); 	
• clear message about the hub's benefit for the public usage.	charging solutions for electric vehicles;	
	 integrate mobility hubs into local SUMP and spatial planning; 	
	 survey on what do users need from mobility hubs, incl. a public consultation process; 	
	 social value (create opportunities for the local community to engage with); 	
	 consider using green-building features, e.g., solar panels, living roofs, rainwater retention, sustainable building materials (renewable, local), greenery, and biologically active surfaces; 	
	• design and execution with a minimal carbon footprint.	

Table 11 Mobility hubs' requirements

An important remark as to the **accessibility of mobility hubs** is that organizing them inside the areas/ properties with restricted/limited access (e.g., within guarded indoor car parks, inside fenced housing estates or office parks with access control, all of which are available only to a limited group of users), clearly weakens the accessibility of a particular mobility hub, thus also decreasing its potential to fulfil its core objectives. We should remember that one of the core features of both public and shared transport is its inclusivity. However, in-house mobility hubs for a limited number of users are also possible.

Another requirement outlined in the table above that needs some clarification is the **clear message about the benefit for the public** of mobility hubs for both users and non-users of mobility hubs, e.g., flexibility, freedom of choice, environmental contribution, saving on car ownership, etc. As CoMoUK states in its guidance, mobility hubs must work for the mainstream.

Also, it is very important to maintain **appropriate branding** of mobility hubs, which should provide legible and clearly visible markings and signage with repeatable design principles enhancing the quality of the public realm. A common and strong brand and signage across the network of mobility hubs helps to be better understood by the users and is also a great promotional tool to encourage new users and help them to better understand the shared mobility opportunities in multiple locations. Moreover, each mobility hub should also have its unique name so that it is set in a local context and differs from other mobility hubs.

For optimal impact, mobility hubs should be planned as a whole **network of mobility hubs**, aligned with public collective transport nodes (fitting the mobility hubs into the public transport network) as well as other spatial/functional requirements. CoMoUK underlines in its guidance that "in many areas the development of mobility hubs may be an incremental upgrade of sites as new shared transport opportunities arise, such as new developments and refurbishment of existing nodes and routes."

As for the safety issues, as mobility hubs are likely to attract some level of vandalism (as all public realm infrastructure), the following measures can be employed: adequate lighting, continuous camera surveillance, or enhanced security.

CoMoUK has also developed a set of 6 factors to be considered in order to build a **successful mobility hub**, which are also taken into account during the mobility hub's accreditation process:

- good visibility and accessibility with mobility hubs being a clear part of the transport network and accessible to all;
- sustainable modes of transport with mobility hubs including public and shared modes of transport and with proper consideration of the needs of pedestrians;
- ease of switching between modes with the mobility hubs ensuring easy access between different modes, both physically and digitally;
- safety with the mobility hubs creating a safe environment for the travellers;
- practical facilities with the mobility hubs offering other non-transport related functions;
- visual, social, and community appeal with the mobility hubs being a positive addition to the neighbourhood incl. their social impact.

When it comes to the requirements that are enforced in mobility hubs, it is also good to indicate the aspect of opening up to different groups of users and adapting the hub's space accordingly:

- individuals (consumers) from the mobility hub's neighbourhood, for both private and professional purposes, e.g.:
 - residents of the surrounding housing estates,
 - employees and guests of nearby companies/offices,
 - clients and personnel of local shops/malls,
 - customers and personnel of local restaurants,
 - people using local public services (administration, health)
 - students and visitors of educational/scientific institutions, incl. dormitories,
 - visitors of touristic attractions in the neighbourhood, if present,

- visitors of local events (both cultural events and others, such as fairs and conferences),
- guest of nearby hotels and apartments for rent,
- other external consumers (random users),
- gig workers delivering food and goods to the neighbourhood (they can park/lock/charge their vehicles: e-bikes, e-mopeds, or swap batteries in the mobility hub);
- drivers of MoD-type (Mobility-on-Demand) services such as taxi-/ride-hailing and ride-sharing;
- people commuting and using the mobility hub as a transfer point to change modalities;
- non-users of shared mobility, but willing, for example, to use other services of the hub such as parking, locking and/or charging their own electric vehicles (both micromobility: bikes, scooters, mopeds, as well as regular cars), or parcel delivery lockers.

7.5 Cost assessment

Of course, the key to assessing the costs of creating and running mobility hubs will be their factual scale and scope, especially whether they require a power supply and installation of some electrical devices (such as chargers, for instance), or not – this factor may double or even triple the costs, as per the calculations presented below. Still, these mobility hubs' fit-out costs are only related to the actual execution of the design and construction works, while the costs of running the entire business should also be taken into account. Moreover, creating viable contracts between all parties involved (the real estate owner, the mobility hub provider, all the providers of the services available in the mobility hub) is also a considerable cost and sometimes a real challenge. Lastly, but definitely not least importantly, there is also the cost of acquiring the legal title to dispose of the real estate where the mobility hub is organized. This element may also be a game-changer for the economic viability of the entire concept. The designated land may be a sort of an in-kind contribution to the mobility hubs' endeavour, and therefore will not impact the budget, but it may also require paying for the lease of the land, even if only at discounted rates – especially when it is public land where certain regulations apply.

Some other challenges associated with the implementation of mobility hubs, and not purely related to monetary expenditures, but still important to consider, concern, for example, the ability of shared mobility providers to cooperate and contribute to the mobility hub project (in case they don't see enough value in it), or the restrictions when signing an agreement with a public entity and the necessity to meet all the requirements resulting from this fact (e.g., tender and equal-treatment procedures).

But, looking at the **capital and operational expenditures**, the costs associated with implementing and running mobility hubs could be as presented in the table below. The data comes from the mobility hubs provider that launched and manages the only multimodal mobility hub in Warsaw, which was also included in the SmartHubs Project for the years 2021-2022.

Capital expenditures	Estimation in EUR	Operational expenditures	Estimation in EUR
fit-out costs (per single location):	9,523	business running costs (annual):	32,953
basic materials	4,681	personnel (3-4 FTE, annual)	76,596
design & construction works	3,298	marketing & PR (annual)	29,617
restoration costs at end of contract	1,545	repairs & maintenance of hubs (annual per single location)	936
charging infrastructure (per single location):	16,330	discounted lease of land (annual per single location)	638
power supply	4,255		
micromobility charger (1x)	3,404		
car charger (1x)	6,383		
design & construction works	2,287		
TOTAL (per single location):	25,853	TOTAL:	140,740

Table 12 Example capital and operational expenditures for a single mobility hub

The above general calculation shows that the required investment (capital expenditure) for creating one mobility hub (an average area of 50 m² was assumed, equivalent to 4 regular parking spaces for cars, incl. the cost of restoration of the land to the previous state after expiration of contract) **ranges from approx. EUR 10,000 to 26,000**, depending on whether it is necessary to supply electricity and install chargers. Assuming there would be a whole network of mobility hubs, the costs could look as follows (an increase in annual fixed operational expenditures was also assumed):

Number of	Capital	Operational	Total costs depending on the durability of the project			
mobility expenditu hubs in EUR	expenditures in EUR	in EUR (annual)	1 year	4 years	8 years	15 years
1	25,853	140,740	166,594	588,815	1,151,777	2,136,960
average annual total cost per 1 hub:		cost per 1 hub:	166,594	147,204	143,972	142,464
10	258,532	154,911	413,443	878,174	1,497,817	2,582,191
average annual total cost per 1 hub:			41,344	21,954	18,723	17,215
50	1,292,660	287,472	1,580,132	2,442,549	3,592,438	5,604,745
average annual total cost per 1 hub:			31,603	12,213	8,981	7,473
200	5,170,638	662,809	5,833,447	7,821,872	10,473,106	15,112,766
average annual total cost per 1 hub:		29,167	9,777	6,546	5,038	
500	12,926,596	1,343,898	14,270,494	18,302,187	23,677,779	33,085,064
average annual total cost per 1 hub:		28,541	9,151	5,919	4,411	

Table 13 Example capital and operational expenditures for a network of mobility hub

From the above, we can clearly see that the larger the scale of the project (that is, the number of mobility hubs) and the longer its durability, the greater the **efficiency of investment per hub** varying from even as much as EUR 166,000 per hub (in case of a 1-year project with just one mobility hub) to as few as EUR 4,400 per hub (in case of 500 mobility hubs and a 15-years long project, which is also the maximum statutory

length of a services concession in Poland). And what may be even more important, the **scale and durability** of the project will allow the project to be valued higher by all of its partners/stakeholders (the real estate owner/s, the mobility hubs operator, and all the suppliers of services available in the mobility hubs), thus increasing its economic viability, which in a long run may be the ultimate solution to successfully introduce a network of mobility hubs in a given city.

When looking for benchmarks regarding the costs, the following European examples can be of inspiration:

- Bremen estimates the cost of creating a single mobility hub (capital expenditure) in a range of EUR 5,000-40,000⁽⁷⁶⁾;
- Vienna foresees an investment of EUR 15 million to create approx. 90 mobility hubs, which gives an average of almost EUR 170,000 per one mobility hub, assuming both capital and operational expenditures.

7.6 Possible forms of implementation

When discussing possible forms of implementation of mobility hubs, an obvious question will be raised, concerning the ownership of mobility hubs or rather even the **ownership of the process of setting up mobility hubs**. Who will claim to be the main decision maker? And it seems there is no single good answer. It is rather about different stakeholders, who all create and impact the so-called public realm:

- cities/municipalities/regions the public sector at the self-government level,
- public institutions representing the State the public sector at the central-government level,
- transport operators (with all the transport nodes they have under their disposal),
- owners and managers of particular real estate (office buildings, retail, hotels, housing estates, others),
- petrol stations shifting more and more towards alternative and electricity fuelled mobility,
- private companies and employers,
- special ventures, such as mobility hub providers, who put all pieces of the puzzle together in order to create and run a consistent network of mobility hubs in a city or neighbourhood.

When analysing the possible forms of implementation of mobility hubs, it is easy to distinguish two basic formulas, depending on which sector – public or private – initiates the whole process. If we recognize that for the success of the concept of mobility hubs, it will be necessary to include the public sector, we will have to look for **forms of implementation that fit into the scope of its activities**. This Study provides much evidence for such an approach, especially as the core objective of mobility hubs – which in short can be described as bringing to urban areas a sustainable mobility alternative to owning and using a private car – is very much in line with long-term public strategies on climate neutrality and quality of life on practically all decision-making levels: the European Union, national programs as well as local (municipal/regional) policies.

