

In collaboration
with Accenture



Transforming Urban Logistics: Sustainable and Efficient Last-Mile Delivery in Cities

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Foreword



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The rapidly growing e-commerce landscape, coupled with the ongoing pursuit of consumer convenience, has created an unprecedented surge in deliveries. While this has brought new economic opportunities, it has also introduced significant challenges in cities, including increased congestion, emissions and safety issues. As we head towards 2030, the imperative for a sustainable, efficient and innovative urban delivery system has never been more urgent.

This white paper is a collaboration between the World Economic Forum and Accenture, with contributions from industry leaders and city authorities, and is intended for global city governments, retailers, delivery companies and

all other stakeholders involved in urban deliveries. It outlines the pressing need for private and public stakeholders to adopt practices that reduce emissions and alleviate congestion in cities and chart a course for a more sustainable urban delivery system. It is a call to action for all stakeholders to adopt more sustainable practices, invest in infrastructure and pioneer innovative solutions.

We invite industry stakeholders and decision-makers within the delivery ecosystem and in urban governance to engage with this paper's findings and recommendations. Together, we can harness the power of collaboration to unlock a more sustainable delivery sector and enhance the lives of urban residents.

Executive summary

Without action, emissions caused by deliveries in urban centres could rise by 60% by 2030.

The rapid growth of e-commerce has significantly altered consumer expectations, leading to a surge in deliveries. Globally, e-commerce already constitutes more than 20% of retail sales and is adding more delivery vehicles to urban roads. While this brings economic benefits and consumer convenience, it introduces challenges such as increased congestion, emissions and safety risks. Transforming urban deliveries into a more sustainable and efficient system is therefore crucial.

Under a business-as-usual scenario, carbon emissions from all urban delivery traffic could increase by 60% by 2030. Despite many consumers indicating a preference for sustainable deliveries, less than 30% are willing to compromise on cost.¹ Without significant changes, continued increases in delivery vehicles will exacerbate congestion and emissions, with some cities seeing 80% more delivery vehicles by 2030.

Forecasting models, applied to six city archetypes in this paper, indicate a significant rise in congestion, emissions and negative impacts on road safety and noise levels. The urgent need to transition to zero-emission fleets and shared infrastructure is evident, with city governments creating incentives for sustainable deliveries and optimizing kerbside usage. Private-sector stakeholders are also working to adopt new operating models that improve efficiency and reduce congestion and emissions.

This paper calls on public- and private-sector stakeholders throughout the value chain to accelerate the transition, and offers recommendations based on existing best practices. These include:



Public sector

- Integrating delivery operations into city strategies, including through sustainable urban logistics plans (SULPs)

- Clarifying and standardizing frameworks and regulations that define how operators interact with the built environment
- Collaborating with the private sector to create incentives for safe, innovative and sustainable practices



Private sector

- Deploying technologies, solutions and collaborative operating models that drive operational efficiencies, such as pick-up and drop-off (PUDO) networks
- Accelerating the transition to zero-emission fleets through support for vehicle roll-out and models for financing
- Providing consumers with information that will drive support for more sustainable deliveries



Collaborative

- Planning, innovating and collaborating throughout the delivery ecosystem to provide necessary infrastructure and operating models for the transition
- Deploying shared infrastructure, assets and other resources in support of last-mile operations, including microhubs, fleets and parcel lockers
- Sharing data that helps to develop a holistic view of delivery operations and achievable insights

By promoting a shared commitment to sustainable and innovative practices, the delivery ecosystem can enact change that enhances quality of life and supports a thriving business environment.

Introduction

This paper examines the future of urban deliveries, highlighting collaboration opportunities for the public and private sectors.

“ Consumers now expect faster deliveries as standard – and this trend is here to stay.

Growth in last-mile deliveries

Since 2020, last-mile deliveries have surged, in large part due to the significant increase in e-commerce, with sales reaching \$5.8 trillion in 2023 and expected to increase by 39% by 2027.² This growth is attributed to factors including urbanization, rising incomes, changing consumer behaviour and technological advances,³ with COVID-19 accelerating some of these trends. The result is that e-commerce has substantially outpaced traditional retail, bringing with it economic benefits and greater choice and convenience for consumers.

However, growth in online retail and quick commerce has caused the number of delivery vehicles in cities to surge. Without further intervention, the number of these vehicles could increase by more than 60% globally by 2030,

exacerbating congestion, emissions and safety issues, and therefore affecting the liveability of cities. For a city such as Sydney, for example, this might mean an additional 10,000 vehicles on the road, including trucks, vans and micromobility, such as pedal and electric bicycles and scooters. For a city like Bengaluru, this could mean a 76% increase in transport emissions.

Retailers selling in multiple online and physical channels are using inner-city stores to hold decentralized inventory closer to consumers, enabling same- and next-day delivery and local pick-up for online orders. Grocery retailers are prominent in quick commerce, with online-only models served by growing numbers of dark stores (small warehouses used for fulfilling online orders) embedded in local communities, contributing substantially to the 290% growth in quick-commerce deliveries since 2019.⁴



Defining the “last mile”

“Last-mile delivery” is defined as the transportation of goods such as packages, groceries, prepared meals and bulky deliveries from the final transportation hub in the supply chain, or, in the case of prepared meals, from where food is prepared. The actual distance of the last mile can vary significantly. For traditional courier and express parcel operators, this may typically be the last 15–20 kilometres,⁵ given the out-of-town nature of many distribution centres. For groceries and prepared food, the distance is typically much shorter, as orders are fulfilled from stores within the urban centre.





Sustainability is also becoming a priority, with over 70% of shoppers indicating they value sustainable delivery options in 2023.

Evolving customer expectations

Consumers now expect faster deliveries as standard – and this trend is here to stay. E-commerce retailers are using delivery speed and easy returns to differentiate themselves in a competitive marketplace. Average delivery time dropped to 2.15 days in 2023 from 2.36 days in 2022. This has inflated last-mile costs, which accounted for 53% of the total cost of shipping in 2023 compared to only 41% in 2018.⁶

Insufficient delivery speed causes 23% of abandoned orders, with a further 48% attributed to shipping fees,⁷ highlighting the importance of shipping in e-commerce. Home delivery remains the preferred option for more than 60% of e-shoppers.⁸ Shorter delivery windows are also crucial, with more than 68% of online shoppers citing this as a determining factor for placing online orders.⁹ The pandemic has also changed travel habits, reducing office deliveries and increasing the need for flexibility in delivery locations.¹⁰

Sustainability is also becoming a priority, with over 70% of shoppers indicating they value sustainable delivery options in 2023.¹¹ While many customers are unwilling to pay extra, some may accept longer delivery times or out-of-home alternatives when this is communicated as a more sustainable option.¹²

All of these shifts have placed substantial pressure on retailers' bottom lines. Retailers must therefore balance the need to meet consumer expectations with the pressure to make deliveries cost-effectively and sustainably.

