



► Last Mile Delivery 2030

How carriers, shippers, cities, and consumers need to adapt



INSIGHTS

//01


Cities will impose regulatory restrictions on delivery traffic by 2030, conflicting with increasing parcel volume.

//02

Reduced traditional delivery capacity in vans must be countered by carriers with alternative transport modes and self-pick-up points. But a significant capacity gap remains.

//03

New innovative delivery concepts and an adaptation of shopping behaviors are needed in a joint effort of shippers, carriers, cities, and consumers.



Introduction

The e-commerce industry experienced an unprecedented boom during the COVID-19 pandemic, and—despite a temporary decrease in parcel volume from 2021 to 2022^{1,2}—a fast recovery and long-term growth are projected. While roughly four billion parcels were sent in Germany in 2020, the German Bundesverband Paket und Express Logistik (BIEK) expects around 4.9 billion parcel deliveries in 2027, with around 5.4 billion to be expected in 2030 if the market continues to grow at the same rate.¹ Carriers in the courier, express and parcel (CEP) industry are not only struggling to cope with the increase in parcel volumes, but also with rising sustainability aspects, as well as increasing rules and regulations in cities that aim to reduce emissions, especially in urban areas. In addition, rising consumer demands, such as next-day delivery, real-time tracing or an easy return process, are increasingly difficult for carriers to meet. Finally, changes in the economic environment, such as labor cost or even availability and the rising energy costs have added additional pressure on the industry.



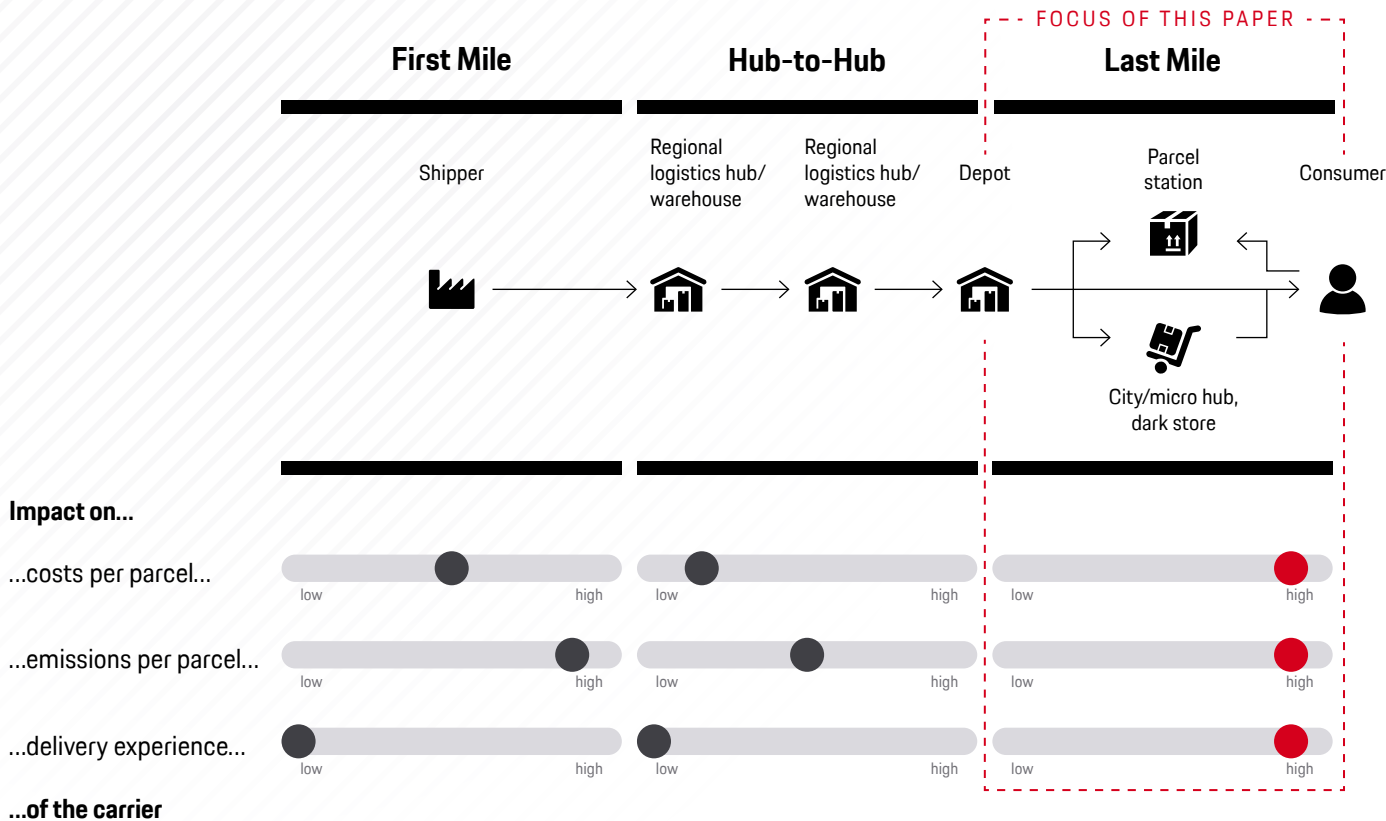


Fig. 1. Delivery process impact on cost, emissions, and delivery experience of carriers with focus on the last mile (schematic)

Common to all developments mentioned above, the last mile of the parcel delivery plays a crucial role for carriers (see Figure 1). The last mile refers to the very last step of the delivery process, when a parcel is moved from a regional depot to the consumer. The last mile accounts for more than 50 percent of overall delivery operating costs³ and more than 66 percent of the emissions⁴ generated by the whole delivery process, and has a significant exposure on consumer experience. Key challenges on the last mile are the identification and potentially time-consuming search of the accurate address for the delivery, the lack of nearby parking space—leading to long walking distances for the delivery staff—as well as the “not-at-home problem”. In fact, the absence of the receiver often-times requires a detour to a neighbor, the nearest parcel locker, or a post shop (corner shop offering postal services).

