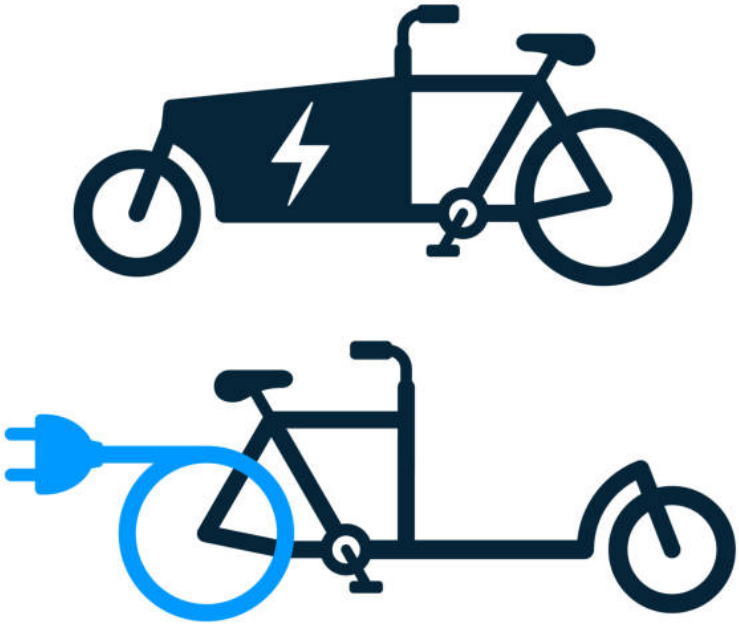

# A case of using micro mobility for last mile deliveries in urban settings

Master's thesis in Supply Chain Management

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Cover: An image of electric cargo bikes with pedal assisted.

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# Abstract

This thesis explores the emerging role of micro mobility solutions in facilitating last-mile deliveries within urban environments. Their potential for transformational change in urban transportation is underpinned by the rapid rise in usage of micro-mobility solutions both among individuals and organizations. The current research has been focused on a particular DIY delivery model, whereby customers use micro-mobility options to bring their purchases home. The research helps in understanding different regulatory frameworks and developments of urban mobility in cities such as Cagliari, Istanbul, Paris, London, Oxford, Copenhagen, Vienna, and Stockholm. It also focuses on low emission zones, congestion charges, and incentives for micro mobility solutions.

The testing ground for Do It Yourself (DIY) delivery model was the city of Stockholm. This urban setting was compared with other cities. From such a comparison, lessons learned from the contributions that micro mobility makes to the urban setting, and how exactly IKEA can reap such benefit in that model, were obtained. According to findings, micro mobility potentially reduces congestion and emissions under supportive policy and infrastructure. This thesis gives useful recommendations for IKEA and other stakeholders on integrating micro mobility into urban logistics strategies. .

Keywords: Urban Mobility, Micro mobility, DIY solutions, regulations, infrastructure

# Acknowledgements

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Anand Nagappa and Karthik Veeraghanti

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# 1
# Introduction

This chapter provides an overview on urban mobility and micro mobility.

## 1.1 Background

Urban mobility is a movement of both people and products in a city or urban setting through public or private transport (Ferrovial [2024]). Every individual in an urban space has their own journey to make to reach their destinations. This can be made through different means of transport such as public and private transport. In public transport, traveling can be done by buses, trains and trams, and in private transport it can be cars, motor bikes, bicycles, and even walking for short distance travel. There is also movement of goods or freight transport, and according to Rodrigue [2024], these movements are decided between cargo owners and logistics service providers. These movements are important in an urban setting and there are several factors which influence these movements. Some of these factors, according to Rodrigue [2024] urban attributes such as human population, economic culture, use of land. Planning of these movement are the factors which influence the movement.

Coxon et al. [2019] mentions in his book 'Urban Mobility Design' the evolution of mobility began with people walking. He mentions that most people did not live in cities, and the main means of travel were walking and bicycles. Animals like horses were also used to transport people, but abundantly they were used to transport goods. Rodrigue [2024] also mentions that people used to travel on foot mostly within cities, and because of the industrial revolution, people started to migrate from rural areas to cities looking for jobs. France was one of the earliest countries to introduce public transport called omnibus services, followed by America, and this a was reason for widening of the cities, which also paved the way to improve city road infrastructures (Rodrigue [2024]). Thus, during the industrial revolution, new inventions were made such as rail roads, locomotives, and four-wheeler motor vehicles (Rodrigue [2024]). These innovations were adopted by many major cities and the density of human populations also started to increase in these cities and the cities started to widen to accommodate people and the infrastructures built for them. As technology developed, more sophisticated travel means were created and in the early 1900s the ownership of an automobile seemed like a luxury. As automobile ownership began to increase, and with the increase in automobiles, urban space started to modify and plan the use of the land according to the movement of the automobile (Rodrigue [2024]).

With the increase in automobiles in developing world the travel time between the destinations also increased, according to Gakenheimer [1999] in developing cities and developed large cities the travel time of commuting within the city was more and the average distance travelled within the city was 7 miles per hours. He also mentions the dedicated use of land for parking infrastructure for automobiles, especially for cars. All of these indicated that congestion was increasing within urban spaces and that this congestion affected the movement of vehicle users. A report on the Urban Mobility congestion of America was made by Schrank and Lomax [2004], which showed that the congestion had grown in all the major cities, and it happened longer during the day for the movement people and goods.

Due to increase in the human population the mobility spread throughout the globe and with this the economy also accelerated globally. In this paradigm, transportation plays a key role in the movement of products from all over the world to all over the world (Cuturela and Manole [2013]). As it is important for the movement of people from one place to another (Yang and Taufen [2022]) it is also important for the movement of goods from one place to another. The transports were earlier carried out through the rails or roads, which is the current case. The only difference being that the efficiency of the automobiles and rails have increased which aided in the expansion of the logistics (Cuturela and Manole [2013]). Urban logistics was a term collectively coined for process involved different stake holders to maximize the usage of goods transportation inside the city with minimum impact (Patier and Routhier [2020]). To consolidate the goods from different places around the world and then distribute them to different places within the city consolidation centres were created within the city limits (Cardenas et al. [2017]). After goods reach the urban goods distributions center they were delivered to the final consumption point to the consumers and this last leg of delivery was called Last mile delivery (Cardenas et al. [2017]). These movements of goods also increased along with the time and technological advances and thus became a reason for congestion within the city limits. During these times the mode of delivery of goods were large trucks and mini-trucks whose emissions also impacted the nature along with the private automobiles moving around the city.

In recent years, micro mobility has become increasingly popular for short-distance travel, particularly for the last mile and within cities. Micro mobility services, such as bicycles and e scooters, are widely used due to their ease of access, flexibility in navigating congested areas, and environmentally friendly nature. Many organizations, including Foodora, Velove, and Postnord, utilize these services for last-mile deliveries. They have also had a positive impact on disrupting the use of private vehicles for short distance travel (Abduljabbar et al. [2021]). According to a case study published by the EU Urban Mobility Observatory (European-Commission [2020]), micro mobility incurs fewer additional costs, such as taxes, services, and congestion charges, when compared to cars. The case study also predicts that the micro mobility market will reach 100 billion Euro by 2030, compared to the half billion Euro of the car industry in 2017. The number of people driving cars is decreasing,

particularly in cities where parking is limited, and public transportation and micro mobility are easily available. Consequently, the conventional method of transporting large purchases or more than a basket size using one's own car is losing popularity. As mentioned by Cairns and Sloman [2019], bicycle logistics are more suitable for urban areas, especially for the last mile deliveries.

Considering the developments in the urban mobility paradigm and the importance of micro mobility in the last mile deliveries, IKEA decided to try this format in their store which is in the heart of the city in Stockholm, Sweden. The IKEA Development and Innovation Network (DIN) team is exploring several ideas and conducting research on introducing micro-mobility as a means for transporting goods purchased by customers. A key aspect of this exploration is that customers themselves will handle the delivery of purchased goods, which is why the project is named DIY Deliveries (Do It Yourself). The idea of the thesis is to study the use of micro mobility in last-mile deliveries within the urban mobility paradigm, which will also help IKEA become as sustainable as possible.

## 1.2 Aim of the study

The aim of the thesis is to analyse a case of using micro mobility for last mile deliveries in view of the urban setting.

This aim helps us to understand the urban mobility and the use of micro mobility in last mile deliveries and its advancements in various cities across the world. The advancement in these cities provides a reference which helps in comparing the urban mobility setting where the pilot test is taking place. The initial step is to analyse the future trends in urban mobility which will impact the last mile deliveries with usage of micro mobility.

## 1.3 Research Questions

These research questions were created to answer the purpose of the thesis

1. What are the key features of using micro mobility in an urban setting?
2. How does the use of micro mobility solutions in last mile deliveries contribute towards urban mobility?
3. How may these solutions (DIY Solutions) benefit retailers like IKEA?

# 2

# Framework

This chapter uses literature to inform the development of urban mobility by analyzing some of the cities around the world.

## 2.1 Developments in Urban Mobility

The phrase "smart cities" is gaining popularity among academics and companies who are keen to apply digital solutions to address a range of urban issues. At first, there had been a little confusion and inconsistent definitions of what makes a smart city. Many other researchers have called for more detail and clarity in the notion to address this Smart City. The meaning of "smart cities" has been improved as time passed. Initial discussions focused on the foundations of information and communication technology (ICT) and its potential to advance growth in cities (Garau et al. [2016]). Furthermore, Komninos [2009] proposed the concept of the "intelligent city," which expanded on the wired city by including cognitive components. In the framework of the "intelligent city" idea, "cognitive aspects" are related to the combining technologies and data analysis techniques to boost decision-making procedures and increase total urban operations and also to manage and enhance the urban environments. But when theoretical frameworks developed, an improved bottom-up viewpoint on urban development arose (Komninos [2009]).

Experts are working to identify the essential components of an effective and successful urban transportation system. As Ilarri et al. [2015] and Ali-Vehmas and Casey [2015] have shown, technology is essential to this effort. Their study emphasizes how crucial it is to employ innovative technologies to improve consumer service and improve transportation connections. Achieving sustainable urban mobility increasingly depends on combining of human and social requirements with technological and physical infrastructure (Garau et al. [2016]). Literature work by Garau et al. [2016] and Caragliu et al. [2011] stress how important it is to match infrastructure spending to the changing requirements of urban areas. By taking an integrated approach, transit systems are guaranteed to be welcoming, responding to community needs, and affordable. Experts work to promote different kinds of transportation as part of modern sustainable transport initiatives. The widespread use of e mobility is promoted by John et al. [2013], Arena et al. [2013], Longo and Roscia [2014], and others as a workable way to lessen reliance on privately owned fuel vehicles and lessen environmental effect (Garau et al. [2016]). Furthermore, as emphasized by Hull [2010], Jones [2012], Kim et al. [2014], López-Lambas et al. [2013], and Man-

augh et al. [2015], they underscore the significance of integrating transportation planning with the larger territorial environment. The customization of transport options to the unique requirements and features of metropolitan regions is ensured by this combined strategy. But reaching this point of integration is difficult and calls for an organized strategy. In order to advance integrated planning, Mattoni et al. [2015]) suggest investigating the connections between several smart city strategic planning pathways. Municipal planners can gain a thorough understanding of urban areas and make judgments that promote sustainable mobility by looking at the relationships between the economy, mobility, environment, people, living circumstances, and government. Moreover, the policies implemented by the European Union, represented by "Horizon 2020", significantly influence the development of urban mobility programs. These policies, which range from changing the usage of traditionally fuelled vehicles to addressing urban traffic congestion and supporting creative alternatives for cleaner and better urban transportation, set high goals for urban surroundings. Consequently, as described by Giffinger et al. [2007] and Zhu [2009], cities in the EU are now using benchmarking methodologies to track and assess the performance of their transport plans (Garau et al. [2016]).

## 2.2 City Cases

This section provides an overview of urban mobility setting in different cities across Europe, highlighting their regulations, infrastructure developments, advancements and intiatives aimed at establishing sustainable transportation in urban spaces.

### 2.2.1 The Case Of Cagliari

The paper "Cagliari and smart urban mobility: Analysis and comparison" by Garau et al. [2016] goes into further detail about the methods Cagliari has used to create a sustainable urban mobility plan (SUMP). The metropolis, Sardinia's political, economic, and cultural hub, serves as the foundation to the 16 towns that make up the metropolitan region. An Intermunicipal Spatial Strategic Plan is the important tool for urban planning at Cagliari, backed by EU local government regulations, sets smart mobility as a top priority within a larger vision for the growth of territory. An essential part of that strategy is the Cagliari Urban Mobility Plan (UMP). It describes the current transportation systems, puts out goals for further advancement, and provides an initial cost estimate for suggested changes. Improving accessibility for the elderly and disabled, encouraging bike and pedestrian infrastructure, and lowering dependency on private vehicles are some of the main goals. The idea is to establish multimodal nodes where different forms of transportation, such cars, bicycles, and public transportation, meet to enable easy movement throughout the city (Garau et al. [2016]).

Cagliari's strategy for urban mobility includes technologies to enhance the effectiveness and usability of the transportation network. This involves using of websites, digital information boards, and smartphone applications that offer real-time trans-

portation data, so increasing the appeal and accessibility of public transportation options.The paper emphasizes that Cagliari's transportation infrastructure must be continuously improved to accommodate changing needs and include new technology, even despite these developments. To improve the sustainability and effectiveness of the city's transportation system, multimodal hub development and technology application growth are essential. In keeping with international recognized practices for urban mobility planning, Cagliari's extensive urban mobility infrastructure development demonstrates a dedication to building a reliable, effective, and user-friendly travel paths (Garau et al. [2016]).

Cagliari showed an immense dedication to improving the foundation for urban mobility, emphasizing improvement of infrastructures and combining the technologies with it to facilitate environmentally friendly transportation. The town's endeavours to integrate real-time information via online platforms, boost connectivity, and decrease dependence on personal vehicles highlight its forward-thinking stance in responding to globally acknowledged urban mobility protocols. These developments help Cagliari achieve its objective of building a smooth, effective, and welcoming transit network, setting it apart as an example for other towns looking to modernize current urban mobility network in accordance with current issues and demands.

The Garau et al. [2018] further discusses on a monitoring tool called the Survey on Conditions of Practicable Environments (SCOPE) was created especially to evaluate the viability of urban areas while keeping an eye on the requirements of children. By examining the compositional, configurational, functional, and social components of urban landscapes, this approach to methodology assesses their quality and usability. The 7 main components of these elements are connectivity, convenience, comfort, commitment, conviviality, conspicuousness, and coexistence. To offer an accurate assessment that encourages child-centric urban development, each parameter is meticulously chosen. This tool supports healthier and appealing venues for young people's social, leisure activities, and academic interests by helping urban policies and plan makers to create or enhance public places to be more welcoming (Garau et al. [2018]).

The goal of Cagliari's Zona a Traffico Limitato (ZTL) is to minimize traffic in the old part of the town, which includes, amongst other places, Castello, Marina, and Villanova.The figure 2.1 show the area which is under influnce of teh ZTL. The ZTL regions are usually busy in the evenings as well as during the start of the day and they set up operating hours. During these particular times, the only people who are allowed entry are people living there, authorized cars, and individuals with special licenses, including delivery vans. These areas with restrictions are also watched over by thirteen surveillance cameras. To meet requires, guidelines are given for temporary permits (Accessibilità-Centri-Storici [2019]).

Cagliari's extensive car and shared bicycle initiatives demonstrate the city's commitment to green urban transportation. Playcar and Ctm (public transport company) have partnered to launch the CaBuBi ("Cagliari by bus and bike") bicycle rental

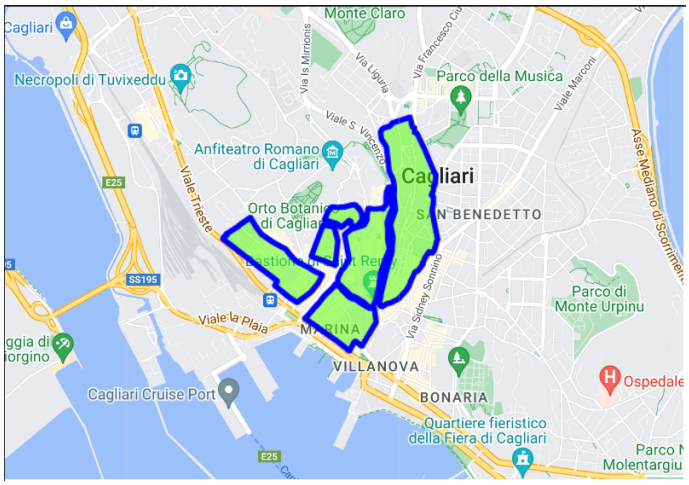


**Figure 2.1:** Cagliari City Limited Traffic Zone (ZTL). The area marked with blue line resembles the ZTL.
Urban-Access-Regulations-Cagliari [2024]

program. With sixty bicycles in its fleet at the moment, this initiative provides tandems, standard pedalling bikes, pedal-assist bikes, and a cargo bike for moving cargo. There are ten stations that are thoughtfully positioned to make it simple to take out and returning those bikes. The program will be even more flexible with an anticipated expanding which will add more bicycles in a free-flow model. This will enable rider to drive and give it back at a wider range of destinations, also involving stations close to main bus stand, promoting greater coordination with different transportation options. Playcar Srl.'s car rental services program, which offers 50 vehicles where 20% of which satisfy EURO5 requirements and 70% of which reach EURO6 standards and also limited number of 10% of the vehicles are electric which reflects a contemporary approach to urban transportation. The program is a reliable and environmentally responsible choice for city transport because it works on a reservation-based model and customers pay according to how much they use (Cagliari-Turismo [2020]).

The municipal department also administers the distribution of pink cards, which secure parking spots for pregnancy mothers and parents of children below twelve months old. This well-considered regulation supports Cagliari's urban plans, which emphasizes openness, social well-being, and environmental responsibility. Together, these programs strengthen Cagliari's position as an inspiration in the development of more assessable infrastructure, economical, and environmentally friendly urban mobility (Cagliari-Turismo [2020])

### 2.2.2 The Case Of Istanbul

The setting up of effective, long-lasting, and easily usable urban transportation networks depends on urban mobility planning. These initiatives address issues including traffic jams, emissions in the atmosphere, and dependence on personal automobiles while trying to increase the use of public transportation, cycling, and walking. The

European cities adoption of the Sustainable Urban Mobility Plan (SUMP) model, which places importance on these objectives, offers a useful foundation for comparisons. For example, cities like Istanbul which targets to reduce traffic congestions and impacts on the environment by promoting sustainable transport options. This is in line with the worldwide goals for urban mobility, which aim to boost the modal share or shift trend towards non-motorized and public transportation. Like projects in cities across the globe, planning efforts in Istanbul include the extension of tram and metro lines as well as the improvement of bus connections. As a common objective in urban mobility planning, these initiatives seek to make it easier for people to switch from driving their own vehicles to more environmentally friendly forms of transportation (modal shift). Istanbul's use of Intelligent Transport Systems (ITS) is an example of how technologies is being integrated into urban transportation, which is a trend (development) seen in many large cities throughout the world (Canitez et al. [2020]).