The changing urban landscape

Many cities have embarked upon an urban transformation that focuses on sustainability and liveability. Road space is increasingly allocated to public transport, cyclists and pedestrians. Urban planning is focusing on creating walkable communities to improve interaction with retail, leisure and services as well as overall quality of life.

The varying nature of cities – in terms of population, density, demographics, congestion, climate, quality of infrastructure and digital readiness – requires nuanced analysis. This white paper uses six city archetypes (detailed in Figure 1) to quantify future challenges. High-level modelling simulates the impact of business-as-usual on congestion and emissions in sample cities, alongside qualitative assessments of health, productivity and economic costs.

This paper examines strategies by retailers, delivery companies and city authorities to tackle last-mile challenges. These include the use of microhubs, the electrification of fleets and the implementation of zero-emission zones, as well as making consumers aware of the impact of their choices. The potential impact of interventions on delivery costs, number of vehicle journeys, congestion and emissions has been modelled. Qualitative assessments cover noise pollution, customer satisfaction, road safety and ease of implementation.

The paper highlights the need for change and the operating models and initiatives that can balance the needs of communities and the environment with consumer expectations. It offers recommendations for stakeholders – including retailers, delivery companies and city governments – with due consideration given to the very different nature of cities around the globe.



1

The impact of last-mile deliveries on cities

By 2030, delivery vehicles may add up to five minutes to the average urban commute and account for 13% of total carbon emissions in cities.

1.1 Impact on urban centres

☞ Projections suggest that in Europe, even with the measures currently planned, transport emissions will drop below 1990 levels only by 2032 and would require additional measures to meet industry targets.

Urban centres are experiencing significant challenges from the increasing levels of delivery traffic, contributing to congestion and emissions, and creating safety issues.

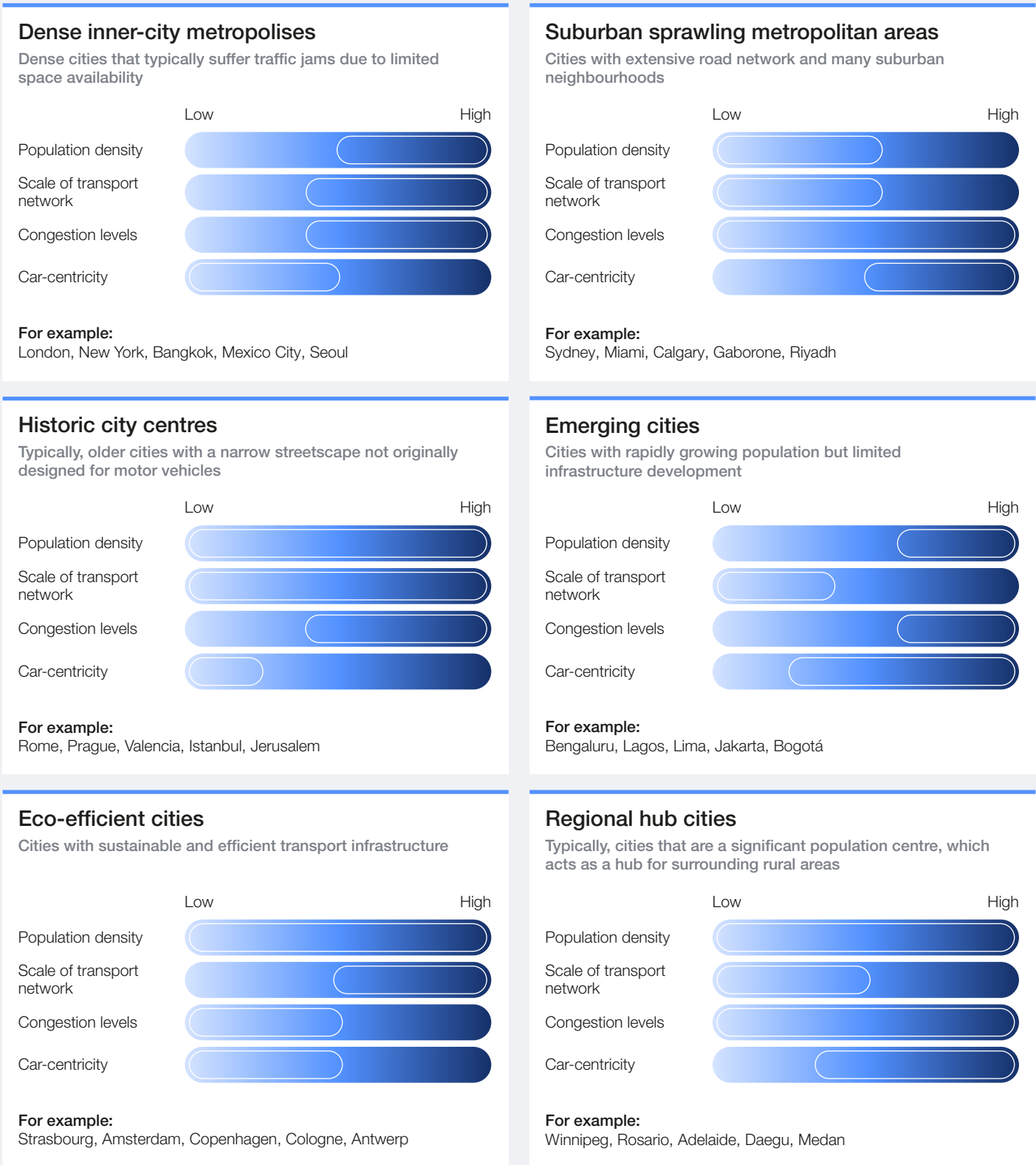
Urban congestion levels have increased significantly in recent years. Dublin's congestion level (average % additional time lost to traffic compared to free flow) increased from 45% to 66% and Milan's from 30% to 45% between 2018 and 2023.¹³ Put simply, more deliveries mean more congestion and more carbon emissions, unless there is a step-change in how deliveries are made. Projections suggest that in Europe, even with the measures currently planned, transport emissions will drop below 1990 levels only by 2032 and would require additional measures to meet industry targets.¹⁴

A shortage of available real estate is also making it difficult to create infrastructure, such as microhubs, electric vehicle (EV) charging points and parcel lockers, that can help to mitigate the impact. Delivery vehicles are often forced to stop in undesignated areas, causing obstructions and safety issues, and to search for parking, which can contribute 30% of traffic in busy areas.¹⁵ Clearer guidelines on road use for commercial vehicles would also help improve road safety and contribute to reduced congestion.¹⁶

High-level modelling has been conducted as part of this paper, viewed through the lens of six city archetypes, described in Figure 1. These archetypes reflect some of the fundamental differences in the characteristics of global cities.



