

# Parcel Locker Policy: Review and Future Directions

PROJECT REPORT



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# 1. SUMMARY

The project focuses on Sweden's growing parcel locker networks used for e-commerce delivery. These lockers have the potential to improve e-commerce logistics' operational and environmental performance if efficiently designed. To achieve this and promote sustainability in Sweden's e-commerce market, effective policy tools are essential.

The project aims to advance knowledge on parcel locker network development from a policy perspective by addressing three main questions: How does the current parcel locker policy influence Sweden's network development? What is the environmental impact of parcel lockers on e-commerce logistics? How can policy tools facilitate the transition to sustainable e-commerce and logistics practices? The findings aid the transition to more sustainable e-commerce practices, utilizing policy to achieve goals efficiently.

The project is a pre-study and consists of three studies: Study 1 reviews existing policies and synthesizes scientific knowledge, Study 2 examines relevant parcel locker markets and initiatives, and Study 3 involves interviews and workshops with various stakeholders, including logistics operators, software providers, municipalities, and policymakers. Among participants of Study 3 are logistics and parcel locker operators, parcel locker and software providers, land and property owners, municipalities and policymakers.

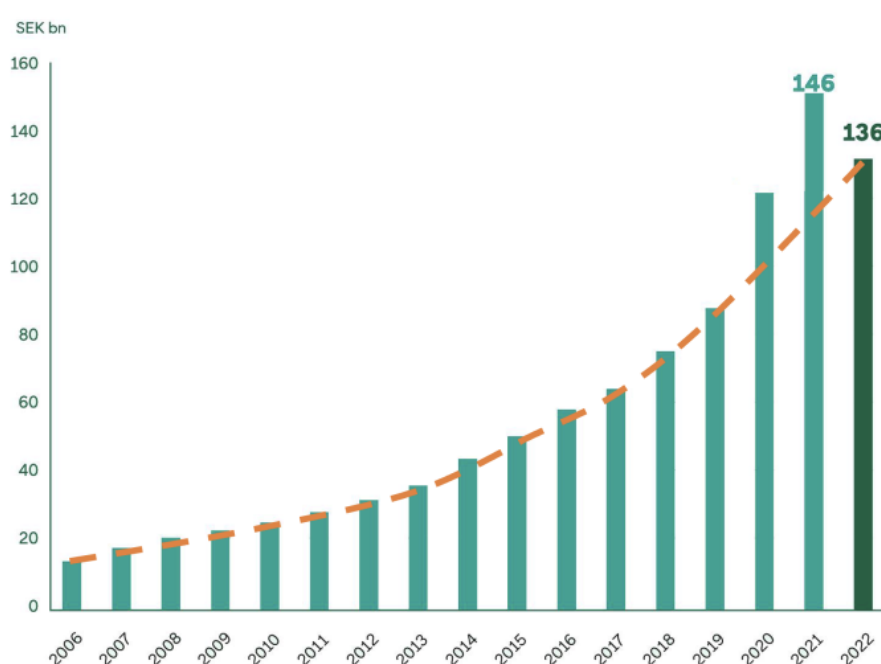
The project is a preliminary study with a total budget of SEK 525.000, of which SEK 400.000 is to be provided by ASTER, and SEK 125.000 is funded by project partners (Nowaste Logistics AB and Helsingborgstad). The project started on November 1, 2022 and was finalized on June 30, 2023. The final report is submitted on July 30, 2023.

## 2. BACKGROUND

### 2.1 E-COMMERCE LOGISTICS IN SWEDEN

The rapid growth of e-commerce has emphasized the critical role of retail logistics in facilitating seamless transactions. However, this surge in online shopping has led to limited availability of public spaces in cities and peri-urban areas, intensifying competition for these locations. Simultaneously, the existing delivery points in Sweden are unable to meet the escalating demands of e-commerce deliveries. To address this challenge and align with market and environmental goals, transformative measures are needed, including the adaptation of current delivery points and the creation of new ones (e.g., in-fridge delivery, in-car delivery, and unattended-home delivery). Nonetheless, expanding the delivery networks faces numerous limitations and barriers, involving challenges related to infrastructure, policies, operations, and financial resources.

**Deliveries in Sweden are heavily dominated by out-of-home modes**, particularly the use of attended delivery points and parcel lockers, which account for **75% of all deliveries**. This places Sweden among the highest in Europe for out-of-home delivery adoption, second only to Finland. The country's strong preference for these delivery methods can be attributed to their advantages in terms of convenience, efficiency, cost, and environmental sustainability.



E-commerce net sales in Sweden (SEK bn)

Source: PostNord & HUI Research, E-barometern 2022

**SWEDEN'S  
E-COMMERCE  
GROWTH IS BACK TO  
PRE-PANDEMIC  
TRAJECTORY,  
LEADING TO  
INCREASING  
PRESSURE ON  
THE LOGISTICS  
NETWORK CAPACITY  
AND ITS  
ENVIRONMENTAL  
IMPACT**

## 2.2 PARCEL LOCKERS IN SWEDEN

Over the last decade, many developed European e-commerce markets like France, Netherlands, and Germany have integrated parcel lockers into their delivery networks. With the rapid rise of self-service technology and consumer acceptance of this solution, parcel lockers became a major delivery method during the COVID 19 pandemic. By the beginning of 2020 when the pandemic hit Europe (and the world), parcel lockers were slowly making their way in Sweden. Before that, for several years, market actors perceived parcel lockers as risky investments, resulting in commitment and investment resistance from different e-commerce actors. Service digitalization, the pandemic, growth of E-commerce, tightening market competition, and restricted capacity of the established logistics network have played their role in the establishment of parcel lockers in the Swedish market.

### OUT-OF-HOME DELIVERY NETWORK IN SWEDEN

\* PUDO – pick-up-drop-off (attended delivery point)

Logistics Operator	PUDOs*	Parcel Lockers
POSTNORD	2,300	4,200
INSTABEE (Instabox & Budbee)	1,000	1,700
IBOXEN		1,400
DHL	1,600	120
BRING	1,712	68
DB SCHENKER	1,600	
DPD	2,014	849
UPS	618	
<b>TOTAL</b>	<b>10,844</b>	<b>8,337</b>