Istanbul's urban rail network has grown dramatically to enhance public transit and lessen reliance on own vehicles. According to the article "Sustainable urban mobility in Istanbul", the Istanbul Metropolitan Municipality (IMM) extended the urban railways connections overall length from 45.1 km in 2004 to 158 km by 2018, and it has ambitions to reach 495.35 km by the end of 2019 and 710.95 km by the end of 2023. The growth of the train service has provided economic, social, and environmental benefits. It has cut down on time spent traveling, the amount of noise and emissions of carbon dioxide, and the number of accidents. In 2016, metro lines had approximately 99.8% reliable service, while tram lines achieved 98% on-time performance. This resulted in a customer experience rating of 75% for transportation by train, which is much higher than lower value for public bus (64%) and BRT services (bus rapid transit 65%). The intention of the railway expansion projects is to make the railways a primary source at centre of the city's transportation infrastructure. Providing connectivity between trains and bus services as secondary source aims to promote utilization of public transportation over private vehicle use (Canitez et al. [2020]).

Istanbul has made significant strides in urban mobility, including the integration of Intelligent Transport Systems (ITS), which highlights the city's overall dedication to innovative and environmentally friendly transit choices. This emphasis is exemplified by a significant project called the "Black Box Project," which is carried out by the Istanbul Electricity, Tramway, and Tunnel General Management (IETT). By utilizing technology to constantly assess driver effectiveness, this initiative drastically lowers pollutants levels and crashes while also improving roadway safety. The Black Box Project integrates advanced data gathering mechanisms into public transportation automobiles, facilitating instantaneous assessment of efficiency and operational modifications. This program increases the dependability and safety of the transit system in addition to improving fuel economy and saving operating expenses. The project's capacity to collect and evaluate enormous volumes of data from transit services enables regular inspection services and repair enhancements. This results in an efficient transit that becomes more dynamic and adaptable (ÇELİKYAY et al.

[2017]).

Furthermore, Istanbul incorporates wider goals of lessening its ecological effects and improving living conditions in cities within its ITS strategy. The town complies with international urban mobility objectives by supporting environmentally friendly, healthier and effective modes of transit. These initiatives establish Istanbul as a progressive city, utilizing technology to address the intricate requirements of contemporary urban transportation and establishing a standard for cities across the globe.

Istanbul's path towards micro mobility commenced in 2013 through the opening of their IsBike public bike-sharing program, that launched initially with considerable fleet and eventually grew to 3,000 bicycles. This project became a pillar for the town's transit plans. Following on that, Istanbul started a new car-sharing services program by Moov, powered by Çelik Motors' subsidiary Garenta in September 2018 with 600 vehicles to serve both locals and tourists. With Marti launching its preliminary scooter-sharing platform in March 2019, the micro mobility landscape grew even more, which was a major step toward building a vibrant collaborative micro mobility environment. Gradually adding e-bikes and mopeds to its list of offerings, Marti developed and quickly emerged among top operators with a fleet of 50,000 vehicles spread throughout 15 cities and more (Gauquelin [2022]).

Turkey created a legal framework in 2021 to efficiently oversee and promote the expansion of shared transportation business. In order to keep up a monitored and secure growth in small-scale mobility offerings, providers must receive a License Permit from the Department of Transportation and Infrastructure at the time, confirming that they fulfill specific functional and business criteria. To further emphasize the controlled expansion of this industry, local transportation agencies such as UKOME are also involved in controlling the sheer quantity of bikes and providers that are permitted within the limits of the town (Gauquelin [2022]).

### 2.2.3 The Case Of London

When studying the shift to more environmentally friendly urban transportation, from the article "Planning more for sustainable mobility" by Hickman et al. [2013] the case studies of Oxfordshire and London offer valuable insights into how to successfully combine transportation funding and urban planning.

Effective initiatives have been put in place to improve public transit and reduce the use of privately owned motors in London. According to the Mayor-Of-London [2018], due to the increase in population, the car ownership had increased and people's behaviour in travel had also changed to driving private vehicles instead of relying on public transport. The report also said that the change in the people's behaviour was due to crowding on public transport and also the fluctuating timings. The public also faced challenges regarding walking or cycling as some parts of London didn't have proper road infrastructure to accomodate these types of transport. The

vision of London 2018 was to encourage walking and bicycling, creating bike lanes and pedestrian zones that would facilitate safer and more environmentally friendly transportation choices (Mayor-Of-London [2018]).

To increase connectivity and minimize traffic, the city has made substantial investments in expanding the Docklands Light Railway, buses, Underground network and even urban cable cars. Furthermore, London has adopted programs that in simpler terms, there's significant funding available to improve walking and cycling facilities. Opportunities exist to develop long pathways for cycling and walking, such as those along the Grand Union Canal in North London. In London, the focus should expand beyond existing Cycle superhighways to create more routes that cater to different directions. While reallocating space, particularly from car lanes, presents challenges, it's crucial to establish these paths along key routes. Ideally, cycling paths should be segregated from car lanes, akin to practices in countries like the Netherlands or Denmark. The Mayor's Vision for Cycling outlines potential improvements and increased funding, but substantial enhancements in cycling infrastructure are needed to encourage more usage, as seen in European countries vehicles (Hickman et al. [2013]). The transport for London also planned to restrict the usage of motorized vehicles on few streets to prioritize the building of cycling paths which results in healthy cycling network throughout the city. Their vision is that by 2041 the cycling network facility will be available within every 400meters,allowing over 60% of the city's population to access it (Mayor-Of-London [2018]).

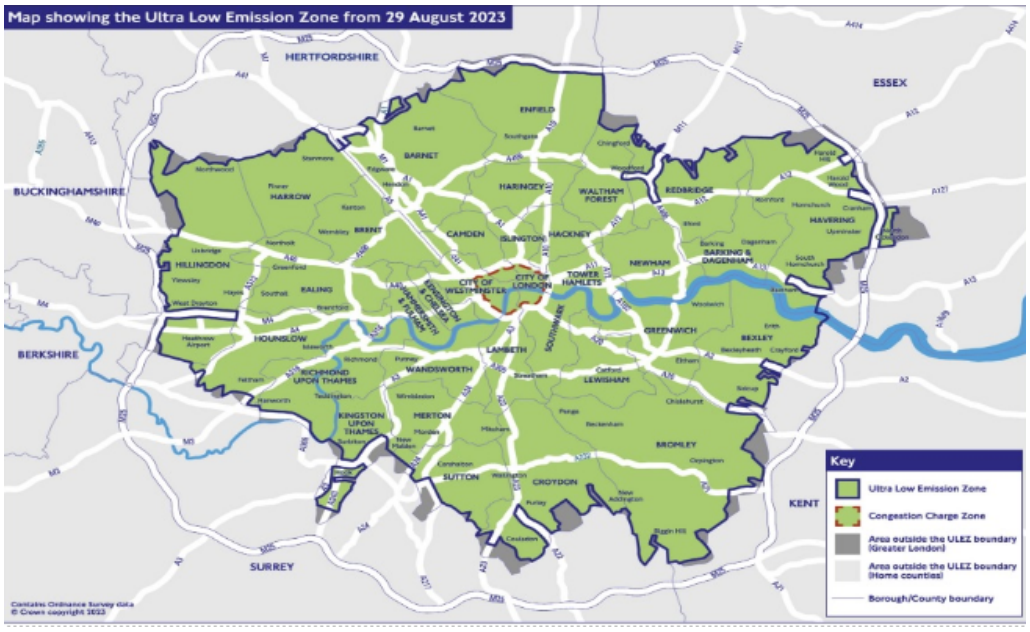


**Figure 2.2:** London City Low Emission Zones. The red dotted line is the congestion charge zone and the boundary marked with blue is the Ultra Low Emission Zone. Urban-Access-Regulation-London [2024]

A key component of London's policy is the establishment of the "Congestion Charging Zone", which prohibits the use of privately owned automobiles in the city central

and therefore lowers emissions and traffic jams while promoting the use of public transportation (Hickman et al. [2013]). The Congestion Charges was implemented on February 17, 2003, and it costs £15 per day on normal days from 07:00 to 18:00 and on weekends and holidays from 12:00 to 18:00 for various kinds of automobiles in Central London, comprising cars, vans, and lorries as shown in the fig. 2.2.

In addition, "Low Emission Zones" have been put in place to prevent older, more environmentally harmful cars from accessing particular areas of the town. Oversized vans, small buses, and heavier vehicles are the focus of the Low Emission Zone (LEZ), which is in effect since of March 1, 2021, and costs as much as £300 for violations of emissions regulations. Additionally, Greater London is firmly governed by tougher emission rules through the Ultra Low Emission Zone (ULEZ), which applies to automobiles, trucks, and bikes with Failure to follow carries a £12.50 fine (Urban-Access-Regulation-London [2024]). This has an important positive effect on reducing the city's air pollution and promoting a healthier atmosphere for vehicle. According to the report by the Mayor of London, almost 90% of the freight handled in the city is transported through roads (C40-Knowledge [2019]). Hence, the municipality proposed to work closely with the freight owners to reduce vehicle emissions and also optimise the routes for goods delivery. To effectively bring down the emissions loCITY programme was launched which helps freight owners to switch to low emission vehicles. The municipality also launched the schemes targeting the small businesses to switch to cleaner vehicles which include electric ones (C40-Knowledge [2019]).

London's formal journey into micro mobility began in July 2010 with the launch of the Barclays Cycle Hire, later rebranded as Santander Cycles. This public bike-share system was initiated under the mayoralty of Boris Johnson, aiming to reduce congestion and promote cycling as a viable and environmentally friendly transport option. The scheme started with around 6,000 bikes and 400 docking stations across central London, providing an accessible and convenient mode of transport for both residents and visitor (Weaver [2010]).

In 2015, the scheme was rebranded as Santander Cycles following a new sponsorship deal. This change brought additional funding, which helped further expand the network and introduce technological enhancements like a mobile app for easier bike hiring. As the popularity of the scheme grew, new docking stations were introduced in areas beyond central London, including the expansion into Brixton in 2017. This expansion allowed the bike-share program to serve a broader demographic and facilitated greater integration with other forms of public transport, thereby supporting London's broader transport strategy. In recent years, Santander Cycles has seen record usage numbers, with millions of hires annually, demonstrating the scheme's success and widespread acceptance. The continuous introduction of technology, such as GPS for tracking and maintenance, ensures the efficiency and sustainability of the service (Transport-For-London [2015]).

### 2.2.4 The Case Of Oxfordshire

Many forward-thinking projects have been implemented in Oxfordshire's urban environment with the goal of changing the region's transit and urban structure. The city is currently working on ways to improve public transportation and encourage environmentally friendly development. It is distinguished by its polycentric layout, which combines historic metropolitan centers with rural areas. The construction of Bus Rapid Transit (BRT) lines to link larger towns like Oxford, Witney, and Bicester with smaller ones is one of the primary objectives. The goal for those BRT lines is to decrease the duration of trips and provide connectivity throughout the county. Additionally, the improvement of mainline rail services is also a top priority which involves adding rail connections such as the Evergreen 3 and East-West rail initiatives as well as increasing train frequencies. The goal of these upgrades is to increase connections between Oxfordshire and important cities like London, making commuting smoother (Hickman et al. [2013]).

Enhancing the region's polycentric urban layout is another goal of urban development initiatives. Raising urban density, encouraging mixed-use construction, and establishing fresh development zones surrounding major and local transportation hubs are all part of strategy. The goal of the strategy is to create a network of integrated metropolitan areas that are effectively connected by public transportation, strengthening the area's economic vitality and togetherness. Furthermore, the strategy calls for a thorough improvement of rural transportation services through programs including taxi-bus schemes, which seek to improve inter-connectivity in areas with fewer people. An enormous network of separated bike lanes is also being developed throughout the entire region with the goal of providing more environmentally conscious and safer options to driving. These initiatives are part of an overall attempt to meet sustainability objectives, like lowering carbon dioxide emissions from transportation, as well as the difficulties brought on by urbanization and the affordable cost of housing while staying inside the boundaries of the Oxford Green Belt. Oxfordshire's dedication to developing a more environmentally friendly and connected urban setting can be seen in these efforts (Hickman et al. [2013]). These programs show how focused urban planning and transportation infrastructure investments may significantly improve urban mobility, tackle environmental issues, and encourage the transition into low-carbon, sustainable urban settings.

Oxford's Low Emission Zone (LEZ) went into effect from first of January 2014, the city buses that operates in the region now have to comply all Euro V emission criteria as shown in the fig. 2.3. More stringent emission standards will be enforced under this rule, which will encourage greener public modes of transportation in the town and drastically decrease the harmful emissions from diesel buses. Enhancing the quality of the air and fostering a healthy city environment are the particular goals of this LEZ effort (Urban-Access-Regulations-Oxford [2024]).The European Union's Euro V emission standards are a component of a regulatory framework designed to minimize dangerous gases from automobiles. The goal of Euro V regulations which was introduced in 2009 is to reduce diesel engine emissions of nitrogen oxides (NOx), particulate matter (PM), and other emissions (RAC [2024]). With the goal

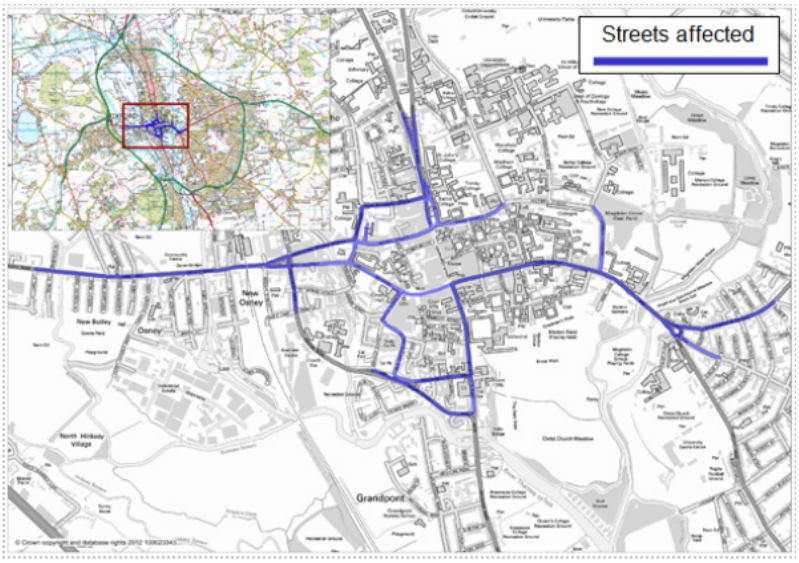


**Figure 2.3:** Oxford city Low Emission Zone. The streets marked with blue lines are LEZ.
Urban-Access-Regulations-Oxford [2024]

to enhance the air's purity and minimize the effect on surroundings, these standards which are more stringent than the earlier Euro IV standards.

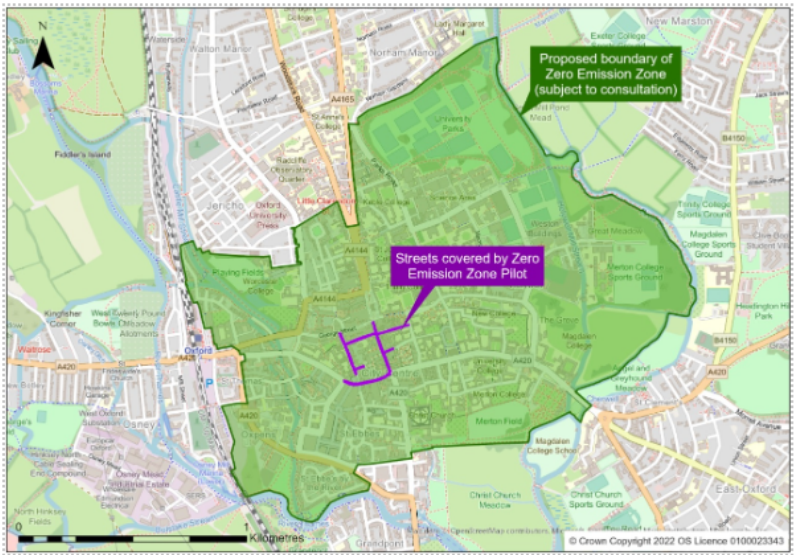


**Figure 2.4:** Oxford City Zero Emission zone. The streets marked with purple line.
Urban-Access-Regulations-Oxford [2024]

The Oxford Zero Emission Zone (ZEZ) was launched as a road user charge scheme on February 28, 2022, with the goal of improving the condition of the air and encouraging zero-emission mobility as shown in the fig. 2.4. Only zero-emission vehicles, such as those that run on battery packs or fuel cell technology, are allowed access. There is a fee associated with vehicles that fail to comply with these regulations, which is

determined by their pollution levels. The entire rollout of the ZEZ throughout the heart of town is expected to be revealed at some point afterwards (Urban-Access-Regulations-Oxford [2024]). Furthermore, Oxford has a special coach's entrance policy that restricts accessibility on a number of centrally located streets according to the time and weight of the automobile. There are designated sites for the pickup and drop-off of travellers, and coaches need licenses to drive on particular roads between specific times. Certain roadways are exclusively designated for the usage of buses, taxis, and private rental cars. Coaches must record information such as date and time of visit, pick-up locations and so on. Oxford is putting into practice a traffic filter trial initiative that will limit automobile traffic on six city routes during specific hours. The initiative covers electric automobiles amongst those who are affected. The objective is to control access and lessen traffic in important parts of the town (Urban-Access-Regulations-Oxford [2024]).

### 2.2.5 The Case Of Vienna

Vienna, the capital of Austria, has 1.89 million residents and is a large, crowded town in Central Europe. In contrast with many American towns, Vienna which is well known for its robust public transportation services has shown trends in the fact that people are less dependent on private vehicles. Vienna has invested a lot of money in bike infrastructure. Riding a bicycle contributed to 7% of travel within the city in 2015, and as much as 13% inside the urban areas. The city has plenty of bike racks, designated bike lanes, and bike-specific signage. Vienna has operated a bike-share program since 2003 and according to 2019, there were 121 stations and about 1,500 bikes (Moran et al. [2020]).

Vienna's current transportation and urban development policies were largely established during the 1990s. The 1980 strategy's primary objectives were extended in the 1993 Transit Plan with the ambition of bringing the car mode share down to twenty-five percent by 2010. In the year 1993, parking management was introduced for the first time in the historically significant area 1st district and to fully handle parking spaces over a large area of the town, the expansion went from districts 2 to 9, and 20 other inner districts had also been included by 1999 (Buehler et al. [2017]). The Vienna City Council planned on building the U-Bahn network in 1968, and the initially constructed 3 km stretch of the subway system began welcoming travellers in 1978. The network kept expanding, and by 1982, a noteworthy 30-kilometer line had been finished. In the early 2000s, there were even more significant extensions to the U-Bahn services. In particular, the link grew to sixty-one kilometres by 2000 and to seventy-five kilometres by 2010. Although the 25% target was postponed until 2020, the city's dedication to lowering the car mode share was reaffirmed in the 2003 Transportation Strategy. During that time, the CityBike bike-sharing program became available and was implemented in 2003, resulting in a significant advancement in the promotion of sustainable urban mobility (Buehler et al. [2017]).

