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Preface



At the time of writing, we are in the middle of the Covid-19 pandemic. Along with many other impacts, this crisis has exposed the importance of the logistics sector. Faced with increased demand and bigger challenges, logistics professionals have managed to keep supply going. I have deep appreciation for their skill and dedication.

Something else that we've all noticed: skies are bluer and the air is cleaner. This inspires us to build back better, to build a more sustainable transport system. Companies are looking for new business models. Cities are rapidly changing to encourage cycling and walking. Many cities have announced zero-emission zones.

Yet green freight still has a long way to go. It is my ambition to change that, given the great potential for and benefits of zero-emission freight. Benefits include healthy, liveable and accessible cities, and a decrease in greenhouse gases as well. I emphasise the title of this guide: Don't wait to start with freight. It's a very efficient, cost-effective and necessary step. Trucks account for only 2% of vehicles on the road—yet they are responsible for 22% of road transport CO₂ emissions in the EU.

In the Netherlands, we aim to have a ZEZ-zone in 30-40 larger cities by 2025.

Greening logistics requires more than replacing fossil fuel-powered vehicles with zero-emission vehicles. We also need new strategies, new forms of cooperation – like consolidating multiple freight streams at the edge of a city and subsequently moving them to destinations with smaller, zero-emission vehicles, including cargo bikes.

The aim of the Transport Decarbonisation Alliance is to build an international network of cities and regions, countries, and companies who develop and exchange knowledge on all these issues and who work together to further green transport worldwide.

With this guide, we wish to extend a helping hand to these partners by sharing the experience of ZEZ-F pioneers and showcasing the enormous potential of zero-emission freight.

I hope the guide inspires every reader.



Stientje van Veldhoven

Minister for the Environment of
The Netherlands and Chair of the
Transport Decarbonisation Alliance

Executive Summary

The Need for Zero-Emission Zones for Freight

More than half the world's population now lives in urban areas, and cities continue to grow. The current freight system intensifies many urban challenges: congestion, traffic safety, noise pollution, air pollution, and greenhouse gas emissions. Yet too often city planners and transportation officials overlook the impact of freight.

As cities around the world seek to reduce their carbon footprint, many are now devising zero-emission zones (ZEZs) for mass transit and personal mobility. But while urban freight produces a substantial share of pollution and CO₂ emissions, few cities and countries have developed a vision and implementation pathway specifically for the freight sector.

Zero-emission zones for freight (ZEZ-Fs) are areas in cities where only zero-emission delivery and freight transport vehicles may enter. ZEZ-Fs can make significant contributions to the urban environment.¹ They can help cities achieve important goals including less congestion, cleaner air and lower greenhouse-gas emissions. Developing ZEZ-Fs can also provide a clear signal to vehicle makers to accelerate the mass production of zero-emission freight vehicles.

The many benefits of ZEZ-Fs lead transport-decarbonization frontrunners to say: Don't wait to start with freight!

Toward a Successful ZEZ-F: Steps for Action

Devising a ZEZ-F is a complex process involving many stakeholders. The following steps are proving helpful in getting buy-in and approval for these zones. The order may vary from city to city, and most will proceed in an iterative and cyclical process.

Build trust with stakeholders throughout the broad freight community

Owners and operators of freight vehicles range from multinational companies to sole-proprietor shops, from tradespeople to professionals providing repair and maintenance services. Freight vehicles include long-haul trucks, delivery and service vans, construction vehicles, waste and street-cleaning vehicles, even cargo bicycles and other "last-mile" solutions.

Understanding the needs, challenges, and interests of the various sub-communities is key to enabling collaboration and devising effective rules and incentives regulating ZEZ-Fs.

Clarify your city's objectives and regulatory powers

Each city's ZEZ-F will be unique—the size, shape, and management depending on the city's vision, the stakeholders and the authority governing it. Goals vary but commonly include:

- Meeting decarbonisation targets
- Reducing air and noise pollution hotspots to improve equity and health for disadvantaged communities
- Lowering congestion and improving efficiency
- Creating green spaces
- Developing more liveable neighbourhoods throughout the city, and
- Stimulating demand for zero-emission freight vehicles, which will signal to manufacturers that now is the time to mass-produce zero-emission vehicles (ZEV).

In some regions, cities have limited powers to regulate vehicle access and may need to set up governance schemes in cooperation with local boroughs and/or regional and national government bodies to create and manage the ZEZ. Alternatively, cities can use additional powers such as kerbside management powers to achieve similar goals.

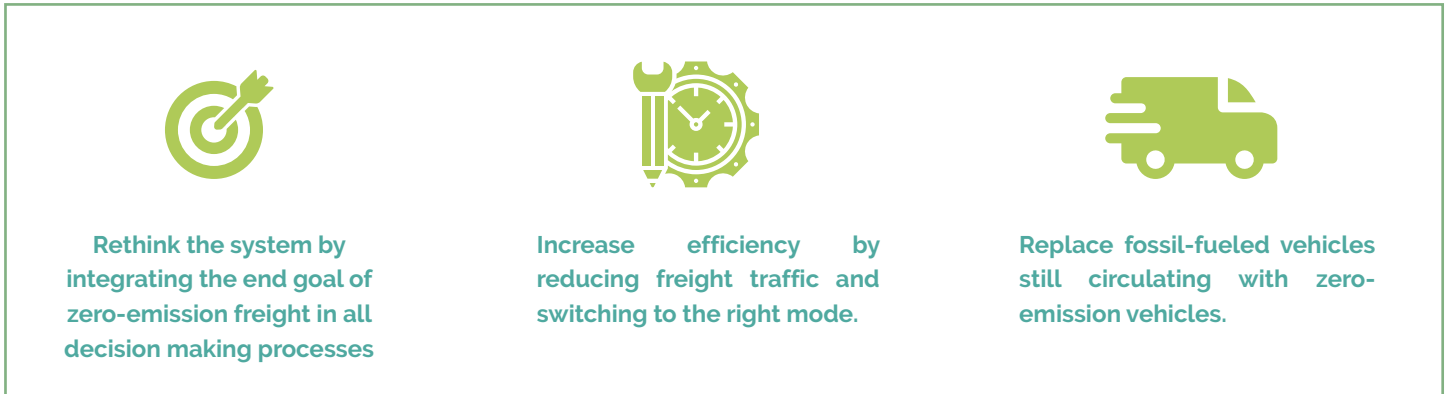
Set an ambitious but realistic target and timeline

Setting an ambitious but progressive and realistic timeline can help put ZEZ-F planning in motion and galvanise the interest of companies and other stakeholders. For instance, the 35 signatory cities to the C40 Green and Healthy Streets Declaration have each committed to implementing a major ZEZ by 2030. They are at work with local partners, who are able to develop clear timelines thanks to the target date. Some cities have set shorter timeframes: London, for example,² aims to implement local zero-emission zones from 2020 and a central London zero-emission zone by 2025. In the Netherlands, 30–40 cities³ will aim to implement ZEZ-Fs by 2025.

Develop an implementation strategy

ZEZ-Fs should not be seen as 'vehicle replacement' or 'one-size-fits-all' interventions. Rather, they can encompass a new way of seeing freight as a system. Objectives include reducing freight trips through enhanced efficiency and new collaborations; rethinking the way goods and services are transported; choosing the most appropriate transport mode; and making sure those transport modes are zero-emission.

Figure 1: ZEZ-F objectives



A ZEZ-F strategy might also be phased. The zone might launch by encompassing the central commercial district, then expand to a larger, mixed-use area within a few years, before reaching its full dimensions at an agreed later date. Partners beyond the freight community have a role to play in strategy design as well, to ensure that all voices are heard and impacts considered.

Test and pilot your desired interventions

Pilot projects allow stakeholders to define new collaboration schemes, test procedures and vehicles, and measure initial impacts—intended or not. Beyond providing data, pilots can build private-sector confidence in investing in zero-emission solutions and help companies make informed decisions about costs and savings.

“Logistics Living Laboratories” accelerate testing and piloting, and are spreading in European and North American cities. Their aim is to co-create and test effective and sustainable solutions on urban logistics in an ongoing and iterative process.

All stakeholders—public and private, policy, research, and industry—work together to streamline testing in real-life operations, and collect and analyse data for modelling and planning.

Implement, monitor, fine-tune...and enforce

Much will be learned about implementation, monitoring and enforcement of ZEZ-Fs as the first cities begin to implement them in the years ahead. Implementation will be specific to each city and zone, taking place in the context of extensive stakeholder consultation, with agreed timelines, key performance indicators (KPIs) and plans for monitoring.

Data collection and analysis by cities, in collaboration with stakeholders, is key to informing an evidence-based policy making process.

To facilitate compliance, cities should accompany enforcement procedures with accessible information about the rules.



Keys to Success

ZEZ-Fs exist within a large ecosystem of regulations, financial incentives, infrastructure investments, and other urban, regional, national and international plans and strategies. Therefore, city officials should be aware that factors both within and beyond city limits can significantly influence the success of ZEZ-F planning.

Align policies across different levels of government

Collaborating with neighbouring city, regional and national governments can facilitate ZEZ-F planning. Examples include establishing a common approach or common principles for the zones, as well as coordinating public outreach and other communications about the zones.

Such measures also create a predictability that helps companies make the business case for zero-emission solutions. Since many companies operate across multiple cities and neighbouring countries, common approaches and consistent implementation timelines allow them to plan and invest with greater confidence. Aligned policy and financial support can encourage uptake of ZEVs as well.

Create incentives and other supporting measures

Financial incentives can spur a shift to a more efficient logistics system that includes ZEVs, by reducing upfront vehicle costs or enabling lower operating costs for fleets and individual operators. Various countries have implemented national subsidies and incentive schemes, such as registration tax exemptions, tax deductions and a reduced rate on truck levies.

Non-monetary incentives can prove useful as well, by providing a competitive advantage for ZEV operators. Such incentives may include extended delivery time windows, preferential lanes or parking, or exclusive loading and unloading areas.

When defining the package of measures to support a ZEZ-F, it is important to note that there is no one-size-fits-all solution for freight. Dialogue with stakeholders is critical to identify the most effective measures for a particular locale.

Develop charging infrastructure for electric freight vehicles

Charging infrastructure for ZEVs is a major hurdle for many freight operators. A coherent, dedicated strategy needs to be developed in concert with logistics and charging-infrastructure operators. The strategy should take into account the specific needs of each category of freight, as well as the balance between public and private infrastructure.

Needs vary by both vehicle and business sector: small

business owners are likely to charge their vehicles at home, with only top-up charging needed in the cities; they can most likely use the charging infrastructure for passenger cars, when available. Fixed-route and other heavier trucks may need more power, provided at dedicated depots, in addition to fast charging in the city. Construction vehicles may best charge at their building sites.

Cities play a key role as facilitators, and can convene multiple stakeholders to ensure a charging infrastructure network that works for all classes of freight vehicles. Moreover, they need to harmonise their strategy with neighbouring municipalities on a regional level, since most (public) chargers are required where the van owners live and at the depots which will likely be located outside the ZEZ.

Some of the parties concerned and their roles include:

- Freight transporters assess and communicate what they need from the grid at their depot (e.g. where, how many vehicles, and for what use cases they would like to charge),
- Utilities, network and grid operators prepare the necessary grid capacity,
- Charge-point operators develop a business case,
- Municipalities and other public authorities convene stakeholders, adapt regulations and issue permits, and
- Land and building owners enable the installation process.

Obtain the necessary data

Data from the public sector, logistics operators, and other economic agents is needed to understand the main drivers of the logistics system. In practice, planners face huge gaps in the data they can access. Since they often rely on the private sector to provide such information, and companies may see it as proprietary, cities are experimenting with both mandates and incentives to obtain key data. Cities can make data sharing a requirement for access to zones or charging stations. Or, in exchange for installing an onboard data unit on vehicles, for instance, they can offer special access to parking areas or bus lanes, or extended hours for ZEZ access or other privileges.

At the same time, cities should clearly define the purpose for which they collect and analyse data, so as to entice the private sector to share them, and establish models to understand and interpret the data for an effective, evidence-based, policy-making process.