On the other hand, the concept of mobility hubs can also be developed as a **project independently from the public sector**, although contributing to co-creating the public realm. If such an approach is adopted, it

⁷⁶ Source: https://www.vcd.org/themen/multimodalitaet/beispiele/mobilpunkt-bremen/

will be possible to shape the principles of cooperation in a simpler way, in accordance with best practices used in business relations, without restrictions related to the management of public funds. And we will also find quite a few attempts of implementing mobility hubs in this very formula. Still, this approach has quite a limited potential, and this is because it is the municipality that has the greatest power to implement solutions on a city-wide scale. None of the mobility market stakeholders, no matter how big, have such a network of roads, parking spaces, bike paths, sidewalks, and transport nodes available in comparison to the city administration and its entities (e.g., public collective transport operators). However, it should also be noted that private property owners have very attractive lands, as well as the required resources and power that can perfectly complement the public realm through setting up innovative and high-quality features, such as mobility hubs, for instance.

All this leads to a clear and obvious conclusion: for the best effect, the concept of mobility hubs should be developed in cooperation between the public and the private sectors. For this reason, this Study proposes in its other chapters a legislative action to define shared mobility as a separate category of transport. This would also allow a more successful development and implementation of the mobility hubs concept. Even though it is not a necessary condition to implement the idea of mobility hubs, it would facilitate the entire process.

When taking into account the possible forms of implementation of mobility hubs within the framework of the cooperation between public and private entities – but not limited to them – the following should be mentioned:

- Municipal network of mobility hubs awarded as a public contract and very much suiting a public-private partnership (PPP) scheme (for example, a services concession) allowing both parties to establish a long term cooperation where every party is responsible for certain parts of the enterprise consistent with its core competencies (e.g., the public sector is providing locations for mobility hubs in the public realm and access to electricity, as well as supplementing mobility hubs with bike sharing stations of the municipal bike sharing system, if applicable, and the private sector is building a viable business model on top of these locations, assuming that both public and private goals are met. The public goal would, of course, be to provide the citizens with an undisturbed and reliable alternative to private car ownership through disseminating multimodal mobility hubs, whereas the private goal would be to run an economically viable business activity together with a number of further partners (e.g., shared mobility providers, MaaS platform providers and/or suppliers of other services available in mobility hubs).
- **Municipal network of mobility hubs** developed in less tight regulatory framework than public procurement, e.g., based on a Memorandum of Understanding (MoU) or a permit, license, agreement, or lease specially adopted and granted for the purpose of setting up and running mobility hubs.
- Stand-alone network of mobility hubs implemented by a sole party/entity (also applies to municipalities), whether public or private (in case of public entities outsourcing/contracting services is subject to public procurement), where:
 - all actions remain managed and executed in-house for direct control,
 - some parts of the activities are outsourced to a third party (particular suppliers/vendors),
 - all of the actions are outsourced to a specialized mobility hub provider/operator (hands-off approach).

7.7 Possible business models

The possible business models will depend on a number of factors, among others, the ownership of land intended to be used for the purpose of mobility hubs, as described in the previous section of this chapter. Another vital aspect will be the **revenue generation and the question of who pays whom for what**.

Sharing expenses

Setting up mobility hubs involves both **capital and operational expenditures**. It seems justified to share these expenses between the partners involved in the execution of the project, **in accordance with their scope and role in the project**. For example, expenses for permanent changes made to the real estate (e.g., power supply, lighting, parking bay/space, street furniture, greenery, and other improvements), which will remain durable even after the project is eventually completed, and which create the so-called public realm and also increase the value of the land (and neighbourhood), would be incurred directly by the property owner (e.g., municipality, transport/parking operator, commercial real estate owner, housing estate, etc.), as it will be the property, that will benefit from having the mobility hub on its premises, e.g., through an increased footfall, a better quality/functionality of the real estate for its customers, etc. According to CoMoUK, the public entities "tend to fund the public realm" while "the individual transport operators would cover their own infrastructure and operating costs." Of course, public subsidies/grants can also support the creation of mobility hubs, especially their initial investment or their pilots, but as we are looking for a healthy business model, they are not considered in this Study as part of the project development.

On the other hand, capital expenditures related strictly to organizing the mobility hubs, and only temporarily connected to the ground (e.g., branding and signage, information pillars, some relevant street furniture, etc.), would be incurred either by the mobility hubs operator or directly by those of the suppliers, who require installing in the mobility hubs costly infrastructure (e.g., chargers for electric vehicles or other devices) in order to generate revenues. Of course, the property owner alone may also want to invest in various types of infrastructure (e.g., chargers) and will then also be the sole party benefiting from, for example, the sale of energy.

When considering the **operational expenditures** of mobility hubs, it is recommended that these should follow exactly the same rule as the capital expenditures. This means that the project partners should cover the costs that correspond to their scope and role in the project, for example, expenses for providing relocation and maintenance of vehicles and/or other related infrastructure (e.g., chargers),would be incurred directly by the suppliers of these services, as it is them, who will benefit from offering these services in a mobility hub, e.g., through keeping 100% of the revenues from the sale of the offered services.

On the other hand, operational expenditures related strictly to managing the mobility hubs would be incurred either by the mobility hubs' operator (the entity with a majority stake in the responsibilities) or directly by the property owner. However, that does not change the fact that they would still need to be justified and cost-efficient, e.g., paying for the facility management services, which would have been performed anyway, even if the mobility hub had not been established yet (e.g., cleaning, maintenance of the real estate's assets, or some other technical activities).

Sharing revenues?

The mobility hubs are designed to provide a smart mobility solution, but they are also meant to become a smart and cost-effective business solution based on win-win principles of the partners' cooperation and mutual complementation of their core competencies and aims. As a general rule, if a party is to bear the costs related to its scope on its own, it would also have the right to exclusively derive the benefits from the same scope (incl. the entirety of revenues), with the following key examples:

- scope of the real estate: the real estate (and/or city) is investing in the mobility hubs and its further operation, but also gets to experience the impact of this investment on their own business, e.g., resulting from increase of the value of the property (and neighbourhood), marketing and promotion of the real estate, more satisfied customers (and citizens), higher value of lease/sale contracts, higher footfall, etc.;
- scope of the providers offering shared mobility services (or other): suppliers of different types of services are investing in the mobility hubs, and its further operations (e.g., through deploying a fleet of vehicles and/or other infrastructure), but then also get to experience the impact of this investment on their own business, e.g., resulting from revenues from sales generated by their services, marketing, and promotion of their services, more satisfied and newly acquired customers as well as the increase in the value of their businesses achieved through establishing new partnerships, regardless of whether they are made with public administration or with other industry players.

In the above context, the mobility hub as such (or rather the mobility hub provider/venture) acts as a sort of **an intermediary platform, a facilitator and an actual re-seller of the services available in the mobility hub**, whether related to shared mobility or other types of services (e.g., charging, parcel lockers), to some extent also handling the mobility hubs' daily operations and maintenance, and shall be therefore entitled to remuneration from all the parties involved: the property (or the city) itself as well as the providers of the services offered in a particular mobility hub. What is important the mobility hubs provider is also a partial investor in the whole proceeding, which guarantees that it will operate in its best interest, meaning also the best interest of all the partners involved.

Of course, in the approach proposed above, the weight of particular components/scope (contributions to the project) may be subject to detailed arrangements between the partners so that the entire project has a chance to be implemented and allows each party to achieve its basic goals. Still, while discussing possible business models for mobility hubs, it is important to outline the **stakeholders who can benefit**

- from mobility hubs, thus might be open to contributing to the project:
 - cities/municipalities/regions willing to offer their citizens improved mobility offerings and better quality of life;
 - public collective transport operators willing to attract more passengers and offer them a broader scope of multimodal mobility offerings they can switch to;
 - owners or managers of particular real estate (offices, retail, hotels, housing estates) willing to increase the value of the property and enhance the range of services for its customers;

- companies and institutions, both public and private, acting as large employers willing to provide their employees with improved mobility solutions, but also to fulfil CSR and ESG strategies;
- companies providing services in the mobility hubs, e.g., shared mobility solutions, charging solutions, logistics solutions, or others – willing to acquire new customers, generate more revenues, improve market penetration and increase the value of their service/brand;
- Last, but not least, the policy makers whose aim is to take climate action and foster sustainable urban mobility (according to CoMoUK, "government funding can help to subsidise investments, especially as mobility hubs can be shown as a support in facilitating a number of key policies such as reducing carbon emissions, congestion, and pollution, and encouragement for an active travel").

The possible business model may also vary depending on the type/scope of services available in a mobility hub. These have been outlined in one of the previous sections of this chapter.

7.8 Risk analysis

The implementation of any project must be preceded by a risk analysis. The basic risks for the implementation of mobility hubs in Warsaw have been presented and described in the tables below. They contain the following aspects of particular risks: their type, importance, probability of occurrence, and methods of mitigation.

	risk type	probability of occurrence	risk description	risk mitigation
	in al an antation		length of administrative procedures for obtaining power supply for mobility hubs	a project coordinator on the city side with appropriate empowerment and project priority
	Implementation		efficient implementation of the project on the city side, incl. public procurement methods	using those city resources (people, projects) that already have PPP-type experience
	demand		limited demand for shared mobility services due to seasonality	decreasing the supply of vehicles impacted with lower demand during low seasons (e.g., winter)
щ	operations	HIGH	inappropriate selection of locations for mobility hubs and some of them underperforming	design a cost-effective (asset-light) fit-out for mobility hubs allowing to switch/adjust locations on the go (based on current performance)
HIGH IMPORTANC			proper and timely recognition of the project among the decision makers in Warsaw	dialogue with the decision makers supported by other stakeholders (e.g., international, domestic)
	policy		lack of regulatory framework for shared mobility services	supporting the legislative initiatives outlined in the Study in order to create shared mobility as a separate official category of transport
	implementation	MEDIUM	length of administrative procedures for obtaining the land/site for mobility hubs	a project coordinator on the city side with appropriate empowerment and project priority
M TO	demand		limited demand for shared mobility services due to weather conditions	roofing those vehicles which are the most exposed to the weather conditions (especially micromobility)
MEDIUN	operations		inadequate size of a mobility hub and the range of services offered	design a modular fit-out for mobility hubs allowing to adjust their size and scope of services offered (based on current performance and development)
			social dissatisfaction e.g., due to the replacement of private car parking spaces with a mobility hub	dialogue with the local community about the project's goals and its benefits for the city/neighbourhood
	implementation		insufficient number of potential project partners from the private sector (e.g., shared mobility providers)	the larger the scale of the project (e.g., a whole network of mobility hubs), the greater its value for partners
	force majeure	LOW	force majeure	foreseeing force majeure in mutual arrangements between the project partners allowing them to exit safely

Table 14 Analysis of medium to high importance risks for implementing mobility hubs in Warsaw

	risk type	probability of occurrence	risk description	risk mitigation
NCE	нідн		disruptions in the functioning and availability of mobility hub due to e.g., demonstrations	ongoing cooperation with the city regarding planned demonstrations and other exclusions in the public realm
operations	operations		damage caused to the vehicles or infrastructure of mobility hubs due to e.g., vandalism	insuring the project, locating mobility hubs in safe locations with the assets-light fit-out, introducing measures increasing safety, e.g., lighting, surveillance
		MEDIUM	limited or interrupted workforce due to COVID- 19 and/or other reasons	teamwork with the possibility of full replacements and remote work
TO LOV	demand		lack of social understanding of the purposes and functions of mobility hubs	introducing proper branding of mobility hubs (delivering the key messages to the public realm) and running social campaign, fostering shared mobility
		1000	limited demand for shared mobility services due to COVID-19	increased disinfection of vehicles and campaign to support shared individual means of transport
D policy		LOW	inconsistency of the project goals with the city's strategic goals	direct entry of the concept of mobility hubs into the Municipal Strategic Documents

Table 15 Analysis of medium to low importance risks for implementing mobility hubs in Warsaw

From the above tables it can be deduced that some of the major risks for optimal implementation of the mobility hubs concept in Warsaw are not related to operational challenges, but rather to the internal ability of the city of Warsaw to **recognize the project's potential and importance**, and then to implement it efficiently. The feasibility of the project should also be assessed by the city of Warsaw, especially as the project is very much in line with the Municipal Strategic Documents.