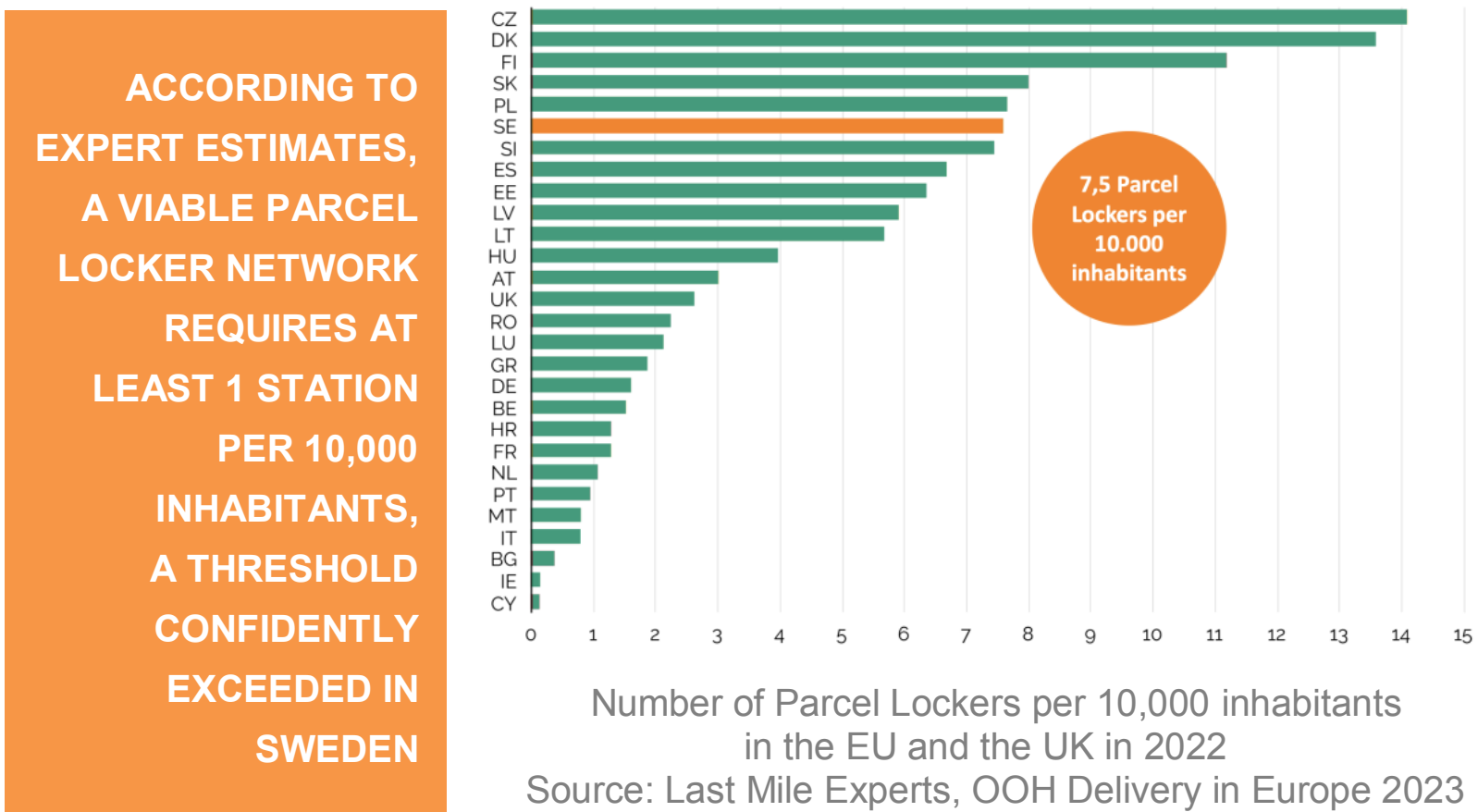
Source: Last Mile Experts, OOH Delivery in Europe 2023; PostNord 2023; Statista 2023



Image source: PostNord

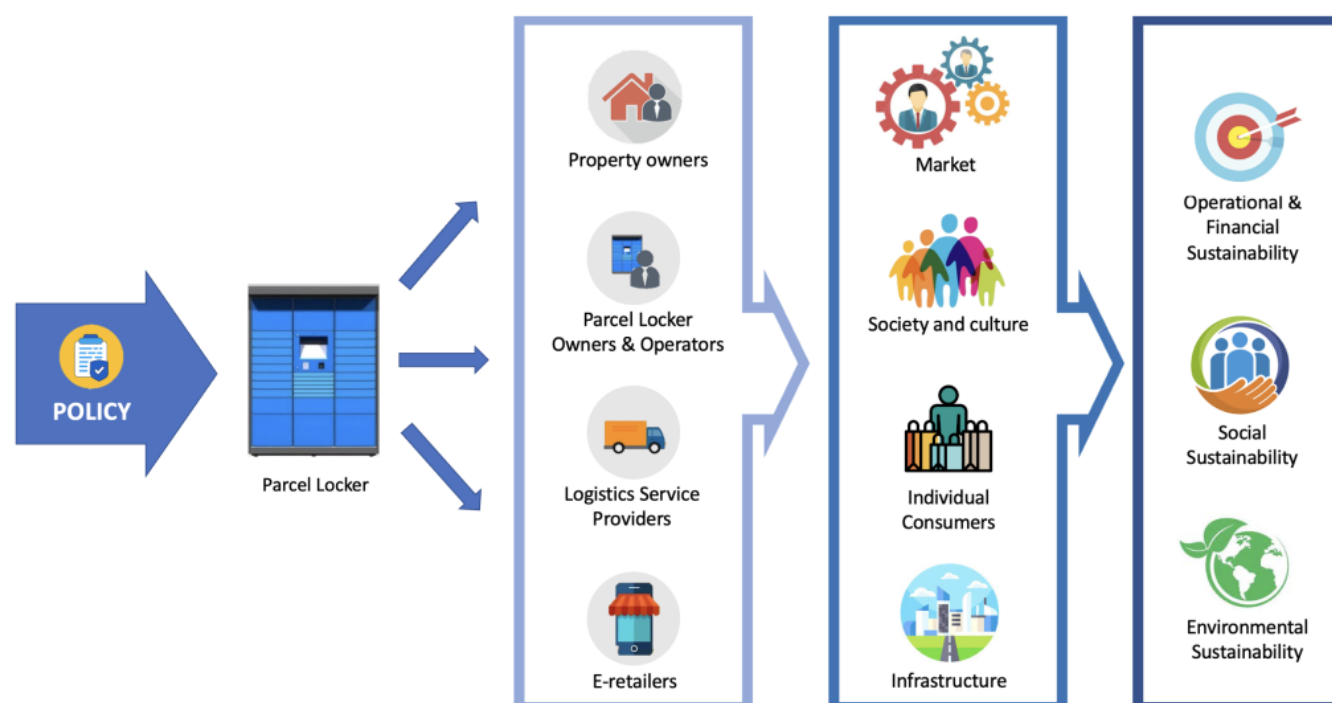
- In 2022, 10% of Sweden’s deliveries were performed through parcel lockers.
- In the last quarter of 2022, 14% of PostNord’s deliveries were performed through parcel lockers in both large and small towns, in comparison with 2% in 2019 and 5% in 2020.
- In 2022, DHL utilized lockers for 18% of the deliveries.