Cases of ZEZ-Fs in Planning and Implementation

Rotterdam: Zero-emission zone for freight in 2024



To improve air quality, the city and business community of Rotterdam have partnered for a local 'green deal' called "010 City Logistics". Over 600 parties are involved with this voluntary initiative. To also comply with national climate targets, Rotterdam is developing a binding ZEZ-F to launch in 2024.⁴ The city will first identify the location of the proposed zone, then engage with stakeholders by segment to address perceived challenges and how each stakeholder can address them. Segments include fresh food, construction, parcel, waste, services, retail and municipalities. The Rotterdam strategy is to find one "frontrunning" stakeholder per segment who is demonstrating the possibilities; to actively solve challenges as they arise; and then to move toward the mandatory phase.

The Netherlands: 30–40 cities to implement harmonized ZEZ-Fs by 2025



The Dutch National Climate Agreement requires the logistics sector to significantly reduce CO₂ emissions. One of the recommended tools is the implementation of ZEZ-Fs in the country's 30-40 largest cities. Cities who will establish a ZEZ-F will announce details of their ZEZ-F four years in advance to allow time to prepare for implementation.

The Netherlands has also developed nationally harmonized principles for zero-emission freight,⁵ including:

- New delivery vans and trucks bought after 2025 must be zero-emission if they are to enter any city with a ZEZ-F.
- Existing fossil-fuel commercial vehicles will be phased out (with the transition extended due to the Covid-19 crisis). The transition phase will end in 2027 for existing vans, and in 2029 for trucks (and even sooner for older vehicles like euro 5 vans).
- The government will offer tax incentives and subsidies between 2021 and 2025 to help companies transition to zero-emission vans and trucks.
- Cities can receive support from an "expert pool" to help identify key challenges for their specific city, create implementation plans, share learnings on a national level, and provide tools and support for the local decision-making process.



Shenzhen: Green Logistics Zones

Shenzhen⁶ was the first city to deploy a significant number of electric freight vehicles--over 77,500 by the end of 2019, representing more than a third of the freight fleet. The city's 10 "green logistics zones" are in operation and have proved effective. Rather than excluding conventional vehicles altogether, these zones offer ZEVs preferential treatment such as all-day access. The zones are sited in industrial and administrative areas as well as in some of Shenzhen's multiple city centres. None include main roads or highways. After stakeholders co-created criteria for the zone, boundaries were established based on emission hotspot data and modelling.

In China, the two main drivers for green logistics zones are:

- To curb growing air pollution in cities. Municipal governments are under pressure to drastically reduce harmful emissions, and freight vehicles are an efficient segment to focus on; and
- The desire to lead in the e-vehicles industry, which will give the country a competitive advantage in this developing global market. Although historically China has not prioritized vehicle production, the country has translated the rapid evolution of e-vehicles into a strong domestic industry.

These aims were enshrined in national targets on zero-emission, or "new energy" vehicles in 2014.⁷ While buses seem on track to meet 2020 targets, urban light duty vehicles, cleaning vehicles and waste collection vehicles lag behind.

Economic support offered by financial incentives (subsidies and scrappage) coupled with free kerbside parking now make ZEVs a cost-competitive option. The endorsement of top leadership as well as cross-departmental collaboration have been key to the implementation of the green logistics zones.

London: From "ultra low" to zero emission

London is planning a series of progressively larger ZEZs to support the Mayor's goal that by 2050, London will be a "zero carbon city" and enjoy the best air quality of any major city in the world.

The London Mayor's Transport Strategy⁸ (2018) declares goals for zero-emission zones in town centres from 2020; a ZEZ in central London from 2025; larger ZEZs in inner London by 2040, and a ZEZ throughout greater London by 2050. Vehicle emission standards and fees for the most polluting vehicles set through the Ultra Low Emission Zone and the Low Emission Zone incentivize the use of cleaner vehicles.

Following a scheme which successfully took 5,000 polluting vans and minibuses off the roads, the city now provides freight operators with incentives to scrap polluting trucks and replace them with a cleaner option to comply with upcoming, tightened emission standards.⁹

To date, two London boroughs are working to implement ZEZs: Hackney and the City of London both restrict access to non-ZEVs.



Santa Monica: A Voluntary Zero-Emissions Delivery Zone

Launched in 2020, the voluntary zero-emission zone in Santa Monica is a three-year pilot run by the Los Angeles Clean Incubator (LACI) and the city of Santa Monica. The pilot covers one square mile of the city and includes key commercial districts and residential areas. The focus of the pilot is on parcel, food and furniture last-mile deliveries typically made by light and medium-duty vehicles.

No access restrictions or emissions-based charging is in force (one could call those “sticks”). Instead, Santa Monica’s pilot uses “carrots:” partners have the opportunity to learn about and participate in zero-emission, last-mile solutions such as e-cargo bike deliveries, zero-emission light and medium-duty vehicles, kerbside management, and other innovations. The pilot also enables participants to form new partnerships with a variety of stakeholders, and influence what organizers hope will become a blueprint for other cities.

While urban freight produces a substantial share of pollution and CO₂ emissions, few cities and countries have developed a vision and implementation pathway specifically for the freight sector.



Zero-Emission Zones: Why Cities Should Not Wait to Start with Freight

The freight sector is energy intensive and pollutes disproportionately

Freight vehicles constitute a small share of global on-road fleets (less than 4%) and vehicle-equivalent miles travelled (10–15%).¹⁰ Yet they account for a high proportion of the on-road sector's energy consumption, greenhouse-gas emissions (27%), and toxic air pollutants (over 50% in the case of PM_{2.5} and NO_x)¹¹. Given its reliance on diesel-powered vehicles, this sector presents significant challenges for global, national and regional climate targets as well as air quality, health, noise and equity outcomes in cities.

Across the world, ensuring a sustainable transition in cities is key to adhering to the 1.5-degree-warming goals of the Paris Climate Agreement. The urban freight sector has a significant role to play in this transition. As highlighted in the 2011 White Paper on Transport¹² of the European Commission, reaching CO₂-free city logistics by 2030 is a major step in the continent's sustainable transition.

Around the world, cities have been at the forefront of the transition to a zero-emission future. As of August 2020, 35 cities have committed to implementing zero-emission areas by 2030 or earlier, in line with C40's Green and Healthy Streets Declaration.¹³

Urban freight operations rely on complex distribution networks and a multitude of actors (e.g. transport operators and companies delivering goods and ensuring the provision of urban services), with varying ownership and control levels over both large and small vehicle fleets, and with different business models. Freight spans food deliveries, electronic commerce (e-commerce) deliveries, small retail shops, transport of construction materials, waste collection, and craft and servicing companies including engineering, maintenance and repair.

The rapid economic, environmental and social changes brought about and augmented by the COVID-19 pandemic demonstrate the changing nature of freight in cities, and the importance of addressing the sector's impacts in a holistic and coordinated way.

The graphic below, based on 2015 data from the city of Rotterdam, shows the proportion of different vehicles —light, heavy (trucks), and busses—on the road, along with their collective contribution to greenhouse gas (GHG) emissions and air pollution.

Figure 2. Proportion of vehicles in terms of traffic and emissions¹⁴



* Please note: this image is based on measurements from 2015. Since that time, the fleet of lorries has been updated and many more Euro VI lorries are active in the city. Up-to-date data is currently lacking, but Euro VI lorries emit almost no NO_x. In the current situation, this suggests that the proportion of NO_x emissions from lorries will be substantially lower than in 2015. Professional road transport actors (including the market leaders in Logistics 010) have already been using Euro VI lorries to supply the city centre for some years.

Cities can help transform freight through ZEZ-Fs

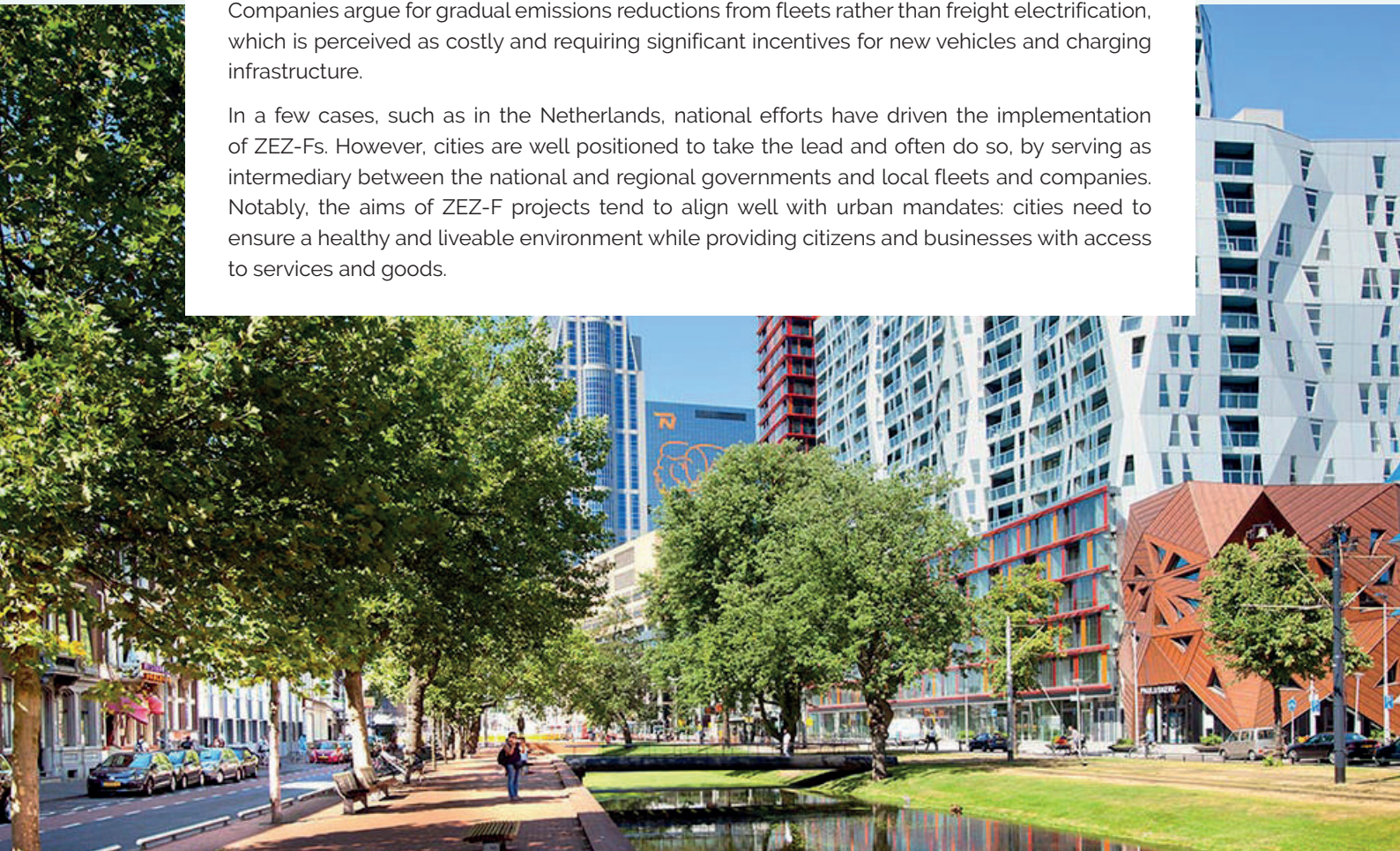
Zero-emission zones for freight (ZEZ-Fs) are areas in cities where only zero-emission delivery and freight transport vehicles may enter.¹⁵ Such access schemes not only reduce pollution and improve the health and liveability of urban areas; they can also improve efficiency and the bottom line for companies. By establishing these zones, cities can accelerate the decarbonisation of transport while simultaneously encouraging more optimised freight service and distribution models.¹⁶

Freight is often overlooked in policy discussions of clean mobility. This oversight may stem from issues related to perceived ownership, accountability and costs among relevant stakeholders. For instance, many national governments consider urban freight to be a local problem, while in some instances simultaneously being reluctant to devolve powers and remove existing regulatory barriers for cities to implement access regulation schemes.

Meanwhile, many cities consider access regulations best addressed on a regional, national, and supra-national level, supported by long-term climate and air quality targets for transport. In addition, many local authorities look to the private sector for solutions, given that most freight activity is generated by private companies.