FIGURE 1 | City archetypes



Notes: These archetypes are used to generalize city models. The challenges and impact experienced by cities will also depend on factors such as their geographies, local climates or politics, which might limit the adoption of recommendations.

Source: Accenture City Archetype Framework



1.2 The need for change

The impact of the growing number of delivery vehicles on congestion and carbon emissions was modelled across the six city archetypes under a business-as-usual scenario.

In a business-as-usual scenario, delivery vehicles could rise by 61% by 2030 across all cities. Carbon emissions from deliveries are also expected to rise on average by 60% by 2030 globally, making up approximately 54% of the transport sector's

emissions and 13% of overall city emissions. This increase would be detrimental to public health, raise healthcare costs by 12% and lead to a 14% rise in congestion. Drivers could therefore face an extra five minutes in their daily commute, while delivery vehicles might lose up to 34 additional minutes to congestion each day. Annually, this would result in up to 30 hours of lost productivity per passenger vehicle and more than 200 hours per delivery vehicle.



Defining “business as usual”

A “business-as-usual” scenario models the impact of continuous growth in the number of deliveries on the city, taking into consideration the ongoing interventions such as the gradual shift towards EVs.

BOX 1 Financial impact of business-as-usual

Modelling analysis indicates that a business-as-usual approach will impose a significant financial burden on delivery companies. By 2030, London-based delivery operators are projected to incur up to \$540 million in collective non-compliance penalties related to low-emission zones and an additional \$520 million in congestion charges. Simultaneously, Seoul-based operators are expected to potentially face \$180 million in fines for low-emission zone violations. The industry will also need to contend with fines for parking violations. Collectively, these charges are projected to account for approximately 9% of delivery costs in London and 12% of delivery costs in Seoul.

FIGURE 2 | Impact in business-as-usual scenario



Notes: This data is derived from modelling conducted as part of this paper or is based on publicly available information. For more on this, please visit <https://initiatives.weforum.org/global-new-mobility-coalition/urban-deliveries>

Source: Accenture City Archetype Framework – “Do Nothing” Scenario

2 How the delivery ecosystem is embracing change

The delivery ecosystem is already innovating to adapt to the challenges of an evolving logistics landscape.

2.1 Ecosystem stakeholders

The whole delivery ecosystem can influence city outcomes, starting with retailers and their customers. The logistics industry plays a significant role, but other partners, including original equipment manufacturers (OEMs) and technology companies, also drive change. Often, stakeholders assume multiple roles. City governments

establish the framework within which the value chain operates and thus have an important convening role.

This paper emphasizes the role of city governments, retailers and logistics operators – specifically those involved in the last mile.

FIGURE 3 Last-mile ecosystem map



Source: Accenture Last-Mile Ecosystem Stakeholder Mapping

2.2 Retailers and their customers

“ A significant transition to EVs and micromobility is under way, especially among larger organizations.

Innovative delivery solutions

Retailers are already adopting innovative solutions to improve efficiency and sustainability. A significant transition to EVs and micromobility is under way, especially among larger organizations. Companies such as Amazon and Ingka Group (IKEA's largest retail franchise operator) are leading the decarbonization of last-mile deliveries by adopting EVs. IKEA is also investing in inner-city stores to reduce the distance of travel for customers. These stores serve as microhubs for fulfilling orders.

Cargo bikes and on-foot deliveries are increasingly being used in densely populated areas where motorized vehicle access is challenging.¹⁷ For example, Ingka Group has already implemented small low-emission vehicles for city deliveries and is trialling the use of the River Seine for last-mile logistics.¹⁸ Quick-commerce delivery models have also surged and many journeys originate from inner-city dark stores, shops and restaurants, making up a growing proportion of traffic. In many cities, quick commerce uses two-wheel modes such as e-bikes and e-mopeds, which mitigate emissions but still contribute to traffic and can pose safety concerns.

Large variations in action are evident between regions and companies. Some businesses are proactively driving the transition, while others are limiting their action to basic compliance with mandatory rules. Company culture, affordability and profitability are

influencing retailers' ability and willingness to enact change, particularly given the high upfront costs of developing and implementing new solutions. This demonstrates the importance of legal and regulatory frameworks to create incentives for change.

Engaging the supply chain

Many retailers rely heavily on third-party logistics operators for order and inventory management as well as deliveries. Therefore, retailers do not always control outcomes in terms of their impact on congestion and carbon emissions.

However, many retailers are actively driving the sustainability agenda. Ingka Group, for example, is setting sustainability requirements for its delivery partners and is supporting its SME supply chain by providing electric vehicles. This is giving some smaller businesses the opportunity to deploy zero-emission vehicles without the need for large capital outlay, effectively providing a financing solution.

Some quick-commerce businesses are also supporting their workers with competitive financing options for zero-emission vehicles. There are, however, challenges related to the short-term and part-time nature of many of the jobs created, which means investment decisions do not always prioritize long-term sustainability. The regulatory framework therefore plays a crucial role in creating incentives for the introduction of more sustainable delivery modes.¹⁹

BOX 2 IKEA – supporting fleet electrification in its supply chain

IKEA is exploring new business models to ensure all deliveries are zero-emission. One of these models involves investing in its own fleet and partnering with small and medium-sized enterprise (SME) transport providers to operate the vehicles. Without this investment, the SMEs could not make the transition to EVs themselves.²⁰



BOX 3 | Wolt – creating incentives for the EV transition by delivery partners

Wolt, a quick-commerce grocery delivery business, has introduced 17 sustainable vehicle types and is conducting pilot projects to gauge their suitability in different markets. The company has implemented a leasing and financing programme in partnership with financial institutions to help its courier partners access modern, zero-emission vehicles and reduce emissions from deliveries.²¹

Customer engagement

As retailers look to improve the efficiency of deliveries, speed can sometimes be compromised to allow for greater consolidation. However, communicating the benefits of this to customers is

crucial. Swiggy, a food delivery company in India, offers an eco-saver delivery option where orders are grouped. While the time to deliver the food increases marginally, customers are compensated via a discount and the company reduces the number of trips and increases delivery partner income.²²

2.3 | Delivery companies

“ There are regional differences, but industry is already investing in technology to electrify, consolidate, re-time and optimize routing of delivery vehicles.