Within the last two years, the proportion of the total deliveries accommodated by parcel lockers continued to grow. Besides the number and the proportion of deliveries to the lockers increasing continuously, Sweden has now seen a great hike in the number of parcel locker stations. The list of logistics companies with their own parcel locker infrastructure in Sweden now includes (among others) PostNord, DHL, iBoxen, Instabox, Budbee, Bring, complemented by e-retailers’ own lockers, like ICA and Wyllis, individual consumer parcel lockers provided by e-Drop, and smaller infrastructure units added to delivery flows when private organizations and communities invest in their own locker stations



## 2.3 PARCEL LOCKER POLICIES

Parcel lockers are often associated with potential emissions reductions compared to other delivery modes. However, the true impact varies due to various service settings and consumer behavior. To promote sustainable pickup locations, policymakers should discourage sole cost-driven decisions and opportunistic location selection, and instead, prioritize proximity to residential areas for customer convenience and environmental benefits. Placing lockers in apartment buildings in cities can also minimize travel distance. However, achieving these goals necessitates an evaluation of existing policies and the growing locker network from different stakeholders' perspectives. Policy alignment with desired market development is crucial for managing the impacts of e-commerce and last-mile delivery. The current policy in Sweden focuses on mitigating risks related to public space use and consumer data security but lacks a clear correlation with the triple bottom line scope. To unlock the full benefits of parcel lockers and transition towards sustainable e-commerce, a comprehensive policy approach is essential.



A crucial aspect of policy development and implementation is the provision of appropriate incentives to drive behavioral change. Equally significant is the timely analysis of the policy's objective and desired outcome, enabling the policy to take on a preventive approach rather than a reactive one, thereby avoiding the need to reverse undesirable trends and behaviors. This principle of policy development holds particular relevance for Sweden's swiftly growing parcel locker market.

### 3. PURPOSE AND OBJECTIVE

The project's **purpose** is to advance the knowledge for parcel locker network development from a policy perspective.

The project is developed with the following **questions**:

- How does the current state of parcel locker policy influence the development of Sweden's parcel locker network?
- What is the environmental impact of parcel lockers on Sweden's e-commerce logistics?
- How can policy tools effectively facilitate the transition of Sweden's e-commerce and logistics towards sustainable practices?

The **objective** is to support the e-commerce and retail logistics transition towards more sustainable performance on environmental, financial, and social dimensions.



Image by David Pisnoy



## 4. METHOD

### STEP 1

#### **Review of existing studies, cases, and policies.**

Analysis and evaluation existing policies, previous policy-driven initiatives, and industrial projects. Additionally, reviewing the latest relevant scientific literature. Secondary data in the form of documents, reports, and articles were utilized to develop a holistic image of the state of parcel-locker-related knowledge and policies.

### STEP 2

#### **Stakeholder analysis.**

Identifying and working with parcel locker stakeholders to understand and analyze their perspectives, strategies, and intentions. Based on the insights and learnings from Step 1, the data was collected through a series of interviews and workshops.

### STEP 3

#### **Knowledge synthesis and recommendation development.**

Assessment of the lockers' potential to contribute to the sustainable e-commerce logistics, and evaluation of the efficacy of existing and potential policy tools in this context. Further, recommendations are developed to serve as a roadmap to facilitate the transition towards a more sustainable e-commerce.

## 5. PROJECT PARTNERS AND PARTICIPANTS

### 5.1 PROJECT PARTNERS



**Lund University** is ranked among the world's top 100 universities. Lund University hosts ReLog, the triple helix research platform with focus on retail logistics. Lund University also hosts Centre for Retail Research – an interdisciplinary research center which affiliates over 60 researchers from different disciplines.



**Helsingborg city** is located in the south of Sweden (Skåne), and its development project is working toward becoming the innovation hub of Sweden, as well as most attractive logistics destination. As a consequence, Helsingborg has launched Helsingborg Declaration with the aim to increase climate transition through concrete collaborative projects among logistics stakeholders.



**Nowaste Logistics** is a large independent transport buyer who cares for transport and distribution throughout Europe. Among its logistics services, Nowaste offers Nowaste Logistics is a value-driven company with core competencies in automation, IT and staff, which provides parcel-locker-enabled deliveries among its services.

### 5.2 PROJECT PI – CONTACT PERSON

**Yulia Vakulenko**, PhD, Lecturer in Packaging Logistics, LTH, Lund University. Taking the roles of project coordinator and principal investigator, Yulia provided expertise in the fields of e-commerce logistics, service design, and service digitalization. Yulia has previously worked on parcel locker research projects in Sweden in collaboration with PostNord and Nowaste Logistics (among others), where parcel locker pilot tests were carried out.



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## 5.3 INTERVIEW AND WORKSHOP PARTICIPANTS

*Disclaimer: Several interview respondents requested anonymity to ensure non-disclosure of their identities, which is reflected in the report.*



## 6. RESULTS: PARCEL LOCKER PERFORMANCE

### 6.1 PARCEL LOCKERS IN OPERATIONS

Parcel lockers have become a popular solution among a number of logistics service providers due to a range of advantages it provides:

- >99% successful first-time delivery
- Flexible to sudden volume changes (modularity and scalability)
- Consolidation
- High capacity per delivery point
- Independence from consumer
- Control of consumer experience

From the network perspective, according to van Duin et al. (2020) there is a potential **15.7% reduction in total distribution costs**, driven by the

introduction of parcel lockers complementary to the existing delivery network, which can lead to increase in operations efficiency and a **reduction in fleet size**.

In Sweden, parcel lockers are present through different forms of hardware and business models. Besides the most common form with the 30-100-cell kiosks operated by a dedicated carrier, there are also offers of individual household lockers (e.g., E-drop by Nowaste Logistics), as well as agnostic (open) system parcel locker provider (i.e., IBoxen).

An increasing number of **supermarket chains are collaborating** with delivery and e-commerce companies to implement parcel lockers at their branches. This partnership comes with both positive and negative factors to consider, including capacity limitations, opening hours, security, and availability of parking spaces. Examples of such partnerships can be seen in Lind in Poland and Lithuania, as well as in Sweden where COOP and ICA have joined forces with Instabox, Budbee, PostNord, and others. Logistics Service Providers in Sweden further utilize the same approach to placement, by **setting agreements with private land owners**.

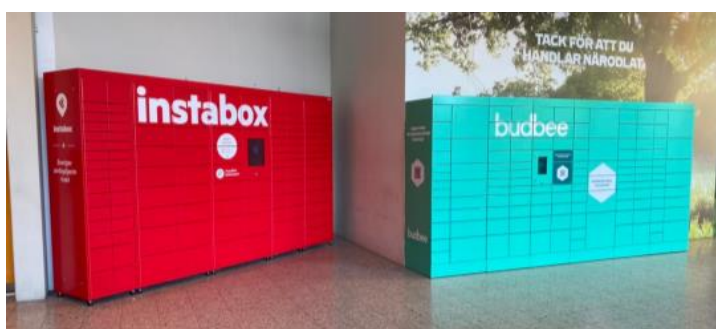


Image source: Coop.se



Image source: HFAB

## 6.2 PARCEL LOCKERS AND CONSUMER EXPERIENCE

Along with the expansion of parcel locker network in Sweden, consumer behavior and preferences have shifted towards them. Consumers are now more open and satisfied with parcel locker deliveries. The factors contributing to this preference are:

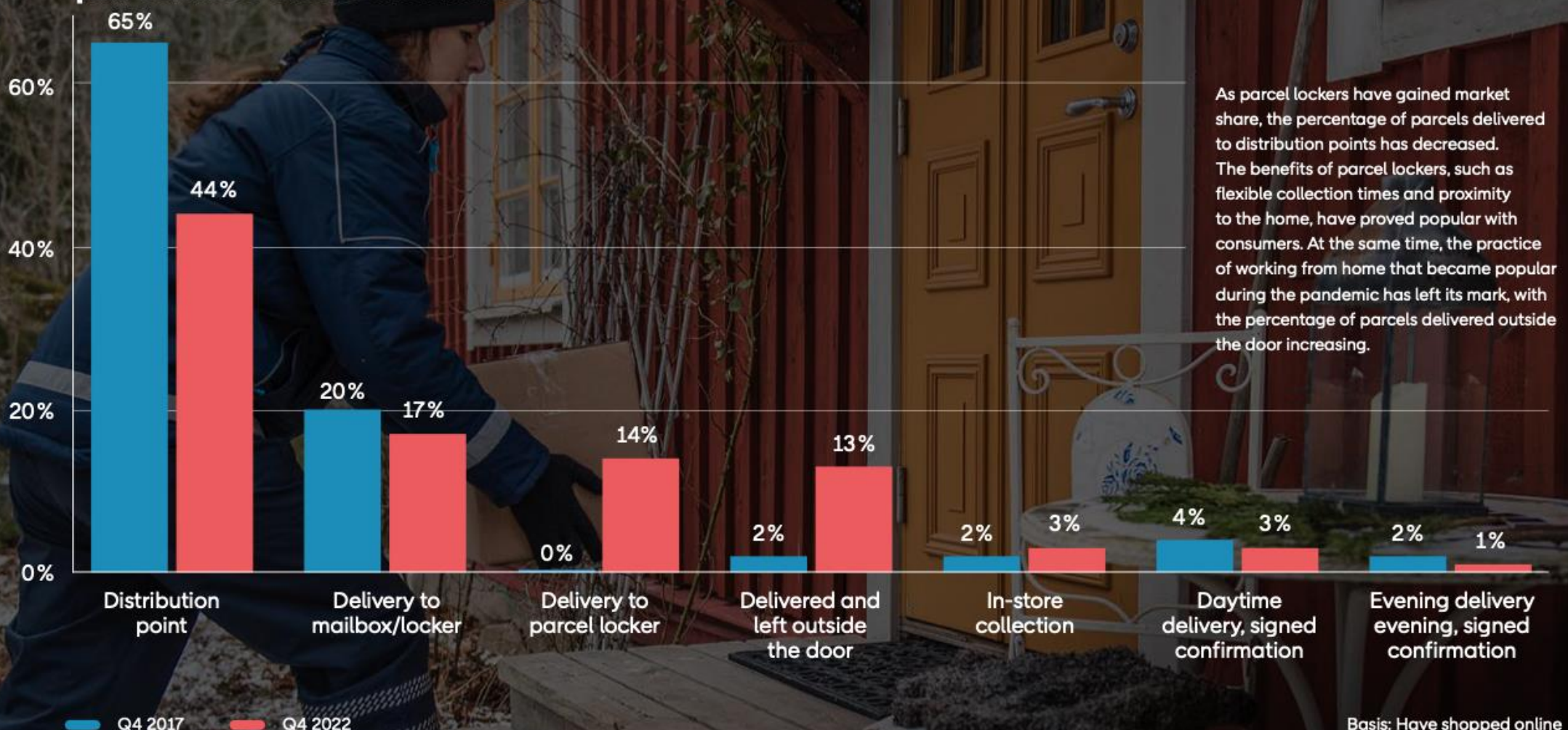
- **Lower delivery costs**
- **Higher accessibility** (especially outdoors)
- **Shorter distance** (available in extensive networks)

These factors translate into **convenience** and **perceived value**.

A study conducted with Swedish consumers has demonstrated that parcel lockers enable the creation of functional, financial, emotional, and social values (Vakulenko et al., 2018). As parcel lockers continue to expand and gain popularity in various markets, **consumers have become more accustomed to the technology**. In Europe, **high satisfaction rates with parcel locker** deliveries have been consistently reported in Germany, Poland, France, Sweden, Norway, Finland, Denmark, UK, Netherlands, and all other developed e-commerce markets where data is available.

Source: PostNord & HUI Research, E-barometern Annual Report 2022

### How consumers' most recent e-commerce purchases were delivered



## 6.3 PARCEL LOCKERS AND ENVIRONMENTAL IMPACT

Parcel lockers are known for their **superior environmental performance** compared to other delivery modes. This information is acknowledged by logistics service providers and is generally supported by the latest scientific reports (summarized in the table below). However, these conclusions **depend on location** (distance to the consumer and vehicle routing), **utilization rate**, and **network and service design**.

### SCIENTIFIC EVIDENCE

STUDY	RESULTS
Peppel & Spinler (2022) <b>Germany</b>	In urban areas, parcel lockers have a positive impact, resulting in total CO <sub>2</sub> e <b>emission savings of up to 2.5%</b> . However, in less populated areas, they contribute to <b>additional emissions (approximately 4.6%)</b> due to longer travel distances during the pick-up process. Additionally, lockers can lead to up to 11% cost savings.
Dong, Hovi, & Pinchasik (2022) <b>Norway</b>	Using more parcel lockers has the potential for significant environmental benefits, including reduced CO <sub>2</sub> , NO <sub>x</sub> , and PM <sub>10</sub> emissions, as well as lower fuel consumption. Converting parts or all home deliveries to parcel locker deliveries could <b>save up to 32.68% of the emissions</b> . <b>Note:</b> study does not consider the effects of customer traffic when picking up parcels.
Prandtstetter et al. (2021) <b>Austria</b>	Parcel lockers <b>can have a positive impact</b> when promoted effectively under specific circumstances. However, it's important to note that no general conclusion of "all parcel lockers reduce CO <sub>2</sub> emissions" can be drawn. The <b>individual surroundings and framework conditions need to be taken into account</b> . For instance, poorly placed parcel lockers could lead to significant detours to collect parcels, which may have a negative impact. To achieve optimal results, either the rate of successful first deliveries or the utilization rate of parcel lockers should be high.
Carotenuto et al. (2021) <b>Italy</b>	Findings show <b>potential environmental benefits of lockers against home delivery</b> . However, these advantages might be mitigated by fleet composition and the number of dedicated customers' trips. The optimization of vehicle type and the choice of lockers' location are found to be fundamental factors affecting the sustainability of the city logistics system.