Vienna's parking management system's operational period was expanded in 2007. The monitoring periods have been increased to 10pm from their earlier end time of

8pm and during the year 2012, and further the municipality launched a €365 yearly ticket that allowed limitless use of public transportation inside its city borders. The goal of this effort was to lower the cost to make it more affordable and increase the availability of transit in order to promote its utilization instead of private vehicles. An increased focus on environmentally friendly transportation was observed during the 2010s. A new target was established by the Transportation Plan of 2014 which stated that by 2025, only 20% of journeys will be made in cars. By 2014, Vienna had managed to decrease the amount of traffic by nearly 80% on neighbourhood roadways through the implementation of traffic control measures, which improved the town's walkability and bicycling conditions. The year 2016 showcased that 16 of the 23 districts had adopted the parking management system, demonstrating the program's ongoing growth (Buehler et al. [2017]).

In addition to the U-Bahn, Vienna's strong and reliable public transportation approach also makes use of buses, trams, and regional rail network (S-Bahn and Regional bahn). Since 1990, advancements have consisted of modern railway stations, shortened headways, dedicated bus lanes, and real-time information technologies. Vienna's "Verkehrsverbund" is a regional transit association that has greatly improved public transit by developing an efficient system such as timeline scheduling, streamlining routes, and fare price balance. The federal government had played an important part in establishing Vienna's Verkehrsverbund and generously financing the U-Bahn. The effective execution of Vienna's sustainable transport policies required this kind of backing. Vienna continues to save a significant portion of its land as parks, forests, and vineyards, preserving harmony among urban growth and green areas (Buehler et al. [2017]).

Vienna continues to keep up its innovative work in urban mobility in recent times. In 2018, the American companies Bird and Lime put forward dockless scooters, which improved Vienna's public transportation choices. The city's transition of dockless bicycle rentals corresponded with this shift. These electric scooters have gained popularity as a more convenient, flexible and less burdening option for getting around the city, particularly in the hot summer months, when compared to standard docked bike-share services. This effort is in line with Vienna's objective to increase the number of eco-friendly modes of transit it offers (Moran et al. [2020]). In 2019, Austrian rules and regulations categorized scooters as practically recognizable as bicycles. This means that scooters are now governed by similar regulations in Vienna as bicycles, which specify and have information on where and how these bikes can be driven and parked. Vienna has taken the initiative to control scooter-sharing. Bikeshare providers had to follow new rules from 2019, they keep an office in Vienna, get a license for operation, and make sure local rules were followed when handling the data. The municipality also established no-parking zones near parks and playgrounds, tourist attractions, and walking zones, as well as a limitation of 1,500 scooters for every provider. Vienna implemented new regulations in April 2020 that mandated scooter owners spread their vehicles more fairly throughout the city. To guarantee wider accessibility, this involved imposing district-specific scooter limits. This modification attempted to decrease the heavily concentrated services in

central regions and enhance the availability in outside regions (Moran et al. [2020]).

Since 1st January 2016, Vienna has a Low Emission Zone (LEZ) dedicated to heavy goods vehicles (HGVs) and trucks. This region requires automobiles that should follow Euro 3 emissions compliance. Automobiles must have a verified Austrian emissions grade label displaying the automobile's emission class on the windscreen for them to obey. This LEZ is in effect continuously, 365 days throughout the year, and police officers manually monitor its regulations. These rules apply to cars that come from other country as well, and they need to get the required label. This zone prohibits the retrofitting of automobiles to comply with emission requirements (Urban-Access-Regulation-Vienna [2024]). The fig. 2.5 shows that the whole city of Vienna is low emission zone.

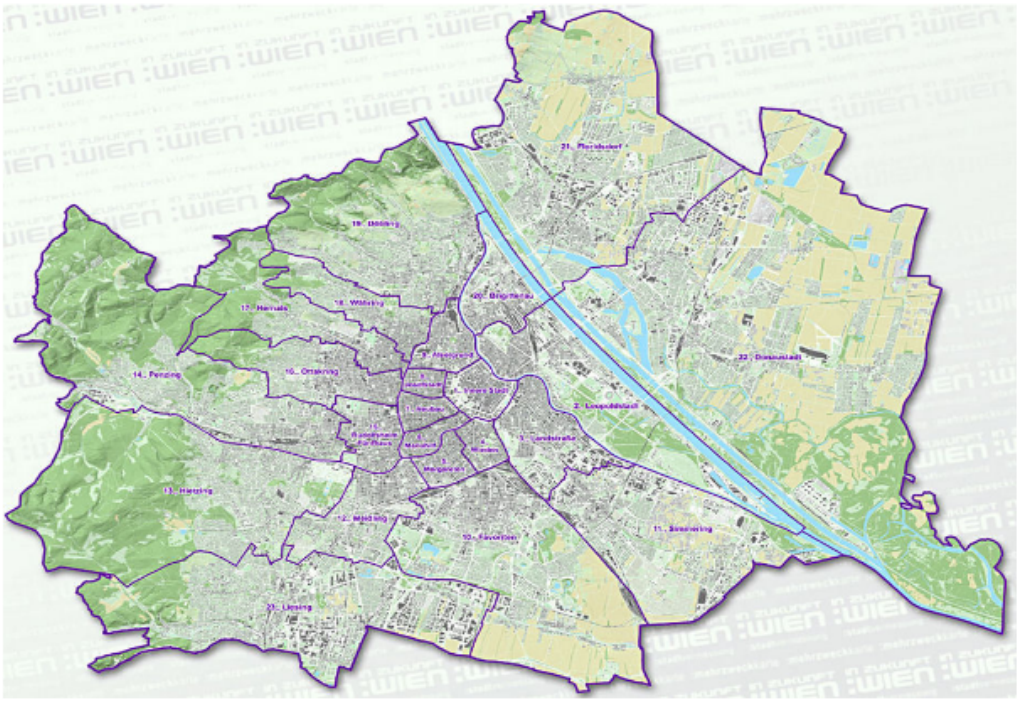

**Figure 2.5:** Vienna city (Entire city) Low emission zone.
Urban-Access-Regulation-Vienna [2024]

Vienna has a two-levels air pollution emergency strategy that goes into effect if PM10 levels are higher than 50 µg/m3 for more than twenty-five days out of the year. Using public transportation and lowering heating in the interior likes houses and buildings to save energy is advised at the first level. The potential of prohibiting cars with internal combustion engines in specific locations exists at the second level. Under these warnings, electric vehicles are not subject to these limitations and can continue operating as intended. Alerts are sent across a variety of media outlets, and this approach is intended to swiftly reduce environmental damage levels (Urban-Access-Regulation-Vienna [2024]).

Vienna has created area-wide short-term parking zones called Kurzparkzonen, where

people from the local place are allowed to park without any time restrictions and non-residents are subjected to restrictions with that, they can park only 2 hours with paid ticket. The hours of operation for this regulation are 9:00 AM to 10:00 PM. These regulations apply to all cars, domestic and foreign, and are manually handled by law enforcement. This approach lessens traffic throughout the town and promotes the usage of public transportation (Urban-Access-Regulation-Vienna [2024]).

### 2.2.6 The Case Of Copenhagen

Copenhagen's urban transportation system is being greatly influenced through the effective implementation of command-and-control, market-based, and soft policy initiatives. All of these strategies have made a substantial contribution to the city's objective of improving cycling facilities and fostering a robust bicycling environment. Copenhagen is now regarded as the benchmark city for cyclists and urban developers due to its all-encompassing urban mobility strategy (Gössling [2013]).

Command-and-Control Efforts include the city's proactive use of technology to encourage bicycle riding. The capital has set up extensive cycling facilities such as big bike lanes and eco-friendly greener bicycle lanes. These have been carefully planned to improve speed, safety, and to promote bicycling as the attracting and the main form of travel for both entertainment and everyday travellers. Copenhagen has further extended its dedication to creating a safe riding atmosphere by installing modern facilities LED sensors at crossings to warn cars concerning cyclists. Market-Based Measures strategies focus on gradually improving bicycle facilities to reduce the traffic jams in the streets of the city, for example, the town has consciously raised parking prices to discourage individuals from driving of own vehicles. Bicycling is now a quicker and more effective means to move around due to the overall decrease in traffic jams, and it has become increasingly appealing as a substitute means of transit in metropolitan areas. Apart from that, one exception to the general market-based policies is the provision of free bicycles transportation in public busses and trains, that serves as a benefit for riders and promotes cycling even more by tying it into transit services. By improving the riding atmosphere, such actions greatly aid in the promotion of bicycling (Gössling [2013]).

Soft policy initiatives in Copenhagen aim to promote a generalized bike lifestyle and influence public opinions. The capital has employed a range of learning opportunities and community involvement efforts to advance bicycling as an environmentally friendly and advantageous means of transportation. These actions are essential to changing people's conception of bicycling as a way of life with many positive health and environmental advantages, rather than just a means of transportation. By these gentle regulations, cycling practices are consistently promoted and encouraged, which upholds Copenhagen's standing as a bike-friendly city (Gössling [2013]). When taken as a whole, these programs have produced remarkable results, such as a rising popularity of bicycling and improved safety for everyone. Backed by regular evaluations and improvements via the town's Bicycle Account, these combined tech-

niques guarantee that bicycling stays a key element of Copenhagen's urban transit environment. With this all-encompassing approach, Copenhagen is guaranteed to become and remain among one of the worldwide most bicycle-friendly cities.

In Copenhagen, the establishment of a flexible and accessible metropolis is the primary emphasis of the close integration of environmentally friendly transportation plans with more general aims of urban growth. To lessen dependency on personal automobiles and promote a healthy environment, the city's plan places a strong emphasis on multimodal modes of transit, effective public transportation infrastructure, and so on. Copenhagen's approach is specially enhanced through Transit-Oriented development (TOD) concepts, focusing growth close to transportation terminals to improve connectivity and encourage more compact, more effective city planning. The city is addressing a variety of urban difficulties such as economic, social, and environmental effectiveness through integrated action between government levels and sectors using an approach of vertical and horizontal policy coordination. The term "vertical policy coordination" describes the collaborative effort and lining up with the various levels of the government such as local, regional, national, and so on. This kind of collaboration guarantees ensuring that laws are administered with equity and uniformity at all administration stages as well as local laws complement and reinforce national government goals. The process of ensuring that regulations are holistic and vary from one another at a similar stage in governance calls for horizontal policy coordination, which entails cooperation between various departments or areas. This involves overseeing initiatives across many various sectors, including living quarters, transit, ecological sustainability, and financial inclusion, to forge connections and tackle difficult problems holistically (Alcantara [2023]).

Furthermore, Copenhagen is setting a high standard for environmentally friendly and regenerative transportation, taking steps to promote the liveliness and regenerating of urban areas rather than merely mitigating negative effects (Alcantara [2023]). In order to address changing urban difficulties, Copenhagen's overall strategy for urban transportation is flexibility and ability to change. The city's Sustainable Urban Mobility Plans (SUMPs), that are revised frequently to take into account fresh information and circumstances, serve as an example of this. An important component of this all-encompassing approach is its focus on participatory planning for community inputs and stakeholder participation. Copenhagen ensures that transportation policies are detailed, popularly endorsed, and responsive of the requirements and demands of residents by engaging people, companies, all organizations in the development of the plan. These cooperative and progressive approaches show Copenhagen's dedication to upholding its position as internationally recognized country in sustainable urban mobility (Alcantara [2023]).

Copenhagen is widely recognized as the most bicycle-friendly city, with a large portion of the population using bicycles as their primary mode of transport (Buehler and Pucher [2021]). This preference for cycling is supported by the city's infrastructure and policies. One significant urban regulation in Copenhagen is the establishment of low emission zones (LEZ) as shown in the fig.2.6. In these areas, buses and lorries

weighing over 3.5 tonnes are not permitted unless they are equipped with specific filters to minimize environmental impact. Notably, an IKEA store is located within one of these LEZ areas (Urban-Access-Regulation-Copenhagen [2024]).

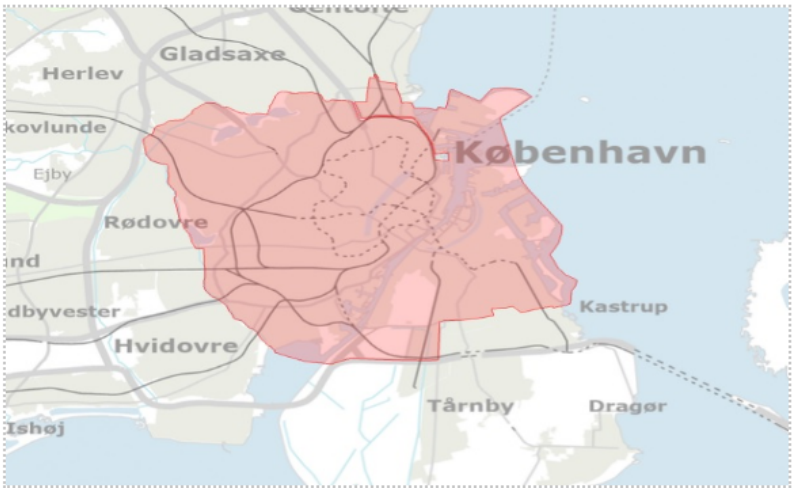


**Figure 2.6:** The Highlighted area is Low Emission Zone of Copenhagen city. Urban-Access-Regulation-Copenhagen [2024]

In recent years, Copenhagen has been planning to introduce zero emission zones. These zones will cover the medieval part of the city and will only allow electric vehicles, completely banning those powered by petrol or diesel. This initiative aims to further reduce pollution and promote sustainability. Additionally, By-expressen, a delivery service in Copenhagen, utilizes cargo bikes without electrical assistance. This choice is practical due to the city's generally flat geography, making it easy to navigate without the need for electric power (Anderluh et al. [2019]).

In 2019, Copenhagen introduced regulations for e scooters, mandating that they must be ridden in cycle lanes to ensure safety and order on the streets (EU-Urban-Mobility-Observatory-Copenhagen [2020]). E scooter rental services are provided by private companies through their respective apps, making it convenient for users to rent and ride these scooters. Initially, there were issues with unregulated parking zones. After using e scooters, users would often abandon them anywhere they pleased. This led to disturbances in public spaces, creating obstacles for bicycles and causing pedestrians to feel unsafe around the haphazardly parked scooters (EU-Urban-Mobility-Observatory-Copenhagen [2020]).

To address these problems, the city municipality implemented a limit on the number of e-bikes and e scooters allowed in certain areas. Specifically, only 400 e-bikes and scooters in total were permitted to operate in the densely populated areas of Copenhagen (Shared-Use-Mobility-Center [2020]). This measure was intended to reduce congestion and improve safety in these busy parts of the city. Furthermore, new regulations were established to ensure that e scooters are parked in designated areas around the city. In certain zones, e scooters are not allowed to begin or end

their journeys, further promoting organized and safe use of these vehicles (Iotkovska [2021]).

### 2.2.7 The Case Of Paris

The urban mobility efforts in Paris mainly target the problems of traffic jams and ecological consequences that come with driving in cities. The adopted approaches aim to enhance the general standard of city life and minimize the negative effects of heavy vehicle traffic in cities, which is in line with international environmentally friendly transportation goals. One of the main efforts is the establishment and administration of roads with tolls as a regulating tactic to control the movement of personal automobiles. This involves thinking about building new toll roadways that are financed by concessions from the private sector in an effort to reduce traffic without adding to the financial strain on the public's pockets. This strategy has been shown to be a viable means to control the rising number of cars on the road and the effects it has on the surroundings. Furthermore, Paris is currently investigating whether car-sharing schemes are a suitable way to help reduce traffic congestion in city. This involves designating lanes exclusively for carpooling, which may promote carpooling by providing quicker travel choices for individuals engaged in such initiatives (Raux [1996]). By encouraging the use of public transportation and other sustainable forms of transportation instead of privately owned vehicles, these plans seek to improve Paris's living standards and environmental conditions in the city.

The Vélib' bicycle sharing program in Paris has grown to be a vital component inside the region's public transit, with a focus on environmentally friendly transportation where the meaning of Vélib means free bicycles. Since its launch on July 15, 2007, when 10,000 bicycles were first made available, Vélib's mission has grown to include more routes and improve connectivity while enhancing the current public mode of transportation. Every 300 meters, the company's well positioned stations make bicycles easily accessible for usage. Around 230 miles of bicycle paths connect these stations, promoting safer and easier bicycle riding around the city (Midgley [2009]).

Free bicycle rentals for the initial thirty minutes encourage short trips and high usage, which combines nicely with additional means of transportation and makes Vélib' a useful choice for a range of customer requirements. The Vélib system currently has a significant number of users, and long-lasting subscriptions show that it is heavily used every day, mostly for travelling. Free bicycle rentals for the initial thirty minutes encourage short trips and high usage, which combines nicely with additional means of transportation and makes Vélib' a useful choice for a range of customer requirements. The Vélib system currently has a significant number of users, and long-lasting subscriptions show that it is heavily used every day, mostly for travelling (Midgley [2009]). In addition to reducing traffic jams, this creative bicycle sharing program in Paris also benefits people's health and the condition of the air, which is in line with larger sustainability goals. The viability of Vélib's urban transportation options has established a standard for towns and cities seeking to adopt comparable environmentally friendly alternatives (Midgley [2009]).

The urban policies in Paris are designed to tackle and control a broad range of issues related to sustainable development, competition within the locality, and social and territorial inequality. The city takes a broad method, utilizing comprehensive actions that are frequently outlined in several contracts and plans. Fighting socioeconomic and territorial inequality is a major goal of Paris policy. Policies like "Policy for Cities" directs large sum of money into impoverished areas with the goal of enhancing quality of life, employment prospects, and public facilities. By concentrating its efforts on regions having significant social and economic issues, this policy promotes greater equality for all. Another fundamental element of Paris's urban policy is environmental sustainability. The city has proposed a number of climate and urban transport initiatives to encourage environmentally conscious choices and minimize the release of greenhouse gases. With the goal of making Paris an example for urban sustainability, these plans concentrate on enhancing public transit, boosting the utilization of energy from renewable sources, and promoting environmentally friendly urban practices (Lefevre [2021]).

Paris has implemented strict urban access regulations to manage traffic and reduce pollution. One of the key regulations is that heavy trucks weighing more than 7.5 tonnes are not allowed inside the city limits except during certain periods (Urban-Access-Regulation-Paris [2024]). This rule helps to reduce congestion and minimize the environmental impact of heavy vehicles within the city.

Additionally, Paris has established a low emission zone in its inner-city center, within the ring road. In this zone, vehicles of various kinds must meet at least the Euro 3 emissions standard to be allowed access between 08:00 and 20:00 (Urban-Access-Regulation-Paris [2024]). Fig. 2.7 shows different coloured areas where different types of vehicles with varying standard of emissions are allowed.