National postal operators are increasingly finding themselves competing with courier, express and parcel (CEP) businesses due to the decline in letter volumes and the surge in package deliveries. Companies such as the Royal Mail in the UK are also more involved in delivering larger, bulky items that customers previously purchased in traditional stores and transported themselves.²³ IKEA's new retail strategy, for example, involves inner-city showroom stores that hold less inventory. Home deliveries are then often conducted using bigger vehicles, which can face operational challenges due to local regulations.²⁴

There are regional differences, but industry is already investing in technology to electrify, consolidate, re-time and optimize routing of delivery vehicles. Microhubs and PUDO networks are also part of this strategy. Investment in these areas is set to continue despite the high capital costs involved.²⁵

Fleet electrification

A key investment area is fleet electrification, particularly for last-mile deliveries. Although capital-intensive, it is easier to implement than solutions requiring extensive external collaboration. Legislation, where it exists, creates incentives for

the shift from internal combustion engine (ICE) vehicles, simplifying compliance. Larger CEP businesses and new players typically have the capital for this transition, while smaller operators may need additional support.

Despite some supply-side delays, CEP businesses such as DHL and retailers such as Ingka Group are working with OEMs, including Renault and MAN, to bring custom zero-emission fleets to market.²⁶ Automotive manufacturer Hero MotoCorp and EV rental service Vammo support EV adoption by addressing high capital costs through financing options²⁷ and range challenges with battery-swapping technology,²⁸ while Evolectric converts existing ICE fleets to EVs at about 50% of the cost of new medium-duty EV trucks.²⁹

A major barrier remains the availability of fast-charging infrastructure, but progress is evident in many cities. Amazon's CHALET tool to identify suitable charging locations³⁰ exemplifies industry collaboration. Hero MotoCorp is also collaborating with other OEMs to establish an interoperable fast-charging network for micromobility fleets, operating in more than 100 Indian cities. However, significant investment in zero-emission fleets and charging infrastructure is still required from both the private and public sectors.

BOX 4 | Hitachi ZeroCarbon – integrated and shared energy hubs

Hitachi ZeroCarbon is revolutionizing EV charging for fleet management by partnering with fleet operators to develop decarbonization strategies that transition traditional depots to efficient electric hubs. These hubs use data and AI to optimize charging schedules and reduce strain on local energy grids, substantially reducing the cost of grid upgrades. Depots that can generate and store energy efficiently can also generate additional revenue streams by making these spaces available to last-mile operators.³¹



Pick-up and drop-off (PUDO) Networks

PUDO networks, including parcel lockers and shops, are increasingly seen as an alternative to home deliveries. This strategy boosts first-time delivery success, with consignments often redirected to PUDO points, allowing for local pick-up. This approach minimizes travel distances and decouples courier and customer schedules.

PUDO networks consolidate drop-offs and reduce the amount of time delivery vehicles spend on the road, enhancing efficiency. Major companies such as DHL, DPD, FedEx and Amazon have established proprietary parcel lockers. However, open parcel locker networks, such as those by InPost and Posten, are also gaining traction, especially in Europe. These carrier-agnostic (or white-label) lockers support delivery businesses without their own networks. DHL's OneStopBox in Germany is an example of this trend.³²

Despite high capital costs and logistical challenges – including access to real estate, permits, maintenance and optimal operational usage – parcel lockers are popular with both companies and customers.³³

Urban microhubs

Microhubs are compact warehouse spaces situated in urban areas, including inner-city locations. These are increasingly deployed to support alternative operating and business models.

Consolidation and cross-docking

Many CEP operators are adopting microhubs to support last-mile operations, including for the transfer of consignments (known also as cross-docking) to micromobility alternatives and walking for the last part of the journey. Walking and cycling are among the most efficient delivery modes in congested urban areas, assuming the appropriate cycling/pedestrian infrastructure is in place.

For example, DPD is investing in a London network, including a £40 million eco-regional sorting centre

and smaller depots, using electric vans and micro-vehicles.³⁴ The KoMoDo project in Berlin, a collaborative urban logistics hub shared by five operators, saved more than 11 tons of CO₂ in one year by delivering 160,000 parcels via e-cargo bikes.³⁵ Similar pilots are ongoing worldwide, from Yokohama to Montreal to Paris.³⁶

Consolidation centres, which combine deliveries from multiple operators into a single trip, are less common. Although they reduce trip numbers, participation is low, as established operators prefer control over end-to-end delivery for efficiency and customer experience. These centres often rely on subsidies due to challenging unit economics. However, rising operational costs from road-use charges, low-emission zones and non-compliance penalties may improve their commercial viability in the future. In the Regent Street area of London, located in a low-emission zone, a single operator runs a delivery consolidation service to major retailers. This initiative has cut congestion in the area by 92% since 2008.³⁷

Where real estate is unavailable, trucks can serve as alternative microhubs. In New York, UPS uses trucks parked in designated kerbside areas to offload packages to cargo bikes for the final stretch, reducing large vehicle movements and improving efficiency. Amazon also partnered with the RATP public transport network in Paris to use bus depots during the day as microhubs for cargo-bike deliveries.³⁸

Dark stores

Microhubs, in the form of dark stores, are also used for warehousing, order fulfilment and dispatching of some e-commerce orders, especially for quick-commerce models and groceries. These dark stores allow for near-instant delivery, operated by companies such as Gopuff.³⁹ However, this operating model has faced a backlash in some cities due to noise and disruption in residential areas, leading to closures and bans in some European countries.⁴⁰ Difficult unit economics are also contributing to the ongoing restructuring of this industry segment.

“ PUDO networks consolidate drop-offs and reduce the amount of time delivery vehicles spend on the road, enhancing efficiency.

2.4 City government interventions

“ City-led initiatives, such as zero-emission zones and shared charging infrastructure, must complement private sector-driven efforts such as electric fleets, e-bikes and parcel lockers.

Many city governments are focusing on decarbonizing and decongesting transport. Road space is being reallocated to prioritize cycling, public transport and public spaces. Meanwhile, demand for road space from delivery vehicles is increasing. Local and regional governments are responding by influencing delivery practices through regulation, infrastructure, kerbside management and other incentives.