	<table border="1"> <caption>CO2 Emissions (kg) by Delivery Method and Scenario</caption> <thead> <tr> <th>Scenario</th> <th>Home delivery</th> <th>Locker delivery without dedicated trips</th> <th>Locker delivery + 10% dedicated trips</th> <th>Locker delivery + 20% dedicated trips</th> <th>Locker delivery + 30% dedicated trips</th> </tr> </thead> <tbody> <tr> <td>small fleet MH1</td> <td>36</td> <td>32</td> <td>36</td> <td>40</td> <td>43</td> </tr> <tr> <td>small fleet MH2</td> <td>36</td> <td>32</td> <td>36</td> <td>40</td> <td>43</td> </tr> <tr> <td>medium fleet MH1</td> <td>30</td> <td>18</td> <td>21</td> <td>25</td> <td>28</td> </tr> <tr> <td>medium fleet MH2</td> <td>25</td> <td>18</td> <td>21</td> <td>25</td> <td>28</td> </tr> </tbody> </table>	Scenario	Home delivery	Locker delivery without dedicated trips	Locker delivery + 10% dedicated trips	Locker delivery + 20% dedicated trips	Locker delivery + 30% dedicated trips	small fleet MH1	36	32	36	40	43	small fleet MH2	36	32	36	40	43	medium fleet MH1	30	18	21	25	28	medium fleet MH2	25	18	21	25	28
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<p>Jiang et al. (2019) <b>China</b></p>	<p>Using parcel lockers in areas where they are highly accepted can lead to <b>reductions of up to 4.5%–51.2% in total delivery costs</b> and <b>18.7%–51.2% in carbon emissions</b>.</p>																														
<p>Hofer et al. (2019) <b>Austria</b></p>	<p>With <b>well-placed parcel lockers</b>, can shift all dedicated pick-up/drop-off car trips beyond 1.9 km (comprising 71% of such trips) to walking or cycling options. This modal shift would account for a 12% reduction in car usage, resulting in a 68% share (compared to 56% before) of eco-friendly transport modes and saving 27% of detour vehicle kilometers and associated emissions per picked-up/dropped-off parcel.</p>																														
<p>Guiffrida et al. (2016) <b>Italy</b></p>	<p>Parcel lockers are <b>more sustainable than home delivery</b> economically and environmentally. This is primarily because they enable logistics providers to carry out deliveries with greater efficiency. The environmental benefits of parcel lockers apply to both couriers and customers if the distance the customer needs to travel by car to reach the PL does not exceed 0.94 km in urban areas or 6 km in extra-urban areas. <b>Consumer location is the key</b> in determining the benefits of parcel lockers. There is a significant difference in urban and peri-urban areas' density, which impacts the costs and emissions of a traditional delivery route.</p>																														

## 7. RESULTS: CASE STUDIES

### 7.1 POLAND

- **Case:** SELF-REGULATED MARKET
- **Country population:** 37.8M
- **E-commerce sales (2022):** US\$ 15.2B
- **E-commerce sales (2027):** US\$ 23B



Over the last decade, Poland has claimed the reputation of the “locker land” due to the highest number of parcel lockers among all European countries, with Germany on the second place with roughly half the number of lockers. In 2023, InPost’s number of lockers in Poland has reached 20.000. The increasing demand for capacity and customer-centric features in the e-commerce and retail sectors is pushing the development of more efficient last mile infrastructure, with a specific focus on out-of-home delivery services, which drives the growth of the parcel locker network.

81% of Poland’s consumers utilize parcel lockers for their deliveries, while courier deliveries to home and office are also high – 43%.



Image source *Unknown*



To date, the parcel locker network expansion has been largely self-regulated by the market as no strategic policies have been issued for parcel lockers. As a consequence of that and the established benefits associated with parcel lockers, the Poland's parcel locker network is characterized by high locker density, which leads to:

**High service availability**, which translates into higher consumer convenience. Lockers are typically installed in open areas, and with 24/7 access, they provide a reliable and convenient option for customers to pick up their parcels at any time.

**High rate of successful first-attempt deliveries**, a prominent and advantageous feature of parcel lockers which translate into operational efficiency, reduced operational costs, and minimizes the environmental impact of the delivery.

**Short pick-up distances**, which translate into higher consumer convenience and lower environmental impact associated with the consumer pick up trips.

**High handling capacity**, which translates into operational efficiency to accommodate the increasing e-commerce parcel volumes.

**High consolidation**, which leads to higher environmental efficiency of the entire network and reduces traffic associated with deliveries.

**Infrastructure redundancy**, which occurs as lockers from different service providers are placed next to each other. Lockers' utilization rate remains undisclosed, but it is assumed that locker infrastructure redundancy often paired with underutilization.

**Opportunistic locker placement**, which is driven by the consumer density and location availability, while environmental benefits occur incidentally.



Image by Handy Wicaksono

## 7.2 SINGAPORE

- **Case:** GOVERNMENT-LED PARCEL LOCKER ALLIANCE
- **Country population:** 5.5M
- **E-commerce sales (2022):** US\$ 5.5B
- **E-commerce sales (2027):** US\$ 9.2B



In 2018 the Singapore government has introduced the "Locker Alliance" initiative, which aims to create a connected network of public lockers in residential areas and popular community spots. The main goal behind this initiative is to enhance the efficiency of last mile parcel deliveries to accommodate the increasing delivery volumes. The alliance network is intended to work alongside the current infrastructure, which primarily consists of private lockers and collection points placed in commercial zones by major delivery companies. This means that the alliance lockers are installed as addition to the existing lockers that are owned and operated by logistics service providers.

Locker Alliance in Singapore is organized as “an open-access, interoperable digital platform with standardized data interchange that is open to all Locker operators, Logistics Service Providers (LSPs), e-commerce Marketplaces and their Merchants. This enables different parcel locker operators to work together under a single system, eliminating the need for each Logistic Service Provider and Marketplace to integrate its systems with multiple parcel locker operators” (<https://www.lockeralliance.net/>, 2023).

**RESULTS:** Placing 1500 additional parcel lockers by the alliance in residential areas, assuring consumer reach within 250m, led to reduction in dedicated pick-up trips among consumers and diverting of 7,5% of deliveries from the city center to residential areas. Project resulted in shift from home- to out-of-home delivery and increase in delivery efficiency. 95% of parcels were picked up within 1,5 days.



Image source lockeralliance.net

## 7.3 NORWAY

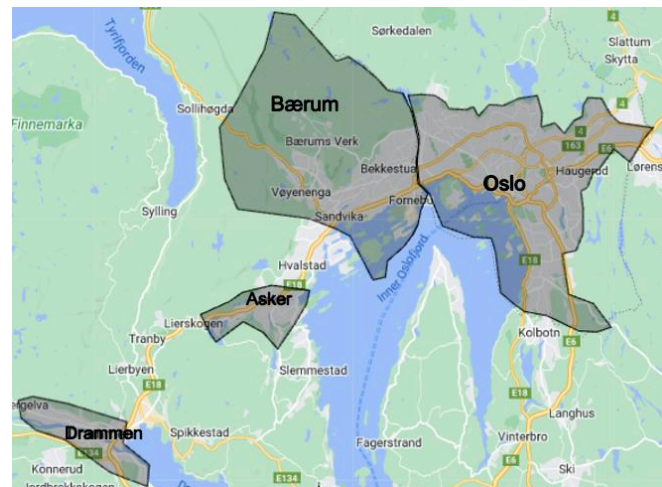
- **Case:** PERMISSIVE POLICIES IN OPEN MARKET
- **Country population:** 5.4M
- **E-commerce sales (2022):** US\$ 8.6B
- **E-commerce sales (2027):** US\$ 14.6B



**SLIPPER  
DISTANCE  
350m**

In 2020, Norway Post conducted research and found that the **optimal distance for placing pickup locations** in urban residential areas for consumer convenience is **350 meters**, with a **maximum** acceptable walking distance of **500 meters** (note: estimates for rural areas are not available). The estimation is now referred to as the “slipper distance” and, while varying slightly among European countries (**300m in Sweden**), today serves as the standard of convenience. The slipper distance also acts as a threshold indicator, signaling when consumers are likely to switch to environmentally friendly transportation modes, such as walking or biking, for their pick-up trips.