This regulation ensures that only relatively cleaner vehicles can enter the area during the day, contributing to better air quality. Looking ahead, Paris plans to introduce zero emission zones starting in 2030. In these zones, only electric vehicles will be permitted, further enhancing the city's efforts to reduce emissions and promote sustainable transportation. These zero emission zones will be implemented in select areas, focusing on the most congested and polluted parts of the city.

Paris was the first city in Europe to introduce e scooters for travel within city limits, with US-based rental companies BIRD and LIME operating these scooters (Lang [2018]). These were free-floating, dockless scooters, meaning that users could pick them up and park them anywhere within the city's boundaries. In May 2019, Paris introduced a Code of Good Conduct for e scooters. This regulation established a public-private partnership for rentals and required the sharing of travel data patterns. It also included rules for proper parking and riding, emphasizing the safety of both riders and pedestrians (EU-Urban-Mobility-Observatory-Paris [2022]).

One of the key aspects of the new regulation was ensuring that e scooters were

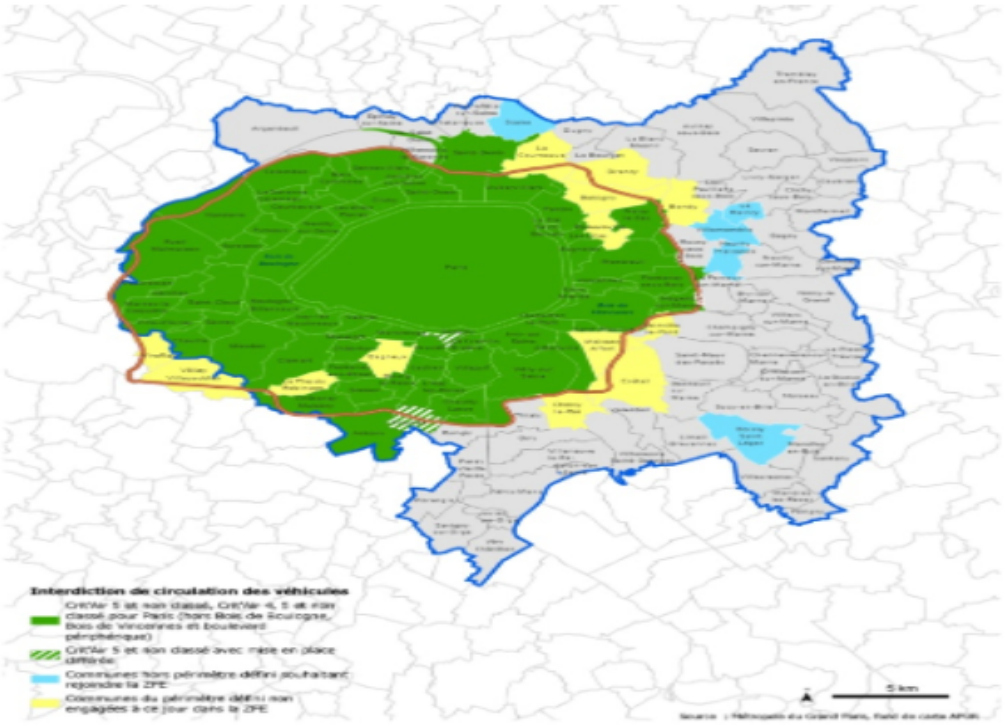


**Figure 2.7:** Paris's low emission zones which are different for varying emission standards.
Urban-Access-Regulation-Paris [2024]

parked responsibly. The municipality published a new law that prohibited parking e scooters on footpaths and pedestrian areas. In July 2019, dedicated parking zones were allocated around the city specifically for e scooters (EU-Urban-Mobility-Observatory-Paris [2022]). Additionally, e scooters were programmed to operate at lower speeds in densely populated areas, while their speeds were regulated in less dense zones to enhance safety.

Despite these measures, Paris decided to ban the rental of free-floating e scooters due to the over-congestion they caused, which was harmful to pedestrians. This decision made Paris the first city in Europe to implement such a ban. In April 2023, a public vote was held regarding the e scooter ban, and more than 80% of residents voted in favor of removing rental e scooters from the city (Kelly [2023]). Beyond e scooters, Paris has embraced other forms of micro mobility for urban logistics. For instance, cargo bikes with pedal assistance are used for postal deliveries (Frost [2022]). Additionally, DB Schenker employs cargo bikes for last-mile deliveries, transporting goods from various hubs directly to customers (Robichet et al. [2022]).

These steps reflect Paris's broader strategy to manage urban mobility and reduce environmental impact while ensuring the safety and convenience of its residents. The city's evolving approach to micro mobility, from pioneering e scooters to their eventual ban and the adoption of cargo bikes, illustrates a commitment to finding the most effective and sustainable transportation solutions.

## 2.3 Micro mobility

The article "The role of micro mobility in shaping sustainable cities: A systematic literature review" by Abduljabbar et al. [2021] tells us that micro mobility is a useful urban transport option intended for shorter journeys such people using this micro mobility for starting or ending trip of the journey. It draws attention to the benefits associated with micro mobility, such as its adaptability, cost-effectiveness, sustainability, and accessibility on-demand. It has the ability to drastically alter urban landscapes by lowering reliance on personal automobiles for smaller transportation distances. Micro mobility refers to the use of lightweight vehicles that typically travel at speeds of less than 45 kph (Peng et al. [2021]), they can be bicycles, skateboards, E-bicycles, cargo bikes, e scooters, etc. They could be shared vehicles or personally owned vehicles, run by electricity or human power. The transition to environmentally friendly transportation with the help of micro mobility solutions offers a substitute that helps in reducing traffic jams and congestion for private vehicle use, particularly on short trips (Abduljabbar et al. [2021]).

New developments in technology for mobile devices have also contributed to the rise in popularity of sharing mobility via applications for smartphones. This technology encourages the usage of micro mobility and enables customers to think again about the necessity for private car ownership when combined with the sharing economy paradigm. This method also promotes physical travel like walking, which enhances cities people health and offers a flexible form of transportation for a range of demands in urban settings, from short journeys to package deliveries. Micro mobility choices, as a component of the sustainable urban mobility ecosystem, may accommodate a range of requirements, from single and family travel to package delivery in urban areas. Globally, shared micro mobility initiatives, particularly bicycle sharing programs are becoming more and more well-liked. According to the paper, they currently service short trips of under five km, which make up 50–60% of the total number of passengers normal travel distance in China, the EU, and the US. They can even manage travels up to 20 km with improved infrastructure, especially in cities (Abduljabbar et al. [2021]).

Abduljabbar et al. [2021] in the article combines previous studies and divides it into four primary areas namely, technology, policy, benefits, and determinants of micro mobility Usage. This gives a comprehensive and complete picture of the revolutionary effects of micro mobility in cities, offering crucial information for creating sustainable urban mobility plans (Abduljabbar et al. [2021]).

### 2.3.1 Benefits

There are substantial social, economic, and environmental advantages to micro mobility which helps to reduce emission levels, minimizes traffic jams, and improves road safety. By substituting smaller electric vehicles that run on battery for the

short distance travelling over the use of private vehicle journeys, it encourages a decrease in carbon dioxide emissions. In comparison with bike-sharing services programs, e scooters proved to be more cost-effective and efficient for journeys under two miles, according to a Chicago analysis. Additionally, the study discovered that young individuals who used e scooters for leisure activities generated some amount of income, demonstrating how micro mobility options can reduce travel time and increase effectiveness and productivity (Abduljabbar et al. [2021]).

In places with insufficient public transportation, micro mobility enhances accessibility. Having effective first and last-mile connectivity to transportation stations enables people to take advantage of these services in saving money economically and crucial amenities. According to Abduljabbar et al. [2021], up to 40% of Lime customers rely on micro mobility to get to their jobs or education highlighting good connectivity.

The advantages of micro mobility for controlling urban environments are well-expressed by Olabi et al. [2023], emphasizing the way it improves the future viability of urban transit and helps to meet several Sustainable Development Goals (SDGs) of the United Nations (UN). In particular, they contribute to a better quality of life in towns and cities by lowering emissions of harmful gases (SDG 3). Additionally, it minimizes carbon footprint, promoting financial development and decent employment (SDG 8). Additionally, it improves green neighbourhoods and town by lowering traffic, increasing the cleanliness of the air, and enhancing transportation connections (SDG 11). Furthermore, micro mobility contributes to fighting climate change by reducing pollution from harmful gases (SDG 13) and promoting ethical production as well as use by improving the effectiveness of modes of transport (SDG 12) (Olabi et al. [2023]).

The study by Fan and Harper [2022], offers a thorough examination of the potential effects on environmental and traffic jams of switching from shorter car journeys to micro mobility options such as bicycles and e scooters. Additionally, the study demonstrates that adopting micro mobility in city transportation can greatly reduce traffic jams, especially on busy highways. This has made practicable by the fact that micro mobility solutions can move around congestion more swiftly compared to cars and usually take up fewer spaces on the roadways. There will be reduced traffic because of fewer journeys by car, resulting in lower vehicle miles traveled (VMT). The shift to micro mobility presents an opportunity to cut down harmful gases coming from cars used for short-distance travel. According to the research, switching to micro mobility instead of driving privately owned vehicles can reduce pollutants and consumption of energy, however, these benefits could be outweighed by the ability to relieve traffic. It also suggests that although micro mobility can help ease traffic jams, its effect on controlling pollution will be small as long as integrated into additional initiatives like electrification of vehicles or more extensive developments to transit services (Fan and Harper [2022]).

Further the author Abduljabbar et al. [2021] discusses, by moving trips out of per-

sonal vehicles, employing micro mobility choices like electric scooters and bikes for initial and the final mile services and for shorter journeys can help minimize traffic jams and pollution. According to research, these forms of transport use less energy and space, increasing accessibility to public transportation and decreasing the need for parking spots. Increased cycling might also considerably reduce CO2 emissions and the number of miles driven by each passenger, which would have a positive impact on both the surroundings and transportation. Cycling and other non-electric micro mobility solutions increase both mentally and physically development. Research has demonstrated that switching from driving to cycling increases physical activity and lowers your chance of health problems, anxiety, stress and depression. However, consumers may engage in fewer physical activities if they switch to e-bikes instead of walking or traditional bicycles (Abduljabbar et al. [2021]).

### 2.3.2 Policy

Initially micro mobility service implementations brought unexpected effects, including responsibility, protection, and infrastructure difficulties. In order to improve connectivity in cities, shared services need careful design and flexible laws. According to surveys conducted in Sweden and Greece, fleet handling guidelines, bike and cycle line infrastructures, and everyone's participation are essential for bike-sharing systems to succeed. According to a study by Pucher and Buehler [2006], early regulations in Canada that prioritized safety and development were the reason for the country's greater bicycling rates than those in the United States (Abduljabbar et al. [2021]).

Pedestrian Space Management rules: Good regulations make sure that sidewalks are managed to keep accessibility for people intact, minimize mess, and allow for micro mobility. Techniques include set parking zones, taxes, equipment's like device caps to restrict the number of cars, and restrictions on speeds and usage (Abduljabbar et al. [2021]).

Rules Regarding the Speed Limits: The effectiveness of imposing speed limits in public areas as a means of reducing the high-speed behaviours of micro mobility vehicles (MMVs), such as e scooters, is a matter of discussion. The research points to the possibility that visually distinct lanes and suitable lane widths work better than speed restrictions. In public areas, restricting speeds are usually implemented to control consumers speeding of micro mobility vehicles (MMVs), such as e scooters. (Zhang et al. [2023]).

Dismount Signs: One practical way to minimize incidents among people walking and MMVs is to put in place dismount signs for bicycle riders and other vehicles. Nonetheless, a lack of regulation frequently hinders MMV accessibility in shared areas (Zhang et al. [2023]).

Unification of the regulations: It is advised that laws be standardized and applied uniformly across nations, areas, and localities to assist MMV users in getting com-

fortable with regulatory requirements and preventing unknowingly breaking of the law. Their openness to use these services may rise as a result of this behaviour (Zhang et al. [2023]).

Equitable (Fair) Service Standards: Customers who lack access to bank cards face obstacles because the majority of pooled micro mobility services rely on them for payment. This problem might be resolved by providing alternate payment options like prepaid cards or payment from public transportation card. Furthermore, those with low incomes can find these services expensive, thus offering discounts or subsidies for selected individuals should be taken into consideration. Non-tech methods such as coin-deposit systems might be developed to accommodate people who do not have access to cell phones or mobile internet. Additionally, some neighbourhood's such as developing regions or suburban areas that are remote from the city might not benefit from shared micro mobility amenities and require improved access (Abduljabbar et al. [2021]).

Enforcement: Enforcement is essential for safety and protection, especially when it comes to clearing sidewalks and guaranteeing pedestrian security. One of the main enforcement strategies is to require the business operators move any equipment blocking walkways in a specific period of time in order to keep public acceptance and right-of-way access. In order to safeguard private belongings, service providers should also take swift action to remove all devices parked outside without the owner's permission. Operators should adjust fleets according to requirements and remove inactive or dangerous equipment to reduce needless clutter and uphold safety regulations in order to guarantee fair service throughout the municipality (Abduljabbar et al. [2021]).

Data Standards: Standardized, publicly accessible data must be accessible to public agencies so they may assess the effects of micro mobility amenities, keep an eye on meeting fair norms, and integrate statistics into their computers in order to give travellers complete, up-to-date holistic information. Recommendations are required to help government organizations integrate data sharing norms into their micro mobility policy in order to promote this. This will make it possible to gather and distribute data in a uniform manner, improving coordination between areas and assisting authorities in making better decisions on the efficient management of micro mobility services while improving customer service (Abduljabbar et al. [2021]).

### 2.3.3 Technology

The growth of innovative mobility solutions in urban areas worldwide has been fuelled by the increasing usage of AI, data analytics, mobile computing, and information technology. Temporal and spatial patterns found in shared mobility records are useful for analysing customer behaviour and pointing out service constraints. By combining various data sets into a multimodal system enables more effective use of various modes, such as shared bicycles and e scooters (Abduljabbar et al. [2021]).

Future services could be improved by utilizing AI and machine learning to analyse more data gathered from every ride, such as origination and places of interest, battery power, mode of payment, and the climate. AI may additionally enhance connectivity in fleet management, guaranteeing efficient implementation based on user requirements throughout urban regions. Bike-sharing services are being made simpler by advances in technology that use station-level data to regulate pickups and balancing bikes. Policymakers or authorities can learn a lot from the spatiotemporal analysis of Chicago's bicycle sharing trends about maintaining, rental bay distribution, and forecasting demand. AI can also increase protection by spotting changes in the road, spotting potential dangers, and alerting people to avoid collisions. Additionally, data are being used to estimate how micro mobility affects other forms of transportation (Abduljabbar et al. [2021]).

### 2.3.4 Determinants of Micro mobility Usage

Micro mobility innovations improve public transportation accessibility greatly. Bicycle sharing programs in North America have been shown to lower the usage of private cars and taxis while increasing overall use of other forms of transportation. Such initiatives are influenced by socio-economic factors and public attitudes. Mode or ride selection is significantly influenced by views on ease, accessibility, and adaptability.
Infrastructure is important as well, bike lanes, walkways, and terrain all influence how appealing is cycling and whereas footpaths connecting to hubs or central stations increase the number of users of active transportation modes, sloping terrain reduce their appeal. The public's responses to fluctuating temperatures and circumstances are influenced by weather patterns as well. Bicycle mindsets and frequent use are promoted by initiatives such as "Bike-to-Workday" (Abduljabbar et al. [2021]).

The customer choices of Urban Shared micro Mobility are impacted by a number of elements, such as walking distance, expenses, travel duration, parking conditions, and social demographic characteristics. Factors like parking availability and price, along with the ease and simplicity of riding a bike, influence this choice of vehicle. More specifically customers preferred over fixed parking areas are floating around places to park methods, which allow users to exit their traveling way wherever close to their intended location. The research written by Jaber et al. [2023] further emphasizes the significance of tackling particular customer requirements and practices. For instance, important objectives like traveling to work or school have a greater influence on the use of shared micro mobility than recreational travel. Additionally, the choice to utilize these facilities is greatly influenced by other factors such as the climate, and this additionally shapes one's choice for micro mobility (Jaber et al. [2023]).

There are issues with e scooters and programs that share bikes as well. Peak hours in Indianapolis, according to temporal usage habits, are from 2 to 7 p.m. on weekends and from 4 to 9 p.m. on weekdays. Usage is hindered by geofences and no-parking zones, shown in Austria. In San Francisco, growing demand in regions not covered

by docked services was fulfilled by the introduction of dockless systems like JUMP along with the existing station-based bike sharing service. Research conducted in Switzerland indicates that e bikes interfere with short-distance vehicle rides by crossing the boundaries of the service areas of taxis (Abduljabbar et al. [2021]).

# 3
# Method

This section introduces a methodology for the study that aims to tackle the challenges of micro mobility and urban mobility in the framework of IKEA's creative do-it-yourself solutions. The methodology's initial phase was devoted to a literature review. This involved looking through previous studies on urban mobility, in order to pinpoint the developments and uses of micro mobility in diverse urban contexts and provide a strong theoretical framework.

In the latter section, a description of how the gathering of data for the case study of IKEA's last-mile delivery solutions is presented. This involved having weekly meetings and direct interactions with the IKEA team, which helped to evaluate the difficulties and practicalities of putting micro mobility solutions into practice in reality, and also to gather insightful information to capture IKEA's point of view.

## 3.1 Research methodology

The application of methods and methodologies is essential for efficiently organizing and directing the work in the research to provide precise, trustworthy, and strong results. The procedures or actions that make up these research methods and methodologies ensure the quality and reliability of the project outcomes and research findings (Håkansson [2013]). To provide readers with a clear understanding of the topic, the chapter includes information on the research, data collection methods, data analysis techniques, and the reasoning behind the chosen methodologies.

The two main categories of research methods are quantitative and qualitative methods, depending on which is appropriate for a particular set of findings and projects. Choosing a research method establishes the nature of a project, quantitative projects use numerical information, while qualitative projects use non-numerical data. This first decision has a big impact on later research plans, data-gathering procedures, and analysis methods (Håkansson [2013]). The goal of qualitative research is to clearly understand concepts, opinions, and actions. It makes use of smaller quantities of data to create new hypotheses and comprehend difficult problems. This approach frequently entails examining texts, findings, and interviews. Data is gathered continuously as long as new information is discovered. Qualitative research is beneficial for gaining comprehensive and deep understandings (Håkansson [2013]).

There are major differences between the study's methodologies of abduction, induction, and deduction across many factors. A research methodology, in the words of Peirce et al. [1932], is "the road of deliberate scientific reasoning." As such, following the study's logical flow is essential to understanding a research method (Spens and Kovács [2006]).