Regulation

City governments are increasingly using road-user charging to manage inner-city traffic, targeting congestion, emissions or both. These schemes vary, often based on vehicle size or emissions. For example, Transport for London's Congestion Charge overlaps with Low Emission Zones (LEZ) and Ultra Low Emission Zones (ULEZ).⁴¹ Europe has more than 320 LEZs,⁴² while cities such as Oslo and Kyoto have implemented road-user charging.⁴³ Some cities, including Santa Monica and Shenzhen, are planning or have already implemented Zero-Emission Zones (ZEZ) as extensions of LEZ schemes.⁴⁴

Other methods, such as low-traffic neighbourhoods or localized pedestrian zones, aim to limit vehicle access, including for delivery vehicles. Low-traffic neighbourhoods prioritize pedestrians and cyclists and offer easy public transport access, as seen in London and Barcelona,⁴⁵ while localized pedestrian zones are widespread throughout the world. In Detroit, the city government enabled fast-tracked planning permissions for logistics pilot projects to speed up innovation in last-mile deliveries. This approach allows for quick learning and implementation while maintaining an emphasis on inclusivity and safety.⁴⁶

Infrastructure

City governments are enhancing infrastructure to support last-mile operations while aligning with broader goals. Many are partnering with the private sector to create multi-tenant microhubs (see Section 2.3). Expanding fast-charging infrastructure for EVs is a priority, with many

governments offering incentives for deployment of charging points. In Shenzhen, 26% of logistics vehicles are electric, with local authorities aiming to expand EV adoption and provide charging points at scale.⁴⁷

New infrastructure can be costly and require permits, causing delays. Reusing existing infrastructure can mitigate these costs. Waterways are being explored as alternatives to road transport for last-mile deliveries. DHL and UPS are piloting this in London and New York, using waterways for the mid-mile and zero-emission vehicles/bicycles for the final leg.⁴⁸ Supported by the Port of London Authority, DHL removes 200,000 trucks from London's roads annually through river freight.⁴⁹

Similarly, Oslo collaborated with car manufacturers and infrastructure providers to establish a robust network of EV charging stations.⁵⁰ City-led initiatives, such as zero-emission zones and shared charging infrastructure, must complement private sector-driven efforts such as electric fleets, e-bikes and parcel lockers. Involving stakeholders from the project definition stage is critical to success.⁵¹

Kerbside management

Kerbside management effectively redistributes urban space and mitigates issues such as double parking by delivery vehicles. One study of commercial vehicle traffic in Seattle indicates that circling while searching for a parking space adds an average of 2.3 minutes to each delivery.⁵² Kerbside management strategically allocates space for efficient use by various stakeholders, including dedicated zones for deliveries, ride-hailing PUDO, waste collection and bicycle/scooter parking. Smart kerbside management further enhances this by dynamically repurposing kerb space based on demand. In New York City, smart kerb technology is being introduced to meet the growing demand for deliveries, waste collection and new transportation modes such as e-bikes and scooters.⁵³ Key considerations for developing smart kerbsides include data integration, enforcing compliance, managing competing priorities for space, and technology infrastructure costs.

BOX 5 Dynamic kerbside management

Impact on Urban Health and Grid Smarter Cities piloted the innovative Kerb-Dock project in partnership with the London Borough of Southwark. The initiative looked at a dynamic kerbside management system to allocate and share space in congested areas among multiple users through a bookable system. Grid Smarter Cities believes they will find this more cost-effective than the annual charge for parking tickets and will also benefit from increased reliability of deliveries. In the areas in which the scheme has already been rolled out, delivery firms have experienced a 21% efficiency saving in their last-mile deliveries to urban areas. This is alongside a 6.6% reduction in nitric oxide and nitrogen dioxide (NOx) emissions from all road transport, a 5.8% reduction in fine particulate (PM2.5) emissions and a 4.6% fall in carbon dioxide (CO₂) emissions.⁵⁴

“ By sharing real-time data on traffic conditions and delivery schedules, stakeholders can optimize space and improve delivery efficiency.

Creating incentives

Many local and national governments offer incentives to promote zero-emission vehicles. Countries such as China, Germany, France, the United Kingdom, Canada, the United States and the Netherlands lead in creating incentives for the development of electric fleets for last-mile delivery.⁵⁵ Financial institutions also support these initiatives. Zenobē, a UK electric fleet provider, secured £410 million for fleet electrification from investors such as Aviva, Scottish Widows and Société Générale.⁵⁶ Creating incentives for EV uptake and the installation of charging infrastructure requires significant investment, often benefiting larger companies. Ensuring equity is essential if smaller companies are to gain from these programmes.⁵⁷ The city government in Delhi offers subsidies and discounted financing to delivery service providers and e-commerce organizations for the EV transition, as it has mandated a transition for such fleets to EVs by early 2030.⁵⁸

Cross-industry collaboration and data sharing

Cross-industry collaboration and data sharing require coordination among public authorities, private companies and research institutes to align urban logistics efforts. The ColisActiv' programme in France subsidizes bike and foot deliveries in exchange for route data to support local infrastructure investments.⁵⁹ By sharing real-time data on traffic conditions and delivery schedules, stakeholders can optimize space and improve delivery efficiency. Rotterdam's local government has committed to actions based on data-led private-sector recommendations, including a zero-emissions zone.⁶⁰ Another initiative includes an urban consolidation centre in Madrid.⁶¹ The main challenges to effective collaboration are trust, governance and stakeholder empowerment.⁶²

BOX 6 Rotterdam's public-private collaborative forum

Rotterdam's Logistiek 010 community is comprised of almost 3,000 logistics companies, government, knowledge institutions and educational bodies, which are working together to remove inefficient journeys and reduce congestion in the city. Together, they have implemented a zero-emissions zone for logistics vehicles, starting in 2025.⁶³