In 2022, a **pilot project** has been conducted in Oslo areas where Posten Norge AS has located their parcel locker at in **VIV-municipalities**: Oslo, Bærum, Asker and Drammen. The purpose was to develop knowledge about how parcel lockers can provide more environmentally friendly last mile deliveries.



As part of the initiative, municipalities granted Posten permission to place parcel lockers on the municipal land. As of 2023, Posten Norge plans to install 1,000 parcel machines, while Post Nord aims for 1,500 parcel lockers. Other players like Instabox, DHL, Boxn, and IBOX also intend to introduce parcel lockers at their collection points.

**RESULTS:** The first conclusions (Caspersen, Jordbakke & Knapskog, 2023, “*Pakkeskapets uforløste potensial Erfaringer fra Drammen, Asker, Bærum og Oslo*”) indicate that:

- Parcel lockers shows potential of reducing the traffic load from last mile deliveries compared to manned pick-up points and home delivery.
- Although travel habits depend on location, consumers use car less frequently to parcel lockers than to other delivery locations. At the same time, logistics operators drive relatively few kilometers on average per parcel delivered in a parcel locker.
- Consumers prefer to collect parcels from parcel lockers at known locations (in the residential area) or on known journeys (at the store or a public transport hub).
- Municipalities have greater leeway to regulate parcel lockers than they use today, for example via the Planning and Building Act, permits and procurement rules, local guidelines and cooperation.
- Shared parcel lockers can be a good solution, but the organization must be carefully considered to avoid a poorly utilized network resulting in more kilometers driven per parcel for the logistics operators than the current solution. As of today, the large logistics operators with their own networks are positive about regulation of parcel lockers, accept to share locations, but not parcel lockers.

The pilot study demonstrated that parcel lockers are the most efficient last mile delivery solution, with the lowest total traffic load in terms of average kilometers driven per parcel when compared to delivery at a shop/kiosk (i.e., DUPOs) or home delivery options.

#### TRAFFIC LOAD in km/parcel

Delivery mode	VIV GROUP			OSLO		
	Consumer	Operator	Total	Consumer	Operator	Total
<b>PARCEL LOCKER</b>	0,96	0,40	1,37	0,47	0,40	0,87
<b>PUDO</b>	2,73	0,10	2,83	1,70	0,10	1,80
<b>HOME DELIVERY</b>	0	2,50	2,50	0	2,50	2,50

Source: Caspersen, Jordbakke & Knapskog, 2023

## 7.4 SWEDEN

- **Case:** RESTRICTIVE POLICIES IN OPEN MARKET
- **Country population:** 10.4M
- **E-commerce sales (2022):** US\$ 13.1B
- **E-commerce sales (2027):** US\$ 20.3B



In Sweden, the last 4 years of e-commerce deliveries were marked by a rapid expansion of parcel locker networks, which are now offered by several logistics providers. Consumers are interested in environmental delivery options and are accustomed to out-of-home delivery. But geography is trickier than the rest of Europe, labor cost is higher, and public rights and social sustainability focus will not allow dense type of network to roll out in an uncontrolled manner. As a result, logistics service providers have been experimenting with different business models for creating value and facilitating deliveries with parcel lockers. Some examples are, agnostic (open) locker systems and collaboration with private land owners for parcel locker placement.

In 2023, after a 1,5-year pilot project, **Trafikkontoret in Stockholm introduced restriction** prohibiting the placement of parcel lockers within a 300-meter radius from the closest parcel agents on the public land. As a result, several logistics service providers (i.e., PostNord and IBoxen which were a part of the pilot project) were compelled to either remove or relocate their parcel lockers from the city zone of Stockholm. The initial offers for alternative land for relocation within the city zone were considered too costly by the logistics service providers.



Image source [iboxen.se](https://www.iboxen.se)

The Stockholm case is a common example of a market with fast-paced trends, resulting in reactive policies of a restrictive and compensating nature. Within the context of a robust social agenda, such as municipal land access, and an open market, restrictive policies become a natural occurrence.

## 8. RESULTS: STAKEHOLDER ANALYSIS

### 8.1 LOGISTICS AND PARCEL LOCKER SERVICE PROVIDERS

In Sweden, the aggressive expansion of parcel lockers has been driven by anticipated rise in parcel volumes and the COVID-19 pandemic. Home deliveries are operationally and financially taxing, making parcel lockers and PUDOs (Pick-Up/Drop-Off points) more preferable in many ways. Moreover, parcel lockers are increasingly playing a vital role in facilitating returns and improving the overall e-commerce experience.



Image by Claudio Schwarz

Consumers consistently opt for parcel lockers over PUDOs due to the convenience and lack of queues, making the expansion of the parcel locker network a natural progression. There is a noticeable shift in consumer behavior, which requires corresponding changes in the distribution system to cope with the growing volume and meet sustainability and logistic service demands. Key factors contributing to consumer satisfaction and reduced road traffic are the proximity to consumers and the density of the network.

From the operations perspective, the success of parcel lockers heavily relies on three aspects: (1) accessibility and integration with e-retail networks, where parcel lockers are intended to absorb volumes; (2) strategic and precise placement of lockers in scattered locations to meet service demands; and (3) service design tailored to suit consumer preferences. Continuous and dynamic monitoring is essential to optimize the system, given the various variables involved.

The rapid network expansion, changes in regulations, and responses from consumers and market stakeholders require logistics and parcel locker service providers to adopt highly agile approaches. The decentralized power to set regulations by municipalities creates inconsistencies, leading to uncertainty in strategy development, implementation, and operations management. Furthermore, potential shifts may arise from volume redistribution and changes in location opportunities granted by landowners.

Municipalities have diverse outlooks on parcel lockers, necessitating customized strategies and agreements to provide nationwide services. The differing preferences between rural and densely populated areas, and among different municipalities, present challenges in meeting core service needs amidst the rapid growth of e-commerce.

Specific legislation pertaining directly to parcel lockers is currently absent. Instead, existing regulations serve a broader purpose, addressing various aspects such as the coordinated use of public spaces, ensuring consumer

usability and accessibility, and safeguarding data protection and usage. These encompassing regulations govern the deployment and operation of parcel lockers within the overall framework of public space management and consumer protection.

Policy makers and land owners advocate for open systems, while market actors generally support agnostic (open) systems, but their views on how to organize such systems differ significantly among different players.