Beginning with an odd observation or anomalies that cannot be explained by any of the current theories, or by purposefully using an alternative explanation to clarify something, is how the abductive research process is initiated. Even in cases where existing theory is inadequate, it starts with empirical findings. In order to identify or create an appropriate framework, researchers constantly cycle across theory and observation. The stages of collecting empirical data and developing theories overlap in abductive research, resulting in ongoing learning. The intention is to propose new theories, generating hypotheses and propositions that are only made general when supported by additional empirical research (Spens and Kovács [2006]). This project research uses theory and empirical data to create an understanding that is very similar to an abductive approach.

To improve the clarity of information, our study is divided into two major parts. The first section consists of a comprehensive overview of the literature in which we carefully examine academic publications and urban studies that have already been published in order to pinpoint significant advancements in urban mobility and micro mobility approaches in a range of cities. This analysis contributes to the establishment of a solid theoretical foundation understanding current trends by offering strong guidelines to support the research on the practical implications of micro mobility in urban settings.

The second section presents how the case study of IKEA's Do-it-yourself last-mile delivery solution was approached. This section describes how primary data was gathered from everyday activities and scheduled weekly meetings with the IKEA team. Discussions with the IKEA team helped to learn and assess the possibilities and challenges related to putting micro mobility solutions into practice. The involvement allowed for witnessing decisions being made in real-time and the application of theoretical frameworks in practice. This engagement also facilitated the sharing of viewpoints and provided an original perspective on the project's practicalities. Through written records of information exchanges and the diverse perspectives from the IKEA team, broad insights were gathered into how micro mobility could be maximized for both environmental and economic reasons in urban transportation settings.

## 3.2 Literature Search

For the thesis, it was important to understand the significance of firmly establishing the theoretical basis and empirical support for the research before starting to understand the concept of micro mobility. The main goal was to study the literature in order to better understand the theoretical foundations as well as practical implications of urban mobility.

Literature was searched by accessing several academic and online information platforms, such as ResearchGate, Google Scholar, and the Chalmers Library. These sites offered a wide variety of sources such as research articles, open-access journals, and so on. Choosing important keywords associated with last-mile delivery, urban mobility, and micro mobility was part of our searching direction. The cities that were chosen for the research were important. In the past, IKEA has set up businesses outside of the big cities in order to benefit from bigger areas and cheaper land prices. Despite this, current patterns indicate that IKEA is setting up shop in the heart of the cities to meet the needs of urban people and lessen the consequences of transportation by its customers. The chosen cities show different adavncements in urban mobility and provide ideas on how micro mobility solutions can help achieve their sustainability goals.

The search began by looking up the locations of IKEA's recently opened city center shops to find pertinent examples of the city. It was noticed that IKEA has well-known shops at the heart of the cities in Stockholm, Copenhagen, Vienna, Paris, and London. The following cities were picked as examples of the types of urban settings in which IKEA is putting its latest approach into practice. Furthermore, these urban regions are renowned for their inventive methods of promoting sustainable urban transportation and their endeavours to enhance the urban surroundings. Once these cities were identified, the study of literature was narrowed down to comprehend the policies, initiatives, and urban settings that they currently have in relation to sustainable urban mobility. The goal was to collect comprehensive data regarding the ways in which these municipalities handle traffic, urban congestion, and effects on the environment. This required looking through a lot of different sources of information, such as research papers, rules and regulations, and city planning information that addresses the laws and efforts related to sustainable urban mobility planning (SUMP) in those urban centers.

Comprehending the theoretical foundation of micro mobility options needed reading multiple articles along with reading earlier studies. This information offered a thorough understanding of current developments in urban settings of these cities, including case studies and research insights. This initial phase of the study was essential because it helped us identify and set up the main conceptual frameworks and examples related to the urban setting. It also helped us gain knowledge about the outcomes and applications of micro mobility alternatives.

## 3.3 Data Collection for the case of IKEA DIY Solution

We will dive into more information about the approaches used for data collection and analysis in the upcoming parts of the report on "Data Collection for the Case of IKEA DIY Solution," presenting an extensive discussion of primary and secondary sources. We will describe the procedure we used to communicate with the IKEA team and show how this exchange of ideas yielded important information about the viability and usefulness of the suggested micro mobility solutions. We'll also talk about how internal company documents shaped our comprehension and the ways what we learned has important outcomes. The following paragraphs make the connection between the data collection and analysis processes, which flows naturally into an exploration of the ways this information can support IKEA's decision-making and implementation in the company.

### 3.3.1 Participant Observation

Observation is a commonly used method, especially in behavioural science studies. However, anybody pays little attention to their surroundings, and these unscientific observations are not accepted. For observations to be regarded as a valid educational tool and a successful way to gather data, they need to serve a particular study goal, be meticulously organized and documented, and go through accuracy and dependability checks. Through the observation approach, the researcher collects data on their own and this method works particularly well for research that involves participants who are not able to express their emotions through speech for different reasons (Mazhar [2021]).

Groups have been an essential component of the collaborative environment in humanity and have been utilized to accomplish goals together in all cultures and times. Group work proved to be more successful than solo efforts in achieving essential objectives like building ancient wonders, particularly when the jobs involved required a variety of abilities and previous experience (Wheelan [2005]).

Participant observation was employed in the research where we were part of the IKEA team involved in discussions to collect details about ideas, thoughts, and views regarding last-mile delivery micro mobility solutions and other information. The participants discussed their opinions on the advantages, difficulties, and usefulness of micro mobility solutions. The participants included employees belonging to the IKEA team. The good insights into the real-world consequences and future developments for micro mobility uses were discussed and the information was gathered through these talks. The collaborative atmosphere of participant observation frequently results in a greater knowledge of the subject, as individuals depend on one another as a team to provide more information and insights.

Weekly meetings allowed us to gather primary information about the project in a joint effort with IKEA. This continued collaboration improved our comprehension,

and this perhaps helped to collect secondary data using internal company documents. Gaining a thorough understanding of the application and effects of IKEA's DIY solutions required such insights.

We gathered a large amount of primary data by means of weekly meetings with the IKEA team. These sessions were essential to the research process as they provided constant information on the status of the work. The team talked about current tasks, project status, difficulties encountered, and possible solutions during these meetings. This ongoing dialogue gave important insights into the realities of putting micro mobility solutions into practice in urban environments.

The weekly meetings enabled a dynamic exchange of knowledge as well as real-time problem-solving. The conversation touched on a wide range of subjects, such as the effects on the environment, customer satisfaction, operational effectiveness, and logistical challenges. These meetings were held every week, which made sure the research was based on real-world scenarios and current knowledge.

We successfully managed to collect primary data and obtain an overview of IKEA's DIY solution through weekly discussions with the IKEA team, which proved to be important for our research. We were able to gain information on the project's state, difficulties, and possible solutions by being involved in these meetings. We gained important knowledge about the actual implementation of micro mobility options in urban settings as a result of this engagement, which also helped to facilitate gathering information and guided our study.

### 3.3.2 Firm Internal Documents

The document Pitchbook includeed details for 19 different companies that were potential sppliers of micro mobility solutions. This information in the document consists of essential details like addresses, phone numbers, headquarters, major competitors, ownership status, products manufactured, and growth rates. This extensive document was used for secondary data collection, gathering information to carefully identify and group companies that are appealing based on the range of vehicles they offer. The companies were classified into categories according to whether they provide free trailers, 3-wheel vehicles, or 4-wheel vehicles. The data gathered in the document aimed at evaluating the suppliers and their respective micro mobility solutions. Another document from IKEA was used as a guide that outlined IKEA's requirements from three major perspectives: usability, affordability, and safety.

## 3.4 Project Contribution

A mixed strategy was used combining quantitative and qualitative research methods to contribute to the team. Quantitative methods were employed to gather and examine numerical data through weekly meetings and online research of potential suppliers. Subsequently, a Return-on-Investment (ROI) analysis was carried out to

determine each supplier's financial feasibility in alignment with IKEA's budget. To guarantee that our suggestions were supported by reliable numeric information, this required evaluating financial metrics, including cost savings, possible earnings, and payback periods, using challenging statistical techniques. The detailed results of the ROI analysis are included in an appendix, which is exclusively accessible to IKEA due to confidential in nature.

Qualitative research was also conducted by reviewing various kinds of literature to gain insight into the fundamental concepts and viewpoints. This helped to analyse deeper and more tailored perspectives coming from the qualitative research in addition to providing statistical support for the quantitative findings. When combined, these techniques gave the project team a broad viewpoint and allowed them to make well-informed decisions about which suppliers to choose for IKEA's DIY delivery services.

## 3.5 Data Analysis

This section of the chapter, "Data Analysis," will outline a plan for analyzing the primary and secondary data that have been gathered in order to answer the research questions and to clarify the effectiveness of micro mobility options in urban environments. The analysis is closely related to the theoretical framework that examines how urban transportation is affected by micro mobility, particularly when it comes to last-mile deliveries. It makes use of the framework and data in the methods covered in Chapter 3 that help to address the empirical findings and analysis in Chapter 5. This is in line with the research objectives with an emphasis on last-mile deliveries, which are to assess how micro mobility contributes to improved urban mobility and less traffic and pollution.

The data gathered from participant observation, in IKEAs meetings was carefully studied. The gathered data was examined using qualitative analysis to find trends and barriers to the adoption of micro mobility alternatives. In order to identify and classify the impacts resulting from the application of micro mobility solutions, data collected through observation was also assessed. The secondary data was examined such as literature reviews and articles from different websites, to give the findings of the primary data some context. This examination assisted in identifying knowledge gaps in the field and in understanding the social as well as regulations that affect micro mobility. Analyzing literature and reviewing it made easier to determine how well-studied data trends match up with current regulations and theoretical projections.

In order to accomplish the thesis objective a simple comparison method was used. This technique included studying and comparing urban mobility projects, in European cities. This comparative assessment provided a view of the similarities and differences in how different cities tackle urban mobility issues. By presenting the data in a manner such as a table, it was simpler to spot trends, innovative approaches

and common themes, in urban settings. The simplicity of this approach made it an effective tool for answering research questions. It also provided a solid foundation for reaching meaningful conlusions about the state of urban mobility in Europe.

From the theoretical framework to the data collection approaches and analysis, every step of the analysis process is thoroughly designed to yield particular insights that when taken as a whole address the main research questions. This technique highlights the success and social acceptability of micro mobility solutions in urban settings.

## 3.6 Research Quality

Important indicators in quantitative research include validity, reliability, generalizability, and objectivity. However, in qualitative research, like urban mobility research, their applicability is less evident. Many researchers argue that the nature of qualitative research is not well-suited to these conventional indicators. Rather, trustworthiness which encompasses qualities like confirmability, credibility, dependability, and transferability should be the primary focus of qualitative researchers. These factors have been more appropriate for assessing the complex and subject-related insights that are characteristic of qualitative research (Sinkovics et al. [2008]).

In qualitative research, as per Guba and Lincoln [1989] credibility is determined by how well realities stated by the participant reports and observations align. To increase the outcomes of credibility in worldwide company contexts, Sinkovics et al. [2008] stress the significance of employing a variety of data collection techniques. Through participant observation, which involved observing and interactions within the team, credibility was established in relation to the IKEA DIY urban mobility solution. This approach made it possible to fully comprehend why the project's DIY solutions were created, making sure that the results accurately represent the viewpoints of the actual participants.

The repeatability of data concerning time and in same circumstances is referred to as dependability. Sinkovics et al. [2008] assert that the dependability of qualitative research is strengthened by keeping track of a record of existence that details all research choices and methods. A document was maintained for the IKEA DIY Solution project, detailing the choices that were performed while in the research phase, such as the task of choosing particular DIY potential solutions to examine using Return on Investments (ROI) analysis aligns with the dependability factor. Transferability is proving that the research's findings are useful in different settings. To help with this step, Sinkovics et al. [2008] recommend giving a comprehensive overview of the research context.

Detailed descriptions of the urban mobility city case Stockholm where IKEA DIY solutions were implemented were provided. These descriptions include physical and social factors, allowing other researchers to evaluate the potential application of the

findings in similar or different urban contexts. Regarding our case study, a good explanation was made of the urban environment of Stockholm, where IKEA DIY mobility solutions were put into practice. These explanations cover social factors like local involvement in urban settings and physical aspects like the Stockholm city layouts and structures. The comprehensive context provided by the study enhances the transferability of what we have found by allowing future investigators to evaluate the outcomes' importance and possible application to different or related urban contexts.

# 4

# The Case Of Developing DIY Mobility Solutions (IKEA)

This segment discusses the details of the project carried out by IKEA, their idea behind the project, and the city of Stockholm's Urban Mobility, where the pilot test was conducted.

## 4.1 Background

IKEA was founded by a young Swedish person named Ingvar Kamprad in a village called Älmhult. The name IKEA in an acronym of the founders' initials (IK), the farm where the founder grew up called Elmtaryd and his hometown named Agunnayrd (IKEA-Global [2024]). It is interesting to know that before IKEA began selling the furniture's it used to sell pens and briefcases and it was in 1952 that they started to sell only furniture and home furnishings (IKEA [2024]). In furniture industry IKEA is one of the biggest players throughout the Europe, America and some parts of Asia. In this fast-changing world of business every organization must evolve according to the changing market and fulfil the needs of the customer to stay ahead in the game, this being done by IKEA through continuous innovation which offers high quality of products with minimal cost (Aaron-Hall-Attorney [2023]). An of which is that during early days the founder ordered a furniture maker to cut down the seat of the chair by a centimetre which though did not affect the quality of the product but the fabric which is to be put on the chair reduced with less wastage (IKEA [2024]), though the value of the single fabric could be less but if large volume of the chairs were to be ordered this would definitely pay the way to savings.

Along with the innovation IKEA began focusing on creating value to the people and re-inventing these values. According to IKEA their value chain starts with listening to the people's needs through which they could create and improve the products accordingly. Hence, customer plays an important role in every business field and thus IKEA understood this and started involving the customer to assemble the furniture. IKEA introduced the flatpacking method where the furniture's were sold in different pieces and the customers were required to assemble them at home (Strategyzer [2023]). Through this concept IKEA also go the product delivered to them in the flatpacking fashion from the manufacturing site with less packaging in volume which also reduced the price for them. IKEA began providing catalogues or instruction books with each furniture for the customer which contained detailed instructions of

the assembling (Aaron-Hall-Attorney [2023]). This was nothing but the start of the DIY (Do It Yourself) format involving customer to be a part of the process.

With its expansion and global reach IKEA revolutionised the furniture industry with innovation new designs affordability. With increase in market trends IKEA began to evolve inculcating the use of technological advances in the business. IKEA began the home delivery in the late 90's and started its e commerce in 2001 in Sweden and Denmark (IKEA [2020]) which was the start of the expansion of e commerce in the coming years. As in the coming years the online shopping were gaining popularity IKEA came up with the idea of providing customer different last mile delivery options such as home delivery, post parcel (pick up from delivery stations), curb side deliveries, domestic deliveries (product is delivered and assembled if needed inside the house) and rental trailers ( where the customer who purchases the product at the store can rent a trailer to get the products delivered themselves)(IKEA.se [2024]). During the evolving phases IKEA kept in mind the environmental aspect too whether it might be the supplier, the logistics part or the manufacturing part they always were trying to be as sustainable as possible.

As the Urban mobility increased the fashion of delivering last mile within the cities also increased. Due the increased urban space there were delay in deliveries and the congestion was almost every day in the view of this IKEA began doing sustainable deliveries with electric vehicles for deliveries. Though there were many options for the customer to get their products delivered, there was a dependence on several factors. For example, to book a rental trailer on has to own a car and have a driving licence, this was difficult to conduct for people without car and licence. And to get the product delivered through home delivery one has to wait for days for the delivery to be done. As IKEA is innovating continuously, a team of Development and Innovation Network started to search for different Ideas to get past through this hurdle. In recent years micro mobility has gained enough appreciation, and many people have started using it for the day to activities to get the products from one place to another and the important thing to focus is that it is completely electric and can be driven in bicycle lanes. The DIN team did their research on the micro mobility and as it is known that IKEA involves people in its process of innovation, the DIN team came up with the idea to let the customers use a form of micro mobility from the IKEA store and load the purchased items on the micro mobility and drive home right away with their products. This how they thought of naming the project as DIY Solution.

## 4.2 The DIY Project

The DIY project began with an ideation campaign which was carried out for 2 weeks to gather insights on touchpoints of last mile delivery. The IKEA's Project Team gathered suggestions from its employees and staff members for enhancing last-mile deliveries through brainstorming sessions and surveys and they were able to collect 101 potential solutions from IKEA's team representing a different view points and

insights associated with last-mile delivery solutions.

After the ideas were gathered, the IKEA project team reviewed the potential solutions spending a week reviewing all the ideas and selecting solutions out of 101 ideas based on viability, uniqueness, and how well the idea aligns and matches with the company's goal to narrow down to number of viable solutions (ideas) that they want to work on. The goal included coming up with concepts to improve last-mile deliveries for customers, especially considering IKEA's concept stores in cities. Customers find it challenging to drive straight to the stores in the city regions due to issues like traffic and parking shortages. As a result, IKEA was looking into better delivery methods.

After the ideation phase, IKEA divided the solutions into two primary groups that is Low-tech and High-tech solutions. This classification ensures that every solution may be properly adjusted to meet customer needs while improving the development process and also focusing on addressing last-mile delivery challenges in an urban environment. The Low-tech solutions included a variety of manual and electrically assisted devices designed to ease the transportation of goods effeciently. The High-tech solutions included incorporating advanced technologies and smart IT integrations. The research also involved studying the various factors that influence the solution such as affordability, ergonomics, compatibility, and environmental friendliness in urban spaces. The process also involved assessing the potential solutions based on different factors such as product sepecifications, safety for the rider and alignments with sustainability goals. This assessment helped to filter out the options to those that best matched the objectives of the DIY project.

## 4.3 Stockholm urban mobility setting

Stockholm is one of the major cities in Europe and also one of the most rapidly growing cities. It was in the year 1877 Stockholm had its first public transportation was introduced which was a tram being pulled by horses (P [2019]), which was major during that period. As the inventions within the scientific community began to raise in 1901 the city had its tram being pulled by electricity. Maudsley [2022] mentions in her book the Swedish planning and development in the 20th and 21st centuries that due the rise of industrialization and developments in the transportation influenced the people to have better life by raising their standard of living. In 1930's a car was seen as a luxury and reflected economic prosperity and later in the years coming mass motorization became a vision for welfare states where most of the politicians expressed their support on the motorization (Thynell et al. [2010]). As indicated in the survey results referenced in the article by Thynell et al. [2010], the car ownership rate in Stockholm in 2002 was 7.5 times greater than that of Delhi. Interestingly, Stockholm had a significantly smaller population than Delhi. This signified that Sweden was moving towards economic growth where the average income was 950 Euros in Delhi whereas in Stockholm it was 24246 Euros (Thynell et al. [2010]).