Finally, many in the private sector claim that freight operations are already efficient enough. Companies argue for gradual emissions reductions from fleets rather than freight electrification, which is perceived as costly and requiring significant incentives for new vehicles and charging infrastructure.

In a few cases, such as in the Netherlands, national efforts have driven the implementation of ZEZ-Fs. However, cities are well positioned to take the lead and often do so, by serving as intermediary between the national and regional governments and local fleets and companies. Notably, the aims of ZEZ-F projects tend to align well with urban mandates: cities need to ensure a healthy and liveable environment while providing citizens and businesses with access to services and goods.



ZEZ-Fs can address health and other inequities from freight activity

Freight distribution and logistics can have a significant and disproportionate impact on air quality and health impacts within disadvantaged communities. Research from the U.S. National Institutes of Health (NIH) and Harvard's T. H. Chan School of Public Health, for example, shows that neighbourhoods with high levels of freight traffic tend to correlate with higher shares of minority residents. These areas are also subject to pollution levels 31% above the national average; substantially more instances of lung cancer per capita; and, recently, COVID-19 infection rates nearly 20% greater than in other areas.^{17 18 19 20}

As Covid-19 has highlighted existing health inequities, addressing these concerns has become more important than ever. The freight sector has immense potential to clean the air for all, and also to prioritise efforts in traditionally marginalised communities that have suffered most from high freight activity (e.g. near warehousing, ports).²¹

ZEZ-Fs nudge logistics operators to avoid unnecessary trips by smart planning and new collaborations. Trips that remain will be done by clean vehicles and thus mitigate health effects. Zero-emission technology solutions will also benefit freight workers, who experience worse health outcomes as a result of elevated PM_{2.5} and NO_x concentrations at logistics hubs and near highways.²²

ZEZ-Fs can stimulate the market for zero-emission freight vehicles

Many believe that zero-emission freight vehicles (ZEFVs) are not yet available in sufficient numbers to meet demand. Member companies of EV100, a global coalition working to transition to electric vehicles, cite lack of supply as the largest barrier.

ZEZ-Fs have the potential to create a sea-change in availability of ZEFVs. When engaged in planning alongside city officials, logistics operators, retailers and suppliers can gain the security of a long-term policy vision, making it less risky and more attractive to invest in zero-emission solutions. By involving the relatively limited number of private-sector stakeholders involved in moving goods (as compared to the number of stakeholders involved in passenger mobility), any impact has the potential to be far-reaching.

Original Equipment Manufacturers (OEMs) would also be incentivised to invest in the development of zero-emission freight vehicles, given the policy certainty of ZEZ-Fs and the demand from companies and fleets.



ZEZ-Fs are areas in cities where only zero-emission delivery and freight transport vehicles may enter.

Understanding the needs, challenges, and interests of the various sub-communities is key to involving them in a collaboration for devising effective rules and incentives regulating ZEZ-Fs.

Toward a Successful ZEZ-F: Steps for Action

Devising a ZEZ-F is a complex process involving many stakeholders. A successful outcome depends on completing the following steps, although the order may vary from city to city, and most will proceed in an iterative and cyclical process.



Build trust with stakeholders throughout the broad freight community

Owners and operators of freight vehicles range from multinational companies to sole-proprietor shops, from tradespeople to professionals providing repair and maintenance services. Freight vehicles include long-haul trucks, delivery and service vans, construction vehicles, waste and street-cleaning vehicles, even cargo bicycles and other “last-mile” solutions.

Understanding the needs, challenges, and interests of the various sub-communities is key to involving them in a collaboration for devising effective rules and incentives regulating ZEZ-Fs.

Inclusive stakeholder engagement and collaboration

Effective public and private stakeholder engagement has the potential to greatly increase the overall effectiveness of ZEZ-Fs in cities, and is a key success factor in their design. This includes:

- **Mapping stakeholders and how they may be impacted:** identifying stakeholders in the urban freight sector directly or indirectly affected by logistics operations and the implementation of the ZEZ-F.
- **Consulting stakeholders:** initiating preliminary and regular dialogue with relevant stakeholders to understand their needs and inform key decisions with regard to ZEZ-F implementation and important adjustments. Many cities already have regular consultation mechanisms with local logistics players. However, many have not yet segmented the different types of actors and their corresponding needs and interests.



In more depth | Mapping stakeholders

Although they may vary from city to city, stakeholders involved in or impacted by the distribution of goods in cities can be grouped into general categories.

Table 1 provides a general mapping of the most common urban freight logistics stakeholders. It is a revised version of the mapping provided by a European Commission study on the engagement of stakeholders when implementing urban freight logistics policies.²³ ZEZ-Fs will include specific freight streams (e.g. retail, waste, construction), and similar mapping would help planners better understand the characteristics and needs of key stakeholders involved in these streams (see Rotterdam case study).

Logistics activities depend on the interaction between many stakeholders. Engagement of representatives from all categories is important to ensuring smooth ZEZ-F operation upon implementation.

Table 1. A spectrum of ZEZ-F stakeholders with their salient features and interests

 <p>Producers and shippers</p> <ul style="list-style-type: none"> ● Produce or aggregate goods ● Some outsource transport and logistics operations ● Some operate their own fleet ● Often located outside cities 	 <p>Freight transport and logistics operators</p> <ul style="list-style-type: none"> ● Form the visible face of urban freight logistics operations ● Provide transport and distribution services ● Highly heterogeneous— small family businesses to major international transport companies ● Hired by producers, shippers or receivers ● Behaviour reflects the need to meet customers' requirements 	 <p>Service providers²⁴</p> <ul style="list-style-type: none"> ● Services such as cleaning, catering, plumbing, or locksmith services, which require the movement of people and goods ● Tend to be locally owned, with lower financial flexibility and older and more polluting vehicles ● Waste-collection service and reverse logistics: can be operators owned by the public authority, or private companies selected through tenders
 <p>Government authorities</p> <ul style="list-style-type: none"> ● Commonly municipalities and local agencies from different sectors ● Focus on the adoption of targets, regulations and infrastructure supporting the shift to ZEZ-Fs ● Balance between promoting sustainable urban development and fostering economic growth ● National/regional governments can either support ZEZ-F adoption targets or be a barrier to implementation 	 <p>Receivers</p> <ul style="list-style-type: none"> ● Highly heterogeneous group: small retailers, construction sites, international retail chains, shopping centres, households, etc. ● Each segment has specific demands in terms of delivery time, transport conditions, pricing, etc. ● Expect high quality of service (reliability, flexibility, short transit times) at reduced prices ● Include public authorities with the potential to influence type of vehicles and modes used for their supplies 	 <p>Residents/ Local communities/ NGOs</p> <ul style="list-style-type: none"> ● May be receivers, through e-commerce ● Receivers expect access to a wide range of high-quality goods at affordable prices ● Are also affected by freight activity ● Expect a good quality of life, e.g. clean air, security, clean built environment, quiet green areas, appealing leisure and shopping zones ● This group includes other non-governmental organisations in the clean transportation space, environmental justice groups and local community groups.
 <p>E-charging infrastructure providers/operators</p> <ul style="list-style-type: none"> ● Charge Point Operator (CPO) manages, maintains and operates charging stations ● Mobility Service Provider (MSP) holds the contract for all services related to electric vehicle operation. ● Energy supplier, electric utility ● Distribution System Operator (DSO) 	 <p>Solution providers and financiers</p> <ul style="list-style-type: none"> ● Investors, infrastructure and land or depot owners ● OEMs, technology providers, are crucial to ensuring the widespread availability of zero-emission freight vehicles on the market at affordable price ranges 	



In more depth | Consulting stakeholders

For public-sector bodies directly responsible for implementing ZEZ-F schemes, engagement provides a meaningful opportunity to understand stakeholder needs as well as revise, update, and receive guidance on ZEZ-F plans from other concerned parties. Each sub-segment of city logistics has different requirements with regard to type of shipment, volumes, customer requirements, type of vehicle, number of stops, etc. Engagement allows officials to consider the full supply chain and overall efficiency.

Wide consultation with residents, civil society and local community groups is especially important to ensure that no key voices are left out of the planning process, and that potential operational or equity issues can be identified before implementation. Stakeholder interactions can be complemented by targeted research, and data collection.

The engagement of the public sector is especially important given the degree to which public authorities are also heavily engaged with logistics activities and the broader economy. The European Commission estimates that public procurement accounts for 14% of EU gross domestic product (GDP)²⁵ – ranging from waste collection to cleaning services, and maintenance of public spaces to catering services for schools.²⁶

Public authorities can demonstrate firm commitment to zero-emission freight and influence the market by setting zero-emission criteria for goods and services delivered to municipal buildings. They can also seek to procure zero-emission vehicles for their own fleets, which may include vans and waste trucks.

Likewise, private-sector stakeholders need to be consulted early on to ensure their needs, priorities and interests are understood. As a means of showing their commitment, cities and companies can then be encouraged to sign voluntary agreements to collaborate on zero-emission mobility, freight and city logistics – for example, through 'corporate mobility pacts' (Lisbon)²⁷ or 'green deals' (Rotterdam, Amsterdam)²⁸ and 'charters for sustainable logistics' (Paris)²⁹ or a forum such as the 'LoCITY Forum' (London).³⁰ Logistics Living Labs (described on page 23), support the co-creation of measures in a dynamic, public-private setting.

Relatively low-cost, these initiatives help establish an ongoing channel of public-private communication, and facilitate joint commitments by cities and companies. This helps boost the visibility of the ZEZ-F as well as engaged enterprises. It also generates greater interest among other private-sector stakeholders who may prove harder to engage at the outset.

During stakeholder consultations and forums, many cities report that small businesses³¹ are under-represented and/or reluctant to embrace a ZEZ-F. Given low profit margins and the fact that a vehicle is vital to their work, small businesses may have more difficulty replacing their vehicle with a zero-emission option. Public authorities should therefore pay particular attention to co-creating interventions with small businesses to support them in adopting more sustainable operations. The small-business community has important implications from an economic and social, as well as environmental, point of view.

Stakeholders often express concern that vehicle access-restriction schemes may lead to a decline in business for local shops. However, increasing evidence shows that this is not the case.^{32 33} As part of the BuyZET project, the cities of Rotterdam, Copenhagen and Oslo involved their suppliers, large and small, in a market dialogue which proved essential to define an inclusive procurement process while maintaining high environmental standards.³⁴



Industry partners with zero-emission freight vision and targets

The private sector is central to logistics operations in all forms. Gathering support among relevant private-sector freight stakeholders can be an important step in generating momentum for ZEZ-F adoption, pushing for policy changes and advancing zero-emission freight more broadly.