E-retailers play a pivotal role in shaping the scope of logistics services. Consumer preferences drive the logistics services e-retailers offer, leading to a focus on meeting customer expectations for convenience and satisfaction. In today's competitive landscape, e-retailers strive to secure consumer loyalty by providing a diverse array of delivery options. E-retailers expect nationwide coverage, efficient last-mile delivery, and proximity to the delivery points, all of which contribute to a comprehensive logistics approach tailored to consumer needs.

*“Wherever our customers, the e-tailers, want it [deliveries], and where the end consumer wants it – that’s where we gonna be”.*

**PostNord AB**

## 8.2 LAND OWNERS

Landowners representing residents express a clear preference for a green and open parcel locker system. The existing practice of placing parcel on residential land is seen as beneficial, as it adds significant value to the residents by providing access to the service and the convenience of nearby delivery stations. However, there are concerns regarding the clustering of multiple lockers side by side, as it may affect the area's aesthetics and functionality.

Furthermore, there is an expectation of well-defined regulations for the parcel locker system, although such guidelines are currently absent. The implementation of clear regulations is considered essential to provide structure and clarity to the system's integration on residential properties and the parcel locker network expansion.

Drawing a comparison between the significance of traditional postal services and the growing importance of e-commerce deliveries, there is an

emphasis on the need for e-commerce deliveries to be conducted in a sustainable and efficient manner. This approach aims to meet the community's demands while minimizing any potential negative impacts on the environment and daily life in residential areas.

When parcel locker placement agreements are established with profit-driven businesses, such as supermarkets, the primary focus is on ensuring profitability of the contract and convenient service availability for consumers. On the other hand, when agreements are made with landowners, such as housing companies, the priorities shift towards emphasizing environmental performance, social benefits and customer service, and economic feasibility.

In residential areas, land-owner agreements are influenced by procurement laws and internal neutrality policies, which make open (agnostic) systems a compelling

*“Economy, environment, and social development is the essence [to parcel locker placement]”.*

**Halmstads Fastighets AB**



option. However, a challenge arises as major logistics service providers already have their own locker infrastructure, leading to limited cooperation with agnostic systems. This situation creates a vicious cycle for parcel locker placement, as the lack of cooperation hinders the expansion and adoption of more environmentally friendly and socially beneficial locker systems.

Currently, landowners are making decisions in a non-coordinated manner regarding parcel locker placements. However, as the demand for locker services grows, residents' representatives will be in position to allow selected types of services,

exclusively environmentally friendly deliveries, and demand neutrality (i.e., agnostic systems). With clear guidelines and cooperation between stakeholders, a more structured and consumer-driven approach to parcel locker expansion can be achieved, benefiting both the community and the environment.

Opportunistic placement of lockers is seen as a temporary trend, and uncontrolled expansion on residential private properties is not welcomed in long term. Clear guidelines and policies are sought to ensure a strategic and harmonious approach to future locker placements, promoting a sustainable and community-friendly.



Image by Anna Permyakova

### 8.3 POLICY MAKERS

While Swedish policymakers and municipalities are actively working on sustainability-focused initiatives, the implementation of parcel lockers in public spaces poses unique challenges. The increasing number of requests from various providers has made it difficult to accommodate all of them, especially in densely populated areas. Safety around the boxes remains a key concern for municipalities.

Proper planning for efficient routing, access to parking spaces, and

capacity utilization is essential. Open (agnostic) systems have advantages based on the consolidation features but can be complex in practice, based on the results so far.

Policymakers' focus lies in reducing home deliveries and promoting consolidated, eco-friendly options. The cities' preferred scenario involves decreasing both the overall number and proportion of home deliveries, as they are considered inefficient and undesirable from the city's standpoint. So far, parcel lockers have not been



Image by Mike Kienle

able to ignite the shift from home deliveries to out-of-home deliveries among the consumers.

While night deliveries are considered as an option by some municipalities, logistics service providers prefer to avoid night labor option. Additionally, municipalities are exploring other potential functions for parcel lockers beyond e-commerce deliveries.

From the municipalities' perspective, some of the best placements in city centers have been on private land, like those on supermarket premises and residential properties. From the policy makers' perspective, this trend is likely to play a significant role in the future locker market development. Market shares are still being redistributed as companies experiment with various strategies and approaches. Therefore, some municipalities, like Stockholm, have adopted restrictive policies to allow for a pause to observe market trends and make informed decisions. The

lack of data and limited practice of data sharing from companies hampers informed decision-making. Strategic planning, and strategic network expansion can significantly impact locker placement and performance outcomes.

An analysis of data from Stockholm's pilot project indicated that lockers were not optimally utilized, largely due to a lack of data, underutilized capacity, and overlapping functions with the existing PUDO network. Furthermore, aggressive locker expansion has led to competition with other projects dedicated to communal needs.

Overall, finding the right balance between environmental initiatives and parcel locker implementation remains a dynamic challenge and an interest for municipalities across Sweden, which are in continuous dialogue with logistics and parcel locker service providers.

*“From the city’s point of view, it [parcel lockers] is an interesting infrastructure, and definitely has a role to fill in the city, but I’m not quite sure that they [companies] have found the right way for that yet.”*

**Trafikkontoret, Stockholms stad**

# 9. SCENARIOS AND RECOMMENDATIONS

## 9.1 DEVELOPMENT SCENARIOS

### Assumptions:

1. E-commerce parcel volumes will continue to grow in Sweden
2. Sustainability demands will continue rising from consumers, land owners, and policy-makers leading to exclusive use of fossil-free fleet (and in some cases green city zones).
3. The increasing volumes will have to be accommodated by increase of delivery points and/or volume of home deliveries.
4. Majority of available PUDO locations have been employed and operate at high-capacity utilization.
5. A scenario or solution can be considered environmentally positive if complying with Scope 1 (i.e., no external environmental costs are taken into account; GHG protocol framework)

**Scenarios do not consider following potential changes in the system:** shorter dwelling time and reconfiguration of e-commerce delivery market.



Image by Mika Baumeister

The policy and incentive tools have the potential to encourage and enhance the adoption and utilization of parcel lockers, unlocking their environmental benefits that are currently underutilized. The scenarios presented here examine various levels of parcel network expansions and the environmental focus of policies. The summarized outcomes are compared to the current ongoing development trend.