During the year 1931, Stockholm started the construction of its first metro and years later the trains were running through the city and the metro was also extended throughout the city with multiple different destination lines (P [2019]). Railways were built extensively throughout Stockholm County to connect with the newly built satellite towns. Many authors like Pojani and Stead [2018], Cervero [1995] in their articles tell that after the second world war Stockholm turned from monocentric to a polycentric transit dependent metropolitan city, this is because Stockholm indirectly inculcated the Transient Orient Development (TOD) model where majority of the resident lived around the public transportation (Stojanovski et al. [2014]). Due to this the development around these habitats began synchronising every day's activities like walking and mobility usage with public transportation system.

As the public transportation grew along with the industrialization and motorization the urban planning was intensified, more cars and heavy automobiles like trucks were seen in the city. Due to this it was evident that the transport infrastructure had to be increased especially within the city. Hence, in 1992 a road toll implementation was proposed which was aimed to fund the road infrastructure with the tax collected but was later withdrawn due to political difficulties (Thynell et al. [2010]). And then in 2002 the tax in the form of congestion fee was proposed for the restricted space inside the city, mainly in the central part of the city where there was more traffic with high human movement (Thynell et al. [2010]). Finally in August 2007 after few demonstrations where in a test was conducted to show the reduction of congestion by 10-15% was successful, the congestion tax scheme was implemented by the government (Eliasson et al. [2009]). According to Eliasson et al. [2009], the primary rationale for introducing congestion charges was to mitigate the adverse effects of vehicular traffic on the urban environment. The congestion charges were implemented to reduce the tax burden on motorists, while exempting a select group of vehicles that utilized alternative fuels, public transportation, and taxis. The interesting fact to know is that Stockholm was one of the earliest cities to implement the congestion tax after Singapore and London (Eliasson et al. [2009]). The below fig. 4.1 depicts the area in the central Stockholm where the congestion charges were collected. Local municipalities and the government collaborated to plan urban areas, public transportation, and policies like congestion taxes and tolls. These efforts informed the public about their intentions to plan urban spaces with less impact on the environment.

Stockholm is the largest city in Sweden, with the population more than 900,000 in 2023 and experience annual increase in people moving to the city (Stockholm-Stad [2024]). As a result of this increased demand for a wide range of products and services, there was a need to import goods into the city. This led to the use of heavy-duty vehicles always entering the city, which has, in turn, caused congestion on the roads and contributed to traffic issues (Anand et al. [2012]). With recent developments in the technology online shopping, e-commerce has gained popularity especially during the covid, which requires to deliver the product to customer directly from the local distribution or warehouse hub which again requires vehicles to drive in the urban areas to deliver the last mile to end customer causing traffic and thus delaying the deliveries which is not good in the freight industry (Fu and

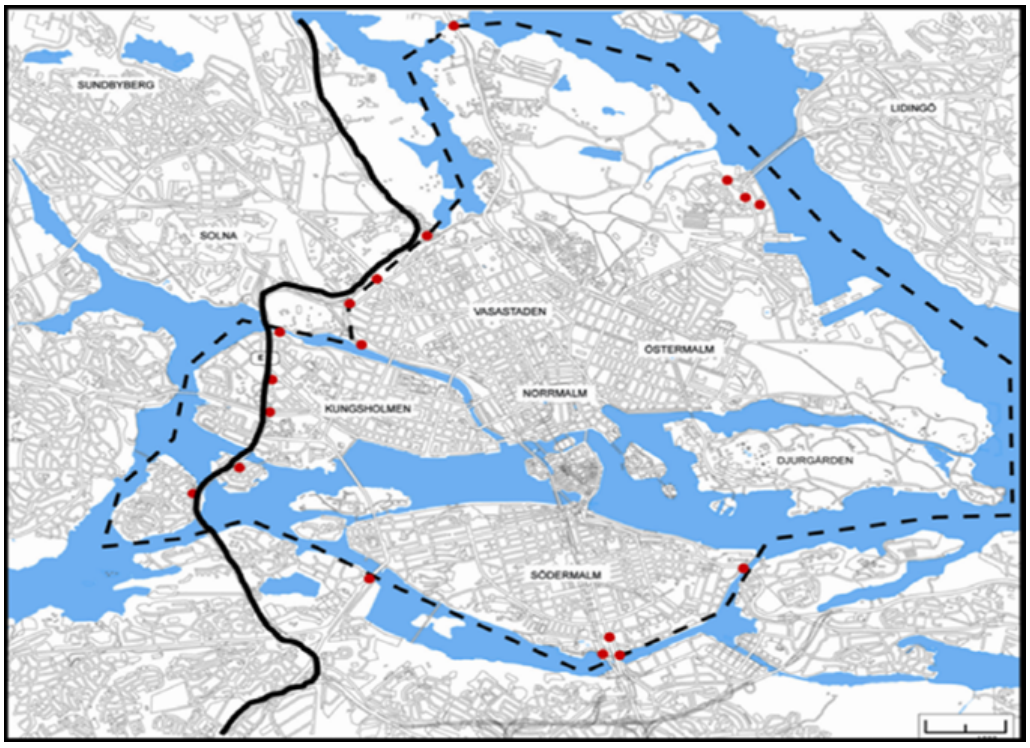


**Figure 4.1:** The dashed line is the boundary within which congestion charges were collected and the dots are the charging points. Eliasson et al. [2009]

Jenelius [2018]). According to Anderson et al. [2005] there are external impacts of the freight transport especially in urban spaces among which are congestion, air pollution, GHG emissions, noise pollution. Stockholm among other major European cities treat urban freight as a part of their transport planning system (Ambrosini and Routhier [2004]).

In the year 2014 the Stockholm city came up with a freight plan to regulate and prioritise the goods delivery system in the city with important objectives few of which a few being to enable more reliable delivery times and to promote clean vehicles (EU-Urban-Mobility-Observatory-Stockholm [2017]). To achieve these goals, they started to set a consolidation centre in the urban space called UCC (Urban consolidation centre) which helped the freight carriers to consolidate their deliveries at a single place without any hassle. The same year the city came up with the new concept of "off peak hours deliveries" (OPHD) (Fu and Jenelius [2018]), which means that deliveries that are done during the time where the traffic on the roads are less frequent, example during nighttime or in the early morning (Sánchez-Díaz et al. [2016]). According to the details mentioned by Fu and Jenelius [2018], these restrictions were especially applied to heavy duty trucks which bring large amount of goods >3.5 tonnes and they have to be hybrid engine with electric mode being used within the city limits or truck which was run by alternative fuels. The heavy-duty truck used to deliver used to deliver from large warehouses outside the city to the 3 different consolidation centres within the city and from there another truck was aligned to deliver to the end stores in different areas of the city. The timing

during which the delivery took place was after 22:00 and before 06:00 hours which reduced the congestion and environmental impact a lot. This act was co-ordinated with the municipality and the Lidl store. According to urban access regulations lorries with Euro 6 version of engine are allowed inside the Stockholm city as shown in the fig.4.2. And for the cars, minibuses and vans minimum of Euro 5 as of 15 January 2022 and Euro 6 as of 1 July 2022 were allowed on the Hornsgatan street as show in the fig.4.3 below (EU-Urban-Mobility-Observatory-Stockholm [2017])

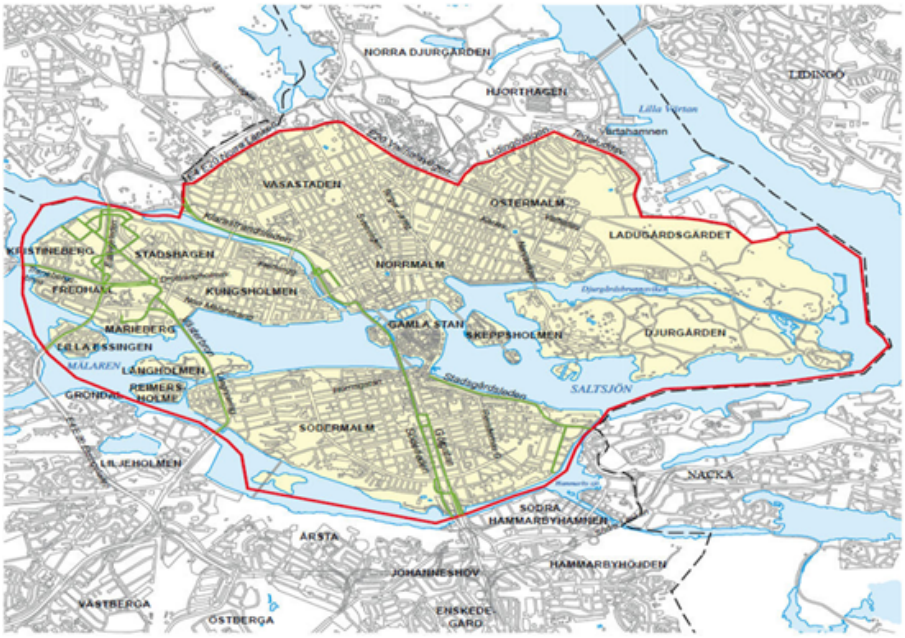


**Figure 4.2:** Low Emission zone marked with red colour which affected the entry of the lorries and buses
EU-Urban-Mobility-Observatory-Stockholm [2017]


**Figure 4.3:** Low Emission Zone in Hornsgatan affecting passenger cars, minibuses and vans
EU-Urban-Mobility-Observatory-Stockholm [2017]

According, the Urban Access regulation all motor vehicles are prohibited in Old

Town from 11:00 to 6:00 all days as shown in the fig.4.4


**Figure 4.4:** Dotted line is pedestrian zone, and the dashed line is pedestrian zone where traffic is allowed from 06 – 11:00 and for transport of handicapped people from 00:00 – 24:00
EU-Urban-Mobility-Observatory-Stockholm [2017]

Stockholm is having new rule under its lates mobility plan where in it is planning to bring a zero-emission zone in the middle of the city from December 2024 where every vehicle in the regarded zone must be completely electric for cars, light truck and light buses and for heavy duty trucks it must be plug in hybrid with Euro 6. (EU-Urban-Mobility-Observatory-Stockholm [2017])

With these regulations Stockholm is setting an example to be more environmentally friendly, in fact Stockholm is planning to go 100% electric on all its public transport by 2030 (Smart-City-Sweden [2020]).

Micro mobility has been gaining traction in Stockholm, with the introduction of e scooters playing a significant role. The first provider to launch e scooters in the city was Voi in 2018, marking the beginning of a new era of urban transportation (Stockholm-Stad [2022]). By February 2022, the number of e scooters allowed within the city was capped at 12,000. This limitation was implemented to manage the growing number of e scooters and to maintain order and safety within the city. To further address the challenges posed by the influx of e scooters, the municipality began collecting those that were improperly parked throughout the city. A penalty of 500 SEK was imposed on operators for each wrongly parked scooter, incentivizing them to ensure their scooters were parked correctly (Stockholm-Stad [2022]). The Stockholm city along with retailers of e scooters came up with data sharing program through the third-party platform called Cityscope.

In response to public demand, Stockholm municipality introduced an app called “felsparkerad” in 2020. This app allowed citizens to report issues related to improper use and parking of e scooters. The complaints were then forwarded directly

to the responsible operators, who were required to resolve the issues. This initiative empowered the public to take an active role in maintaining the city's order and ensured that operators were held accountable for their scooters.(Stockholm-Stad [2022]).

Starting in 2021, the traffic department took additional measures to address the problem of wrongly parked e scooters. They began patrolling the streets, actively looking for improperly parked scooters. When they found them, they would re-park the scooters themselves to clear pedestrian paths and bicycle lanes. This proactive approach helped to keep the city's sidewalks and bike paths clear and accessible for everyone. Moreover, the municipality introduced speed limit zones for e scooters in certain areas of the city. These zones were designed to enhance safety for both e scooter riders and other road users. By regulating the speed of e scooters, the city aimed to reduce accidents and improve the overall safety of its streets. Stockholm city even provide recommendations to the retailers to work closely with the cityscope and consider geofencing for data sharing and learning to improve (Stockholm-Stad [2022]).

E cargo bikes have also taken their place in the urban setting especially for the last mile deliveries in many EU countries of which one is Stockholm city. One of the major logistics companies like DHL started using cargo bikes in late 2017 for the last leg of deliveries due to their accessibility throughout the city especially in the dense areas and central part (Sundström [2017]). Sweden's postal services Post Nord also uses cargo bikes for the last leg of the deliveries (C40-Cities [2022]), similarly Velove and many more.

# 5

# Analysis

This chapter involves analysing the urban mobility setting of different cities which were described earlier and try to compare it with the Stockholm urban setting. Based on the analysis the research questions are discussed.

It is important to understand how different cities approach urban mobility and to identify similarities and differences among them. The important parameters to compare were the insight into the policy, the advances in mobility and stakeholders, for example, the end users and providers of micro mobility vehicles involved in the urban setting. By comparing these parameters, it provides us with the knowledge that all cities have different infrastructure arrangements, and based on these arrangements, policies and regulations are designed to enhance mobility in an urban setting.

From the table 5.1,there are many similarities between all the cities. They are working towards the reduction of private vehicles and increasing the usage of shared mobility, such as public transport and different types of shared micro mobility for both people and goods, especially within the city limits. It can be observed that most of the cities mentioned in the table have low emission zones within the center of the city where there is more movement of more people. These low emission zones, as mentioned earlier, require vehicles moving through the prescribed area of the city to be least polluting. Oxford City has a zero emission zone where only electric vehicles are allowed, and a similar concept is going to be implemented in Stockholm in a couple of years. The remaining cities are also working to implement zero emission zones in the coming years to promote emission free automobiles.

The micro mobility sector also holds significant importance in the listed cities. As shared micro mobility solutions, such as e scooters, have increased, the municipalities have sought to regulate them. Several regulations are common for the listed cities, such as the designated parking lots, capping the usage of total amount scooters in an area, speed limits for dense areas and heavy fines for the scooter providers who do not follow the rules. Through this micro mobility, e cargo bikes have gradually gained popularity, as they are used for the last mile of the deliveries, especially in many of the listed cities. Many cities, including Vienna, Stockholm, London are expressing the importance of using e cargo bikes and are providing incentives to encourage their purchase. A comparison was made based on regulations and advancements, but the parameters like population and demographics were not considered.

| City | Regulations | Advancements |
|---|---|---|
| **Cagliari** | Focus on minimizing traffic in historical areas through Zona a Traffico Limitato (ZTL); operates at peak times, restricting access to residents and authorized vehicles only; Laws regarding the e scooters parking; Incentives for purchasing e cargobikes | Smartphone app assists drivers to avoid penalties by notifying them when entering ZTL areas. |
| **Istanbul** | Cap on the number of shared scooters around the cities; Regulations regarding the speed of the e scooters in the dense areas | Implementing low emission zones; More junctions for cyclists and e bikes; Congestion charging |
| **Paris** | Low emission zones in the central part of the city; Code of Conduct for sharing traveling patterns with municipality | Use cargo bikes for delivery during Olympic games; Zero Emissions zones from 2030 |
| **London** | Establishment of Congestion Charging and Low Emission Zones (LEZ) to reduce central city traffic and emissions; Zero emission zones on few streets | Grants for the usage of e cargo bikes |
| **Oxford** | Low Emission Zone (LEZ) from 2014 requiring city buses to meet Euro V emission standards; Zero Emission Zone (ZEZ) introduced in 2022 to enhance air quality by allowing only zero-emission vehicles. | Initiatives aimed at reducing harmful emissions from diesel buses and promoting greener public transportation methods. |
| **Copenhagen** | Low emission zones with weightage limit on heavy vehicles; Regulations regarding parking of e scooter in designated areas; Incentives for purchase on electric cargo bikes | Planning to implement zero emission zones in the inner part of the city |
| **Vienna** | Implementation of a Low Emission Zone (LEZ) for heavy goods vehicles (HGVs) and trucks, requiring Euro 3 emissions compliance; Continuous operation, monitored by police officers; Incentives on purchase of e cargo bike | Stressing the use of cargo bikes for last mile deliveries within the city. Promotion of sharing instead of owning |
| **Stockholm** | Stockholm has low emission zones in the central part of the city; The city has a congestion charge in place for the central part of the city; The city also has a regulation of heavy-duty vehicles entering the city; Regulation on the speed of the e scooters in dense areas; Parking regulations of e scooters | Planning to Implement zero emission zones;<br>Promotion for mobility sharing;<br>Promoting cargo bikes for last mile deliveries |

**Table 5.1:** Comparison of Regulations and advancements of different cities

## 5.1 Contributions to Stockholm Urban Mobility

Based on the comparison made from different cities, the first two research question will be answered in this part. Three important aspects have been brought up to answer the question: Actors, Regulations and Environmental aspects. Let's look into each one of them and how they impact the urban mobility especially with regard to micro mobility.

### 5.1.1 Actors and Collaborations

In the urban mobility landscape, various stakeholders play crucial roles, including providers of micro mobility solutions like e scooters, transport agencies, government bodies, and the customers who utilize these services. These actor categories remain the same throughout all the cities that were taken into consideration for comparison. Providers of micro mobility services, such as e scooters, are required to share real-time data with transport agencies or government bodies. This data exchange enables these entities to analyze usage patterns and identify opportunities for enhancing mobility initiatives and infrastructure within their respective cities. By leveraging this data, cities can develop new strategies and improvements aimed at optimizing transportation systems while minimizing environmental impact.

Something similar is being developed by the Stockholm municipality with its initiative called Cityscope where different micro mobility providers contribute to real time data. This data provides the municipality with clear picture regarding the ride patterns of the users and based on the data trends and patterns, they can provide timely recommendations to mobility providers to enhance their services. This also means that the municipality also uses this data to manage and build a better transport infrastructure for the micro mobility sector alongside various automobiles with safety a priority and also without compromising surrounding environment. This mutual exchange of information fosters better relationships between public authorities and private companies which help in driving continuous innovation and improvement in the urban mobility sector.

In the context of IKEA's potential adoption of micro mobility solutions, similar principles apply. If IKEA integrates these solutions into its operations, collaborating with Stockholm municipality, for instance, would involve sharing travel pattern data. This data sharing would enable municipal authorities to enrich their database with insights into how these solutions impact city mobility. By leveraging such data, Stockholm can refine its urban planning strategies, ensuring they align with the evolving needs and behaviours of its residents and visitors. IKEA can also benefit from this partnership where in the city municipality provides important information to improve the services in better ways. This collaborative approach not only enhances the efficiency and sustainability of urban mobility but also underscores the importance of data-driven decision-making in shaping future transportation policies. It points to the importance of every actor categories from a mobility providers to government agencies in devising effective systems of urban mobility that may

succeed in meeting various kinds of citizens' needs, taking care of environmental awareness, and guaranteeing easy accessibility to transport services.

### 5.1.2 Regulations

Most of the cities mentioned have different age constraints to ride e scooters, for example, few cities have 16 years as age limit, and some have 18 years. Apart from this, a majority of the regulations were similar among the cities, though few of them had their rules set up after the other had already established theirs. Initially, there were few rules for the usage the e scooters, which caused a lot of trouble for the pedestrians and other public. For example, in the city of Paris, there were no proper regulations for e scooters, which led to lot of troubles and accidents. This prompted the municipality to bring stricter regulations in place for the use of shared e scooters. This problem was caused by the behaviour of the users who haphazardly used the bikes or parked in the wrong places around the city which led to ban of use of shared free floating e scooters.