All other circumstances for the project, including its financial viability, are theoretically available and favourable, and only need to be properly managed. Moreover, the identified project risks are relatively easy to be reasonably mitigated, assuming there will be an understanding of what kind of benefits are delivered by the mobility hubs to the public realm and how they can contribute to making urban mobility more sustainable. In conclusion, the key to the success of the project and discovering its full potential is convincing the city to engage in a **joint implementation** of the project as all other aspects can then be properly managed.

7.9 Appropriate locations for mobility hubs

Before going into more detail of the aspect of appropriate locations for mobility hubs, the important question is, **how many of these mobility hubs should there be in a city?** A reference here could be the approach of the Belgian car sharing industry organization , whose strategy assumes one mobility hub for every 2,000 inhabitants in more densely populated urban areas and one mobility hub for every 1,000 inhabitants in less densely populated urban areas. Taking a closer look at the 18 city districts of Warsaw, that are populated more or less densely, and adopting a similar approach towards the relationship between the number of mobility hubs and the population density (1,500 inhabitants for one mobility hub as the benchmark for the Warsaw's average population density), we come to the figure of almost 1,200 mobility hubs that could be created in the city, if they were to reach 100% of the population in the entire administrative area of the city. A scenario of establishing in Warsaw almost 1,200 mobility hubs located in less densely populated areas of Warsaw. Therefore, this Study proposes a downward adjustment of 37% on the aforementioned total number of mobility hubs, comprising of a slight increase in the number of mobility hubs in the most densely populated city districts (in order to better distribute the demand locally) as well as a noticeable

decrease in the number of mobility hubs in the less densely populated city districts (in order to increase the utilization of these mobility hubs, thus improving the performance of the entire concept). The proposed adjustment assumes taking the population density level of 5,500 inhabitants per 1 km² and treating it as a threshold to either increase or decrease the number of mobility hubs in given city districts. These calculations **estimate the number of mobility hubs for Warsaw at approx**. **750** and have been presented in the table below.

Warsaw city districts	number of inhabitants	area (km²)	population density	inhabitants for 1 mobility hub	number of mobility hubs	number of mobility hubs after adjustment	adjustment increase or decrease
Mokotów	217,424	35	6,138	2,654	82	91	12%
Praga-Południe	180,066	22	8,046	3,479	52	76	46%
Ursynów	151,288	44	3,455	1,494	101	64	-37%
Wola	142,694	19	7,409	3,204	45	60	35%
Białołęka	132,281	73	1,811	783	169	56	-67%
Bielany	130,848	32	4,046	1,750	75	55	-26%
Bemowo	125,270	25	5,021	2,171	58	53	-9%
Targówek	124,742	24	5,150	2,227	56	52	-6%
Śródmieście	111,338	16	7,151	3,092	36	47	30%
Ochota	82,018	10	8,438	3,649	22	34	53%
Wawer	79,078	80	992	429	184	33	-82%
Praga-Północ	63,442	11	5,555	2,402	26	27	1%
Ursus	62,399	9	6,667	2,883	22	26	21%
Żoliborz	52,907	8	6,246	2,701	20	22	14%
Włochy	44,343	29	1,549	670	66	19	-72%
Wilanów	43,423	37	1,182	511	85	18	-79%
Wesoła	25,926	23	1,130	489	53	11	-79%
Rembertów	24,679	19	1,279	553	45	10	-77%
Totals and averages:	1,794,166	517	3,469	1,500	1,196	754	-37%

Table 16 Area and population density of the city districts of Warsaw as of the end of 2020, source: Central Statistical Office

Another reference for the **density of mobility hubs** in a city can be the approach developed in the German city of Bremen that has almost 20 years of experience in setting up mobility hubs in the public realm. This approach assumes establishing a network of mobility hubs with a **maximum distance** of 300 meters between them. If we were to evenly designate such a network of mobility hubs in Warsaw, taking into account only the built-up and urbanized area of the city (51% of the administrative area of Warsaw, excluding green, agricultural and non-defined areas), it would mean that there would have to be almost 5,900 mobility hubs in Warsaw. In order to achieve a total of approx. 750 mobility hubs, as indicated in the previous calculation, mobility hubs would need to be designated with an approx. average distance of 840 meters between them. That is almost 3 times less densely compared to the Bremen guidelines.

The **typology of mobility hubs** depends on various factors, e.g., the location of the mobility hub or its dominant function. The basic typologies have been presented in the table below.

By location	By function	Distinguished by CoMoUK
 city centre or city district's centre mobility hubs; 	 high demand mobility hubs to cope with an increased demand for shared mobility; 	 large interchange or city centre mobility hubs;
 public transport nodes mobility hubs (e.g., at railway/metro stations, bus/ tram stops or P&R parking facilities); 	 interchange mobility hubs allowing easy switch between transport modes; 	 transport corridors, smaller interchanges or linking mobility hubs;
 rural areas and/or suburbs mobility hubs; 	 public realm mobility hubs (implemented e.g., due to safety concerns, parking clutter, regulatory issues); 	 business park or new housing development mobility hub;
 housing estates mobility hubs; 	• first/last mile connection mobility hubs;	• suburbs or mini mobility hubs;
 commercial real estate mobility hubs (e.g., offices, retail, hotels). 	 recreational, leisure, or touristic mobility hubs; 	 small market town or village mobility hubs;
	 seasonal and/or temporary mobility hubs (e.g., only during events, holidays); 	• tourism mobility hubs.
	• mobility hubs enhanced with a particular function, e.g., parcel delivery.	

Table 17 Selected typologies of mobility hubs

Some other typologies of mobility hubs, also impacting their location, are determined either by the ownership of land (with the simplest division into publicly owned and privately owned, and with definitely fewer public formats possible, e.g., more opportunities for municipal mobility hubs in comparison to private ones) or the size/scale of a mobility hub (from large and extensive multimodal mobility hubs combining public and shared modes of transport with accompanying services, either relevant for transport or not, to small-sized and compact mobility hubs combining sometimes only as few as two modalities). There is also no "one size fits all" design for mobility hubs, but rather the necessity to adapt its functions to local needs and the space available.

But what are the **most appropriate locations** for mobility hubs? If we take as a measure of success just the demand for services available in the mobility hubs and their utilization, expressed as the number of hub users (and this approach seems to be the most justified and also allowing to measure the hubs' performance as well as to compare it between different hubs), the mobility hubs should strive the possibly highest demand/utilization of the services offered, whether that's public or shared transport. And seen from this perspective, the most appropriate (or most effective) locations for mobility hubs will be places that guarantee a large footfall, e.g.:

- interchange transport nodes (in particular those that allow convenient onward travel in different directions and using different modalities);
- city centre (or city district centre) locations in the immediate vicinity of objects generating the largest footfalls (e.g., public services, workplaces, shopping, etc.)
- large housing estates with high population density;
- crowded commercial real estate (buildings and/or areas with a high saturation of office, retail and accommodation functions, either mixed-use or monofunctional objects).

Still, the concept of mobility hubs is far not only about footfall and utilization. It is also very much about making urban transport more inclusive, environmentally friendly, and minimize its negative impact on our neighbourhoods. Also, an important feature of mobility hubs is to initiate a massive transformation needed in terms of the urban mobility behaviour and the way people move around in cities through offering an alternative to private car ownership. And in this context, the **location of mobility hubs is also part of the local transport policy** and cannot be measured solely by the utilization rate, as if it was a purely commercial project. This justifies a public intervention and support provided for setting up multimodal mobility hubs. According to CoMoUK, mobility hubs are already seen by some regions/cities (e.g., Flanders and Bergen) as "key drivers of shared transport uptake and a resultant reduction in private car use."

7.10 Fitting mobility hubs in local public transport network

Now looking into the most appropriate locations for mobility hubs in the city of Warsaw, apart from keeping them as evenly distributed as possible (where justified), first of all, they should fit into the local public transport network, meaning the **proximity of mobility hubs to key public collective transport nodes**: metro and railway stations, major interchange stations, bus and tram loops, the airport, municipal car parks (incl. P&R parking facilities) and some key road intersections. Then, mobility hubs should be located in the most important points of the city centre and city district centres (incl. public utility buildings, universities, hospitals, sports facilities, cultural objects, cemeteries, parks, etc.), at the largest housing estates (areas with the highest population density or the largest and compact estates), next to the largest commercial facilities (offices, shopping malls, and retail centres, hotels, etc.), which perfectly complement the public realm suiting the local communities, as well as next to large employers (e.g., industrial plants or headquarters of large companies and institutions). All these categories have been indicated on the chart below, the following set of maps and described in the accompanying tables.



Figure 19 Mobility hubs in Warsaw by category

The two largest categories (**housing estates and public utilities**) account for more than half (52%) of all of the locations, however, it should be emphasized that some other locations (e.g., retail or public transport nodes) are often also located within intensive housing areas but have been proposed as good locations for mobility hubs that will complement the public realm and also allow many stakeholders (both public and private) to get involved into creating the network of mobility hubs in Warsaw.

The list of potential locations for mobility hubs in Warsaw presented in this section of the Study contains approx. 750 selected locations and does not exhaust the list of all potential locations for mobility hubs in Warsaw. It has been prepared as a benchmark for the calculations presented above and for the purpose of further investigations once the endeavour is assessed in more detail prior to its eventual implementation.