Due to the projected increase of parcel volumes and additional challenges such as stricter city regulations and rising customer demands, there is an urgent need for action to address the changing conditions on the last mile.

This paper explores the interdependency within the delivery network between carrier, shipper, and consumer as well as city authorities, and outlines how carriers have to tackle the increasing challenges by rethinking the last mile. Thereby, different delivery methods are examined, ranging from the traditional delivery via van, cargo bike, or pick-up points up to more innovative concepts, such as autonomous delivery shuttles. Based on three guiding hypotheses, this paper derives relevant recommendations for action, guiding carriers to meet the increasing demand on parcel delivery by adhering to strict regulations and fulfilling customer demands.

HYPOTHESIS 01

Cities will impose regulatory restrictions on delivery traffic, conflicting with increasing parcel volume.

E-commerce has been booming for the some years and there is no end to its growth in sight. At the same time, the need to meet sustainability targets is becoming ever more urgent. While cities increasingly reduce emissions and limit or ban conventional urban road traffic, carriers are exposed to the conflict of an increasing parcel volume and the shrinking road capacity for delivery vans. Meeting these two megatrends is not an either-or but a both-and decision.

THE SURGE IN E-COMMERCE

The COVID-19-pandemic pushed the amount of parcel deliveries to a new all-time high. In Germany alone, 4.5 billion parcels were delivered in 2021.¹ In 2022, the volume of parcel, express, and courier shipments decreased by 7.9 percent, reaching a total of 4.15 billion shipments.¹ Despite this decrease, the volume of shipments still remains significantly higher compared to pre-COVID levels, having grown by 14 percent since the start of the pandemic.¹ The market is expected to continue its growth in the coming years, driven by the increasing prevalence of e-commerce and ongoing advancements in delivery technologies and logistics.

The increasing popularity and adoption of e-commerce forces carriers to cope with an ever-rising amount of parcel deliveries. This also raises the attention of cities, which are finding that the situation is getting out of hand with the increasing number of delivery vans that populate our cities.

Simply adding more and more delivery vans will not solve the issue and is not a viable option for meeting the sustainability and global CO₂ targets.⁵

URBAN LOGISTICS NEED TO CONTRIBUTE TO THE QUALITY OF LIVING AS WELL AS SUSTAINABILITY

To meet the target of the Paris Climate Agreement, global carbon dioxide (CO₂) emissions need to be cut by 45 percent compared to 2010 levels. The transportation sector's role in global carbon emissions is no secret. It accounted for 20 percent in 2021.⁵ Carrier operations cause pollution and disturbance in various ways, e.g., air pollution and greenhouse gas emissions, noise pollution, traffic congestion due to double parking, blocking of sidewalks, and, thus, congestion for both pedestrians and cyclists. The logistics industry in general, and carriers in particular, yield significant emission reduction potential in the transition to sustainable modes of transportation.

As of now, these circumstances show the urban delivery industry in a less favorable light from a sustainability perspective. Shifting from conventional to electric vans alone will not solve the problem. Furthermore, an intensifying regulatory framework imposed by cities with further requirements for the last mile can be expected from city authorities.

CITIES ARE ACTING TO REDUCE URBAN ROAD TRAFFIC SIGNIFICANTLY AT THE EXPENSE OF CARRIERS

Local city authorities set their own targets for sustainability and urban planning and aim to reduce emissions and urban road traffic with regulatory means. The general rationale of such measures is not always exclusively linked to sustainability but does also target the quality of living in general with safe, healthy, and easily accessible urban areas.

Thereby, many regulatory actions are targeted at motorized private transport, trying to make the car less attractive or blocking cars from city centers. However, urban logistics carriers also suffer from collateral effects such as drive-through bans, stricter speed limits as well as dismantled or re-naturalized road space. On the other hand, numerous measures are explicitly targeted at a reduction of the number of delivery vans or at an increase of attractiveness of new delivery methods. More and

more cities are following these examples and increase their governance on urban traffic in general or urban logistics in particular (see breakout box). One particularly ambitious target has been set by the city of Hamburg:



It is our goal that by 2030, a maximum of 45 percent of last-mile shipments will be made by light commercial vehicles.

Dr. Melanie Leonhard
Senator for Economy & Innovation
City of Hamburg

Hamburg

By 2030 only 45 percent of last-mile shipments by light commercial vehicles, thereof 95 percent deliveries with emission-free vehicles.⁶

Berlin

Implementing pilot operations for a carrier-agnostic micro-depot designed for cargo bikes.⁷

Zurich

Trial of a multi-distribution hub within the congestion belt and further microhubs in living areas to test different operating models.⁸

Stuttgart

Development of a software app for smart routing and order management in downtown cargo bike deliveries.⁹