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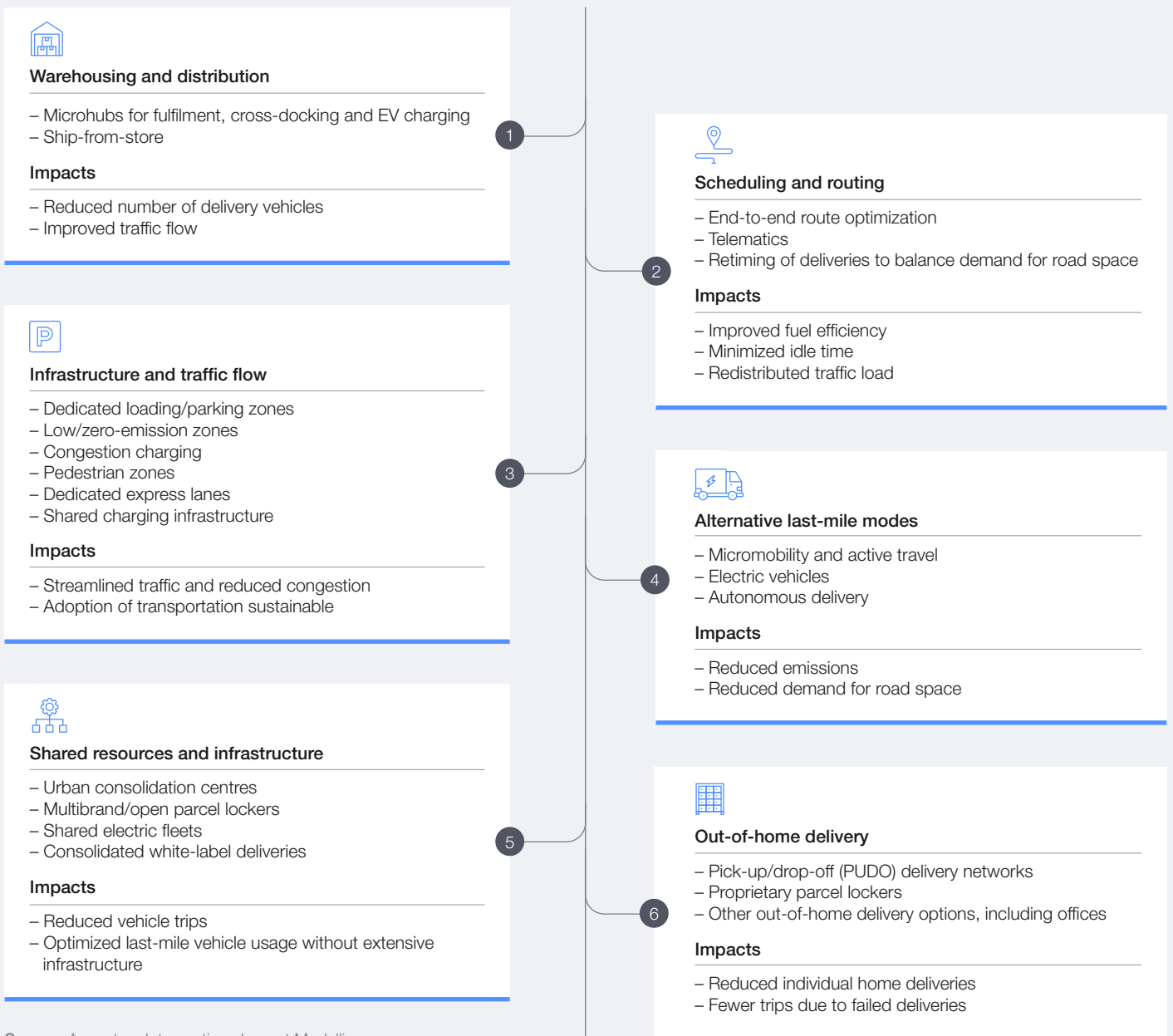
Potential areas of intervention

Last-mile delivery can be transformed through holistic ecosystem innovation, powered by data and collaboration.

The previous section set out some of the solutions being adopted to address the negative impacts of last-mile delivery (summarized in Figure 4, covering the stages of the value chain). This section builds upon this by modelling the potential impact of select

interventions on reducing emissions and congestion as well as considerations such as the economic benefits. Contextual considerations regarding the potential impact of these solutions are first set out in Section 3.1.

FIGURE 4 Market map of possibilities



Source: Accenture Interventions Impact Modelling

3.1 Enabling framework and conditions

“ Replacing ICE vans with EVs could reduce carbon emissions by up to 85%.

The effectiveness of last-mile delivery interventions varies significantly depending on the geographical, political, economic and social contexts.

Micromobility solutions such as e-bikes and scooters may suit high-density areas but may not work well over the larger distances that need to be covered in sprawling cities. Similarly, the availability of land for logistics applications and cycle infrastructure will determine the optimal combination of interventions. Topography and weather also affect the adoption of solutions that feature cycling and walking.

Political factors, regulations and policies can accelerate or hinder the adoption of solutions. The ability to invest in infrastructure such as EV

charging or cycle lanes is also essential to enable these interventions. Economic factors, including affordability and market competition, affect the cost and speed of implementation. In regions with limited capital or less competition, the roll-out of solutions such as EV fleets and parcel lockers may be slower.

Finally, public perception and social norms play a significant role. In areas or communities in which sustainability is a mainstream concern, there is often greater acceptance of interventions such as EVs and e-bike deliveries. In contrast, communities with deeply ingrained practices may resist such changes as using PUDO points instead of home deliveries. Public support is essential for these solutions to succeed.

3.2 Impact of solutions

Modelling interventions offer valuable insights into their impacts on the last-mile delivery landscape. The most impactful interventions identified through modelling are highlighted in this section. The model focuses on the effects on delivery costs, number of delivery journeys, congestion and carbon emissions – the areas of impact most critical to the delivery ecosystem. The six city archetypes provide some nuance to a global challenge, and the outcomes of interventions have been assessed using these.

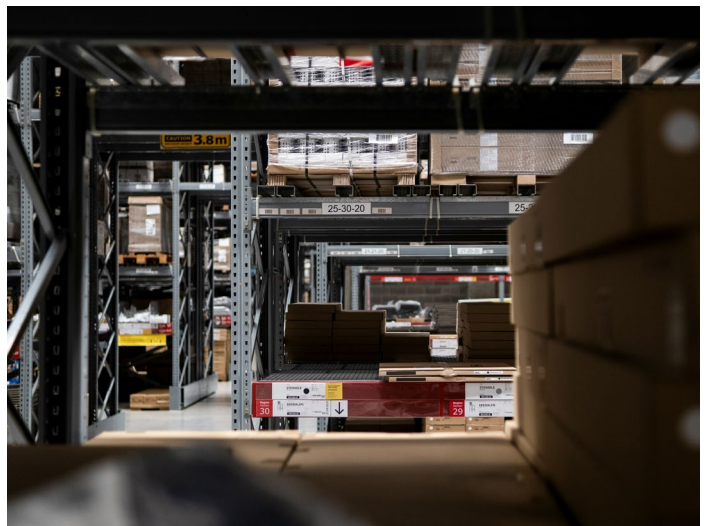
Zero-emission zones can help accelerate the environmental benefits of a transition to EVs

Replacing ICE vans with EVs could reduce carbon emissions by up to 85%. Switching from ICE two-wheelers to e-bikes in cities could cut carbon emissions by 90% and last-mile delivery costs by 22%. Introducing zero-emission zones in city

centres can accelerate the transition to clean fleets, achieving carbon savings of up to 55% citywide. With supporting infrastructure such as charging points and cycle lanes, these measures can significantly reduce environmental impacts.

Single-operator microhubs for cross-docking can unlock new efficiencies

Couriers' use of their own microhubs near consumers enables fewer, shorter, zero-emission deliveries. When the microhub also dispatches deliveries using zero-emission two-wheelers or limited-range vehicles, this can lower carbon emissions by up to 93% and reduce congestion by up to 11%. Cross-docking facilities allow couriers to access areas that exclude motorized four-wheelers, making the journey to customers more efficient.