Figure 20 Map of Warsaw with an overview of all of the proposed locations for mobility hubs

Subsequent sets of maps and tables, presented on the following pages, will concern the possible location of mobility hubs within different categories.



Figure 21 Map of Warsaw with mobility hubs for the category of housing estates

Category	Name	Status
Housing estates	Wilanów/Sarmacka- peak population density	Existing
Housing estates	Bemowo/Wrocławska- peak population density	Existing
Housing estates	Bemowo/Pełczyńskiego- peak population density	Existing
Housing estates	Bemowo/Świetlików- peak population density	Existing
Housing estates	Ursus/Zagłoby- peak population density	Existing
Housing estates	Ursus/Chełmońskiego- peak population density	Existing
Housing estates	Włochy/Radarowa- peak population density	Existing
Housing estates	Ochota/Mołdawska- peak population density	Existing
Housing estates	Ochota/Grójecka- peak population density	Existing
Housing estates	Ochota/Dorotowska- peak population density	Existing
Housing estates	Ochota/Słupecka- peak population density	Existing
Housing estates	Wola/Olbrachta- peak population density	Existing
Housing estates	Wola/Żytnia- peak population density	Existing
Housing estates	Wola/Chłodna- peak population density	Existing
Housing estates	Wola/Anielewicza- peak population density	Existing
Housing estates	Wola/Wolność- peak population density	Existing
Housing estates	Bielany/Broniewskiego- peak population density	Existing
Housing estates	Bielany/Kwitnąca- peak population density	Existing
Housing estates	Bielany/Tołstoja- peak population density	Existing
Housing estates	Bielany/Wrzeciono- peak population density	Existing
Housing estates	Bielany/Przy Agorze- peak population density	Existing
Housing estates	Bielany/Godowska- peak population density	Existing
Housing estates	Żoliborz/Elbląska- peak population density	Existing

Housing estates	Żoliborz/Sarbiewskiego- peak population density	Existing
Housing estates	Śródmieście/Dubois- peak population density	Existing
Housing estates	Śródmieście/Grzybowska- peak population density	Existing
Housing estates	Śródmieście/Tamka- peak population density	Existing
Housing estates	Śródmieście/Górnośląska- peak population density	Existing
Housing estates	Śródmieście/Wilcza- peak population density	Existing
Housing estates	Śródmieście/Plac Zbawiciela- peak population density	Existing
Housing estates	Mokotów/Podchorążych- peak population density	Existing
Housing estates	Mokotów/Piaseczyńska- peak population density	Existing
Housing estates	Mokotów/Dąbrowskiego- peak population density	Existing
Housing estates	Mokotów/Ligocka- peak population density	Existing
Housing estates	Mokotów/Etiudy Rewolucyjnej- peak population density	Existing
Housing estates	Mokotów/Malczewskiego- peak population density	Existing
Housing estates	Mokotów/Gołkowska- peak population density	Existing
Housing estates	Mokotów/Sobieskiego- peak population density	Existing
Housing estates	Mokotów/Egejska- peak population density	Existing
Housing estates	Mokotów/Sonaty- peak population density	Existing
Housing estates	Mokotów/Śniardwy- peak population density	Existing
Housing estates	Mokotów/Modzelewskiego- peak population density	Existing
Housing estates	Ursynów/KEN- peak population density	Existing
Housing estates	Ursynów/lastrzebowskiego- peak population density	Existing
Housing estates	Ursynów/Dereniowa- peak population density	Existing
Housing estates	Lirsynów/Braci Wagów- peak population density	Existing
Housing estates	Lirsynów/Belgradzka- neak nonulation density	Existing
Housing estates	Ursynów/Bronikowskiego- peak population density	Existing
Housing estates		Existing
Housing estates	Wawer/Kerkewa, peak population density	Existing
Housing estates	Praga Pld /Kwiatkowskiego, neak population density	Existing
Housing estates	Praga Pld / I mińskiego- peak population density	Existing
Housing estates	Praga Pld /Poligonowa, poak population density	Existing
Housing estates	Praga Pld /Sacka, poak population density	Existing
Housing estates	Praga Pld /Eginska, poak population density	Existing
Housing estates	Praga Pid./Egipska- peak population density	Existing
Housing estates	Praga Pid./Majuariska- peak population density	Existing
Housing estates	Praga Md./Czapelska- peak population density	Existing
Housing estates	Praga Pid./Nobielska- peak population density	Existing
Housing estates	Praga Pid./wspoina Droga- peak population density	Existing
Housing estates	Praga Pid./Łukowska- peak population density	Existing
Housing estates	Praga Pin./Ząbkowska- peak population density	Existing
Housing estates	Praga Pfn./ Iarchominska- peak population density	Existing
Housing estates	Praga Pin./Stalowa- peak population density	Existing
Housing estates	Praga Pin./Szymanowskiego- peak population density	Existing
Housing estates	iargowek/Ussowskiego- peak population density	Existing
Housing estates	iargowek/szczepanika- peak population density	Existing
Housing estates	Iargowek/Rembielińska- peak population density	Existing
Housing estates	iargowek/Nieszawska- peak population density	Existing
Housing estates	largowek/Łojewska- peak population density	Existing
Housing estates	largowek/Suwalska- peak population density	Existing
Housing estates	largowek/Krasiczyńska- peak population density	Existing
Housing estates	Białołęka/Skarba z Gór- peak population density	Existing
Housing estates	Białołęka/Porajów- peak population density	Existing
Housing estates	Białołęka/Erazma z Zakroczymia- peak population density	Existing

Housing estates	Białołęka/Ordonówny- peak population density	Existing
Housing estates	Białołęka/Trąby- peak population density	Existing
Housing estates	former Empark	Plan
Housing estates	Pozytywny Mokotów	Existing
Housing estates	Re:set	Existing
Housing estates	Hubertus	Existing
Housing estates	Moduo Apartments	Existing
Housing estates	Marina Mokotów	Existing
Housing estates	Santorini	Existing
Housing estates	Nowy Raków	Existing
Housing estates	Vis a Vis Wola	Existing
Housing estates	Bliska Wola	Existing
Housing estates	19. dzielnica	Existing
Housing estates	Wiślany Mokotów	Existing
Housing estates	Moje Miejsce	Existing
Housing estates	Central Park Ursynów	Existing
Housing estates	Fort Służew	Existing
Housing estates	Ursynów/Kazury neighbourhood	Existing
Housing estates	Ursynów/Małej Łąki neighbourhood	Existing
Housing estates	Ursynów/Migdałowa neighbourhood	Existing
Housing estates	Ursynów/Cynamonowa neighbourhood	Existing
Housing estates	Ursynów/Herbsta neighbourhood	Existing
Housing estates	Wilanów/Rzeczypospolitej neighbourhood	Existing
Housing estates	Wilanów/Lentza neighbourhood	Existing
Housing estates	Mokotów/Wilanowska neighbourhood	Existing
Housing estates	Mokotów/Pory neighbourhood	Existing
Housing estates	Mokotów/Dąbrowskiego neighbourhood	Existing
Housing estates	Mokotów/Wyścigowa neighbourhood	Existing
Housing estates	Mokotów/Ksawerów neighbourhood	Existing
Housing estates	Mokotów/Racjonalizacji neighbourhood	Existing
Housing estates	Mokotów/Modzelewskiego neighbourhood	Existing
Housing estates	Mokotów/Piekałkiewicza neighbourhood	Existing
Housing estates	Mokotów/Łowicka neighbourhood	Existing
Housing estates	Mokotów/Kazimierzowska neighbourhood	Existing
Housing estates	Wola/Ostroga neighbourhood	Existing
Housing estates	Wola/Agawy neighbourhood	Existing
Housing estates	Wola/Obozowa neighbourhood	Existing
Housing estates	Wola/Ciołka neighbourhood	Existing
Housing estates	Wola/Ulrychów neighbourhood	Existing
Housing estates	Wola/Elekcyjna neighbourhood	Existing
Housing estates	Wola/Piaskowa neighbourhood	Existing
Housing estates	Wola/Niska neighbourhood	Existing
Housing estates	Wola/Jana Kazimierza neighbourhood	Existing
Housing estates	Żoliborz Artystyczny	Existing
Housing estates	Żoliborz/Przasnyska neighbourhood	Existing
Housing estates	Żoliborz/Rydygiera neighbourhood	Existing
Housing estates	Żoliborz/Sady Żoliborskie neighbourhood	Existing
Housing estates	Żoliborz/Braci Załuskich neighbourhood	Existing
Housing estates	Śródmieście/Okrąg neighbourhood	Existing
Housing estates	Śródmieście/Pokorna neighbourhood	Existing
Housing estates	Śródmieście/Sapieżyńska neighbourhood	Existing

Housing estates	Żoliborz/Plac Grunwaldzki neighbourhood	Existing
Housing estates	Żoliborz/Plac Inwalidów neighbourhood	Existing
Housing estates	Żoliborz/Krasińskiego neighbourhood	Existing
Housing estates	Żoliborz/Krajewskiego neighbourhood	Existing
Housing estates	Bielany/Klaudyny neighbourhood	Existing
Housing estates	Bielany/Kochanowskiego neighbourhood	Existing
Housing estates	Bielany/Aspekt neighbourhood	Existing
Housing estates	Bielany/Bogusławskiego neighbourhood	Existing
Housing estates	Bielany/Kolumbijska neighbourhood	Existing
Housing estates	Bielany/Nocznickiego neighbourhood	Existing
Housing estates	Bielany/Lektykarska neighbourhood	Existing
Housing estates	Bemowo/Fort Bema neighbourhood	Existing
Housing estates	Bemowo/Żołnierzy Wyklętych neighbourhood	Existing
Housing estates	Bemowo/Wrocławska neighbourhood	Existing
Housing estates	Bemowo/Pirenejska neighbourhood	Existing
Housing estates	Bemowo/Dywizjonu 303 neighbourhood	Existing
Housing estates	Bemowo/Pełczyńskiego neighbourhood	Existing
Housing estates	Bemowo/Olbrachta neighbourhood	Existing
Housing estates	Bemowo/Człuchowska neighbourhood	Existing
Housing estates	Bemowo/Sternicza neighbourhood	Existing
Housing estates	Centroom	Existing
Housing estates	Włochy/Cegielniana neighbourhood	Existing
Housing estates	Włochy/Globusowa neighbourhood	Existing
Housing estates	Włochy/Batalionu AK "Włochy" neighbourhood	Existing
Housing estates	Włochy/Chrobrego neighbourbood	Existing
Housing estates	Włochy/Astronautów neighbourhood	Existing
Housing estates	Włochy/Lechicka peighbourhood	Existing
Housing estates	Ochota/Włodarzewska neighbourhood	Existing
Housing estates	Ochota/Harfowa neighbourhood	Existing
Housing estates	Ochota/Filtrowa neighbourhood	Existing
Housing estates		Existing
Housing estates	Lirsus / Posag 7 Panien neighbourbood	Existing
Housing estates		Existing
Housing estates	Ursus/Czerwona Droga neighbourbood	Existing
Housing estates		Existing
Housing estates		Existing
Housing estates	Ursus/I maja neighbourhood	Existing
Housing estates	Draga Błd /Chłopickiego poietkourtood	Existing
Housing estates	Praga Pid /Poztuska poict have beed	Existing
	Praga Pid./Kuziucka neighbournood	Existing
Housing estates	Praga Piu./Skaiskiego neighbournood	Existing
Housing estates	Praga Piu./Ustrzycka neighbourn000	Existing
Housing estates	Praga Piu./Grenadierow neighbournood	Existing
Housing estates	Praga Prd./IVIIędzyborska neighbourhood	
Housing estates	Praga Prd./Kechniewskiego neighbourhood	Existing
Housing estates	Praga Pid./Mikołajczyka neighbourhood	Existing
Housing estates	Praga Pid./Łukowska neighbourhood	Existing
Housing estates	Praga Płd./Białowieska neighbourhood	Existing
Housing estates	Praga Płd./Walewska neighbourhood	Existing
Housing estates	Praga Płd./Francuska neighbourhood	Existing
Housing estates	Praga Płd./Paryska neighbourhood	Existing
Housing estates	Praga Płd./Zwycięzców neighbourhood	Existing