Barcelona

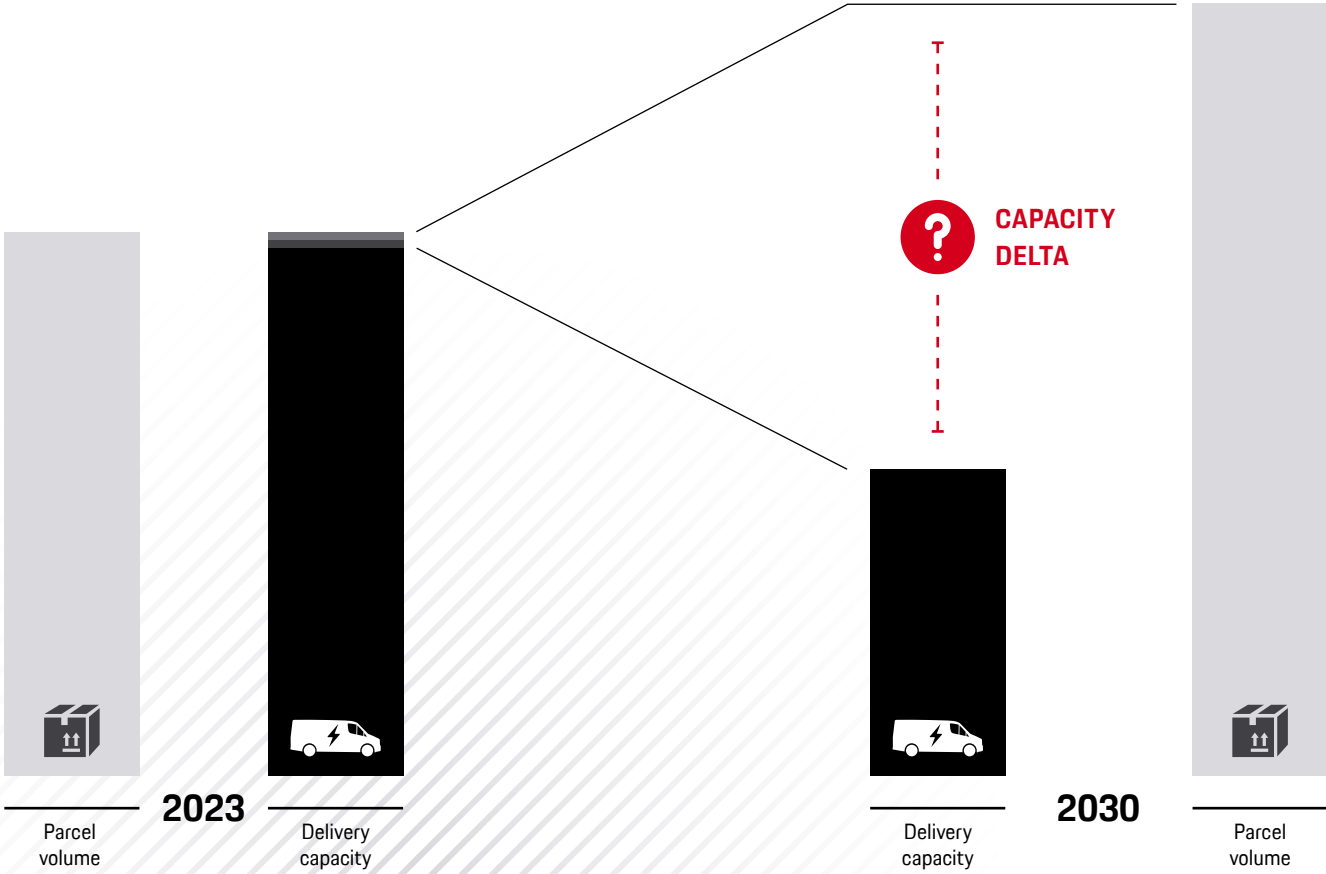
Trial nighttime deliveries to benefit from lower traffic and utilize 24-hour operations.¹⁰

Paris

Transform into a "City of 15 Minutes"¹¹ by reducing the need for commuting, enhancing bike infrastructure, and implementing a 30 km/h speed limit to reduce road congestion.¹²

While this imposes challenges for carriers, there are also opportunities such as incentives for electric vehicles, improved bicycle infrastructure, or vacancies in stationary retail in city center locations. Cities are in the unique position to steer the entire mobility ecosystem and to define carrier-agnostic solutions. Cities' pursuit of sustainable urban development, entailing a significant reduction in delivery traffic in urban areas, is not just a visionary aspiration but a tangible imperative

fueling a conflict of goals between increasing parcel volume and shrinking urban road capacity for delivery vans (see Figure 2). The resulting decrease in the mode of transportation that has traditionally been responsible for handling most of the parcel volume poses considerable difficulties for carriers and rises a pivotal question: How can carriers effectively counterbalance this decline in delivery capacity while simultaneously handling more and more parcel volumes?



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Fig. 2. Capacity delta of increasing number of parcels and shrinking number of traditional delivery vans in 2023 and 2030 (schematic for Germany)

HYPOTHESIS 02

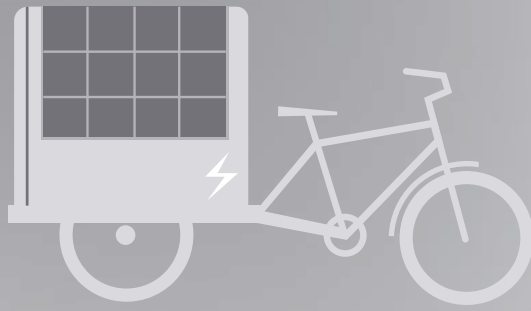
Reduced traditional delivery capacity in vans must be countered by carriers with alternative transport modes and self-pick-up points. But a significant capacity gap remains.

By 2030, the traditional delivery van will be a less frequent sight in urban areas, and those who are still on the road will be emission-free battery-electric vehicles. While such vans will continue to serve as a backbone for last-mile operations, the expansion of existing alternative transport modes, especially cargo bikes and self-pick-up solutions will have to take over a significant share of the delivery landscape. Nevertheless, a capped capacity of vans cannot be compensated by the alternative delivery modes we know today. The anticipated capacity gap of 30 percent of parcels will pose a key challenge for carriers in 2030.