Companies can help accelerate the shift towards zero-emission freight by setting a target date for switching their fleets to zero-emission vehicles in certain cities or other areas. For instance, the Ingka Group (formerly IKEA) has set a target for zero-emission deliveries in the urban cores of five major global cities by the end of 2020: Amsterdam, Los Angeles, New York, Paris and Shanghai (where this was already achieved by early 2019).³⁵ DPD Group has announced green delivery in 225 European cities by 2025.³⁶

More broadly, EV100 members will replace more than 340,000 owned combustion vehicles and a further 2.3 million leased vehicles with electric vehicles by 2030. Commercial Drive to Zero members also work to accelerate the growth of global zero and near-zero-emission commercial vehicles, with the aim of zero-emission technology becoming commercially competitive by 2025 and dominant by 2040 in specific vehicle segments and regions.³⁷

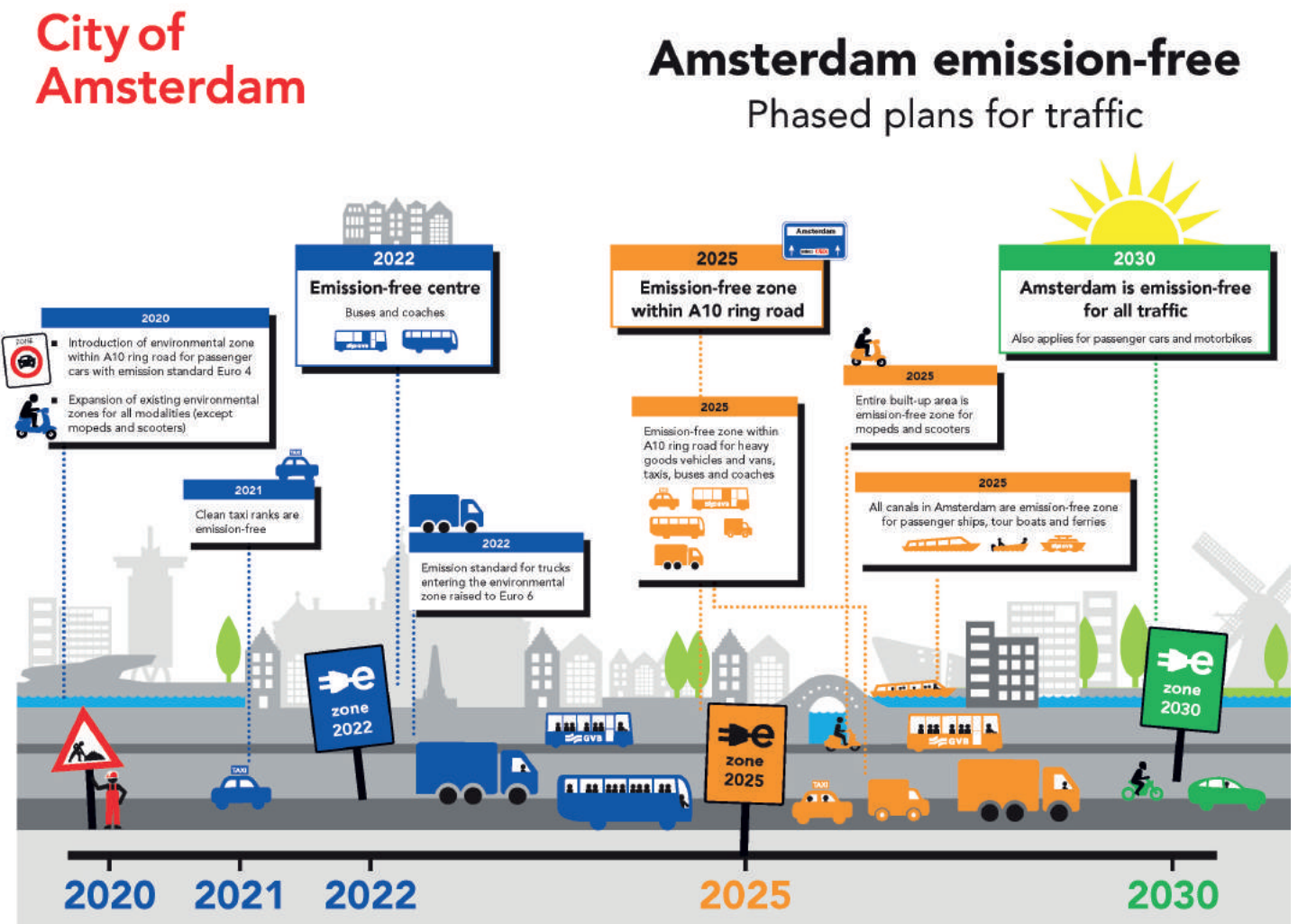
Companies can also present their own vision for ZEZ-Fs, ensuring that policies are grounded in the day-to-day operations of freight companies and their long-term goals. In relation to the Dutch government's call for 30-40 cities to establish ZEZ-Fs by 2025, PostNL, a postal service in the Netherlands, provided a set of considerations to take into account in determining how to implement the ZEZ-Fs. These include physical, historic and demographic properties of cities; existing environmental zones and infrastructure for enforcement; current and future policies; and traffic movement.



Effective communications – clear timelines and predictability

Key timelines, milestones and long-term goals should be communicated early on in the process. Since asset investments are often required for the implementation of the ZEZ-F (e.g. new vehicles, charging infrastructure), a minimum of five years' notice should be provided for full implementation. Different fleets will follow different vehicle replacement cycles, so the earlier that cities start engaging these stakeholders, the better.

Figure 3. Timelines for Amsterdam's Clean Air Action Plan³⁸



Tying communications to national and global efforts, particularly when engaging with manufacturers and solution providers, or large retailers, can help show how local efforts contribute to larger programs to address the climate crisis and improve air quality for all. These efforts can help show how ZEZ-Fs and zero-emission transport are becoming the 'new norm' and encourage participation. For example, by 2030, more than 30 cities will have implemented ZEZ-Fs as part of their Green and Healthy Streets Declaration, and 30–40 cities in the Netherlands will have done so by 2025.



Clarify your city's objectives and regulatory powers

Each city's ZEZ-F will be unique—the size, shape, and management depending on the city's vision, the stakeholders and the governing authority. Goals differ and may include:

- Meeting decarbonisation targets
- Reducing air and noise pollution hotspots to improve equity and health for disadvantaged communities
- Lowering congestion and improving efficiency
- Creating green spaces
- Developing more liveable neighbourhoods throughout the city, and
- Stimulating demand for zero-emission freight vehicles, which will signal to manufacturers that now is the time to mass-produce ZE vehicles.

In some regions, cities may have limited powers to regulate vehicle access and may need to set up solid governance schemes in cooperation with local boroughs and/or national agencies.

It is important to clearly identify and communicate the issues that the ZEZ-F aims to solve and their baseline. Once the issue(s) have been identified, a clear set of objectives, goals and key performance indicators (KPIs) to be achieved by the ZEZ-F scheme should be defined, against the existing baseline (e.g. CO₂ reduction or percentage of zero-emission goods movement, reducing air and noise pollution, and/or the level of congestion from freight traffic). These should be accompanied by a timeline.

Some European countries have national low-emission zone plans and frameworks in place, substantially easing the process of implementing low-emission zones and ZEZ-Fs at the city level. In China, low-emission zones have been established in cities such as Beijing and Shenzhen. These are included in China's 13th Five-Year Plan.³⁹

In the US, cities are often federally preempted from implementing access control regulations on environmental grounds.⁴⁰ However, they are often allowed to implement incentive-based programmes to reduce congestion. Cities also control the kerb and can set specific rules and pricing for kerb usage, providing preferential treatment to zero-emission freight vehicles. These types of interventions can help achieve similar goals to ZEZ-Fs that control vehicle access.



Set an ambitious but realistic target and timeline

Setting an ambitious but realistic timeline can help put ZEZ-F planning in motion and galvanise the interest of companies and other stakeholders. For instance, the 35 signatory cities to the C40 Green and Healthy Streets Declaration have each committed to implementing a major ZEZ by 2030.⁴¹ They are at work with local partners, who can develop clear timelines. Some cities have set shorter timeframes; London, for example, aims to implement local zero-emission zones from 2020 and a central London zero-emission zone by 2025.⁴² In the Netherlands, 30–40 cities will aim to implement ZEZ-Fs by 2025.⁴³

National and regional government targets

Government targets can be an important driver of ZEZ-F adoption. In the Netherlands, the 2019 National Climate Agreement⁴⁴ defined a series of measures to reduce carbon dioxide emissions by at least 49% by 2030 compared to 1990 levels. The Agreement sets out key actions on sustainable mobility and logistics, including a requirement that by 2025, the 30–40 largest cities in the Netherlands introduce ZEZ-Fs. These commitments are part of a national agreement led by the central government, and build on the voluntary Zero-Emission City Logistics Green Deal in 2014,⁴⁵ signed by cities including Amsterdam, The Hague, Rotterdam and Utrecht alongside more than 50 Dutch companies.



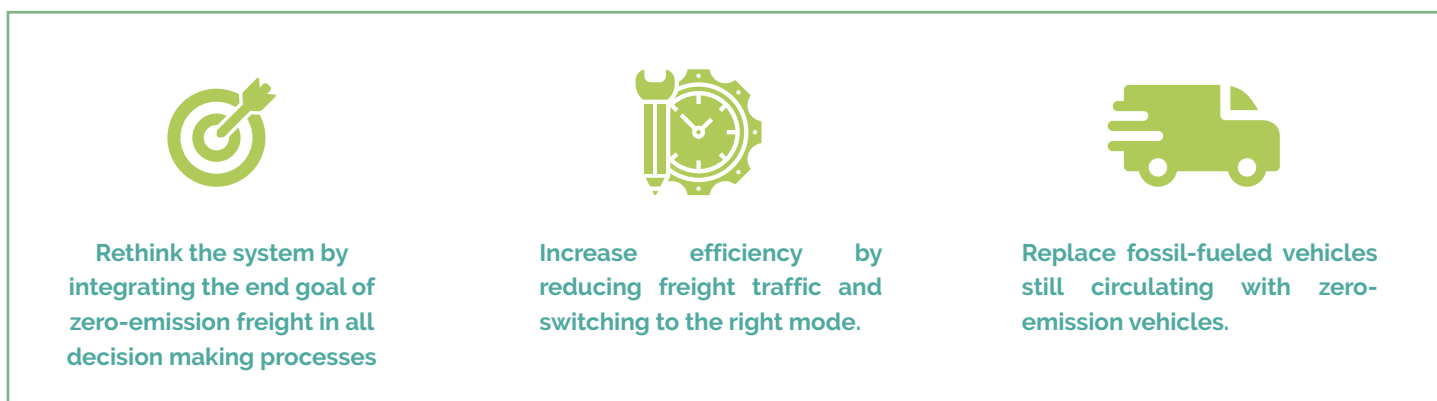
Develop an implementation strategy

ZEZ-Fs should not be seen as 'vehicle replacement' or 'one-size-fits-all' interventions. Rather, they can encompass a new way of viewing freight as a system. Objectives include reducing freight trips through efficiency and new collaborations; re-thinking the way goods and services are transported; choosing the most appropriate transport mode; and making sure those transport modes are zero-emission (see scheme below).

It is essential to link the ZEZ-F with the city's long-term vision. How will the ZEZ-F contribute to the city's sustainable logistics vision? And how do relevant stakeholders play into its implementation?

Cities should also consider measures that are complementary to zero-emission vehicle schemes, such as micro-hubs, cycle logistics, and vehicle-sharing schemes.⁴⁶ Companies and businesses can then avoid purchasing new vehicles and transition to alternative modes where feasible.

Figure 4: ZEZ-F objectives



A ZEZ-F strategy might also be phased. The zone might launch by encompassing the central commercial district, then expand to a larger, mixed-use area within a few years, before reaching its full dimensions at an agreed later date. Partners beyond the freight community have a role to play in strategy-building as well, to ensure that all voices are heard and impacts considered.

Developing a successful strategy for the chosen ZEZ-F relies on engaging a range of stakeholders and considering and acting on their diverse perspectives and needs, directly or indirectly. Ideally, strategy development involves city government, transport departments, public-sector agencies (health, air quality, climate and energy), electric utilities, businesses (selling, delivering and receiving goods or services), neighbouring municipalities and the general public (through consultation and community outreach specifically targeted at disadvantaged populations to ensure an equitable and inclusive planning process).

It is important to ensure coordination, and that all voices are heard and impacts considered. For instance, the strategy should consider the impacts on small businesses located in the ZEZ-F and their suppliers, and the potential links between a central ZEZ-F and suburban communities or communities living on the edge of the zone. Cities should be as transparent as possible about their implementation procedures, key changes and timelines to ensure optimal stakeholder participation and planning.



Selecting the ZEZ-F location and size

Setting clear objectives for the ZEZ-F can help cities identify where the zone or multiple zones should be located and what size they should be. It will also provide clarity and predictability to stakeholders in terms of interventions likely to be proposed.

Understanding the wider distribution of freight transport and impacts within cities can also help identify particular freight sectors to focus on for the ZEZ-F location, depending on where most of the activity and impacts are seen. Figure 5 shows a schema for subsegments of logistics freight in Rotterdam.

Some cities may wish to build on existing low-emission zones to transform these areas into ZEZ-Fs. In the lead-up to the target date for the ZEZ-F, exemptions for certain groups or types of vehicles may be considered. However, these should be granted carefully and follow a strict timeline for all vehicles to ultimately comply with the zero-emission standards, coinciding with the launch of the ZEZ-F. Allowing many exceptions to the existing low-emission zone could fail to stimulate the market to produce and take up the necessary zero-emission freight vehicles.⁴⁷

Analysis from Transport & Environment shows that “more restrictive zones that only allow the cleanest emission vehicles into a city’s center are driving much of [their] results.”⁴⁸ In other words, greater stringency tends to increase effectiveness. To inform their efforts, cities can use tools such as the Zero-Emission Technology Inventory⁴⁹ to keep track of zero-emission vehicles to be deployed in regions across the world, based on manufacturer commitments.