Praga Płd./Międzynarodowa neighbourhood	Existing
Praga Płd./Brukselska neighbourhood	Existing
Praga Płd./Marokańska neighbourhood	Existing
Praga Płd./Meissnera neighbourhood	Existing
Praga Płd./Jugosłowiańska neighbourhood	Existing
Praga Płd./Boremlowska neighbourhood	Existing
Praga Płn./Otwocka neighbourhood	Existing
Praga Płn./Białostocka neighbourhood	Existing
Praga Płn./11 listopada neighbourhood	Existing
Praga Płn./Rondo Starzyńskiego neighbourhood	Existing
Praga Płn./Plac Hallera neighbourhood	Existing
Targówek/Syrokomli neighbourhood	Existing
Targówek/Św. Hieronima neighbourhood	Existing
Targówek/Chodecka neighbourhood	Existing
Targówek/Malborska neighbourhood	Existing
Targówek/Samarytanka neighbourhood	Existing
Targówek/Św. Wincentego neighbourhood	Existing
Targówek/Barkocińska neighbourhood	Existing
Targówek/Borzymowska neighbourhood	Existing
Wilno	Existing
Białołęka/Łopianowa neighbourhood	Existing
Białołęka/Myśliborska neighbourhood	Existing
Białołęka/Ceramiczna neighbourhood	Existing
Białołęka/Antalla neighbourhood	Existing
Riviera Park	Existing
Klasyków	Existing
	Praga Płd./Międzynarodowa neighbourhoodPraga Płd./Brukselska neighbourhoodPraga Płd./Marokańska neighbourhoodPraga Płd./Meissnera neighbourhoodPraga Płd./Jugosłowiańska neighbourhoodPraga Płd./Boremlowska neighbourhoodPraga Płd./Boremlowska neighbourhoodPraga Ph./Otwocka neighbourhoodPraga Ph./Otwocka neighbourhoodPraga Ph./Białostocka neighbourhoodPraga Ph./Białostocka neighbourhoodPraga Ph./Rondo Starzyńskiego neighbourhoodPraga Ph./Rondo Starzyńskiego neighbourhoodTargówek/Syrokomli neighbourhoodTargówek/Syrokomli neighbourhoodTargówek/Sw. Hieronima neighbourhoodTargówek/Samarytanka neighbourhoodTargówek/Samarytanka neighbourhoodTargówek/Barkocińska neighbourhoodTargówek/Borzymowska neighbourhoodTargówek/Borzymowska neighbourhoodBiałołęka/Łopianowa neighbourhoodBiałołęka/Lopianowa neighbourhoodBiałołęka/Antalla neighbourhoodBiałołęka/Antalla neighbourhoodRiviera ParkKlasyków

Figure 22 List of mobility hubs for the category of housing estates



Figure 23 Map of Warsaw with mobility hubs for the category of public utilities

Category	Name	Status
Public: public utilities	Museum of King Jan III's Palace at Wilanów	Existing
Public: public utilities	Museum of the History of Polish Jews	Existing
Public: public utilities	National Museum	Existing
Public: public utilities	The Warsaw Rising Museum	Existing
Public: public utilities	Museum of John Paul II and Primate Wyszyński	Existing
Public: public utilities	Polish History Museum	Plan
Public: public utilities	Museum of Modern Art.	Plan
Public: public utilities	PGE Narodowy	Existing
Public: public utilities	Legia Stadium / Torwar	Existing
Public: public utilities	Polonia Stadium	Plan
Public: public utilities	Skra Stadium	Plan
Public: public utilities	Palace of Culture & Science	Existing
Public: public utilities	Copernicus Science Centre	Existing
Public: public utilities	District Hall: Praga Południe	Existing
Public: public utilities	District Hall: Rembertów	Existing
Public: public utilities	District Hall: Wesoła	Existing
Public: public utilities	District Hall: Mokotów	Existing
Public: public utilities	District Hall: Śródmieście	Existing
Public: public utilities	District Hall: Wola	Existing
Public: public utilities	District Hall: Białołęka	Existing
Public: public utilities	District Hall: Bielany	Existing
Public: public utilities	District Hall: Ochota	Existing
Public: public utilities	District Hall: Wawer	Existing
Public: public utilities	District Hall: Praga Północ	Existing
Public: public utilities	District Hall: Ursus	Existing
Public: public utilities	District Hall: Żoliborz	Existing
Public: public utilities	District Hall: Włochy	Existing
Public: public utilities	District Hall: Ursynów	Existing
Public: public utilities	District Hall: Bemowo	Existing
Public: public utilities	District Hall: Targówek	Existing
Public: public utilities	District Hall: Wilanów	Existing
Public: public utilities	ZTM Head Office	Existing
Public: public utilities	ZDM Head Office	Existing
Public: public utilities	ZTP Head Office	Existing
Public: public utilities	MJWPU	Existing
Public: public utilities	Statistical Office	Existing
Public: public utilities	Social Security Office's Head Office	Existing
Public: public utilities	Social Security Office	Existing
Public: public utilities	Social Security Office: branch 2	Existing
Public: public utilities	Social Security Office: Wola branch	Existing
Public: public utilities	Social Security Office: Ursynów branch	Existing
Public: public utilities	Social Security Office: Zoliborz branch	Existing
Public: public utilities	Social Security Office: OChota branch	Existing
Public: public utilities	Social Security Office: Praga Płn. Branch	Existing
Public: public utilities	Masovian Customs and Tax Office	Existing
Public: public utilities	Tax Office: Sródmieście	Existing
Public: public utilities	Tax Office: I Mazowiecki	Existing
Public: public utilities	Iax Office: Tarchomin	Existing
Public: public utilities	lax Office: Praga	Existing
Public: public utilities	Tax Office: Białołęka	Existing
Public: public utilities	Tax Office: Bemowo	Existing
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Public: public utilities	Tax Office: Bielany	Existing
Public: public utilities	Tax Office: Wola	Existing
Public: public utilities	Tax Office: Ursynów	Existing
Public: public utilities	Tax Office: Wawer	Existing
Public: public utilities	Tax Office: Mokotów	Existing
Public: public utilities	Parliament	Existing
Public: public utilities	Cabinet of Ministers	Existing
Public: public utilities	General Prosecutor's Office	Existing
Public: public utilities	Warsaw School of Economics	Existing
Public: public utilities	Warsaw University of Technology	Existing
Public: public utilities	Warsaw University of Life Sciences	Existing
Public: public utilities	Military University of Technology	Existing
Public: public utilities	University of Warsaw	Existing
Public: public utilities	University of Warsaw: management branch	Existing
Public: public utilities	University of Warsaw: psychology branch	Existing
Public: public utilities	University of Warsaw: linguistics branch	Existing
Public: public utilities	SWPS University	Existing
Public: public utilities	Kozminski University	Existing
Public: public utilities	Vistula University	Existing
Public: public utilities	Łazarski University	Existing
Public: public utilities	Academy of Fine Arts in Warsaw	Existing
Public: public utilities	University of Physical Education	Existing
Public: public utilities	Medical University of Warsaw	Existing
Public: public utilities	Wyszynski University	Existing
Public: public utilities	Chopin University of Music	Existing
Public: public utilities	National Academy of Dramatic Art in Warsaw	Existing
Public: public utilities	UTH University	Existing
Public: public utilities	UTH University Jagiellońska Campus	Existing
Public: public utilities	Maria Grzegorzewska University	Existing
Public: public utilities	Jański University	Existing
Public: public utilities	Higher School of Education in Sport	Existing
Public: public utilities	WSB University	Existing
Public: public utilities	Teatr Wielki- Opera Narodowa	Existing
Public: public utilities	Powszechny Theatre	Existing
Public: public utilities	Rampa Theatre	Existing
Public: public utilities	Komedia Theatre	Existing
Public: public utilities	Kwadrat Theatre	Existing
Public: public utilities	Syrena Theatre	Existing
Public: public utilities	Roma Theatre	Existing
Public: public utilities	Buffo Theatre	Existing
Public: public utilities	Ateneum Theatre	Existing
Public: public utilities	Capitol Theatre	Existing
Public: public utilities	Kamienica Theatre	Existing
Public: public utilities	Zachęta National Gallery	Existing
Public: public utilities	CSW Gallery	Existing
Public: public utilities	Philharmonic	Existing
Public: public utilities	Z00	Existing
Public: public utilities	Służewiec Racecourse	Existing
Public: public utilities	Stegny skating track	Existing
Public: public utilities	Warszawianka	Existing