SHIFT TOWARDS ALTERNATIVE TRANSPORT MODES AND SELF-PICK-UP POINTS

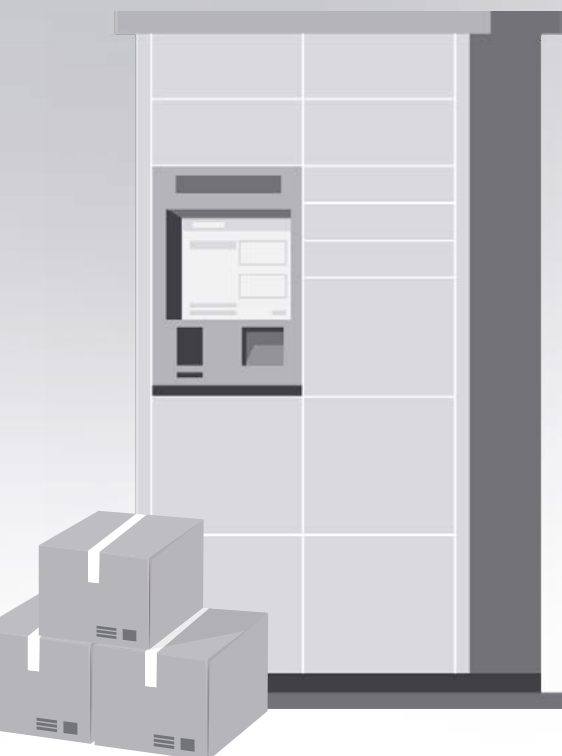
Taking the city of Hamburg as an example for the implementation of regulatory means, the delivery of total last-mile shipments with delivery vans will—independently from their powertrain solution—be reduced to a maximum of 45 percent in 2030.⁶ It can be assumed that other major cities in Germany and Europe are also aiming for similar scenarios.

In the realm of last-mile delivery, primarily moving assets such as (electric) delivery vans and cargo bikes, as well as stationary assets like self-pick-up points are currently shaping the logistic landscape.



Self-pick-up points

Self-pick-up points are manned counters in existing stores or unmanned lockers that can be placed virtually anywhere. Within these categories, the focus will increasingly shift towards parcel lockers, as scaling via parcel shops is hardly possible. One reason for this is the gradual vanishing of downtown areas due to higher vacancy rates in shopping areas, which has continued to increase even after the COVID-19 pandemic and is expected to reach a permanent level at 14 to 15 percent in Germany in the long term.¹³ Hence, it can be expected that parcel stations will play an increasingly important role in the future and the battle for space is already in full swing: DHL is currently the dominant player in Germany, with more than 11,500 current parcel stations but new players are also entering the market.¹⁴ In addition to Amazon Lockers, new players like Myflexbox are now stirring up the market with the help of strong partners and an investment of 75 million euros.¹⁵



Cargo bikes

Cargo bikes are equipped with special boxes or elaborated buildups for commercial use. They are usually powered by an electric motor. Because of their potential to move quickly and easily in congested urban areas and, above all, without emissions, they are becoming increasingly popular and are recognized by industry players as a real alternative.

The main challenge with cargo bikes is ensuring consistent uptime and increasing their parcel load capacity (most cargo bikes have limited cargo volume of $\leq 2 \text{ m}^3$, while weight is oftentimes not a restricting factor in parcel delivery). Scaling is the key lever for making the business model sustainable.

Delivery by cargo bike requires the installation of micro-depots, which are used for transfer of goods from trucks and vans to cargo bikes covering the very last mile. These hubs can be located in pre-existing real estates (e.g., former shops or parking garages) or in temporary structures (containers or trucks with swap-bodies).

(Electric) Delivery vans


Parcel delivery by van as a traditional way of delivery will be reduced in the future, driven by city regulations. Nevertheless, doorstep delivery will remain a popular and relevant delivery option in 2030 to satisfy customer demands despite high cost and volume pressure and related challenges such as the time-consuming search for handover points, the lack of nearby parking, and the "not-at-home" problem.

With the switch to electric vehicles, which is already in full swing due to environmental friendliness and efficiency aspects DHL, for example, currently operates 23,000 electric delivery vans and aims for 60 percent of delivery to be electric by 2030¹⁶ the development of a reliable charging infrastructure will be one of the relevant levers to success.



Aligned with the ongoing trend of vehicle electrification, the incorporation of cargo bikes and the strategic placement of pick-up stations play a crucial role. The COO agenda, as exemplified by Marco Schlüter at Hermes Germany, underscores these initiatives, emphasizing the significance of a

precise and flexible customer experience, environmentally friendly delivery options, and the tailoring of strategies to fit the unique circumstances of each city. This approach also corresponds with the broader shift toward more sustainable and customer-centric solutions in last-mile delivery.



As a parcel logistics provider, our goal is to make parcel shipping and receipt as precise and flexible as possible for our customers. At the same time, we are driving sustainable solutions to make our contribution to reducing emissions and traffic: important elements for us include the gradual electrification of our vehicle fleet, the use of cargo bikes, intelligent digital route planning, and consolidated delivery to our ParcelShops. Since the general conditions in every city are different, an individual, needs-oriented approach is essential.