☞ **White-label deliveries can reduce the number of journeys by 30% and cut total delivery costs by 51% when combined with the use of e-bikes and other zero-emission micromobility modes.**

White-label deliveries, combining urban consolidation centres and microhubs, can substantially reduce the number of trips

White-label deliveries, where one courier takes responsibility for the last-quarter-mile in a defined area, can reduce the number of journeys by 30% and cut total delivery costs by 51% when combined with the use of e-bikes and other zero-emission micromobility modes. This allows customers or businesses to receive packages from multiple retailers and couriers in a single delivery and substantially reduces the number of vehicles operating in a specific area.

PUDO networks reduce the total number of trips

PUDO networks (parcel lockers and shops) offer a form of consolidation and reduce the number of failed first-time deliveries. PUDO points can reduce the number of delivery trips by up to 15% and reduce congestion by up to 2%, even when considering trips made by customers to collect their

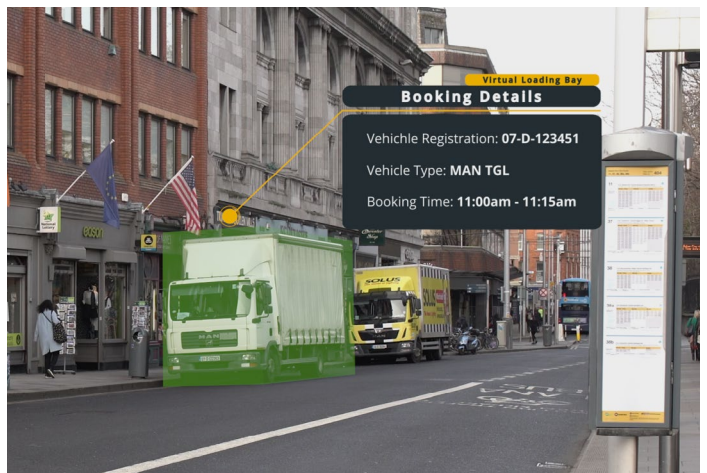
items. They can also reduce the cost of deliveries by up to 15%.

Autonomous delivery for congestion relief

Autonomous delivery, both aerial (UAVs) and ground (AUGV) vehicles, have the potential to reduce congestion. UAVs, which use airspace for delivery of smaller items, could reduce congestion by 9–13%, while AUGVs can be operated off-road and in pedestrianized areas.

Smart kerbside management can help reduce congestion

As parcel volumes grow, the number of delivery vehicles on the road increases, leading to parking challenges for couriers. This results in high idling times, exacerbating congestion and emissions. Smart kerbside management can optimize existing kerbside and parking spaces. Strategically planned delivery parking zones can reduce congestion by 3% and carbon emissions by 9%.



Despite the substantial benefits, several challenges need to be addressed for these solutions to reach their full potential. Many of these solutions – such as EVs, microhubs and parcel lockers – involve high upfront costs as well as the installation of infrastructure. While parcel lockers reduce delivery journeys, they could unintentionally increase emissions if customers drive to pick up their parcels.

White-label delivery models often rely on subsidies due to challenging unit economics, although this may change over time. Lack of enabling regulation is currently the biggest blocker for deployment of autonomous vehicles, but the technology also needs further development to provide the necessary capability and ensure public confidence.

4

Recommendations

City governments should take an active role, but each player in the ecosystem needs to play its part.

Every city's transformation journey is unique, and cities have evolved to varying levels of maturity and readiness in terms of transport infrastructure and logistics planning. Consequently, the optimal strategies for each city depend on its specific circumstances. The recommendations in this section are presented as a guide to be considered alongside city governments' own assessments of their unique context.

Additionally, the recommendations in this white paper should be viewed from the perspective of the changes in behaviour required to create less congested, more sustainable and more liveable cities that can thrive economically. For example,

local PUDO pick-up deliveries could reduce the number of vehicles on the road if consumers accept such a change of location and are prepared to pick up their parcels through sustainable modes; this is an area where e-commerce retailers can influence and educate their consumers.

The recommendations below are structured around key themes. Some are more strategic, others more tactical. Each recommendation is attributed to a principal theme, but the interconnected and complex nature of the urban environment and the required interventions means that the impact will inevitably also extend across multiple other themes.



4.1 Recommendations for city governments

TABLE 1 Checklist for city governments

Themes	Recommendations checklist
Strategy roadmap	<ol style="list-style-type: none"> 1. Integrate logistics into urban planning by addressing industry needs in master plans, guided by a sustainable urban logistics plan (SULP). Include space for microhubs and EV charging and create incentives for industry collaboration. 2. Develop and communicate the city's EV transition strategy and vision. Work closely with industry and form relevant working groups.
Regulatory standardization	<ol style="list-style-type: none"> 3. Develop clear, standardized and practical logistics rules, covering last-mile operations, kerbside use and micromobility. These should be harmonized between city government departments, across city governments and at national level where possible. 4. Promote a collaborative environment for innovation and investment by creating an appropriate framework. Allocate resources to support the private sector in navigating regulations and expediting planning processes, especially for emerging technologies. 5. Share global best practices to speed up the implementation of initiatives. Use other cities' experiences and allocate dedicated resources in support of this effort.
Collaboration	<ol style="list-style-type: none"> 6. Allocate public space for logistics, including charging stations, parcel lockers and microhubs. Work with city departments and private landowners to identify suitable locations. 7. Ensure widespread installation of EV charging facilities. Consider partnering with charging-point operators to install stations at appropriate scales for EV adoption. 8. Facilitate safe and beneficial data sharing between the public and private sectors. Consider implementing data platforms that protect sensitive data and offer collective insights, possibly as a condition of kerbside access. 9. Create conditions for innovation and the implementation of test projects. Consider building co-creation labs and convening stakeholders around specific challenges.
Emissions	<ol style="list-style-type: none"> 10. Create incentives for micromobility and on-foot modes. Consider designating low-traffic neighbourhoods and zero-emission zones, limiting vehicle access and providing sustainable alternatives. 11. Make zero-emission fleet adoption financially viable. Consider using tools such as road-user charging discounts, purchase subsidies, favourable loans and contracts for difference (CFD).
Safety	<ol style="list-style-type: none"> 12. Ensure safe environments for on-foot and micromobility deliveries. Consider investing in segregated cycle infrastructure and providing clear rules on the use of public space. 13. Maintain high safety standards for all road users. Consider reviewing legislation, engaging with national government and standardizing safety approaches. 14. Improve logistics-fleet safety standards. Consider implementing a safety accreditation scheme for motorized and micromobility fleets, standardized across cities.
Infrastructure development	<ol style="list-style-type: none"> 15. Enhance kerbside management to meet delivery needs without disrupting traffic. Consider adding loading capacity and using digital solutions to manage space based on real-time demand, prioritizing zero-emission vehicles. 16. Assess non-road transport capacity. Consider delivery pathways such as rivers, canals and UAV air corridors and the necessary policies for private-sector use. 17. Provide transparent data on charging infrastructure. Consider using a citywide open-source platform to map infrastructure and pricing and to match EV charging-point infrastructure supply and demand. 18. Ensure visibility of the urban delivery landscape. Consider using a data platform to analyse citywide deliveries to support enabling infrastructure investment decisions.
Technology	<ol style="list-style-type: none"> 19. Optimize transport network operations in real time. Consider using digital twin technology to predict traffic flows and plan scenarios, offering geospatial data to help last-mile operators navigate restrictions.