Public: public utilities	OSiR Wawer	Existing
Public: public utilities	OSiR Ochota	Existing
Public: public utilities	OSiR Włochy	Existing
Public: public utilities	OSiR Bemowo	Existing
Public: public utilities	OSiR Wola	Existing
Public: public utilities	OSiR Ursus	Existing
Public: public utilities	OSiR Mokotów	Existing
Public: public utilities	OSiR Ursynów	Existing
Public: public utilities	OSiR Żoliborz	Existing
Public: public utilities	OSiR Bielany	Existing
Public: public utilities	OSiR Śródmieście	Existing
Public: public utilities	OSiR Wilanów	Existing
Public: public utilities	OSiR Praga Płd. "Wodnik"	Existing
Public: public utilities	OSiR Praga Płd. "Szuwarek"	Existing
Public: public utilities	OSiR Praga Płn.	Existing
Public: public utilities	OSiR Praga Płn. "Namysłowska"	Existing
Public: public utilities	OSiR Targówek	Existing
Public: public utilities	OSiR Białołęka	Existing
Public: public utilities	National Library	Existing
Public: public utilities	University of Warsaw Library	Existing
Public: public utilities	Supreme Court	Existing
Public: public utilities	Supreme Administrative Court	Existing
Public: public utilities	Regional Court	Existing
Public: public utilities	Regional Court: commercial branch	Existing
Public: public utilities	Regional Court: Praga branch	Existing
Public: public utilities	District Court	Existing
Public: public utilities	District Court: Żoliborz and Wola branches	Existing
Public: public utilities	District Court: Praga branches	Existing
Public: public utilities	District Court: Mokotów branch	Existing
Public: public utilities	Medicover Hospital	Existing
Public: public utilities	Military Institute of Medicine Hospital	Existing
Public: public utilities	Praski Hospital	Existing
Public: public utilities	Bródnowski Hospital	Existing
Public: public utilities	Centrum Zdrowia Dziecka Hospital	Existing
Public: public utilities	Cardiology Hospital	Existing
Public: public utilities	Bielański Hospital	Existing
Public: public utilities	Banacha Hospital	Existing
Public: public utilities	Children's Clinical Hospital	Existing
Public: public utilities	Children's Bogdanowicza Hospital	Existing
Public: public utilities	Wolski Hospital	Existing
Public: public utilities	Czerniakowski Hospital	Existing
Public: public utilities	Południowy Hospital	Existing
Public: public utilities	Oncology Hospital	Existing
Public: public utilities	MSWiA Clinical Hospital	Existing
Public: public utilities	Solec Hospital	Existing
Public: public utilities	Orłowski Hospital	Existing
Public: public utilities	Grochowski Hospital	Existing
Public: public utilities	Powązki Cemetery	Existing
Public: public utilities	Powązki Wojskowe Cemetery	Existing
Public: public utilities	Bródnowski Cemetery	Existing
Public: public utilities	Wawrzyszewski Cemetery	Existing

Public: public utilities	Na Służewie Cemetery	Existing
Public: public utilities	Północny Cemtery	Existing
Public: public utilities	Wolski Cemetery	Existing
Public: public utilities	Wolski Prawosławny Cemetery	Existing
Public: public utilities	Na Solipsach Cemetery	Existing
Public: public utilities	Tarchomiński Cemetery	Existing
Public: public utilities	Służewiec Arrest	Existing
Public: public utilities	Police Headquarters	Existing
Public: public utilities	Warsaw Police Headquarters	Existing
Public: public utilities	Regional Police Headquarters IV	Existing
Public: public utilities	Agrykola/Łazienki Parks	Existing
Public: public utilities	Szczęśliwicki Park	Existing
Public: public utilities	Pole Mokotowskie Park	Existing
Public: public utilities	Polskich Wynalazców Park	Existing
Public: public utilities	Olszyna Park	Existing
Public: public utilities	Szymańskiego/Sowińskiego Parks	Existing
Public: public utilities	Kępa Potocka Park	Existing
Public: public utilities	Sady Żoliborskie Park	Existing
Public: public utilities	Górczewska Park	Existing
Public: public utilities	Moczydło Park	Existing
Public: public utilities	Morskie Oko Park	Existing
Public: public utilities	Promenada Park	Existing
Public: public utilities	Arkadia Park	Existing
Public: public utilities	Dygata Park	Existing
Public: public utilities	Lasek Brzozowy Park	Existing
Public: public utilities	Przy Bażantarni Park	Existing
Public: public utilities	Skaryszewski Park	Existing
Public: public utilities	Bródnowski Park	Existing
Public: public utilities	Krasińskich Park	Existing
Public: public utilities	Saski Park	Existing
Public: public utilities	Rydza-Śmigłego/Na Książęcem Parks	Existing
Public: public utilities	Wyględów Park	Existing
Public: public utilities	Skłodowskiej-Curie Park	Existing
Public: public utilities	Hassów Park	Existing
Public: public utilities	Szypowskiego Park	Existing
Public: public utilities	Nad Balatonem Park	Existing
Public: public utilities	Myśliborska Park	Existing

Figure 24 List of mobility hubs for the category of public utilities



Figure 25 Map of Warsaw with mobility hubs for the category of public transport nodes, car parks and metro/rail stations

Category	Name	Status
Public: transport nodes	Chopin Airport	Existing
Public: transport nodes	Gocław loop	Existing
Public: transport nodes	Bródno-Podgrodzie loop	Existing
Public: transport nodes	Powsińska/Morszyńska loop	Existing
Public: transport nodes	Witolin loop	Existing
Public: transport nodes	Esperanto loop	Existing
Public: transport nodes	Conrada loop	Existing
Public: transport nodes	Stare Bemowo loop	Existing
Public: transport nodes	Nowe Włochy loop	Existing
Public: transport nodes	Szczęśliwice loop	Existing
Public: transport nodes	Ursynów Płn. loop	Existing
Public: transport nodes	Trocka loop	Existing
Public: transport nodes	Warszawa Wschodnia bus terminal	Existing
Public: transport nodes	Warszawa Zachodnia bus terminal	Existing
Public: transport nodes	Waszyngtona Roundabout	Existing
Public: transport nodes	Służewiec PKP	Existing
Public: transport nodes	Piaski loop	Existing
Public: transport nodes	Wilanów loop	Plan
Public: transport nodes	Marymont-Potok loop	Existing
Public: transport nodes	Woronicza loop	Existing
Public: transport nodes	Winnica loop	Existing
Public: transport nodes	Popularna/Jerozolimskie intersection	Existing
Public: transport nodes	Gandhi/Rosoła intersection	Existing
Public: transport nodes	Wilanowska/Sikorskiego intersection	Existing

Public: transport nodes	Sobieskiego/Kostrzewskiego intersection	Existing
Public: transport nodes	Niepodległości/Nowowiejska intersection	Existing
Public: transport nodes	De Gaulle Roundabout	Existing
Public: transport nodes	Royal Castle	Existing
Public: transport nodes	Zamkowy Square	Existing
Public: transport nodes	Jana Pawła II/Solidarności intersection	Existing
Public: transport nodes	Jana Pawła II/Nowolipki intersection	Existing
Public: transport nodes	Jana Pawła II/Stawki intersection	Existing
Public: transport nodes	Smocza/Nowolipki intersection	Existing
Public: transport nodes	Powązkowska/Krasińskiego intersection	Existing
Public: transport nodes	Potocka/Gwiaździsta intersection	Existing
Public: transport nodes	Kochanowskiego/Reymonta intersection	Existing
Public: transport nodes	Radiowa/Powstańców Śląskich intersection	Existing
Public: transport nodes	Krakowska/Komitetu Obrony Robotników intersection	Existing
Public: transport nodes	Bitwy Warszawskiej/Jerozolimskie intersection	Existing
Public: transport nodes	Wawelska/Raszyńska intersection	Existing
Public: transport nodes	Grójecka/Kopińska intersection	Existing
Public: transport nodes	Wołoska/Odyńca intersection	Existing
Public: transport nodes	Puławska/Wałbrzyska intersection	Existing
Public: transport nodes	Plac Szembeka	Existing
Public: transport nodes	Kinowa/Waszyngtona intersection	Existing
Public: metro/rail stations	Dworzec Wschodni	Existing
Public: metro/rail stations	Zacisze-Wilno	Existing
Public: metro/rail stations	Ursus	Existing
Public: metro/rail stations	Włochy	Existing
Public: metro/rail stations	Reduta Ordona	Existing
Public: metro/rail stations	Jerozolimskie	Existing
Public: metro/rail stations	Dworzec Zachodni	Existing
Public: metro/rail stations	Ochota	Existing
Public: metro/rail stations	Śródmieście	Existing
Public: metro/rail stations	Dworzec Centralny	Existing
Public: metro/rail stations	Powiśle	Existing
Public: metro/rail stations	Olszynka Grochowska	Existing
Public: metro/rail stations	Gocławek	Existing
Public: metro/rail stations	Międzylesie	Existing
Public: metro/rail stations	Radość	Existing
Public: metro/rail stations	Miedzeszyn	Existing
Public: metro/rail stations	Falenica	Existing
Public: metro/rail stations	Żwirki i Wigury	Existing
Public: metro/rail stations	Rakowiec	Existing
Public: metro/rail stations	Rembertów	Existing
Public: metro/rail stations	Wesoła	Existing
Public: metro/rail stations	Wola	Existing
Public: metro/rail stations	Młynów	Existing
Public: metro/rail stations	Коłо	Existing
Public: metro/rail stations	Powązki	Existing
Public: metro/rail stations	Dworzec Gdański	Existing
Public: metro/rail stations	ZOO	Existing
Public: metro/rail stations	Praga	Existing
Public: metro/rail stations	Toruńska	Existing
Public: metro/rail stations	Płudy	Existing

Public: metro/rail stations	Choszczówka	Existing
Public: metro/rail stations	Raków	Existing
Public: metro/rail stations	Salomea	Existing
Public: metro/rail stations	Opacz	Existing
Public: metro/rail stations	Ursus Płn.	Existing
Public: metro/rail stations	Gołąbki	Existing
Public: metro/rail stations	Okęcie	Existing
Public: metro/rail stations	Dawidy	Existing
Public: metro/rail stations	Wileńska	Existing
Public: metro/rail stations	Ząbki	Existing
Public: metro/rail stations	M1: Kabaty	Existing
Public: metro/rail stations	M1: Natolin	Existing
Public: metro/rail stations	M1: Imielin	Existing
Public: metro/rail stations	M1: Stokłosy	Existing
Public: metro/rail stations	M1: Ursynów	Existing
Public: metro/rail stations	M1: Służew	Existing
Public: metro/rail stations	M1: Wilanowska	Existing
Public: metro/rail stations	M1: Wierzbno	Existing
Public: metro/rail stations	M1: Racławicka	Existing
Public: metro/rail stations	M1: Pole Mokotowskie	Existing
Public: metro/rail stations	M1: Politechnika	Existing
Public: metro/rail stations	M1: Plac Konstytucji	Plan
Public: metro/rail stations	M1: Centrum	Existing
Public: metro/rail stations	M1/M2: Świętokrzyska	Existing
Public: metro/rail stations	M1: Ratusz- Arsenał	Existing
Public: metro/rail stations	M1: Muranów	Plan
Public: metro/rail stations	M1: Dworzec Gdański	Existing
Public: metro/rail stations	M1: Plac Wilsona	Existing
Public: metro/rail stations	M1: Marymont	Existing
Public: metro/rail stations	M1: Słodowiec	Existing
Public: metro/rail stations	M1: Stare Bielany	Existing
Public: metro/rail stations	M1: Wawrzyszew	Existing
Public: metro/rail stations	M1: Młociny	Existing
Public: metro/rail stations	M2: Rondo ONZ	Existing
Public: metro/rail stations	M2: Rondo Daszyńskiego	Existing
Public: metro/rail stations	M2: Płocka	Existing
Public: metro/rail stations	M2: Młynów	Existing
Public: metro/rail stations	M2: Księcia Janusza	Existing
Public: metro/rail stations	M2: Ulrychów	Plan
Public: metro/rail stations	M2: Bemowo	Plan
Public: metro/rail stations	M2: Lazurowa	Plan
Public: metro/rail stations	M2: Chrzanów	Plan
Public: metro/rail stations	M2: Karolin	Plan
Public: metro/rail stations	M2: Nowy Świat- Uniwersytet	Existing
Public: metro/rail stations	M2: Centrum Nauki Kopernik	Existing
Public: metro/rail stations	M2/M3: Stadion Narodowy	Existing
Public: metro/rail stations	M2: Dworzec Wileński	Existing
Public: metro/rail stations	M2: Szwedzka	Existing
Public: metro/rail stations	M2: Targówek Mieszkaniowy	Existing
Public: metro/rail stations	M2: Trocka	Existing
Public: metro/rail stations	M2: Zacisze	Plan