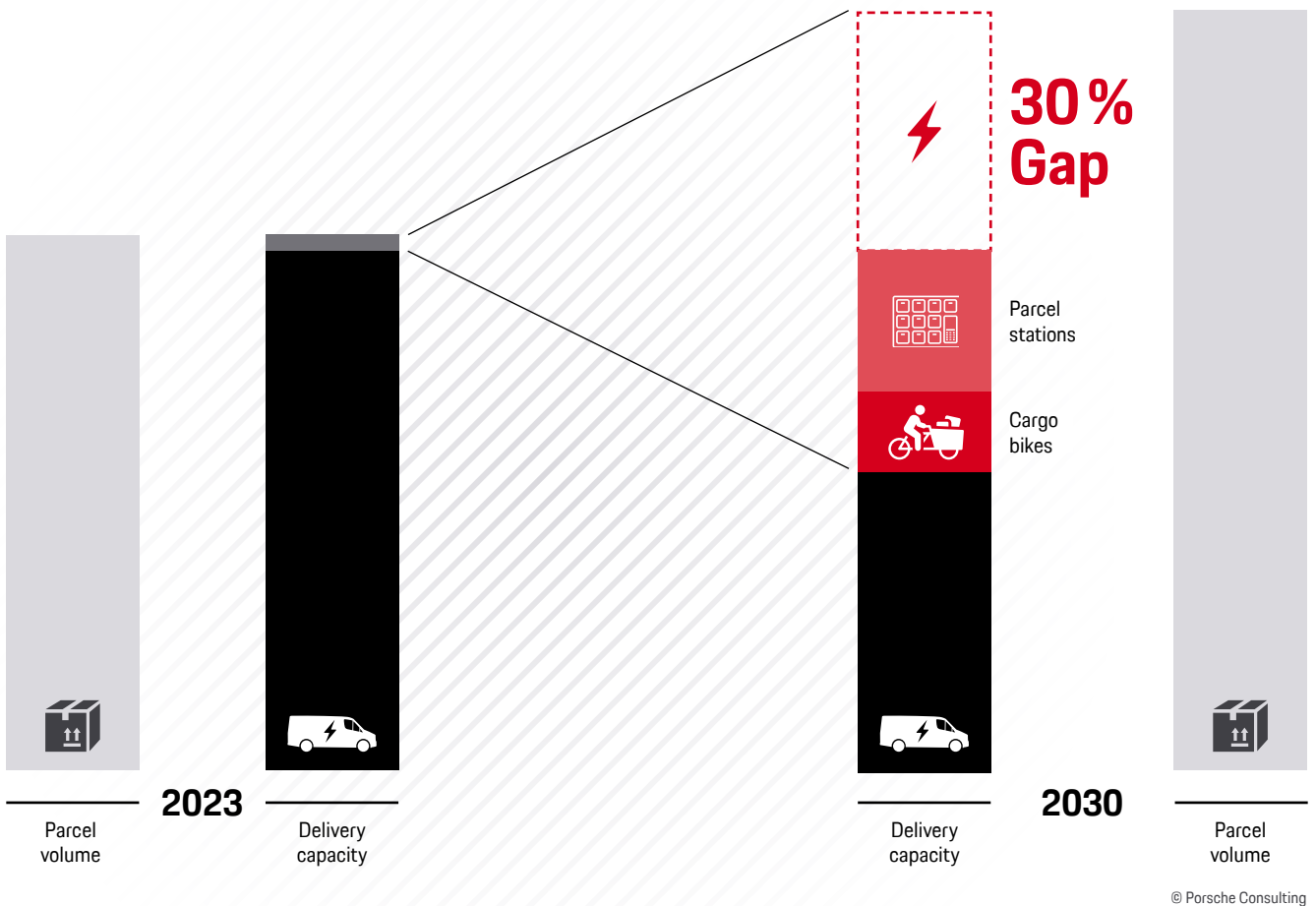
Marco Schlüter
Chief Operations Officer
Hermes Germany



Quantifying the gap

Based on the example of Hamburg, we assume that the share of delivery vans⁶ of today's level in 2030 due to regulatory constraints, delivery alternatives such as cargo bikes and parcel stations have to cover significantly larger parcel volumes. Despite a

fourfold increase in cargo bikes and parcel lockers, a significant capacity gap will remain, as illustrated in Figure 3. This gap is projected to 30 percent of overall parcels in 2030 that won't fit into the new delivery setup.



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Fig. 3. Insufficient closing of the capacity delta gap despite the delivery alternatives such as electric delivery vans, cargo bikes and parcel stations (assumption for Germany)

A comprehensive analysis of a major carrier's data in the city of Frankfurt am Main reveals that more than 60,000 parcels¹⁷ are delivered in the city per day by all major carriers, most of which with ICE and BEV delivery vans. Factoring in a 27 percent growth in overall parcel volume by 2027¹ and extrapolating this growth rate, a daily parcel volume of almost 80,000 parcels per day can be expected in 2030 in Frankfurt alone.

Even with an assumed fourfold increase¹⁷ of cargo bikes and parcel lockers by 2030, a reduction of

delivery vans to 45 percent of today's level would leave a gap of 24,000 undelivered parcels in the city of Frankfurt alone.

Extrapolating to the broader context of the German B2C parcel market, a nationwide shortfall of approximately 2.2 million parcels per day emerges.¹⁸

Addressing this gap of 30 percent is one of the key challenges for carriers and will have a huge impact on shippers and customers.

HYPOTHESIS 03

New innovative delivery concepts and an adaptation of shopping behaviors are needed in a joint effort of shippers, carriers, cities, and consumers.

To close the capacity gap, it is not enough to simply add more cargo bikes or parcel lockers (which above a certain extent is also not realistic due to staff shortage and required CAPEX). Instead, holistic solutions must be found in the triangle between customer, shipper, and carrier. Carriers hold a challenging position between both stakeholders, as depicted in Figure 5, serving the expectations of both. To keep up with such a dynamic environment, it is essential for carriers to find new ways of either finding more efficiencies or generating more delivery capacity.