Preliminary results from current ZEZ-F implementation in cities such as Shenzhen also indicate that very small zones are difficult to enforce: drivers of conventional vehicles found ways to circumvent the regulation by using car parks, side streets and driveways. Larger ZEZ-Fs may be more effective in ensuring compliance, while the objectives of the ZEZ-Fs are met and negative impacts outside the ZEZ-F avoided. A larger zone sends a strong signal to key stakeholders and the automotive sector that the city is committed to zero-emission freight. It enables fleet managers to more efficiently plan how they will expand their ZEFV portfolio or rethink their distribution model.

By working together and with partners to set a similar level of ambition for ZEZ-Fs by 2030 and shared strategies, cities can collectively influence how rapidly availability in the zero-emission freight vehicle market improves.





Test and pilot your desired interventions

Pilot projects allow stakeholders to define new collaboration schemes, test procedures and vehicles, and measure initial impacts, intended and not. Beyond providing data, pilots can build private-sector confidence in investing in zero-emission solutions and help companies make informed decisions about costs and savings.

"Logistics Living Laboratories" accelerate testing and piloting, and are spreading in European and North American cities. Their aim is to co-create and test effective and sustainable solutions on urban logistics in an ongoing and iterative process. All stakeholders—public and private, policy, research, and industry—work together to streamline testing in real-life operations, and collect and analyse data for modelling and planning.

As discussed above, pilots should also consider interventions and logistics models that can first help improve the efficiency of freight movement and, ideally, reduce the number of vehicles on the road by providing access to alternatives (e.g. micro-hubs, cycle logistics, vehicle sharing).

Some organisations and research centres provide support for such projects. 'Logistics living labs', adopted by different cities worldwide, are defined by the CITYLAB project as a "permanent working table, in which all stakeholders, public and private, are involved for the co-creation and testing of effective and sustainable solutions on urban logistics".⁵⁰ They can provide the right environment to test, assess and adjust the ZEZ-F and supporting measures.

Living labs/urban freight labs working with cities and businesses on freight pilots

- **CILOLAB**,⁵¹ a Dutch city-logistics living lab, focuses on how to achieve zero-emission city logistics through an increase in inner-city logistics efficiency, without replacing all diesel-powered vans and trucks with zero-emission vehicles.
- The Los Angeles Cleantech Incubator (LACI)⁵² runs the **Transportation Electrification Partnership**, which aims to catalyse the shift to electric vehicles and zero-emission goods delivery in Southern California. LACI has a wide set of stakeholders and partners that can benefit cities in the region and beyond.
- **London FreightLab** is an initiative of Transport for London (TfL)⁵³ which incubates market innovators in sustainable freight. The FreightLab works with a range of logistics partners as well as local government through the Mayor's Civic Innovation Challenge.
- The **University of Washington (UW) Urban Freight Lab**⁵⁴ is a research group formed with logistics stakeholders around Seattle as well as researchers at the UW Supply Chain Transportation and Logistics Center. The Urban Freight Lab studies freight pilots for business in the region and beyond.
- As a follow-up to CITYLAB, the city of Rome has permanently established a **Logistics Living Lab of Rome**,⁵⁵ coordinated by Roma Tre University and supported by Rome Mobility Agency,⁵⁶ to experiment with and implement solutions from the new SUMP (Sustainable Urban Mobility Plan).⁵⁷
- The Île-de-France Region (Paris) encourages public-private projects within the framework of the **Regional Freight and Logistics Strategy**.⁵⁸ The Region has funded new projects aimed at the supply, circulation, storage, distribution, deliveries and removal of goods in cities, for all business sectors.



Implement, monitor, fine-tune...and enforce

Much will be learned about implementation, monitoring and enforcement of ZEZs-F as the first cities begin to implement them in the years ahead. Implementation will be specific to each city and zone, taking place in the context of extensive stakeholder consultation, with agreed timelines, key performance indicators (KPIs) and plans for monitoring.

Data collection and analysis by cities, in collaboration with stakeholders, is key to an evidence-based policy-making process.

To facilitate compliance, cities should accompany enforcement procedures with active information about the rules in place.

To evaluate the performance of ZEZ-F pilots and the zones themselves upon implementation, cities should collect KPIs. These could include air quality, pollutant and particulate emissions; traffic levels and vehicle mileage travelled within the ZEZ-F; traffic levels near distribution hubs or micro-hubs and at the edge of the ZEZ-F; costs and benefits to businesses; and others depending on objectives. These should be accompanied by appropriate monitoring technologies. The European Commission has published a technical report⁵⁹ on logistics vehicles in Urban Vehicle Access Regulation schemes, which can provide some inspiration to cities looking to implement and monitor ZEZ-Fs.

Cities and national governments need to steer the regulatory changes necessary to implement and enforce ZEZ-Fs.

The most effective and widespread system for enforcing low emission zones or access restriction schemes is based on access gates controlled by automatic number-plate recognition (ANPR) cameras. Access-restriction schemes are in use in Madrid, Rome, Brussels and other cities. However, the absence of a European number-plate register means that cities cannot recognise foreign number plates—making it extremely challenging to control foreign vehicles. Without ANPR cameras, cities need to rely on other options such as permits, licenses, and stickers, with enforcement conducted by local ticketing officers.

In the future, geofencing applications could be used in some regions to help drivers comply with local policies, for example, hybrid vehicles could automatically switch to electric modes within specific areas. However, this would need further research and a robust monitoring and enforcement system.⁶⁰

Harmonisation to ensure international enforcement and information

To ensure that foreign vehicles are compatible with local access restrictions, countries and regions need to exchange information. This can provide greater enforcement power and ultimately boost compliance. The European Commission plans to focus on end-user information and enforcement, by revising the Directive on cross-border exchange of information on road safety related traffic offences and the European Electronic Toll Service (EETS) Directive.

Moreover, UVARBOX⁶¹ is a newly awarded EU Project, established to tackle fragmented or unavailable information on up to date and relevant UVARs (Urban Vehicle Access Regulations). Launched with the POLIS Network, this project will provide tools to structure data on UVARs in machine-readable formats for navigation systems and mobile applications.



Since many companies operate across multiple cities and neighbouring countries, common approaches and consistent implementation timelines across cities allow them to plan and invest with greater confidence.



Keys to Success

ZEZ-Fs exist within a large ecosystem of regulations, financial incentives, infrastructure investments and other urban, regional, national and international plans and projects. Cities should be aware that factors both within and beyond city limits can significantly influence the success of ZEZ-F planning.



Align policies across different levels of government

Collaborating with neighbouring city, regional and national governments can facilitate ZEZ-F planning. Examples include establishing a common approach or common principles for the zones, as well as coordinating public outreach and other communications.

Such measures also create a predictability that helps companies make the business case for zero-emission solutions. Since many companies operate across multiple cities and neighbouring countries, common approaches and consistent implementation timelines allow them to plan and invest with greater confidence. Aligned policy and financial support can boost uptake of zero-emission vehicles as well.

National and regional targets help ZEZ-Fs succeed

Broader policies implemented at national and supranational levels, such as vehicle sales targets for manufacturers and/or CO₂ reduction targets for freight vehicles, help boost the success of ZEZ-Fs.

For example, China has set a target for 25% of vehicles sold to be New Energy Vehicles (BEV, PHEV, FCEV)⁶² by 2025. The Regulation on reducing CO₂ emissions from heavy-duty vehicles⁶³ sets a legally binding 30% reduction target for the average fleet emissions of new trucks by 2030. The intermediary target is 15%, to be achieved by 2025. For new vans, the reduction target is 31% by 2030, with an intermediate reduction target of 15% by 2025.⁶⁴

California's Advanced Clean Trucks (ACT) mandate requires OEMs to increase zero-emission truck sales by 30–50% by 2030 and 40–75% by 2035. Various countries have also implemented national financial incentives such as registration tax exemptions, road tax discounts, tax deductions and a reduced rate on truck levies.





Create incentives and other supporting measures

While announcing a ZEZ-F is a cornerstone policy in itself, complementary measures are needed to ensure its effectiveness. Such measures include financial incentives and subsidies to reduce upfront vehicle costs, as well as benefits that "encourage behaviour change of operators, shippers, or receivers, offering various additional services, facilities or incentives".⁶⁵

Financial incentives and subsidies can spur a shift to more efficient logistics vehicles by reducing upfront vehicle costs or enabling lower operating costs for fleets and individual operators. Various countries have implemented national subsidies and incentives schemes, such as registration tax exemptions, tax deductions and a reduced rate on truck levies.

Non-monetary incentives can provide a comparative advantage for ZE operators. These may include extended time windows, exclusive use of preferential lanes, parking, and loading and unloading areas.

When defining the package of measures and incentives supporting a successful ZEZ-F, it is important to note that there is no one-size-fits-all solution for freight. Dialogue with stakeholders is critical to identify the most effective measures.



Develop charging infrastructure for electric freight vehicles

Charging infrastructure for ZEVs is a major hurdle for many freight operators. A coherent and dedicated strategy needs to be developed in concert with logistics and charging-infrastructure operators. This should take into account the specific needs of each category of freight, as well as the balance between public and private infrastructure.⁶⁶

An effective charging strategy for urban logistics depends most on three factors:

- Location: where to charge and how often charging can or should take place
- Type of charger: fast or slow
- The vehicle's battery size.

Needs vary by both vehicle and business sector: small business owners are likely to charge their vehicles at home, with only top-up charging needed in the city; they can often use charging infrastructure available for passenger cars. Fixed-route and other heavier trucks may need more power, provided at a dedicated depot, in addition to fast charging in the city. Construction vehicles may best charge at their building sites.

Electricity utilities, too, need to be engaged. Transport & Environment's Recharge EU Trucks paper,⁶⁷ for example, estimates that 80% of the energy used for electric truck charging will come from private stations at depots, 15% from destination chargers, and 5% from public charging stations. A Dutch study for Topsector Logistiek found similar results – 78%, 16% and 6% respectively.⁶⁸ Home charging is less relevant for truck operators since trucks typically charge overnight at the depot.

However, the same study found that, in Amsterdam, commercial vans largely charge at home (45%) or at the depot (44%), while they use limited fast charging (due to costs and time) and top up at the delivery point, because of the short duration of their stops. For this type of vehicle, home charging options should be encouraged.

It is also important to segment the charging needs per sector:

- **Retail food and non-food:** mostly charge at the depot. For long trips (>100km), charging at customer premises is more likely.
- **Buildings and construction sector:** commercial vans mostly charge at home, trucks at a depot. Charging at building sites requires innovation and temporary solutions.
- **Postal services:** charge mostly at home and at the depot. Fast charging is not required due to limited range.
- **Service logistics:** home charging is most frequent.

Another research by ElaadNL, shown in figures 5 and 6, foresees a similar distribution of charging locations and elaborates a detailed simulation of where the electric vans and trucks will charge.