This has not been the case in Stockholm. After the introduction of e scooters, there was similar misuse of e scooters, but the municipality developed an application which helped the providers of e scooters to improve their services. The city municipality designed dedicated parking lots for the e scooters as did the municipalities of other cities. The city municipality is also closely working with the e scooter providers to implement geofencing technology. This technology will help limit speed of the e scooters in densely populated areas of the city, enhancing safety for both the users as well as the pedestrians. This also improves the integration of e scooters into the urban environment.

At times, regulations set by different cities are not the same. Each one of these has been developed to adapt with the changing landscape brought about by urban mobility and micro-mobility, which also poses a variety of challenges. Such regulations have evolved through time in order to manage micro-mobility more satisfactorily. Hence, a certain regulation which works for one city at one particular time may not work for another city. Every city has its own urban landscape and specific challenges according to it, which requires tailored regulations to manage micro mobility. The cities are using a combination of strategies, including incentives given for the purchase of micro mobility vehicles, restrictions on the number of micro mobility vehicles by the providers, and infrastructure changes to manage mobility. Hence, it can be said that the cities are learning from each other's experiences and from their own to manage and overcome the hurdles of micro mobility.

### 5.1.3 Environmental Aspects

As mentioned in the earlier chapter, all the cities listed above are working towards the betterment of the environment by reducing the emission from vehicles to become as low as possible. When considering Stockholm in this regard, it is evident that the low to zero emissions from the micro mobility solutions used for transporting both

goods and people play a significant role. The micro mobility solutions are pedal and electric assisted, which cause no tailpipe emissions and no sound pollutions. Most of the micro mobility solutions are small and easily maneuvrable in the city's dense spaces compared to automobiles. This provides an upper hand to the users of the micro mobility which helps them to easily move within the city without any hassle.

These micro mobility solutions also cause less congestion within the city as compared to other automobiles, which can be time consuming, especially during peak hours, while moving within the city limits. Most of the cities mentioned have the low emission zones, and a few have zero emission zones. These regulations are perfectly suited for micro mobility solutions, as they can be easily used within these constraints. The primary motive of the Stockholm city municipality introducing micro mobility was to decrease the use of space-consuming private vehicles, cars or last mile delivery vans on roads, thus reducing congestion. IKEA's DIY project will generate an element of a sustainable city space without harming the environment. Such micro mobility solutions are feasible because of their dimensions which can be transported and navigated around the city with ease even in jam-packed areas. Most importantly, it is the e cargo bikes which are going to be ridden by people who want to help create a greener future.

It will be an important component in creating a sustainable urban environment as part of Stockholm's City Development Plan, and also serve to develop cost-effective last-mile delivery solution for more efficient transport flows. This would push the city further in its quest for a cleaner, quieter and altogether more efficient transport system, representing a public improvement effort which is now closely tied to issues of sustainability and environmental responsibility. This is the main reason why most EU cities are adapting to micro mobility within the cities.

## 5.2 Contributions of micro mobility Cargo Solutions to IKEA

Micro mobility solutions are becoming an integral part of the Urban logistics in particularly last mile deliveries. This part of the chapter involves the explanation to how the DIY solution in micro mobility will impact IKEA which answers the third research question.

### 5.2.1 Enhanced Customer Base and Sales Volume

IKEA has different types of delivery services for all types of items based on the weight of the product to be delivered. But these deliveries require time for IKEA to bring them to the end consumers. There are products which are not large enough to order them under home deliveries but too large to be carried by the consumers. So, the DIY concept by IKEA which provides micro mobility solutions such as e cargo bikes/e cargo scooters to customer increases the ease of bringing the products home for consumers without relying too much on the traditional delivery options.

Consequently, knowing this fact could increase the purchase of goods by the consumers significantly, as they feel they have an easy and immediate transportation option waiting for them. Hence, with the increase in the number of purchases by the consumer due to the introduction of micro mobility solutions, the company's sales could also increase.

By streamlining the last mile deliveries of goods for the customers through micro mobility solutions, IKEA can increase their customer base who might have refrained from purchasing bulky materials due to transportation or home delivery constraints. This could significantly increase IKEA's market expansion by increasing the customer base including urban dwellers or those without access to vehicles. The usage of this concept could lead to be cost beneficial for the company as the time required to bring home the products is faster compared to traditional delivery methods. Hence, over the time home deliveries could be reduced with increase in micro mobility solutions which could reduce the logistics expense, paying the way to save the cost and allocate the resources over the company efficiently in the other areas of operations.

### 5.2.2 Enhanced Brand Image and Customer Loyalty

IKEA in recent years been on a bid to reduce the impact on environment by using electric vehicles. With the DIY concept of using micro mobility solutions for last mile deliveries, IKEA is planning to significanlty reduce environmental impact. By introducing this concept, which will be the first of its kind in Stockholm, IKEA is collaborating with the municipality to enhance the urban mobility. This commitment to sustainability strengthens IKEA's brand image as an environmentally responsible company fostering positive reputation in the market.

IKEA has always been a people centric company involving the customers and their feedback for new innovations. This concept is no different. By supporting customers to do the last mile deliveries themselves using micro mobility solutions, IKEA is once again engaging people in reducing the carbon footprint. As mentioned, this solution could also improve urban planning for the micro mobility sector, which on a whole provides the customer with a sense of responsibility towards the enhancement of the negative environmental impact. This could lead to increased customer base of loyal patrons who support the organization in its work towards sustainability.

## 5.3 Challenges Associated with micro mobility Cargo Solutions

As seen in the previous sections the positive impacts of the micro mobility solutions have been addressed. In this part of the chapter the challenges associated with micro mobility solutions was focused.

### 5.3.1 Safety Concerns

Safety is a priority for every city. In this context, the safety of both the rider using the micro mobility solution and the pedestrian is important. As observed in the case of Paris, the riders used to ride the bikes in the pedestrian paths, which caused a lot of problems for pedestrians and sometimes led to accidents. The safety also depends on the rider's behaviour while riding the micro mobility vehicles. In a few spots around the city, the pedestrian paths and the micro mobility paths are the same, which puts both the riders as well as the pedestrians in harm's way. For e cargo bikes, the rider should ride with extra precautions, as it might be difficult to travel with cargo in dense areas where the movement of people is more intense. There are other areas within the city limits where the motorized vehicle space is being shared by the micro mobility space, which can and has caused conflicts. Another important factor to consider is that the diverse geographical environment such as uneven terrains, steep roads, inclinations and different whether conditions through which the rider has to ride the cargo bikes is challenging.

### 5.3.2 Infrastructure

The infrastructure for mobility is important for riders of all kinds of vehicles. As the use of micro mobility especially e scooter and e cargo bikes increases, the infrastructure pertaining to them should also improve effectively so that they can be used safely. Though the use of e scooters is more extensive than the e cargo bikes, they can be driven in the bicycle lane. As mentioned earlier there are some nodes in the cities where the motorised vehicle lanes and the bicycle lanes meet, and also where the pedestrian lanes intersect with bicycle lanes. This could lead to serious issues, which could cause people to file complains with the municipality. As the e cargo bikes are bigger than e scooters, they take up most part of the bicycle lane while travelling, causing troubles to the fellow micro mobility travellers. Hence, dedicated bicycle lanes for some micro mobility vehicles are not efficient when considering all the categories of bikes under the micro mobility category.

In the initial days of e scooters, there were no proper regulations in place, but over time, many have been implemented to contain the overpopulation and proper usage of micro mobility. There is a lack of knowledge regarding the existing regulations for riding micro mobility solutions. In some cases, there are people who do not know which type of infrastructure to use while riding the e scooter (Anke et al. [2023]). This could cause serious issues not only for the rider but also for others. There are no common regulations among European cities, which might be confusing at times.

# 6

# Conclusion

The thesis started with a focus on micro mobility which is a subset of solutions to urban mobility as a majority of the micro mobility solutions are used in urban spaces. The thesis also addresses the evolving landscape of urban mobility, particularly focusing on micro mobility. Urban mobility is critical to facilitate smooth movement of goods as well as people from one place to another within the urban setting. The purpose of the thesis was to analyse a case of using micro mobility in last mile deliveries. Prior research on how different cities deal with urban mobility planning and micro mobility provided knowledge and understanding of the concept. The case of IKEA's introduction of micro mobility solutions for last mile deliveries, involving customers to do it by themselves, is an example of an innovative approach for sustainable mobility in urban environments.

The thesis addressed the core research question of how the micro mobility solutions like those designed by IKEA could possibly contribute to urban mobility. The comparison of approaches applied in different cities, and the city where the pilot test took place i.e., Stockholm, provided the answers to the research questions. Through a literature review, as well as data gathered from regular meetings with IKEA, the study found that micro mobility solutions can extensively cut down congestion and pollution in the urban spaces. The study also found the importance of how different stakeholders need to be involved in the implementation of micro mobility solutions, and their efforts to increase the use of micro mobility solutions within the city limits. Micro mobility solutions should offer ease of movement across the city and different municipalities are working to regulate the use of different micro mobility solutions to curb the negative impact. A comparative approach was taken to consider how different cities arrive at different approaches.

The study also showed how a retailer like IKEA can benefit from offering micro mobility solutions in the last leg of deliveries by increasing the brand image, customer satisfaction as well as sales. While micro mobility solutions offer various benefits, the study also reflected upon challenges to be addressed which involve lack of infrastructure and regulations and also safety concerns of both the riders and the non-riders. Micro mobility solutions such as e cargo bikes and e cargo scooters are viable alternatives for last mile deliveries and are being used by various governmental agencies and private firms in the field of urban logistics.

## 6.1 Recommendations

As IKEA is planning to continue to work on this project there are a few recommendations brought forward during the study which would contribute to achieve positive impact:

- IKEA can cap home delivery services for larger volume product that do not fit into the micro mobility solution, encouraging people to use more of the new DIY solutions. Home deliveries can be offered for products which require bigger vehicles than what is suitable for the micro mobility solutions. By doing this IKEA provides the customers with a broader range of opportunities and better use of the micro mobility solutions capacity.
- As most of the municipalities in general are offering incentives on the purchase of the micro mobility (e scooters/e cargo bikes), IKEA should choose wisely from various options. It is sensible to take advantage of subsidies or incentives to increase the use of products and services which have a positive impact on the surrounding - in this case the micro mobility solutions.
- A partnership with a provider of micro mobility solutions could also prove significant for IKEA in the near future. Instead of purchasing the micro mobility solutions, IKEA could get into a partnership with a producer or a retailer who could handle services such as bookings and maintenance of the micro mobility solutions.

## 6.2 Future Research

The thesis provides an understanding of key aspects of urban and micro mobility solutions as well as how these aspects differ in different cities. However, the parameters used for comparisons of urban settings in the thesis are general. To further the understanding of the differences among cities a suggestion is to look into more specific aspects for example to dig deeper regarding the demographics of different cities of interest. Below, a few research questions to be explored in further studies, especially for a retailer like IKEA, are suggested:

- There are a few key factors that affect the usability of micro mobility solutions (e.g., e cargo bikes) in an urban environment, especially access to parking spaces and IT platforms to be used for booking, as well as who will be responsible for handling the applications.
- The pickup of the micro mobility vehicles from the store may be simple but to return it back to the same place might be perceived as difficult by the users. To deal with this, IKEA should look for simple ways for the customers to return the vehicles with various options like common parking spaces in few areas of the city.
- Though the pickup and drop off, the micro mobility solutions may be suitable for the IKEA stores within cities, but will they be possible to use for the IKEA stores which are located outside the city? Customer expectations may be a key aspect to consider when deciding on these matters.
- When urban infrastructure is concerned, research regarding bike lanes in different cities, like in a few of the Asian countries, is needed before implementing the DIY

solutions.

# References


Aaron-Hall-Attorney. Creating Value: IKEA's innovative business strategy, 9 2023. URL https://aaronhall.com/insights/creating-value-ikeas-innovative-business-strategy/.

Rusul L. Abduljabbar, Sohani Liyanage, and Hussein Dia. The role of micro-mobility in shaping sustainable cities: A systematic literature review. *Transportation Research Part D Transport and Environment*, 92:102734, 3 2021. doi: 10.1016/j.trd.2021.102734. URL https://doi.org/10.1016/j.trd.2021.102734.

Accessibilità-Centri-Storici. ZTL Cagliari: mappa, orari, telecamere, parcheggi, 10 2019. URL https://www.accessibilitacentristorici.it/ztl/sardegna/cagliari.html.

Maria Natalia Paulino Araujo Alcantara. *Scrutinizing sustainable mobility strategies in Integrated Urban development: Perspectives from Copenhagen and Curitiba*. Elsevier, 1 2023. doi: 10.1016/b978-0-323-91718-6.00023-2. URL https://doi.org/10.1016/b978-0-323-91718-6.00023-2.

Timo Ali-Vehmas and Thomas R. Casey. Examining possible value system transitions: the case of smart mobility services. *2015 48th Hawaii International Conference on System Sciences*, 1 2015. doi: 10.1109/hicss.2015.523. URL https://doi.org/10.1109/hicss.2015.523.

Christian Ambrosini and Jean-Louis Routhier. Objectives, Methods and Results of Surveys Carried out in the Field of Urban Freight Transport: An International Comparison. *Transport Reviews*, 24(1):57–77, 1 2004. doi: 10.1080/0144164032000122343. URL https://doi.org/10.1080/0144164032000122343.

Nilesh Anand, Hans Quak, Ron Van Duin, and Lori Tavasszy. City Logistics Modeling Efforts: Trends and Gaps - A review. *Procedia - Social and Behavioral Sciences*, 39:101–115, 1 2012. doi: 10.1016/j.sbspro.2012.03.094. URL https://doi.org/10.1016/j.sbspro.2012.03.094.

Alexandra Anderluh, Vera C. Hemmelmayr, and Pamela C. Nolz. *Sustainable Logistics with Cargo Bikes—Methods and Applications*. Elsevier, 1 2019. doi: 10.1016/b978-0-12-814242-4.00008-9. URL https://doi.org/10.1016/b978-0-12-814242-4.00008-9.

Stephen Anderson, Julian Allen, and Michael Browne. Urban logistics—how can it meet policy makers' sustainability objectives? *Journal of Transport Geography*,

13(1):71–81, 3 2005. doi: 10.1016/j.jtrangeo.2004.11.002. URL https://doi.org/10.1016/j.jtrangeo.2004.11.002.

Juliane Anke, Madlen Ringhand, Tibor Petzoldt, and Tina Gehlert. Micro-mobility and road safety: why do e-scooter riders use the sidewalk? Evidence from a German field study. *European Transport Research Review*, 15(1), 9 2023. doi: 10.1186/s12544-023-00607-z. URL https://doi.org/10.1186/s12544-023-00607-z.

Marika Arena, Federico Cheli, Dario Zaninelli, Alfonso Capasso, Regina Lamedica, and Antonio Piccolo. Smart mobility for sustainability. *AEIT Annual Conference (pp. 1–6).*, 10 2013. doi: 10.1109/aeit.2013.6666811. URL https://doi.org/10.1109/aeit.2013.6666811.

Ralph Buehler and John Pucher. *Cycling for sustainable cities*. MIT Press, 2 2021. doi: 10.7551/mitpress/11963.001.0001. URL https://doi.org/10.7551/mitpress/11963.001.0001.

Ralph Buehler, John Pucher, and Alan Altshuler. Vienna's path to sustainable transport. *International Journal of Sustainable Transportation*, 11(4):257–271, 10 2017. doi: 10.1080/15568318.2016.1251997. URL https://doi.org/10.1080/15568318.2016.1251997.

C40-Cities. GrowSmarter: Sustainable delivery platform in Stockholm - C40 Cities, 2 2022. URL https://www.c40.org/case-studies/growsmarter-sustainable-delivery-platform-in-stockholm/.

C40-Knowledge. Freight and Servicing Action Plan: making London's streets safer, cleaner, & more efficient, 2019. URL https://www.c40knowledgehub.org/s/article/Freight-and-Servicing-Action-Plan-Making-London-s-Streets-Safer-Cleaner-and-more-Efficient.

Cagliari-Turismo. Sustainable mobility, 2020. URL https://cagliariturismo.comune.cagliari.it/en/cagliari-sostenibile/suggerimenti/sustainable-mobility.

Sally Cairns and Lynn Sloman. Potential for e-cargo bikes to reduce congestion and pollution from vans in cities. *Transport for Quality of Life Ltd*, 2019.

Fatih Canitez, Pelin Alpkokin, and Sabahat Topuz Kiremitci. Sustainable urban mobility in Istanbul: Challenges and prospects. *Case Studies on Transport Policy*, 8(4):1148–1157, 12 2020. doi: 10.1016/j.cstp.2020.07.005. URL https://doi.org/10.1016/j.cstp.2020.07.005.

Andrea Antonio Caragliu, C. Del Bo, and P. Nijkamp. Smart cities in Europe. *Journal of Urban Technology*, 18(2):65–82, 4 2011. doi: 10.1080/10630732.2011.601117. URL https://doi.org/10.1080/10630732.2011.601117.

Ivan Cardenas, Yari Borbon-Galvez, Thomas Verlinden, Eddy Van De Voorde, Thierry Vanelslander, and Wouter Dewulf. City logistics, urban goods distribution and last mile delivery and collection. *Competition and Regulation in Net-*

*work Industries*, 18(1-2):22–43, 3 2017. doi: 10.1177/1783591717736505. URL https://doi.org/10.1177/1783591717736505.

Robert Cervero. Sustainable new towns. *Cities*, 12(1):41–51, 2 1995. doi: 10.1016/0264-2751(95)91864-c. URL https://doi.org/10.1016/0264-2751(95)91864-c.

Selby Coxon, Robbie Napper, and Mark Richardson. *Introduction – Urban Mobility Design*. Elsevier, 1 2019. doi: 10.1016/b978-0-12-815038-2.00001-3. URL https://doi.org/10.1016/b978-0-12-815038-2.00001-3.

Sandu Cristian Cuturela and Alexandru Manole. A Short Historical Perspective on the Evolution of Logistics and its Implications for Globalization, 2013. URL https://econpapers.repec.org/RePEc:rsr:supplm:v:61:y:2013:i:3:p:188-198.

Jonas Eliasson, Lars Hultkrantz, Lena Nerhagen, and Lena Smidfelt Rosqvist. The Stockholm congestion – charging trial 2006: Overview of effects. *Transportation Research Part A Policy and Practice*, 43(3):240–250, 3 2009. doi: 10.1016/j.tra.2008.09.007. URL https://doi.org/10.1016/j.tra.2008.09.007.

EU-Urban-Mobility-Observatory-Copenhagen. Electric scooters banned from being parked on Copenhagen Streets, 10 2020. URL https://urban-mobility-observatory.transport.ec.europa.eu/news-events/news/electric-scooters-banned-being-parked-copenhagen-streets-2020-10-30_en?prefLang=da.