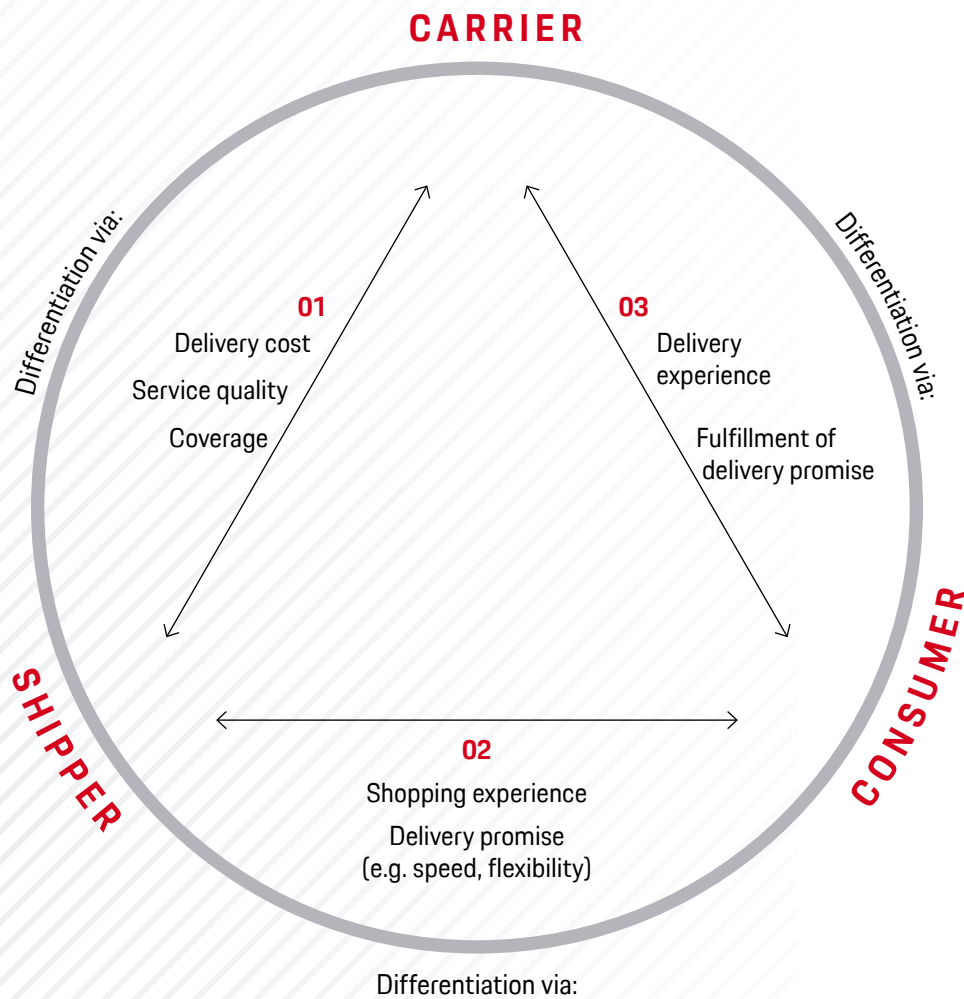
Carriers today are in a dilemma: on one hand there is the shipper, who wants an excellent shopping experience for the consumer and thereby makes a delivery promise to the customer with shipment options that are ideally cheap and reliable. On the other hand, there is the consumer, who expects a reliable and transparent shipment with excellent delivery experience. Given these market conditions, the business model of carriers is under immense pressure, as Michael Knaupe, Chief Customer Experience Officer of DPD points out:



All in all, the market is undergoing immense changes: increasing regulation, lack of drivers, and still the cost pressure remains extremely high. Consumers need to understand the real value of logistics, and we need to develop differentiating services.

Michael Knaupe

Chief Customer Experience & Business Development Officer
DPD Germany GmbH



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Fig. 4. Holistic solutions to close the capacity gap within the triangular connection between carrier, consumer, and shipper

Efficiency is key in the business model of carriers and will become ever more important under the pressure of a possible capacity gap. Carriers can only get out of it if they take new, disruptive paths. Three levers can make a significant contribution here: the improvement of the efficiency of existing structures, the generation of more delivery capacity through new modes, and the systematic reduction of certain parcel shipments.



01 Improvement of efficiency in existing structures

Even though delivery operations today are already highly optimized, there is still potential driven by innovation and technology. Rethinking packaging and parcel loading as well as realizing efficiency gains through digital solutions can help to increase the utilization of the often limited spaces of the existing assets.

PARCEL LOADING

Space inside a delivery vehicle (be it a van, autonomous shuttle, or cargo bike) is limited and precious. While the absolute number of vehicles might be limited or reduced by regulation in the future, the space utilization within the vehicles still bears room for improvement and the loading process of the vehicles plays a crucial part. The art of parcel loading is that on the one hand, space within the delivery van has to be optimized and on the other hand parcels must be easy to locate and unload in a sensible sequence that also corresponds to the route (the same applies for cargo bikes to a certain

extent). This activity is usually carried out by the delivery drivers themselves. The challenge, however, is that parcels come in different sizes and shapes. Modern commercial robots offer the potential for optimization of space usage and packing order. Leveraging recent advancements in optics, sensors, and artificial intelligence enables robots to identify, grab, and stack boxes of various sizes and shapes to ensure the best possible space utilization in the delivery vehicle, as has already been demonstrated by carriers.¹⁹



SMART PACKAGING

Apart from a smarter stacking of parcels, another approach to reduce the “air” that a vehicle is carrying around town is to optimize the packaging of the goods. While it was common not too long ago to always receive items in cardboard boxes, there are many ways today to optimize the packaging. IKEA, for example, is famously known for improving their packaging to make the items as densely packed and as stackable as possible, resulting in their iconic “flatpacks,” where no cubic centimeter

is wasted. Other shippers are continuously evolving their packaging strategy. Amazon claims to have reduced the weight of their packaging by 41 percent since 2015 by using more lightweight paper bags²⁰, and recently introduced an option to let customers return their items without packaging.²¹ All in all, even if such micro-improvements seem inconspicuous, they have significant impact on the big picture.