4.2 Recommendations for retailers and delivery companies

TABLE 2 Checklist for retailers and delivery companies

Themes	Recommendations checklist
Operating models	<p>20. Balance demand for road space from last-mile operations against availability. Reschedule deliveries to off-peak and overnight periods where feasible.</p> <p>21. Prioritize suppliers with sustainable practices. Make sustainability a contractual requirement, offering support and incentives as needed.</p> <p>22. Reduce duplication and industry footprint by sharing resources. This may include fleets, charging infrastructure, PUDO networks and cross-docking microhubs.</p> <p>23. Assess and transform retail models and the supply chain to reduce emissions and congestion. Explore operating models that increase the focus on sustainability and the liveability of cities, balanced against consumer needs.</p>
Collaboration	<p>24. Invest in EV charging and battery-swapping infrastructure. Make the most of partnerships with charging-point operators and city governments.</p> <p>25. Collaborate with city governments to access and optimize land use. Take a data-led approach to situating microhubs, charging stations, parcel lockers and loading areas.</p> <p>26. Support open innovation to drive city-specific solutions. Collaborate with local research labs to develop city-specific solutions.</p> <p>27. Enhance the availability of transport data. Develop a deep understanding of public-sector needs on data and collaborate with local authorities.</p>
Emissions	<p>28. Prioritize zero-emission delivery vehicles and phase out ICE fleets. Consider converting legacy ICE fleets to electric.</p> <p>29. Use advanced technology for route optimization. Use real-time vehicle tracking and telematics to improve fleet management.</p> <p>30. Use financial support from governments for EVs and charging infrastructure. Explore tax incentives and low-interest loan programmes targeting the transition to EVs.</p>
Congestion	<p>31. Prioritize micromobility modes for last-quarter-mile deliveries to reduce emissions and congestion. Options to consider include cargo bikes and on-foot delivery.</p> <p>32. Invest in microhubs for cross-docking, consolidation and charging of microfleets. Microhubs could be proprietary or shared, dependent on individual circumstances.</p> <p>33. Offer out-of-home consolidated delivery options. Use proprietary or open PUDO networks to reduce last-mile journeys.</p>
Awareness	<p>34. Provide information to retail customers on sustainable delivery choices. Provide Incentives for slower, consolidated and off-peak deliveries.</p> <p>35. Implement a customer portal for specifying delivery preferences. Sustainable and efficient options should be promoted. Consider collaborating on the portal with other delivery businesses.</p>



4.3 Role of the wider ecosystem

To maximize changes to the urban delivery landscape, wider ecosystem stakeholders need to act. This includes technology companies,

OEMs and financial providers, who can help tackle challenges in logistics, such as fleet electrification, optimized operations or consolidations.

TABLE 3 Checklist for other ecosystem stakeholders

Ecosystem player	Recommendations checklist
OEMs	36. Develop custom vehicles for urban delivery needs. Collaborate with businesses to create safe, sustainable and efficient designs for urban areas.
Technology companies	37. Develop enabling industry solutions for retailers and last-mile operators. Partner with industry and city governments to develop technologies for real-time data, kerbside management, vehicle-to-infrastructure communication, customer engagement and digital twin simulations.
Financial organizations	38. Promote zero-emission delivery vehicles, including micromobility. Offer financial products such as favourable loans, insurance and lease options to offset high capital costs. 39. Provide affordable funding for sustainable delivery infrastructure. Offer green bonds for charging stations and other energy transition solutions.

Conclusion

The challenges of last-mile logistics are significant, but the opportunities to create more efficient and sustainable delivery systems are within reach.

Ecosystem stakeholders need to embrace **data and technology, innovation and collaboration** as the three strategic pillars that will enable change and ensure that urban logistics contribute to, rather than detract from, the liveability and sustainability of cities.

Role of city governments

City governments play a pivotal role in promoting sustainable last-mile deliveries. Their responsibilities include:

- **Strategic planning:** Ensuring that the needs of the logistics industry are an important consideration in urban planning to enable alternative operating models.
- **Regulation and safety:** Regulating the use of public infrastructure by last-mile operators to ensure that their services enhance city safety and liveability.
- **Promoting innovation:** Developing shared infrastructure and making space available to pilot logistics projects. This can be achieved by assigning dedicated functions to logistics and streamlining regulations and policies that support the rapid adoption of new pilots, thereby levelling the ecosystem playing field.
- **Facilitating data and knowledge-sharing:** Encouraging data and knowledge-sharing between ecosystem stakeholders to enhance collaboration and efficiency.

Private-sector initiatives

Private-sector stakeholders should focus on adopting initiatives and operating models that help to reduce emissions and the distances driven. The main strategies include:

- **Operational adjustments:** Rescheduling deliveries to balance demand for road space, using cross-docking, collaborating with environmentally responsible logistics providers and sharing resources with other businesses.
- **Collaborating with the public sector:** Engaging in data integration, innovation and infrastructure development with public-sector organizations.
- **Investments in infrastructure:** Investing in microhubs and parcel lockers to streamline operations and further cut congestion and carbon emissions.
- **Transitioning to electric vehicles:** Collaborating with OEMs in the supply chain to develop fit-for-purpose electric fleets and making EV use a requirement in third-party contracts where practical.

Despite the positive impact of these initiatives, their effectiveness will ultimately depend on the archetype of the city, as well as the relevant geographical, cultural, economic and political factors. Interventions will need to be prioritized according to local challenges, goals and available resources to be successfully implemented. City governments and private-sector stakeholders should be mindful of these local contexts and prioritize interventions that help accelerate the sustainable transformation of the urban delivery landscape.

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Endnotes

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