Public: metro/rail stations	M2: Kondratowicza	Plan
Public: metro/rail stations	M2: Bródno	Plan
Public: metro/rail stations	M3: Dworzec Wschodni	Plan
Public: metro/rail stations	M3: Mińska	Plan
Public: metro/rail stations	M3: Rondo Wiatraczna	Plan
Public: metro/rail stations	M3: Ostrobramska	Plan
Public: metro/rail stations	M3: Jana Nowaka-Jeziorańskiego	Plan
Public: metro/rail stations	M3: Gocław	Plan
Public: car parks	P&R Metro Młociny II	Existing
Public: car parks	P&R Metro Młociny III	Existing
Public: car parks	P&R Metro Wawrzyszew	Existing
Public: car parks	P&R Metro Marymont	Existing
Public: car parks	P&R Połczyńska	Existing
Public: car parks	P&R Ursus- Niedźwiadek	Existing
Public: car parks	P&R Al. Krakowska	Existing
Public: car parks	P&R Metro Wilanowska	Existing
Public: car parks	P&R Metro Ursynów	Existing
Public: car parks	P&R Metro Stokłosy	Existing
Public: car parks	P&R Warszawa Stadion	Existing
Public: car parks	P&R Wawer SKM	Existing
Public: car parks	P&R Anin SKM	Existing
Public: car parks	P&R Żerań PKP	Under construction
Public: car parks	P&R Jeziorki PKP	Under construction
Public: car parks	Plac Krasińskich	Existing
Public: car parks	Metro Politechnika	Existing
Public: car parks	Plac Defilad	Existing
Public: car parks	Plac Powstańcow Warszawy	Plan
Public: car parks	Bednarska	Existing
Public: car parks	Boleść	Existing
Public: car parks	Bugaj	Existing
Public: car parks	Filtrowa	Existing
Public: car parks	Hoża	Existing
Public: car parks	Karasia	Existing
Public: car parks	Miła	Existing
Public: car parks	Myśliwiecka	Existing
Public: car parks	Plac Młynarskiego	Existing
Public: car parks	Plac Żelaznej Bramy	Existing
Public: car parks	Al. 3 maja	Existing
Public: car parks	PKP Powiśle	Existing
Public: car parks	Ptasia	Existing

Figure 26 List of mobility hubs for the category of public transport nodes, car parks and metro/rail stations

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Figure 27 Map of Warsaw with mobility hubs for the category of commercial objects and large employers

Category	Name	Status
Commercial: mixed use	Browary Warszawskie	Existing
Commercial: mixed use	Koneser	Existing
Commercial: mixed use	Elektrownia Powiśle	Existing
Commercial: mixed use	Plac Unii	Existing
Commercial: mixed use	Towarowa 22	Plan
Commercial: mixed use	Złota 44	Existing
Commercial: mixed use	Cosmopolitan	Existing
Commercial: mixed use	Norblin	Existing
Commercial: mixed use	Port Praski	Plan
Commercial: mixed use	EXPO XXI	Existing
Commercial: mixed use	Koszyki	Existing
Commercial: mixed use	Chełmska	Plan
Commercial: mixed use	South Park	Plan
Commercial: mixed use	Żwirki i Wigury	Plan
Commercial: mixed use	Chopin Airport City	Plan
Commercial: mixed use	Galeria Ursynów	Existing
Commercial: mixed use	The Tides	Existing
Commercial: mixed use	Klif	Existing
Commercial: mixed use	Babka Tower	Existing
Commercial: hotels	Mercure Grand	Existing
Commercial: hotels	Holiday Inn Warsaw City Centre	Existing
Commercial: hotels	Intercontinental	Existing
Commercial: hotels	Europejski / Bristol	Existing
Commercial: hotels	Sofitel Warsaw Victoria	Existing

Commercial: hotels	Marriott	Existing
Commercial: hotels	Double Tree by Hilton	Existing
Commercial: hotels	Radisson Blu Sobieski	Existing
Commercial: hotels	Campanile Warszawa	Existing
Commercial: hotels	Hampton by Hilton Mokotów	Existing
Commercial: hotels	Four Points by Sheraton	Existing
Commercial: hotels	Arche Hotel Krakowska	Existing
Commercial: hotels	Arche Hotel Puławska	Existing
Commercial: hotels	Regent Warsaw	Existing
Commercial: hotels	Novotel Warszawa Centrum	Existing
Commercial: hotels	Puro Hotel Warszawa Centrum	Existing
Commercial: hotels	Sheraton Grand	Existing
Commercial: hotels	Motel One	Existing
Commercial: hotels	Mercure Warszawa Ursus Station	Existing
Commercial: hotels	Airport Hotel Okęcie	Existing
Commercial: hotels	Ibis Warszawa Reduta	Existing
Commercial: hotels	lbis Warszawa Ostrobramska	Existing
Commercial: hotels	Best Western: Felix	Existing
Large employers	Agora	Existing
Large employers	Miasteczko Orange	Fxisting
Large employers	mBank	Existing
Large employers	Siekierki heat and nower plant	Existing
	Żerań beat and power plant	Existing
	Wola beat plant	Existing
Large employers		Existing
	Polcat	Existing
		Existing
	TVP Hood Office	Existing
	Polish Padio	Existing
	National Park of Poland	Existing
	RNID Daribas	Existing
	DNY Ydi Dds	Existing
		Existing
	DUS Dalik	Existing
Large employers	N. H. H.	Existing
Large employers	Nestle House	Existing
Large employers	NFOSIGW	Existing
Large employers	InPost	Existing
Large employers	Pekao	Existing
Large employers	Central Statistical Office	Existing
Large employers	Ministries: of Education and Foreign Affairs	Existing
Large employers	Ministry of Infrastructure	Existing
Large employers	Ministry of Economic Development and Technology	Existing
Large employers	Ministry of Justice	Existing
Large employers	Ministry of Health	Existing
Large employers	BGK Bank	Existing
Large employers	PWPW	Existing
Large employers	Municipal Head Office	Existing
Large employers	PZU Tower	Existing
Large employers	Mennica	Existing
Large employers	Polish Olympic Committee	Existing
Large employers	Procter & Gamble	Existing

Commercial: offices	Jerozolimskie 94-96	Existing
Commercial: offices	Jerozolimskie 100-132	Existing
Commercial: offices	Business Garden	Existing
Commercial: offices	Saski Crescent/Point	Existing
Commercial: offices	Riverside Park	Existing
Commercial: offices	Małachowski Square	Existing
Commercial: offices	Adgar Park West	Existing
Commercial: offices	Newcity	Existing
Commercial: offices	Adgar Plaza	Existing
Commercial: offices	Konstruktorska Business Center	Existing
Commercial: offices	Warsaw Spire	Existing
Commercial: offices	Generation Park	Existing
Commercial: offices	Marynarska Business Park	Existing
Commercial: offices	Warta Tower	Existing
Commercial: offices	Royal Wilanów	Existing
Commercial: offices	Horizon	Existing
Commercial: offices	Europlex	Existing
Commercial: offices	Warsaw Trade Tower	Existing
Commercial: offices	Spark	Existing
Commercial: offices	Hub Warsaw	Existing
Commercial: offices	Skysawa	Under construction
Commercial: offices	Rondo1	Existing
Commercial: offices	WFC	Existing
Commercial: offices	Q22	Existing
Commercial: offices	Intraco	Under construction
Commercial: offices	Gdański Business Center	Existing
Commercial: offices	Millennium Park	Existing
Commercial: offices	Millennium Plaza	Existing
Commercial: offices	Prosta Office Centre	Existing
Commercial: offices	Ilmet	Plan
Commercial: offices	Atrium Centrum	Existing
Commercial: offices	Chałubińskiego 8	Existing
Commercial: offices	Central Tower	Existing
Commercial: offices	Postępu 14	Existing
Commercial: offices	Domaniewska Office Hub	Existing
Commercial: offices	Mokotów Nova	Existing
Commercial: offices	Trinity I	Existing
Commercial: offices	Tulipan House	Existing
Commercial: offices	Platinium Business Park	Existing
Commercial: offices	Neopark	Existing
Commercial: offices	Łopuszańska Business Park	Existing
Commercial: offices	The Park Warsaw	Existing
Commercial: offices	GreenWings	Existing
Commercial: offices	Batory Office Buildings	Existing
Commercial: offices	Renaissance Tower	Existing
Commercial: offices	Poleczki Business Park	Existing
Commercial: offices	CEDET	Existing
Commercial: offices	Ethos	Existing
Commercial: offices	Atrium Plaza	Existing
Commercial: offices	Vipol Plaza	Existing
Commercial: offices	Ogrodowa 58 Business Center	Existing