OPTIMIZED DYNAMIC ROUTING

In many ways, delivery vehicles face the same challenges as commuters: the time it takes to drive to a certain destination is highly dependent on external factors such as the time of the day and the traffic. While commuters often rely on their navigation system or local knowledge, carriers should rely on other tools and methods to optimize their route planning and thus find the most efficient ways through the city and traffic. UPS is well known for a simple yet effective approach to save time and

reduce accidents on their routes by almost never letting the delivery trucks turn left. While this was a very simple means, the general idea can be transferred to the present day and enriched with modern technology, for example by leveraging data such as traffic patterns, peak times, and the number of packages. The start-up kepler.ai has shown with DPD that modern simulation tools can significantly improve dynamic route planning, achieving up to 14 percent productivity increase.²²



02 Generation of more delivery capacity through new modes

While today's common delivery methods will reach a natural limit, other, as yet undeveloped areas and infrastructures will have to be used to a greater extent. Therefore, innovative new concepts need to be defined and operationalized. Many promising approaches already exist and are being piloted today.

AUTONOMOUS DELIVERY SHUTTLES

One solution to enhance the last mile of delivery is to rely on innovative transport modes to cater to the growing customer demand in ecommerce. For example, autonomous delivery shuttles can play a crucial role. While it would be possible to have a delivery courier drive along for doorstep delivery, the more likely use case will be a merging between delivery vehicle and parcel locker. Using autonomous delivery shuttles as mobile parcel lockers can be especially useful in dense urban areas, where a lot of customers could be served on a single stop. In an operating model in which the autonomous shuttles stop in certain locations for a certain time, customers could meet their autonomous delivery vehicle at their preferred location,

saving them time and effort compared to getting to a fixed parcel locker. Although autonomous delivery sounds like a future scenario, multiple companies are already conducting pilot projects across the world (see, for example, Clevon's Autonomous Robot Carrier, part of DHL Express's Estonia Fleet²³, JD Logistics' robots operating in 30 cities across China as autonomous delivery service in a wide range of environments²⁴, or Starship and Bolt piloting autonomous food delivery across multiple countries²⁵). Yet in this case, regulation will also be pivotal, e.g., whether such shuttles would also fall under the same cap as delivery vans, or if they will be regulated in other ways respectively.

WATERWAYS

While autonomous shuttles are still road-bound, other modes of transportation should be leveraged as well. Especially in cities with access to water (rivers, canals, lakes), waterways can be used to relieve road congestion and resolve land use conflicts. In most cities that are eligible, waterways still represent a mostly untapped potential, although some have already started the exploration

of delivery by water. In Paris for example, the supply of supermarkets in the city center is partly carried out by ships on the river Seine.²⁶ In Berlin, the carrier DHL started pilot trials of parcel deliveries with electric ships.²⁷ Delivery via waterways can provide relief, but rather as a feeder for other modes on the "very last" mile (e.g., cargo bikes).

RAIL

A mode that is more applicable in a wider range of cities is rail. While downtown rail lines (e.g., suburban trains, subways, and trams) form a backbone of people mobility within cities, their use for cargo

is not currently common, yet suggested in our previous study "Intermodal Logistics Chain in Cities"²⁸ as a major lever to handle significant parcel volumes with low emissions.



03 Systematic reduction of certain parcel shipments

It may sound absurd, but one way to prepare e-commerce for the future may be to reduce parcel shipments. Not in absolute sales numbers, but rather the amount of avoidable or unnecessary shipments should be the focus of this lever. To achieve this, customer behavior must be redirected.

LEVERAGE VIRTUAL TRY-ON SOLUTIONS

The average return rate of clothing purchased online is 24.4 percent.²⁹ One of the most common reasons for returns is the size uncertainty of fashion retail customers. Companies are beginning to offer virtual try-on solutions (see for example Zylar³⁰ or Kleep³¹), leveraging augmented reality

and artificial intelligence to decrease the rate of returns. Enabling customers to make better purchases with virtual try-ons results in cost savings for fashion retailers, while also reducing parcel volume and potentially increasing sales due to improved customer experience.



REDUCING PARCEL THEFT

Another way to tackle the growing number of parcels is to reduce parcel theft, which leads to a re-order of the same product. Globally, nearly 1 out of 10 customers suffered from parcel theft in 2022, indicating that more than one billion parcels have been stolen.³² While the location and status of a parcel can nowadays be determined with delivery tracing methods, theft can still occur at the destination. Carriers are starting to tackle this challenge with more enhanced and data-based protection measures. UPS is enhancing shipping intelligence

by identifying high-risk addresses with artificial intelligence based on historical loss patterns. The recipients' addresses are assessed in a scoring model and customers in high-risk areas are offered to relocate their package delivery to a secure destination.³³ Such data-based technologies do not just avoid a loss of parcel and a potential re-delivery, but moreover benefit the overall delivery experience and trust of the customer with regard to the carrier.



LEVERAGING STATIONARY RETAIL / OMNICHANNEL

E-commerce can be considered as competition to stationary retail. Yet, there is not necessarily an "either/or" logic to be applied, but rather, e-commerce and stationary retail should be combined in an omnichannel approach. Groceries in particular have demonstrated that the right interplay between physical and digital channels meets customers' needs in the best possible way, as our previous study Transforming Stationary Retail³⁴

pointed out. Concepts like deliveries out of stores or click & collect combine the best of both worlds. Moreover, stationary retail stores can—due to their location—be valuable hubs. It is a more than common sight that stationary retailers accommodate parcel lockers & pick-up stations, creating essentially a one-stop-shopping experience for their customers.