EU-Urban-Mobility-Observatory-Paris. Local governance of micromobility – the Paris example, 8 2022. URL https://urban-mobility-observatory.transport.ec.europa.eu/resources/case-studies/local-governance-micromobility-paris-example_en.

EU-Urban-Mobility-Observatory-Stockholm. Stockholm makes urban Freight an integrated part of its mobility plan (Sweden), 7 2017. URL https://urban-mobility-observatory.transport.ec.europa.eu/resources/case-studies/stockholm-makes-urban-freight-integrated-part-its-mobility-plan-sweden_en?prefLang=es.

European-Commission. The rise of micromobility, 2020. URL https://urban-mobility-observatory.transport.ec.europa.eu/resources/case-studies/rise-micromobility_en. Last accessed 20 August 2024.

Zhufeng Fan and Corey D. Harper. Congestion and environmental impacts of short car trip replacement with micromobility modes. *Transportation Research Part D Transport and Environment*, 103:103173, 2 2022. doi: 10.1016/j.trd.2022.103173. URL https://doi.org/10.1016/j.trd.2022.103173.

Ferrovial. Mobility, 2024. URL https://www.ferrovial.com/en/resources/mobility/.

Rosie Frost. Paris Post is being delivered by cargo bikes in a bid to cut emissions, 11 2022. URL https://www.euronews.com/green/2022/11/29/paris-post-is-being-delivered-by-cargo-bikes-in-a-bid-to-cut-emissions.

Jiali Fu and Erik Jenelius. Transport efficiency of off-peak urban goods deliveries: A Stockholm pilot study. *Case Studies on Transport Policy*, 6(1):156–166, 3 2018. doi: 10.1016/j.cstp.2018.01.001. URL https://doi.org/10.1016/j.cstp.2018.01.001.

Ralph Gakenheimer. Urban mobility in the developing world. *Transportation Research Part A Policy and Practice*, 33(7-8):671–689, 9 1999. doi: 10.1016/s0965-8564(99)00005-1. URL https://www.sciencedirect.com/science/article/pii/S0965856499000051?via%3Dihub.

Chiara Garau, Francesca Masala, and Francesco Pinna. Cagliari and smart urban mobility: Analysis and comparison. *Cities*, 56:35–46, 7 2016. doi: 10.1016/j.cities.2016.02.012. URL https://doi.org/10.1016/j.cities.2016.02.012.

Chiara Garau, Alfonso Annunziata, and Mauro Coni. A methodological framework for assessing practicability of the urban space: the Survey on Conditions of Practicable Environments (SCOPE) procedure applied in the case study of Cagliari (Italy). *Sustainability*, 10(11):4189, 11 2018. doi: 10.3390/su10114189. URL https://doi.org/10.3390/su10114189.

Alexandre Gauquelin. Turkey: An emerging market bursting with opportunity for shared mobility, 5 2022. URL https://shared-micromobility.com/turkey-an-emerging-market-bursting-with-opportunity-for-shared-mobility/.

Rudolf Giffinger, Christian Fertner, Hans Kramar, and Evert Meijers. Smart Cities - Ranking of European Medium-sized Cities. *ResearchGate*, 1 2007. URL https://www.researchgate.net/publication/261367640_Smart_cities_-_Ranking_of_European_medium-sized_cities.

Egon G. Guba and Yvonna S. Lincoln. *Guba, Egon G. and Yvonna S. Lincoln, Fourth Generation Evaluation. Newbury Park, CA: Sage Publications, 1989.* Sage Publication, 1 1989. URL https://stars.library.ucf.edu/cirs/2141/.

Stefan Gössling. Urban transport transitions: Copenhagen, City of Cyclists. *Journal of Transport Geography*, 33:196–206, 12 2013. doi: 10.1016/j.jtrangeo.2013.10.013. URL https://doi.org/10.1016/j.jtrangeo.2013.10.013.

Robin Hickman, Peter Hall, and David Banister. Planning more for sustainable mobility. *Journal of Transport Geography*, 33:210–219, 12 2013. doi: 10.1016/j.jtrangeo.2013.07.004. URL https://doi.org/10.1016/j.jtrangeo.2013.07.004.

Angela Hull. *Transport matters: Integrated approaches to planning city-regions.* Routledge, 2010.

Anne Håkansson. Portal of Research Methods and Methodologies for research projects and degree projects. *Proceedings of the International Conference on Frontiers in Education: Computer Science and Computer Engineering FECS'13, 67–73*, pages 67–73, 1 2013. URL http://kth.diva-portal.org/smash/get/diva2:677684/FULLTEXT02.pdf.

IKEA. After 70 great years, IKEA is turning the page - IKEA Global, 2020. URL

https://www.ikea.com/global/en/newsroom/retail/after-70-successful-years-ikea-is-turning-the-page-201207/.

IKEA. The story of IKEA – IKEA Global, 2024. URL https://www.ikea.com/global/en/our-business/how-we-work/story-of-ikea/.

IKEA-Global. The story of IKEA, 2024. URL https://www.ikea.com/global/en/our-business/how-we-work/story-of-ikea.

IKEA.se. Hemleverans eller hämta själv - IKEA, 2024. URL https://www.ikea.com/se/sv/customer-service/services/delivery/.

Sergio Ilarri, Dragan Stojanovic, and Cyril Ray. Semantic management of moving objects: A vision towards smart mobility. *Expert Systems with Applications*, 42 (3):1418–1435, 2 2015. doi: 10.1016/j.eswa.2014.08.057. URL https://doi.org/10.1016/j.eswa.2014.08.057.

Svilena Iotkovska. E-scooters return to Copenhagen but with significant restrictions, 10 2021. URL https://www.themayor.eu/en/a/view/e-scooters-return-to-copenhagen-but-with-significant-restrictions-9134.

Ahmed Jaber, Jamil Hamadneh, and Bálint Csonka. The preferences of shared Micro-Mobility users in urban areas. *IEEE Access*, 11:74458–74472, 1 2023. doi: 10.1109/access.2023.3297083. URL https://doi.org/10.1109/access.2023.3297083.

Reiner John, Martin Schulz, Ovidiu Vermesan, and Kai Kriegel. Semiconductor technologies for smart mobility management. *Design, Automation & Test in Europe Conference & Exhibition (DATE), 2013*, 1 2013. doi: 10.7873/date.2013.352. URL https://doi.org/10.7873/date.2013.352.

Peter Jones. Developing sustainable transport for the next generation: The need for a multi-sector approach. *IATSS Research*, 35(2):41–47, 3 2012. doi: 10.1016/j.iatssr.2011.11.001. URL https://doi.org/10.1016/j.iatssr.2011.11.001.

Liv Kelly. Paris has become the first European city to ban e-scooters, 9 2023. URL https://www.timeout.com/news/paris-has-become-the-first-european-city-to-ban-e-scooters-090123.

Jedok Kim, Karam Hwang, and In-Soo Suh. Smart mobility strategy in korea on enhanced safety and higher capacity toward 2025. *17th International IEEE Conference on Intelligent Transportation Systems (ITSC)*, 10 2014. doi: 10.1109/itsc.2014.6957645. URL https://doi.org/10.1109/itsc.2014.6957645.

Nicos Komninos. Intelligent cities: towards interactive and global innovation environments. *International Journal of Innovation and Regional Development*, 1(4):337, 1 2009. doi: 10.1504/ijird.2009.022726. URL https://doi.org/10.1504/ijird.2009.022726.

Amina Lang. The first electric scooter sharing services land in Europe, 8 2018. URL https://www.sustainability-times.com/clean-cities/the-first-electric-scooter-sharing-services-land-in-europe/.

Christian Lefevre. *Paris*. Agenda Publishing, 1 edition, 2021. URL https://ebookcentral.proquest.com/lib/chalmers/reader.action?docID=6768957.

Michela Longo and Mariacristina Roscia. Sustainable transportation application for smart mobility. *2014 International Symposium on Power Electronics, Electrical Drives, Automation and Motion, Ischia, Italy, 2014, pp. 1054-1059,*, 6 2014. doi: 10.1109/speedam.2014.6872112. URL https://doi.org/10.1109/speedam.2014.6872112.

María Eugenia López-Lambas, Maria Vittoria Corazza, Andres Monzon, and Antonio Musso. Rebalancing urban mobility: a tale of four cities. *Proceedings of the Institution of Civil Engineers - Urban Design and Planning*, 166(5):274–287, 10 2013. doi: 10.1680/udap.11.00044. URL https://doi.org/10.1680/udap.11.00044.

Kevin Manaugh, Madhav G. Badami, and Ahmed M. El-Geneidy. Integrating social equity into urban transportation planning: A critical evaluation of equity objectives and measures in transportation plans in North America. *Transport Policy*, 37:167–176, 1 2015. doi: 10.1016/j.tranpol.2014.09.013. URL https://doi.org/10.1016/j.tranpol.2014.09.013.

B. Mattoni, F. Gugliermetti, and F. Bisegna. A multilevel method to assess and design the renovation and integration of Smart Cities. *Sustainable Cities and Society*, 15:105–119, 7 2015. doi: 10.1016/j.scs.2014.12.002. URL https://doi.org/10.1016/j.scs.2014.12.002.

Ann Maudsley. *Swedish planning and development in the 20th and 21st centuries*. Routledge, 8 2022. doi: 10.4324/9781003271666-12. URL https://doi.org/10.4324/9781003271666-12.

Mayor-Of-London. Mayor's transport strategy, 2018. URL https://www.london.gov.uk/programmes-strategies/transport/our-vision-transport/mayors-transport-strategy-2018.

Syeda Ayeman Mazhar. Methods of data collection: a fundamental tool of research. *JOURNAL OF INTEGRATED COMMUNITY HEALTH*, 10(01):6–10, 6 2021. doi: 10.24321/2319.9113.202101. URL https://doi.org/10.24321/2319.9113.202101.

Peter Midgley. The role of smart bike-sharing systems in urban mobility. *Journeys*, 2(1):23–31, 2009.

Marcel E. Moran, Barbara Laa, and Guenter Emberger. Six scooter operators, six maps: Spatial coverage and regulation of micromobility in Vienna, Austria. *Case Studies on Transport Policy*, 8(2):658–671, 6 2020. doi: 10.1016/j.cstp.2020.03.001. URL https://doi.org/10.1016/j.cstp.2020.03.001.

A.G. Olabi, Tabbi Wilberforce, Khaled Obaideen, Enas Taha Sayed, Nabila Shehata, Abdul Hai Alami, and Mohammad Ali Abdelkareem. Micromobility: Progress, benefits, challenges, policy and regulations, energy sources and storage, and its role in achieving sustainable development goals. *International Jour-*

*nal of Thermofluids*, 17:100292, 2 2023. doi: 10.1016/j.ijft.2023.100292. URL https://doi.org/10.1016/j.ijft.2023.100292.

Christelle P. All you need to know about Stockholm's public transport, 2 2019. URL https://www.lasuedeenkit.se/all-you-need-to-know-about-stockholms-public-transport/.

Danièle Patier and Jean-Louis Routhier. Urban Logistics in the light of sustainable development: still a long way to go. *Transportation research procedia*, 46:93–100, 1 2020. doi: 10.1016/j.trpro.2020.03.168. URL https://doi.org/10.1016/j.trpro.2020.03.168.

Charles Sanders Peirce, Charles Hartshorne, and Paul Weiss. Collected Papers of Charles Sanders Peirce. Vol I.: Principles of Philosophy, 1931. *Philosophy*, 7(26), 1 1932. URL https://philpapers.org/rec/PEICPO-6.

Helinyi Peng, Yuuki Nishiyama, and Kaoru Sezaki. Estimation of greenhouse gas emission reduction from shared micromobility system. *2021 IEEE Green Energy and Smart Systems Conference (IGESSC)*, 11 2021. doi: 10.1109/igessc53124.2021.9618701. URL https://doi.org/10.1109/igessc53124.2021.9618701.

Dorina Pojani and Dominic Stead. *Past, Present and future of Transit-Oriented development in three European capital City-Regions*. Academic Press, 1 2018. doi: 10.1016/bs.atpp.2018.07.003. URL https://doi.org/10.1016/bs.atpp.2018.07.003.

John Pucher and Ralph Buehler. Why Canadians cycle more than Americans: A comparative analysis of bicycling trends and policies. *Transport Policy*, 13(3): 265–279, 5 2006. doi: 10.1016/j.tranpol.2005.11.001. URL https://doi.org/10.1016/j.tranpol.2005.11.001.

RAC. Euro 1 to Euro 6 – Vehicle emissions standards, 4 2024. URL https://www.rac.co.uk/drive/advice/emissions/euro-emissions-standards/.

Charles Raux. Changing daily urban mobility : less or differently ? France, 1996. URL https://shs.hal.science/halshs-01735298/.

Antoine Robichet, Patrick Nierat, and Francois Combes. First and last miles by cargo bikes: ecological commitment or economically feasible? The case of a parcel service company in Paris. *Transportation Research Record Journal of the Transportation Research Board*, 2676(9):269–278, 4 2022. doi: 10.1177/03611981221086632. URL https://doi.org/10.1177/03611981221086632.

Jean-Paul Rodrigue. *The geography of transport systems*. Routledge, 3 2024. doi: 10.4324/9781003343196. URL https://doi.org/10.4324/9781003343196.

David L. Schrank and Timothy J. Lomax. The 2004 Urban Mobility Report, 9 2004. URL https://rosap.ntl.bts.gov/view/dot/61839.

Shared-Use-Mobility-Center. Copenhagen, Denmark: e-scooters, administrative rules, 2019 - Mobility Learning Center, 5 2020. URL https://learn.shar

edusemobilitycenter.org/atlas/city-technology-and-environment-committee-amendment-to-road-act/#title-regulations.

Rudolf R. Sinkovics, Elfriede Penz, and Pervez N. Ghauri. Enhancing the trustworthiness of qualitative research in international business. *Management International Review*, 48(6):689–714, 12 2008. doi: 10.1007/s11575-008-0103-z. URL https://doi.org/10.1007/s11575-008-0103-z.

Smart-City-Sweden. Sustainable public transport in Stockholm, 4 2020. URL https://smartcitysweden.com/best-practice/368/sustainable-public-transport-in-stockholm/.

Karen M. Spens and Gyöngyi Kovács. A content analysis of research approaches in logistics research. *International Journal of Physical Distribution & Logistics Management*, 36(5):374–390, 6 2006. doi: 10.1108/09600030610676259. URL https://doi.org/10.1108/09600030610676259.

Stockholm-Stad. Data driven regulation of micromobility. Technical report, Stockholm Stad, 2022. URL https://miljobarometern.stockholm.se/content/docs/tema/trafik/elsparkcykel/Data%20driven%20regulation%20of%20micromoblity.pdf.

Stockholm-Stad. Statistik efter ämnesområde - Stockholms Stad, 8 2024. URL https://start.stockholm/om-stockholms-stad/utredningar-statistik-och-fakta/statistik/befolkning/.

Todor Stojanovski, Tesad Alam, and Marcus Janson. Transit-oriented development (TOD): analyzing urban development and transformation in Stockholm. *Annual Simulation Symposium*, 46:1–, 4 2014. doi: 10.5555/2664323.2664324. URL https://dl.acm.org/doi/10.5555/2664323.2664324.

Strategyzer. IKEA business model, 2023. URL https://www.strategyzer.com/library/ikea-business-model.

Amanda Sundström. DHL Express delivers packages with electric bikes, 11 2017. URL https://www.transportnet.se/article/view/570389/dhl_express_levererar_paket_med_elcyklar.

Iván Sánchez-Díaz, Peter Georén, and Märta Brolinson. Shifting urban freight deliveries to the off-peak hours: a review of theory and practice. *Transport Reviews*, 37(4):521–543, 11 2016. doi: 10.1080/01441647.2016.1254691. URL https://doi.org/10.1080/01441647.2016.1254691.

Marie Thynell, Dinesh Mohan, and Geetam Tiwari. Sustainable transport and the modernisation of urban transport in Delhi and Stockholm. *Cities*, 27(6):421–429, 12 2010. doi: 10.1016/j.cities.2010.04.002. URL https://doi.org/10.1016/j.cities.2010.04.002.

Transport-For-London. Mayor announces Santander as new cycle hire sponsor, 2015. URL https://tfl.gov.uk/info-for/media/press-releases/2015/february/mayor-announces-santander-as-new-cycle-hire-sponsor.

Urban-Access-Regulation-Copenhagen. Copenhagen, 2024. URL https://urbanaccessregulations.eu/countries-mainmenu-147/denmark-mainmenu-221/kobenhavn-frederiksberg.

Urban-Access-Regulation-London. London, 2024. URL https://urbanaccessregulations.eu/countries-mainmenu-147/united-kingdom-mainmenu-205/london.

Urban-Access-Regulation-Paris. Paris, 2024. URL https://urbanaccessregulations.eu/countries-mainmenu-147/france/paris.

Urban-Access-Regulation-Vienna. Wein (Vienna), 2024. URL https://urbanaccessregulations.eu/countries-mainmenu-147/austria-mainmenu-78/wien-vienna.

Urban-Access-Regulations-Cagliari. Cagliari, 2024. URL https://urbanaccessregulations.eu/countries-mainmenu-147/italy-mainmenu-81/sardegna-region/cagliari-ar.

Urban-Access-Regulations-Oxford. Oxford, 2024. URL https://urbanaccessregulations.eu/countries-mainmenu-147/united-kingdom-mainmenu-205/oxford.

Matthew Weaver. London Cycle hire launch – live updates, 7 2010. URL https://www.theguardian.com/uk/2010/jul/29/cycle-hire-scheme-live-updates.

Susan Wheelan. *The Handbook of Group Research and Practice*. SAGE Publications, Inc., 1 2005. doi: 10.4135/9781412990165. URL https://doi.org/10.4135/9781412990165.

Yizhao Yang and Anne Taufen. *The Routledge Handbook of Sustainable Cities and Landscapes in the Pacific RIM*. Routledge, 3 2022. doi: 10.4324/9781003033530. URL https://doi.org/10.4324/9781003033530.

Cheng Zhang, Bo Du, Zuduo Zheng, and Jun Shen. Space sharing between pedestrians and micro-mobility vehicles: A systematic review. *Transportation Research Part D Transport and Environment*, 116:103629, 3 2023. doi: 10.1016/j.trd.2023.103629. URL https://doi.org/10.1016/j.trd.2023.103629.

Joe Zhu. *Quantitative models for performance evaluation and benchmarking*. Springer Science Business Media, LLC, 1 2009. doi: 10.1007/978-0-387-85982-8. URL https://doi.org/10.1007/978-0-387-85982-8.

Hicran HAMZA ÇELİKYAY, Arif EMECEN, and Recep KADİROĞLU. BLACK BOX APPLICATION IN PUBLIC TRANSPORTATION AS AN INTELLIGENT TRANSPORT SYSTEM AND THE RESULTS OF DRIVER PERFORMANCE: THE CASE OF ISTANBUL ELECTRICITY, TRAM-WAY AND TUNNEL ADMINISTRATION (IETT) BLACK BOX PROJECT, 10 2017. URL https://www.acarindex.com/pdfs/1117663.

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