Figure 5. Van charging needs according to ElaadNL study⁶⁹

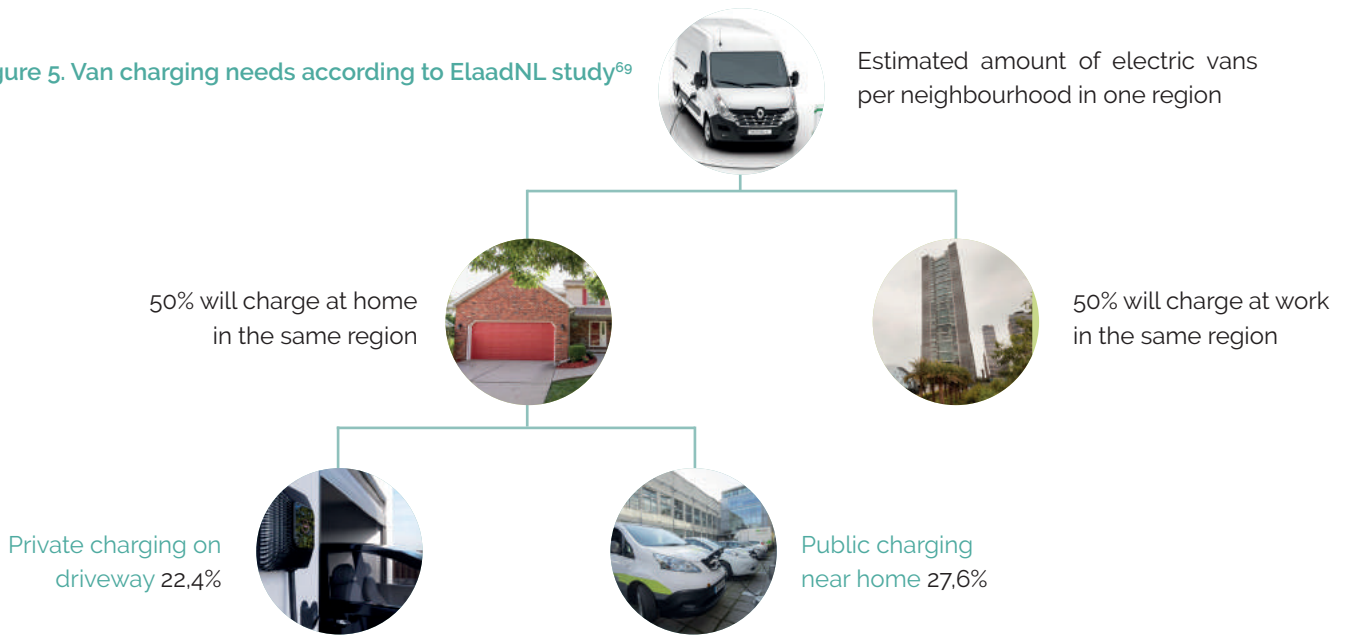
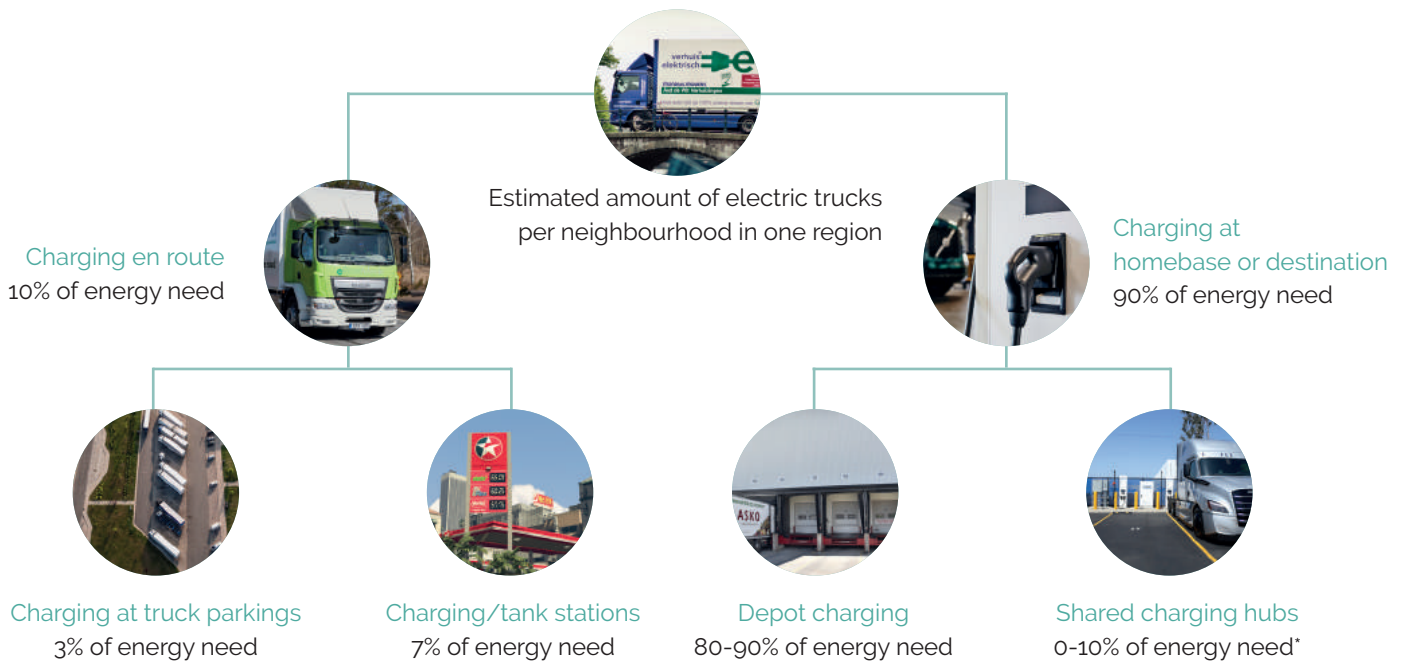


Figure 6. Truck charging needs according to ElaadNL study⁷⁰



*This amount is expected to rise

Given this analysis, depots (for trucks) and homes (for vans) require major charging infrastructure investments, while most public chargers are required outside the city centre (outside Amsterdam's environmental zone in this case). These would typically be used by commercial vans in the service logistics and buildings and construction sectors.

Cities should develop ZEZ schemes while simultaneously considering the different charging needs of operators when advancing the electrification of fleets. The ASSURED project⁷¹ is investigating the role of rapid e-charging infrastructure for ZEZs, in particular looking at the impact of ZEZ regulation and design on the location and use of e-charging infrastructure.

Managing grid impact

Vans have similar power requirements to passenger cars and can use the same charging infrastructure. But the high energy demand (up to 1MW) along with the lack of standardisation of medium- and heavy-duty vehicles impacts the grid more heavily and calls for careful, targeted planning.⁷²

UPS implements smart charging and helps manage its impact on the local grid

UPS has been deploying electric vehicles from its Camden depot to serve North London since the late 2000s. As the company expanded its use of electric vehicles, the burden on the local electricity supply became significant. To increase grid capacity, UPS worked with third-party partners to upgrade the supply. Upgrading proved costly and time-consuming, but the business case for electric freight remained strong.

UPS then decided to electrify all 170 vehicles operating out of the depot – but with different grid modernisation strategies. The company formed a partnership with UK Power Networks⁷³ (the electricity distribution network operator for southeast England) as well as Cross River Partnership⁷⁴ and the UK Office for Low-Emission Vehicles.⁷⁵ This collaboration resulted in the Smart Electric Urban Logistics project, with £2.5m in government funding.

The project developed an active network-management system to control the volume of power delivered to vehicles, and implemented an onsite battery storage system to deal with peak charging times. With the innovations introduced by this project, all 170 vehicles can be charged simultaneously in an efficient manner.

Governance and collaboration

Cities play a key role as facilitators and can convene multiple stakeholders to ensure a charging infrastructure that works for all classes of freight vehicles. Cities also need to harmonise their strategy with neighbouring municipalities on a regional level, since most (public) chargers are required where the owners live; depots are located outside the ZEZ.

Since a ZEZ-F would likely boost the number of zero-emission freight vehicles, it is important to further consider roles and responsibilities of all parties involved in the e-freight charging system.⁷⁶

The three main types of stakeholders are:

- Policymakers at different levels: local, regional and national
- The private sector: freight transport and logistics operators, OEMs, land and depot owners, charging infrastructure companies
- The energy sector: energy supply companies, electric utilities, network and grid operators.

To optimize charging infrastructure, stakeholder roles include the following:

- Freight transporters assess and communicate what they need from the grid at their depot (e.g. where, how many vehicles, and for what use cases they would like to charge)
- Utilities, network and grid operators prepare the necessary grid capacity
- Charge-point operators develop a business case
- Municipalities and other public authorities convene stakeholders, adapt regulations and issue permits, and
- Land and building owners enable the installation process.



Oslo – Oslo City Hub

In 2019, the large logistics company DB Schenker opened its first low-carbon city distribution hub, in the centre of Oslo. The company aims to reduce CO₂ emissions from urban goods delivery by ~80% by streamlining delivery through the micro-hub. As of August 2020, all DB Schenker deliveries in Oslo were done with a zero-emission vehicle.

In developing the facility, DB Schenker worked with Oslo's municipal government (specifically the Oslo for Agency for Urban Environment, BYM). BYM has offered to contribute by facilitating the required infrastructure, such as, for example, water and sewerage, charging points, marking and signage, and helping convene the various stakeholders. At the moment, only DB Schenker has set up a facility in the area, but there are plans for additional stakeholders in the mobility sector to join in later.

An evaluation of the hub⁷⁷ shows that an analysis of electricity requirements and capabilities is central to the development of effective urban micro-hubs. The Oslo case highlights five criteria for a successful micro-hub:

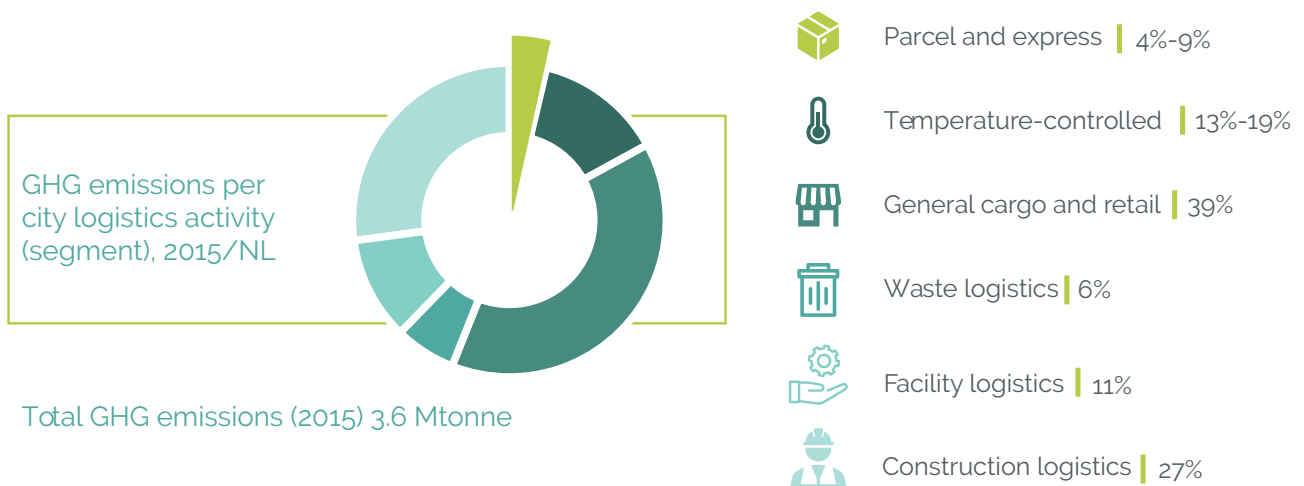
- 1 Trust between the collaborators
- 2 Expert knowledge and a dedicated driving force in the planning and design process
- 3 Support from and good cooperation with the public sector
- 4 A suitable and available location for the depot in the city centre
- 5 A simple and flexible design for the depot.

National coordination of charging infrastructure and grid capacity assessment

The Netherlands Knowledge Platform for Public Charging Infrastructure (NKL)⁷⁸ exemplifies a strong, multi-stakeholder partnership for rapid expansion of a cost-efficient and flexible charging network for electric transport, organised within the National Agenda for Charging Infrastructure (NAL). The partnership takes responsibility for all types of charging for all modalities and considers technology, the roll-out process, smart charging, and supporting policy, such as safety and cyber security.

A specific working group on charging for logistics is preparing an implementation roadmap⁷⁹ with the aim of making charging infrastructure "future-proof," clarifying stakeholder roles and allowing grid operators to prepare and plan. An important element for the roadmap is the use-case-specific outlooks prepared by smart-charging innovation centre ElaadNL.⁸⁰ These scenarios include detailed maps of what infrastructure is needed and where, including challenges likely to arise.

Figure 7: GHG emissions per city logistics activity





Collect, share and manage the necessary data

Data from the public sector, logistics operators, and other economic agents is needed to understand the main drivers of the logistics system. Decisions about the size, affected vehicles, location, incentives and enforcement of the ZEZ-F should be based on local data and evidence.⁸¹

Figure 7 on page 30 shows that although parcels are significant, most GHG emissions come from other segments such as construction.⁸² In practice, however, planners face huge gaps in the data they can access. Since they often rely on the private sector to provide such information, and companies may see it as proprietary, cities are experimenting with both mandates and incentives to obtain key data.