Commercial: offices	Wola Plaza	Existing
Commercial: offices	Vectro+	Existing
Commercial: offices	Athina Park	Existing
Commercial: offices	Wólczyńska 133	Existing
Commercial: offices	Starościńska	Existing
Commercial: offices	City Point Matuszewska	Existing
Commercial: retail	Arkadia	Existing
Commercial: retail	Blue City	Existing
Commercial: retail	Galeria Młociny	Existing
Commercial: retail	Galeria Wileńska	Existing
Commercial: retail	Złote Tarasy	Existing
Commercial: retail	Galeria Mokotów	Existing
Commercial: retail	Factory Ursus	Existing
Commercial: retail	Sadyba Best Mall	Existing
Commercial: retail	Zielone Tarasy Wilanów	Plan
Commercial: retail	Galeria Północa	Existing
Commercial: retail	Factory Annopol	Existing
Commercial: retail	M1 Marki / Homepark	Existing
Commercial: retail	Atrium Targówek	Existing
Commercial: retail	Atrium Promenada	Existing
Commercial: retail	Atrium Reduta	Existing
Commercial: retail	Marywilska 44	Existing
Commercial: retail	Galeria Bemowo	Existing
Commercial: retail	Galeria Żoliborz	Existing
Commercial: retail	CH Gocław	Existing
Commercial: retail	King Cross Praga	Existing
Commercial: retail	Kaufland Stalowa	Existing
Commercial: retail	CH Modlińska	Existing
Commercial: retail	Selgros Marsa	Existing
Commercial: retail	Leclerc Bielany	Existing
Commercial: retail	KEN Center	Existing
Commercial: retail	CH Ursynów	Existing
Commercial: retail	CH Skorosze	Existing
Commercial: retail	Bricoman Połczyńska	Existing
Commercial: retail	Fort Wola	Existing
Commercial: retail	CH Górczewska	Existing
Commercial: retail	Wola Park	Existing
Commercial: retail	Hala Mirowska	Existing
Commercial: retail	Hala Banacha	Existing
Commercial: retail	Hala Marymoncka	Existing
Commercial: retail	Hala Kopińska	Existing
Commercial: retail	Domy Towarowe Centrum	Existing
Commercial: retail	Panorama	Existing
Commercial: retail	Łopuszańska 22	Existing
Commercial: retail	Leclerc Jerozolimskie	Existing
Commercial: retail	Mokpol Surowieckiego	Existing
Commercial: retail	Plac Vogla	Existing
Commercial: retail	Pasaż Wilanowska	Existing
Commercial: retail	Reymonta 12 pavilion	Existing
Commercial: retail	Lidl Ksiecia Bolesława	Existing
Commercial: retail	Okęcie Park	Existing

Commercial: retail	Carrefour Sierpińskiego	Existing
Commercial: retail	Galeria Gawra	Existing
Commercial: retail	Biedronka Warszawska 42	Existing
Commercial: retail	Lidl Jagiełły 6	Existing
Commercial: retail	Ferio Wawer	Existing
Commercial: retail	CH Szembeka	Existing
Commercial: retail	Lidl Ostrobramska 97	Existing
Commercial: retail	OBI Radzymińska	Existing
Commercial: retail	Aldi Radzymińska	Existing
Commercial: retail	Galeria Łodygowa	Existing
Commercial: retail	Kaufland Birżańska	Existing
Commercial: retail	Lidl Radzymińska	Existing
Commercial: retail	Lidl Modlińska	Existing
Commercial: retail	Pasaż Tarchomin	Existing
Commercial: retail	Auchan Światowida	Existing
Commercial: retail	Galeria pod Dębami	Existing
Commercial: retail	Biedronka Światowida	Existing

Figure 28 List of mobility hubs for the category of commercial objects and large employers

Apart from physical fitting of mobility hubs into the local public transport network and a variety of building types, there is also the **digital aspect** of integrating shared mobility and bundling the services of both public and shared modes of transport in a number of tools, e.g., multimodal route planners and MaaS-type platforms, which should incorporate the entire network of mobility hubs into their algorithms and the services provided.

7.11 Assessing mobility hubs' performance

How to measure the success of the mobility hubs concept or the lack of it? How to measure the performance of particular locations of mobility hubs, and what results should actually be perceived as a success? In order to evaluate the mobility hubs' performance and answer these questions, **key performance indicators** (KPI) must be set, both for the entire concept (a network of hubs) as well as for individual mobility hub locations.

Speaking of the KPI for the entire concept of mobility hubs, it is worth recalling the ultimate goal of implementing multimodal mobility hubs in a city or neighbourhood, and that is providing both individuals as well as whole groups of people (incl. local communities) with a tool allowing to become less dependent on private car ownership, and to make smarter and more sustainable mobility choices, that is using public and shared means of transport to a much wider extend. But what to measure in order to know if we are successful in achieving these goals? A number of indicators on city-level could be considered as relevant, e.g., the so-called **modal split**, which is an indicator of what mobility choices we make as a society and what modalities we choose – is it active mobility, shared modes of transport, public collective transport, a private car or something else. Another indicator could be the individual **motorization rate** specifying the number of passenger cars per number of inhabitants. Assuming the rise of shared mobility (and micromobility) and fostering multimodal journeys would be successful, in the long run there should be a decline in private car ownership observed.

And now, looking at the performance of particular mobility hubs located in various parts of the city, a simple general rule will most probably apply: the more a mobility hub (and its services) is used, the better. Thus, specific indicators must be identified that will **measure the utilization of each mobility hub** as well as try to measure the non-materialized demand for services in a particular mobility hub. These could refer, for example, to the following:

- the **number of users** who used any service available at a mobility hub (reported by the suppliers of these services);
- the **number of trips/rentals** that either started or ended in a mobility hub, broken down by types of vehicles and modalities (reported by the suppliers);
- additionally, other details on trips/rentals from/to a mobility hub, including distance, duration, transaction value, starting point, and/or destination (reported by the suppliers);
- the **total footfall** at a mobility hub (reported by an analytical device installed in the hub, e.g., a camera with special people counting software), not necessarily related to the use of any of the services available, but aiming to assess:
 - the number of potential users, who failed to use a service at the mobility hub for a number of reasons,
 - the number of non-users, some of which could also turn into users,
 - the number of people, who performed other specific activities in the mobility hub, e.g., parked their own vehicle;
- the **number of mobility apps openings** in the vicinity of a mobility hub because some potential users will never physically appear in the hub, as they will digitally and remotely check the availability of the services present (or not) in the hub.

The KPI outlined above are basic ones, but they have the potential to quite accurately assess both the success of the entire mobility hubs concept and the performance of individual mobility hub locations.

7.12 Summary

Summarizing chapter 7 of the Study, focusing on the feasibility of mobility hubs in Warsaw, it is worth recalling the SmartHubs' purpose and the expected outcome of the Project, as indicated in the Project's proposal, which can be described as **developing and validating effective and economically viable mobility hubs solution**. Examples of deployments of mobility hubs in other European cities are also presented, from Germany, Austria, the Netherlands, Belgium, Norway, France as well as Poland. Interestingly, in almost every case, mobility hubs are launched as a joint effort of the public and the private sector – apart from Poland where it is very rare.

With regards to the scope of services available in mobility hubs, the following three key areas have been identified: **transport solutions** (e.g., shared mobility, public collective transport, Mobility-on-Demand, and privately owned micromobility), **charging solutions** (either for micromobility vehicles with plug-in and/or battery swap options, or for electric cars) and **logistics solutions** (e.g., parcel delivery/collection points). Of course, other functionalities may also be implemented within the area of mobility hubs.

In addition to the scope of services, the location requirements for mobility hubs were also discussed in this chapter, indicating those essential, recommended, and optional. Among the **essential requirements**, the following should be named: sufficient flow of users, sufficient space for the hub, 24/7 operational capacity, at least one self-service shared mobility service (of course more are recommended), periodically replenished fleet of shared vehicles, a clearly designated space in the public realm with good visibility, appropriate branding, clear message about the benefit to the public and lighting, focus on the convenience of users and the hub's accessibility, and, last but not least, compliance with the local spatial plan. For optimal impact, **mobility hubs should be planned as a whole network** of mobility hubs, aligned with public collective transport nodes as to fit the mobility hubs into the public transport network.

Looking into the cost assessment and the business model for mobility hubs, the investment required for one hub ranges from EUR 10,000 to 26,000, depending on whether it is necessary to supply electricity and install chargers. Also, the higher the number of mobility hubs and the longer the project's duration, the greater the **efficiency of investment** per hub varying from as much as EUR 166,000 per hub (1 year, 1 hub) to as few as EUR 4,400 per hub (15 years, 500 hubs).

With regard to the forms of implementation of mobility hubs, the Study provides much evidence that it should be an approach allowing to execute the project jointly by the public administration together with the private sector, each of the parties focusing on fulfilling its core aims, e.g., in the form of a **public-private partnership (PPP)**, in particular a services concession and coordinated/led by a mobility hubs operator/ provider being an intermediary between all stakeholders involved. Also, an important remark as to the cost and revenue sharing mechanism is that each of the project partners should fund the endeavour in accordance with its scope and the role in the project, and also should have the right to keep the revenues resulting from its core activity, whether it is business or public policy oriented.

Speaking of the risks associated with executing a network of mobility hubs in Warsaw, the major risks are not really related to operational challenges, which are manageable, but rather to the internal ability of the city of Warsaw to recognize the project's potential and importance, and then to implement it efficiently. Some other **risks identified** with a high probability of occurrence are related to the project's implementation (length of administrative procedures for obtaining a legal title for the location and/or power supply for mobility hubs as well as public procurement proceedings), operations (mainly related to inappropriate selection of locations for mobility hubs and the possibility of some of them underperforming) and limited demand for shared mobility services due to seasonality.

Some basic key performance indicators (**KPI**) have also been defined, allowing for tracking mobility hubs performance, both as a whole concept (network) as well as only in particular locations. On a general level, they involve the local modal split (breakdown of people's mobility into modalities) and the local motorization rate (number of privately owned passenger cars per 1,000 inhabitants), whereas assessing particular locations of mobility hubs in terms of their performance is possible e.g., through the number of users, the number of trips/rentals, generated footfall or mobility apps' launches.

With regard to the **appropriate locations** for mobility hubs, their primary aim should be fitting with their network into the public transport network, meaning the proximity of mobility hubs to all sorts of **public transport nodes** such as metro/rail stations, bus/tram loops, interchange stations, P&R and municipal car parks or key roads' intersections. Another key component of the locations for mobility is bringing them as close as possible to the local society, thus locating them **close to housing estates and public utilities**, allowing the residents to benefit from the mobility hubs on a daily basis. Last, but not least important factor

is complementing the network of mobility hubs with commercial real estate: offices, shopping malls, and retail centres as well as hotels.

The Study also analysed Warsaw's administrative area in the context of the appropriate location of mobility hubs. In conclusion, approx. **750 locations for mobility hubs in Warsaw** have been indicated. Still, the successful implementation of the project will, first of all, require proper recognition of the benefits it can deliver to the environment, to the city and its inhabitants, to the municipal transport system, as well as to the businesses operating in the public realm, especially shared mobility services and commercial real estate.









This Study has been prepared for information purposes and, in the opinion of its author, the data contained therein are accurate, reliable and up to date. Despite the utmost care, however, it is not possible to guarantee the full correctness or completeness of the data presented. Therefore, the use of the data contained in the Study is at the sole risk of the user.

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