All in all, it is important to understand that there will not be a “one-size-fits-all” solution to cope with upcoming parcel volumes. The innovative concepts described are building blocks that, taken together, can help fill the gap (see Figure 6). But of course, there will be also other concepts and tools to cope with the rising demand. What is essential is that carriers are not left to solve this problem on

their own. Closing the gap is a combined effort. Carriers and shippers need to work together to find the best possible solutions in the offering concept and variety of their delivery options. And customers too need to play their part and adapt their user behavior in certain ways—e.g., getting used to picking up parcels instead of receiving them on the doorstep, or adapting their shopping habits.

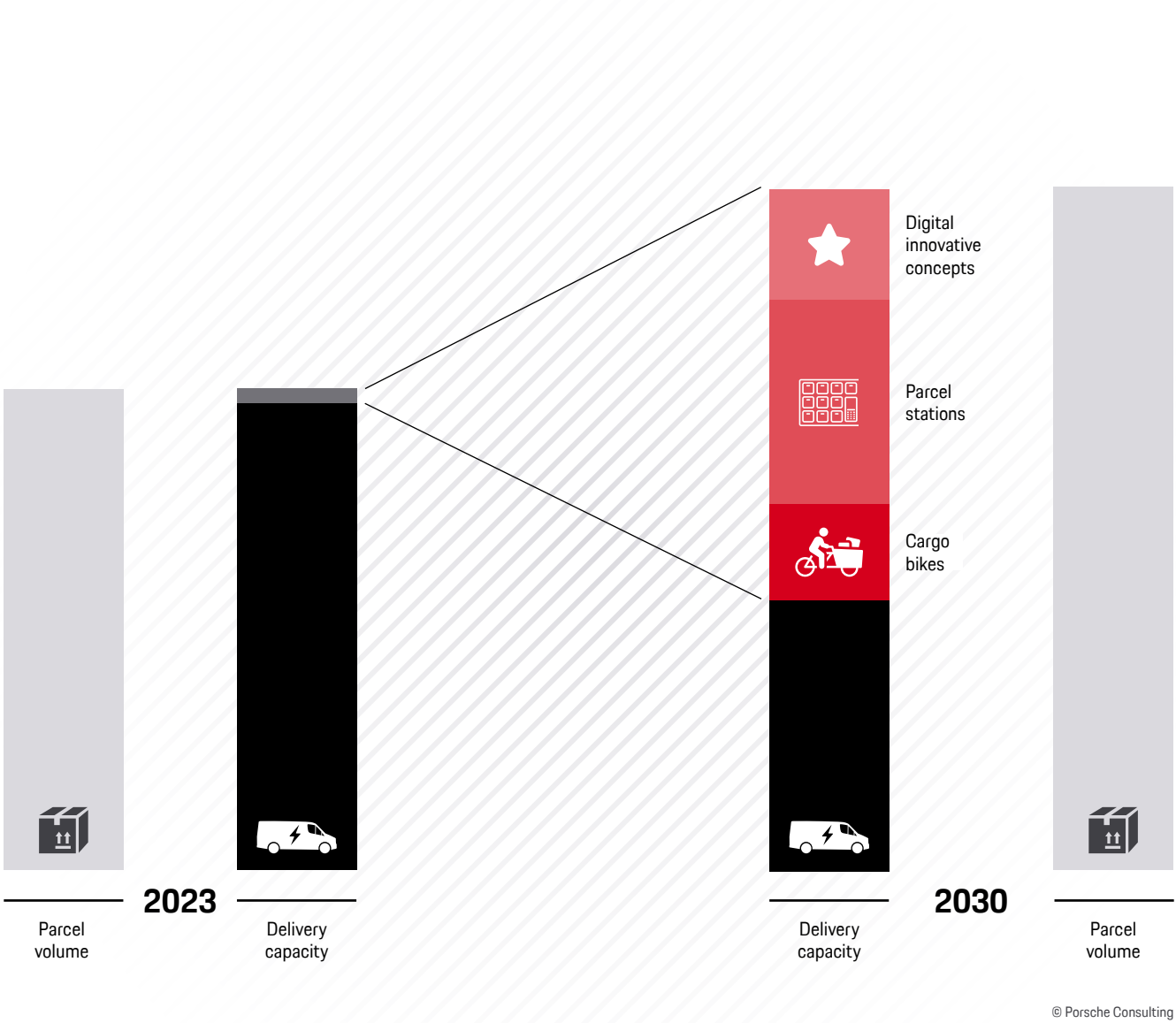


Fig. 5. Complete closing of the gap through the application of a combination of innovative concepts (schematic for Germany)

IN BRIEF

- 01** In the future, the volume of parcel deliveries will continue to increase. At the same time, city authorities will impose more and more regulations for urban traffic, aiming to meet sustainability targets.
- 02** To meet regulations and customer demands without compromising margins, carriers must rethink last-mile delivery, incorporating methods like cargo bikes and parcel stations for future success.
- 03** Nonetheless, there will be a significant gap of up to 30 percent between delivery capacity and the projected parcel demand in case other delivery methods are not implemented.
- 04** Instead, carriers and shippers need to continue to strive for innovative approaches to create more delivery capacity in new modes of transportation, optimize their existing structures, or reduce avoidable parcel volume caused by consumer behaviour.

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Glossary

BIEK German Bundesverband Paket und Express Logistik
CEP Courier, express and parcel
B2C Business to consumer
CO₂ Carbon dioxide

PUDO Pick up, drop off
BEV Battery electric vehicle
ICE Internal combustion engine
CAPEX Capital expenditures

Appendix

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