For instance, cities can make data sharing a requirement for access to zones or charging stations. Or they can incentivize operators to install an onboard data unit on vehicles by offering privileges such as special access to parking areas or bus lanes, or extended hours for ZEZ access.

At the same time, cities should clearly define the purpose for which they collect and analyse data, so as to entice the private sector to share them, and establish models to understand and interpret the data for an effective, evidence-based, policy-making process.

The EU Topic Guide on Sustainable Urban Logistics Planning⁸³ suggests a minimum set of data for describing urban freight characteristics, which should ideally be collected regularly by local authorities. It includes:⁸⁴

- Number of deliveries/collections
- Time of day of delivery/pick-up
- Time required to carry out deliveries/collections
- Type and quantity of goods delivered/collected
- Number of vehicles and vehicle size/type
- Loading/unloading activities
- Type of distribution
- Journey speed and length.

While ZEZ-F planning may be led by a specific department (often environmental, economic or mobility), data sharing and planning should happen across city departments and agencies to maximise impacts and address knowledge gaps. Cities should work with other departments to get more complete information as well as with chambers of commerce and industry representatives. Universities and research centres can act as valuable partners in the data-collection process because they can act as neutral third parties, facilitating data collaboration with the private sector.

Cities can get vital data by offering special access to low-emission zones

In January 2019, the City of Milan launched Area B, the largest low-emission zone in Italy, covering 129 km². Area B covers 72% of the city's area and includes 98% of Milan's residents. Area B planners were particularly sensitive to the challenges such a zone may pose to owners of small businesses, particularly street market vendors.

To provide vendors with time to comply with the new restrictions, and gather data on freight traffic and routes for this freight segment, the city initiated an experiment. This project included exemptions for vendors who agreed to have an onboard unit (OBU) installed in their vehicle to track the distance and routes travelled within the area, with an allowance of 500 kilometres per year. Once a vendor had reached this limit, it was no longer able to access the area unless it complied with the new emissions standard.

The trial ran until 31 March 2020; at the time of writing, it was being evaluated. The scheme has inspired further efforts across the Lombardy region, which encompasses Milan – for example, the Move-In project, aiming to further catalyse the shift to low emission vehicles.⁸⁵ A similar scheme involving logistics operators has also been established in Turin, in the Piedmont region, which received a positive evaluation regarding enhanced operational and environmental performance.⁸⁶

Requirements for data sharing can also be mandated as part of vehicle access or charging schemes. Brussels city officials, for instance, required an onboard unit installed on heavy trucks as part of the congestion charge scheme implemented in Flanders.⁸⁷ Thanks to the OBUs, planners were able to obtain and analyze GPS data for truck routes.

Using real-world emissions data to inform ZEZ-F location and implementation

The Real Urban Emissions (TRUE) initiative assesses real-world vehicle emissions in major cities. It enables governments to develop informed, data-driven policies to reduce air pollution from vehicles, and consumers to have better information about the emissions from vehicles they own or are considering for purchase.

A partnership between the FIA Foundation and the International Council on Clean Transportation (ICCT), the project uses data from remote-sensing technology to evaluate the emissions of vehicles operating in cities. This data supports a wide range of analysis, including estimates of discrepancies between the advertised and real-world emissions of different vehicles, and identification of the most-polluting segments of the vehicle stock.

As of early 2020, the TRUE initiative had completed remote-sensing studies in London and Paris, and had contributed to the development of broader regional remote-sensing databases in Europe and the US. The findings from London⁸⁸ and Paris⁸⁹ validate the effectiveness of low-emission zones, but also support the idea that a faster transition to zero-emission vehicles will be necessary in order to maximise the benefits of these zones. Similar analysis for freight vehicles could help to guide the implementation of ZEZ-Fs.

Companies have an increasing number of ways to share data about movements in a specific city without it being a risk to their operations. Ultimately, sharing data with cities will enable companies to impact the discourse on ZEZ-F implementation. For example, DPDgroup, a major postal company operating in Europe and beyond, has initiated an air-quality monitoring pilot as part of their corporate social responsibility outreach programme. The scheme was successfully trialled in Lisbon, Madrid, and Paris under a pilot programme that ended in 2019.⁹⁰ DPD postal vehicles and other partner fleets (including SEUR in Madrid) in these cities were equipped with Pollutrack laser sensors, which collect air-quality data (particularly PM_{2.5} levels) on a granular, street-by-street level every 12 seconds. Sensors have also been installed at key pickup points and urban delivery depots.

The data is made publicly available in real time through the DPD AirDiag platform,⁹¹ and provides valuable insight for policymakers, health officials and private sector logistics businesses, while also enabling researchers and city authorities to monitor and address air quality issues.

Planners in Lisbon used this data to inform the city's low emission zone.⁹² Given the pilot's success, full roll-out of the scheme across 20 European cities is planned for 2021.



Once a location has been identified for the ZEZ-F, additional data specific to the area identified should be reviewed to inform the ZEZ-F design.

Additional data specific to the ZEZ-F location could include:

- Characterisation and analysis of local residents, including social, economic, environmental, health and equity factors
- Characterisation and analysis of local businesses, including the number, size and location per type of shop or service within the area, and their supply chains and needs
- Characterisation of space and infrastructure supporting loading and unloading activities, parking and charging infrastructure
- Segmentation of freight and servicing trips within the area by sector, as each segment has different requirements (e.g. shipment, volumes, customer requirements, type of vehicle, number of stops, etc.). Knowledge of the typical requirements of these sectors can be enriched with specific trips data from companies.

A public-academic-private partnership yields key data for freight

In 2017, the Seattle Department of Transportation (SDOT) engaged the Urban Freight Lab (UFL) at the University of Washington to study two particular elements in the downtown area that relate to loading and unloading of commercial vehicles: alleys, and privately owned loading bays and docks under and next to buildings.⁹⁵

The UFL collaborated closely with the private sector for accuracy. Data collectors in the field initially identified 548 potential loading bays. However, in 206 cases, the doors were closed. UFL engaged UPS, the global parcel delivery company, whose local drivers reviewed the closed door locations, based on their extensive knowledge of the area. The Urban Freight Lab provided photos and location information. The review allowed the Lab to rule out 90% of the locations behind closed doors, reducing uncertainty from 38% to <1%.

The study found that 87% of Seattle's high-rise buildings relied on deliveries from kerb and alley spaces, having no private loading bays or docks.

SDOT also engaged the UFL to collect data needed to operate carbon-free delivery zones. The research aimed to: 1) develop a baseline cordon vehicle count for the Greater Downtown area, and 2) create a vehicle typology of commercial vehicles. The volume of commercial vehicles entering and leaving downtown on 15 major and minor truck routes was captured by day of the week, time of day, vehicle body type, vehicle use and number of axles. The study⁹⁶ found that, within the Greater Downtown area, about half of all commercial vehicles during the weekday were smaller vehicles.

As seen throughout this chapter, companies can be valuable partners to cities seeking to transition to zero-emission freight and ZEZ-Fs. To aid city-company sharing, and enable a shared data model for the ZEZ-F, cities, together with logistics operators, should define specific use cases and a framework of principles for data sharing. In the short term, this can include benefits and incentives for companies sharing data, such as prioritised access.

The World Business Council for Sustainable Development (WBCSD), in partnership with member companies, recently released a position paper on emerging principles for data sharing in urban mobility.⁹³ A similar report by Populus⁹⁴ provides an overview of mobility data-sharing practice and policy issues for regulatory agencies, such as cities and mobility operators.

National and subnational governments are also often in possession of vast amounts of transportation data. Integrating this with urban data collection and ensuring this information is widely available can help streamline the ZEZ-F development process. Setting up platforms for urban data-sharing through national or subnational governments is another means of improving information efficiency, and hence the success of ZEZ-F planning and implementation efforts.



To aid city–company cooperation, and enable a shared data model for the ZEZ-F, cities, together with logistics operators, should define specific use cases and a framework of principles for data sharing.



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Case Studies



Rotterdam: Zero-emission zone for freight in 2024

Background

The Municipality of Rotterdam has been working in partnership with the business community for many years to reduce the number of logistical movements in the city, using both smart logistics solutions and access regulations. They have done this on a voluntary basis with a local 'green deal' called 010 City Logistics, involving over 600 parties.⁹⁷

With the introduction of the Dutch National Climate Agreement, Rotterdam is required to implement a ZEZ-F by 2025 (along with the 30–40 largest cities in the Netherlands). In June 2019, the Mayor and Executive Board officially established the Roadmap Zero-Emission City Logistics (ZECL) strategy.⁹⁸

Scheme

Intended outcomes for the ZECL include improving air quality and mobility, reducing CO₂ from urban freight, and developing sustainable solutions for freight. The Rotterdam strategy is to find one "frontrunning" stakeholder per segment who is demonstrating the possibilities; to actively solve challenges as they arise; and then to move toward the mandatory phase.

Stakeholder involvement

The National Coordination Team for zero-emission zones will include all major cities in the Netherlands in addition to the national government, energy companies, auto manufacturers and other key stakeholders.

Delivery company engagement

The Roadmap Zero-Emission City Logistics plan focuses on freight transport and engages a range of delivery-company stakeholders. The ZECL aims to develop agreements with key stakeholders on vehicle access restrictions and ZEZ-Fs, as shown below.



Technology deployment

Various local and national programs and incentives have been developed to support zero-emission delivery in the zone, including;

- **ECOSTARS:** Through the ECOSTARS programme, carriers earn stars for sustainable operations. Logistics brokers visit transporters on behalf of the city of Rotterdam to give them non-binding advice about how they can save more fuel and also switch to emission-free transport;
- **Privileges for emission-free freight transport**, such as a waiver for the shared use of 19 bus lanes;
- **Extra access to pedestrian areas** (waiver for restricted access windows);
- **Zero-emission van subsidy scheme:** Entrepreneurs can receive a subsidy from the city of Rotterdam to buy an electric vehicle. On a national level, a subsidy for zero-emission vans and one for heavy-duty vehicles have been announced
- **Buy Zero-emission Transport (BuyZET):** The municipality has a direct influence on the transport services it purchases, whether or not this is done through a tender procedure. For the past two years the programme has also focused on emission-free construction transport.⁹⁹
- **Construction logistics hubs:** The city is working closely with partners to agree arrangements for the optimum use of construction hubs, transport by water and zero-emission last-mile deliveries. Funds from the central government are being used to prepare a subsidy scheme that will reduce construction-related freight movements in the city and reduce related emissions.
- **Subsidy helpdesk:** The city is making capacity available to assist businesses to apply for national and/or European subsidies. One example of this is the central government's demonstration scheme for climate-related technologies and innovations in transport (DKTI), intended to finance innovative projects for sustainable transportation. Rotterdam has already helped draft several applications.

Next steps

Next steps will be made in close collaboration with national implementation. Once the national agenda is finalised, the city will develop and sign the covenant Green Deal 010 zero-emission City Logistics 2.0, together with the logistics sector. This includes an action programme as well as a concrete ZEZ-F zone plan, with the aim of moving toward implementation and then monitoring.



The Netherlands: A national harmonised approach for 30–40 cities to implement ZEZ-Fs

Background

The Netherlands has emerged as a leader on national planning and stakeholder engagement with regard to ZEZ-F planning. No other country has developed as robust a framework in terms of setting the stage for effective and smooth ZEZ-F implementation.

In June 2019, the Dutch government presented the National Agreement on Climate Change (NACC). Finalizing the agreement took more than a year of conversations between representatives of national and local government, businesses, trade unions, the scientific community, environmental organisations and others. More than 100 parties jointly worked on a cohesive set of commitments with the aim of achieving greenhouse gas reduction in line with the Paris Agreement.

One of the commitments in the NACC is that 30–40 Dutch cities implement zero-emission zones for the logistics sector by 2025.¹⁰⁰ The aim is to reduce CO₂ emissions by 1 megaton while simultaneously improving air quality in high-risk areas.

Zero-emission zones: Creating a level playing field

In 2020-21, it is challenging for 30–40 municipalities to decide to implement an effective zero-emission zone by 2025. Under Dutch law, each local council has to adapt its own Traffic Regulation Order stipulating when, where and under what conditions a zero-emission zone will enter into force. In the absence of a national legal framework, each municipality has to consider the political, social and practical choices. Moreover, new local legislation is required: in principle each municipality needs to review all current regulations and solve the challenges concerning a zero-emission zone.