	Open Competitive Market	Free Market Focus on Environment	Focus on Sustainable Development
	No or minimal restrictive policies	Narrow targeted regulations	Broad extensive regulations
Broad Parcel Locker Application	<ul style="list-style-type: none"> <li>• Dense parcel locker network</li> <li>• Consumer centricity &amp; Retail focus</li> <li>• Underutilized infrastructure</li> <li>• Close proximity to consumer (fewer pick-up trips)</li> </ul>	<ul style="list-style-type: none"> <li>• Dense parcel locker network</li> <li>• <b>Option 1:</b> Higher consolidation (locker or vehicle)</li> <li>• <b>Option 2:</b> Strategic environmentally-focused location</li> </ul>	<ul style="list-style-type: none"> <li>• Dense parcel locker network</li> <li>• Exclusively green transport</li> <li>• High consolidation</li> <li>• High-capacity utilization in lockers and vehicles in urban areas</li> <li>• Lower traffic</li> </ul>
Limited Parcel Locker Application	<ul style="list-style-type: none"> <li>• Dense parcel locker network</li> <li>• Consumer centricity &amp; Retail focus</li> <li>• Increase in ratio of home deliveries</li> <li>• Increase in delivery-related traffic (beyond the trend)</li> <li>• Development of alternative delivery method</li> </ul>	<ul style="list-style-type: none"> <li>• Dense parcel locker network</li> <li>• Higher consolidation (locker or vehicle)</li> <li>• <i>Potential:</i> increase in ratio of home deliveries (and hence traffic)</li> </ul>	<ul style="list-style-type: none"> <li>• Dense parcel locker network</li> <li>• Exclusively green transport</li> <li>• High consolidation</li> <li>• High-capacity utilization in lockers and vehicles in urban areas</li> <li>• Lower traffic</li> <li>• Rise of gig economy and need for work legislation</li> </ul>

## 9.2 RECOMMENDATIONS

The analysis of the six scenarios indicates that implementing targeted policies and incentives can facilitate the transition towards more environmentally-focused e-commerce deliveries. Notably, the scenario with a broad parcel locker network shows promising potential for achieving sustainable development goals. In a broader scope of recommendations, approaches to policy for utilizing parcel lockers as a tool to facilitate the environmental transition of e-commerce delivery services can benefit from the following:

### 1. Incentivize and promote systematic data collection and sharing ...

... in order to enable informed management, strategy development, and decision-making for all stakeholders. Access to updated and representative insights plays a vital role in facilitating environmental accountability and practices, which have become essential and are recognized by all involved parties. The effective collection and management of information are key factors in reaching sustainability goals and ensuring responsible practices in the long run in the entire system.

### 2. Incentivize and promote environmentally-driven strategic parcel locker network design.

The benefits of parcel lockers outweigh the negative effects for all core stakeholders. However, after conducting a literature review, analyzing various market cases, and conducting an interview study with Swedish actors, it becomes evident that these potential benefits are contingent upon four factors: (1) the parcel locker utilization rate, (2) the location and proximity to consumers, (3) the network density, and (4) the operations design. These aspects play a crucial role in determining the overall success and effectiveness of parcel locker systems, particularly from the environmental perspective.

### 3. Incentivize and promote consolidation.

In order to achieve a sustainable and efficient parcel delivery system, there is a need to prioritize and encourage consolidation practices. This can be achieved through a combination of incentives and, when necessary, restrictive policies to promote the benefits of consolidation. As cities move towards greener zoning and environmentally conscious urban planning, it is crucial to consider not only the adoption of electric vehicles but also the consolidation of parcels in vehicles and delivery points. Additionally, the proximity of consumers to the nearest consolidation point or parcel pickup location with all major logistics providers should be taken into account. By encouraging consolidation, cities can significantly reduce emissions, optimize delivery routes, and improve overall logistics efficiency, ultimately leading to a more environmentally friendly and customer-oriented parcel delivery system.

### 4. Holistic system approach to policy development.

Parcel lockers are complementary to the PUDOs (manned delivery points) and individual postal boxes delivery systems, particularly during peak periods when PUDOs experience capacity constraints. However, it is essential to be cautious about restricting use of parcel lockers, as this could lead to unplausible consequences such as an increase in the rate of home deliveries, which are considered undesirable from the municipalities and carriers' perspective. Instead, policymakers should take inspiration from holistic system design initiatives like the 15-minute city concept, which adopts a holistic approach to system design, optimizing decisions for multiple stakeholders and complex phenomena, ultimately leading to improved social and environmental sustainability outcomes. By considering the broader context and fostering collaboration among various stakeholders, a more effective and sustainable logistics system solution can be achieved, benefiting consumers, businesses, and the environment.

The market for parcel lockers remains fluid and unsettled, as evidenced by the diverse approaches to their utilization, placement, and value-creation strategies. Moreover, the competing nature of stakeholder interests adds further complexity to the landscape. Given these uncertainties and competing forces, the recommendations provided are intentionally kept at a generic level to accommodate the evolving dynamics of the market. By offering flexible and adaptable guidelines, policymakers can navigate the challenges presented by varying stakeholder interests and foster an environment that promotes sustainability while allowing for market-driven competition and innovation in the e-commerce delivery sector. Based on the project findings and results, the stakeholder-intended conclusions can be summarized as following:

### **Logistics and Parcel Locker Service Providers**

In the current market landscape, considering the state of regulations and development trends, collaborating and reaching agreements with property and land owners emerge as a more secure and viable strategy for expanding the parcel locker network. Additionally, open systems are highly favored by various stakeholders, offering the potential for sustainable relationships with consumers and parties responsible for issuing locker placement permits.

### **Land and Property Owners**

Parcel lockers are a source of service availability and convenience for consumers, especially when they are situated within a "slipper distance" and accessible 24/7. Decision-makers should prioritize factors like proximity and accessibility when considering locker placement, besides the economic value. A coordinated approach to decision-making can allow to manage the traffic and delivery types.



## Policy Makers

Studies have provided evidence of parcel lockers significantly enhancing consumer satisfaction and improving the environmental performance of deliveries. As lockers complement the existing delivery system and are not meant to replace it, they currently play a crucial role in preserving the out-of-home delivery culture, which remains prominent in Sweden. Despite the increasing volumes of e-commerce, the total number of home deliveries is not anticipated to decrease. However, parcel lockers serve as a valuable tool to prevent their proportion from further expanding, thereby contributing to a more sustainable delivery ecosystem.



Image by Sigmund

## 10. CONCLUSIONS

As of 2023, the parcel locker network is experiencing aggressive expansion, with multiple players adopting diverse approaches to locker placement and utilization. These lockers are commonly located on the premises of businesses such as supermarkets, office centers, shopping centers, or on private land owned by housing companies and landowner associations.

Parcel lockers serve as a vital logistics tool, and their prevalence is set to increase in the future. Generally, they offer the potential for greater environmental efficiency compared to other delivery methods, but this requires a wide network and strategically chosen location. Notably, the environmental benefits are conditional and are not guaranteed. In Sweden, the expansion of parcel lockers faces certain restrictions due to the strong social agenda and decentralized governing structure.

In the context of the continuous 10-15% annual growth in e-commerce volume and the high rate of utilization of manned pick-up points (PUDOs), the current parcel locker infrastructure, even in the context of partial limitations, is hindering the

transition from out-of-home deliveries to home-delivery practices. The parcel locker network will continue expanding to accommodate the escalating e-commerce demands. To support out-of-home delivery practices and harness the potential environmental advantages of parcel lockers, strategic and holistic network design is imperative.

Consolidation, thorough environmental assessments, and disclosure of operational data need to be considered in order for lobbying, marketing, and multi-stakeholder negotiation initiatives to succeed and to support informed decision-making.



Image by Itadaki

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