At the same time, it is essential for the logistics sector that the regulations in the different cities are similar and provide a level playing field. The willingness of entrepreneurs to comply and invest in zero-emission vehicles and efficient supply systems will depend on timely and unambiguous decision-making in the municipalities.

Expert pool to help make ZEZ-Fs a reality

To hasten local decision-making, stimulate harmonisation, and tackle implementation issues, the national Ministry of Infrastructure and Water Management initiated the 'SPES' programme, which can be translated as the 'Cooperation Project Expert Pool on City Logistics,' in late 2018. Commissioned and financed by the ministry, this two-year project has been conducted by a consortium led by CE Delft.

SPES aims to bring municipalities together and facilitate their process of designing and organising zero-emission zones. To achieve this, a common pool of experts in city logistics is made available to them. An important goal is that cities (both officials and elected officials) learn from their peers, so SPES offers various options to assist local officials and administrators:

- Financial support for developing plans
- A pool of experts in logistics, zero-emission techniques, legal services, litigation support and research
- A platform to collaborate with other cities and learn from each other through meetings, webinars, a website and newsletters
- Advice on how to engage local elected officials
- Support when submitting project proposals.

In addition, SPES offers a number of resources:

- A step-by-step manual on how to introduce a zero-emission zone for city logistics
- Legal analysis, offering a best-practice guide to implementing a Traffic Regulation Order
- An outline for local communications and building local support
- Several factsheets on specific issues
- 20+ best-practice examples of cities dealing with zero emissions.

So far, 31 projects involving 36 municipalities have been approved, which all aim to develop plans for the implementation of a zero-emission zone. In addition, a national framework to supplement the local plans is under construction and expected to be adopted by national and local governments and the commercial sector in 2020.

Examples of expertise that municipalities require from SPES are:

- Impact analysis of introducing a zero-emission zone: on businesses, inhabitants and the council, in terms of traffic flows and number of vehicles that frequent the zone;
- Cost-benefit analysis of zero-emission zones: cost in terms of investments in vehicles, camera control and enforcement; benefits in terms of environment and attractiveness of the city centre;
- Advice on the optimum size of the zone, considering impact and cost-benefit analysis;
- Stakeholder involvement: building joint action plans between all relevant local stakeholders, engaging small businesses as well as nationwide logistics operators;
- Adaptation of the Traffic Regulation Order: judicial aspects; and
- Creation of alternative logistics models in connection with freight distribution centres.

Evaluation

Despite the enthusiasm with which cities have embraced the possibilities that SPES offers, there is still far to go. Of 36 city councils currently working on implementation, only a few (including Utrecht, Amsterdam and The Hague and Rotterdam) have officially decided to implement a zero-emission zone; another 10 are expected to do so in the short term. The discussion and knowledge platform that SPES offers should prove valuable for the acceptance of zero-emission zones, and the Dutch approach offers much to emulate by other countries.



Shenzhen: Green Logistics Zones

Shenzhen is leading China's logistics vehicle electrification.¹⁰¹ By the end of 2019, the city had more than 77,500 battery-electric logistics vehicles in operation, including vans, lorries, trucks, dump trucks and road-sweeping and waste-collection vehicles. The total number of electric logistics vehicles has surpassed that of electric buses and taxis, becoming the largest operational fleet in the city.

Shenzhen is also the first Chinese city to have adopted zero-emission freight zones. In July 2018, the city introduced 10 "Green Logistics Zones". Electric logistics vehicles (with gross vehicle weights under 4.5 tons) get all-day access, while conventional freight vehicles are banned.

Background

In the Accelerating New Energy Vehicle Application Guideline issued by China's State Council in 2014, urban light-duty logistics vehicles (including vehicles for cleaning and waste collection), together with buses, were proposed for prioritised vehicle electrification. The target was to have over 600,000 electric logistics vehicles, buses and coaches by the end of 2020. (At the end of 2018, the figure stood at around 130,000.)

Although China has a relatively large stock of electric logistics vehicles, most of them are in a selected number of cities like Shenzhen, Chengdu, Xi'an and Beijing. This indicates the vital role played by city-level ambition and policy incentives. A common denominator among these frontrunner cities is that they all put logistics vehicle electrification at the top of their political agenda, and have adopted a variety of policy incentives to encourage purchase and use of electric logistics vehicles. These incentives include monetary incentives like subsidies that directly reduce purchase costs, and non-monetary measures that provide electric vehicles with vehicle-registration or road-access privileges.

Road-access privileges (also known as time window restrictions) offer a cost-effective solution that was highly recommended by the Ministry of Transport and Ministry of Public Security. To curb traffic congestion and air pollution, many Chinese cities have banned most logistics vehicles from entering downtown areas during daytime (peak) hours. Lifting this ban, particularly for electric logistics vehicles, allows service providers to meet more stringent demands from shippers, and has therefore helped cities like Shenzhen and Chengdu to rapidly electrify their logistics fleet.



Table 2. Overview of monetary and non-monetary incentives in Chinese cities¹⁰²

		Shenzhen	Chengdu	Xi'an	Beijing	Guangzhou
Monetary incentives	Local purchase subsidies	✓	✓	✓	✓	✓
	Operation subsidies	✓	✓		✓	
	Charging utility rate discounts	✓				
	Subsidies on charging infrastructure provision	✓	✓	✓	✓	✓
	Diesel vehicle scrappage subsidies	✓				
	Parking incentives	✓	✓	✓		
Non-monetary incentives	Road access management	✓	✓	✓	✓	✓
	Vehicle registration requirement	✓				
	Load consolidation		✓			✓
	City-specific data platform	✓	✓		✓	

Road access management in Chengdu

In Chengdu, a road-access (time window) policy plays an important role in incentivising logistics- vehicle electrification. The city imposes a time window restriction to most freight vehicles, preventing them from entering the city from 07:00 to 22:00. Exemptions are granted to 4,300 light-duty logistics vehicles, which get permits for 24-hour access. The permits are distributed through an online bidding system. At the end of each year, all permits are revoked and re-tendered online. The base price for an A1 licence was set at 1300RMB in 2018.

Zero-emission logistics vehicles, however, are automatically entitled to city access permits at no cost. To further accelerate vehicle electrification, Chengdu is gradually shrinking the total pool of city access permits, and planned to stop issuing them altogether to non-zero-emission vehicles in 2020.

Table 3. Comparison of road access policies in Chengdu, Shenzhen and Beijing¹⁰³

	Chengdu	Shenzhen	Beijing
Access restrictions for zero-emission logistics vehicles	No road access restrictions No need to apply for a city access permit	No road access restrictions	With road access restrictions Need to apply for a city access permit
Access restrictions for fossil-fuelled logistics vehicles	Operators bid each year to obtain a limited number of city access permits City issues fewer and fewer permits; to stop issuing them to conventional vehicles in 2020.	Allows access based on odd/even licence plate parity Bans fossil-fuelled vehicles from entering the 10 Green Logistics Zones in the city.	City access permits allocated quarterly according to a merit-based system Reserves 90% of permits for ZE logistics vehicles starting in 2020.

Scheme

Intended outcomes

The aim of the Green Logistics Zones is to curb Shenzhen's growing air pollution. The transport sector's PM_{2.5} emissions account for half of the city's total. In 2017, Shenzhen's PM_{2.5} emissions increased 8.6% from 2016; municipal government came under pressure to drastically reduce PM_{2.5} emissions from 38µg/m³ in 2017 to 26µg/m³ in 2018. The idea of zero-emission freight zones was proposed by the Environment Bureau amid a host of measures to attain the pollution-reduction goal.

Stakeholder engagement

Shenzhen did not start with a long-term plan for zero-emission zones. Instead it took a trial-and-error approach in which different stakeholders all have a role to play. However, in a top-down decision-making process, public agencies – especially the top leadership's endorsement and cross-departmental collaboration – are key for its implementation.

After proposing the scheme, the Municipal Environment Bureau and the Traffic Police Department worked together to design the zones. The goal is that each urban district (a total of 11 districts in Shenzhen) will have a Green Logistics Zone sited based on emissions hotspot analysis. Public outreach and communications were carried out to finalise the specific boundaries. The Traffic Police Department took responsibility for implementing and enforcing the policy. Post-evaluation and impact analysis fell under the purview of the Environment Bureau to ensure the scheme delivers on its emission-reduction goal. All the efforts were overseen by the Mayor of Shenzhen.

Building on the initial screening of the zero-emission zones, extensive consultation meetings took place before and soon after the zones were established. These were organised by the relevant government departments and involved local retailers, property owners and public organisations within the zones, large and frontrunner logistics service providers (like SF Express, UPS, Deppon), city-wide freight vehicle leasers (like DST), and freight vehicle-hailing platforms (Uber-like truck services for on-demand deliveries).

The messages delivered to these stakeholders were carefully crafted. Besides underscoring the significant air quality and health benefits, public agencies also framed the zero-emission zones as a critical measure to curb local traffic congestion and alleviate on-street parking challenges – a narrative that resonated well with stakeholders, although the actual result is arguable.

However, two preconditions were critical for the widespread acceptance of the zero-emission zone policy by municipal officials and the public:

- **Timing:** Shenzhen timed the introduction of the Green Logistics Zones to coincide with the commercial roll-out of electric logistics vehicles. The fact that a large number of these – one fifth of the total logistics vehicle fleet – were already on the streets aided public buy-in.
- **Ample economic support:** Before the introduction of ZEZs, a significant number of public subsidies were already supporting electric vehicle purchases, operation and scrappage. Furthermore, electric logistics vehicles had one hour of free kerbside parking (and two hours of free parking in city-owned parking lots). These economic incentives made electric logistics vehicles a cost-competitive option for logistics service providers.

Zone selection and characteristics

The results of the public consultation led to the co-creation of the criteria on setting the sizes and boundaries of zero-emission zones, as well as deciding which vehicles would be exempt. Besides emissions hotspots, other criteria for the establishment of the Green Logistics Zones included the following:

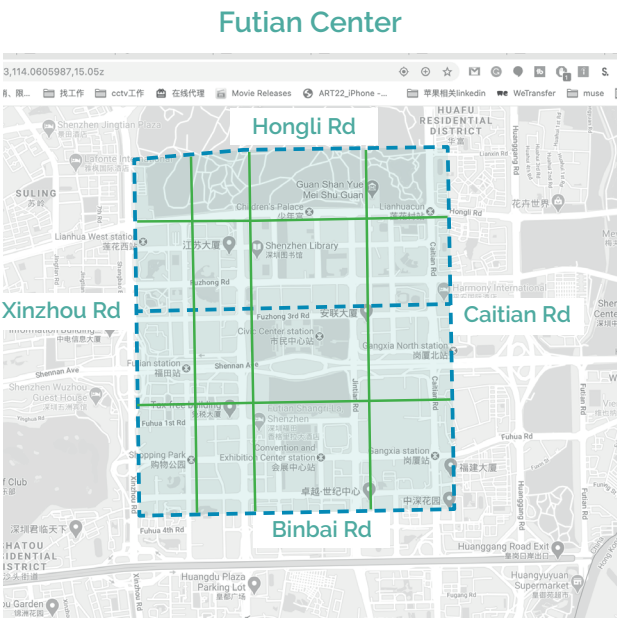
- The zones should start small, with the possibility of future expansion. Compared to one single large zone, the smaller sizes guarantee a small number of stakeholders involved and less public resistance.
- The zone should include as many office complexes, administrative agencies and residential neighbourhoods as possible, thereby avoiding potential impacts on economic vitality .
- The zones should be bounded by (but exclude) major roads to ease enforcement and provide alternative routes for through traffic.
- The targeted vehicle models are four-wheeler parcel, furniture and construction last-mile delivery vehicles. Vehicle models that are difficult to electrify, such as temperature-controlled vehicles and hazardous material (HAZMAT) vehicles, are exempted.

Based on these criteria, the Green Logistics Zone boundaries were set. The total land coverage of the zones is 22.33 square kilometres, 1.1% of Shenzhen's total land area, with the size of the zones spanning from 0.37 square kilometres to 5.4 square kilometres.

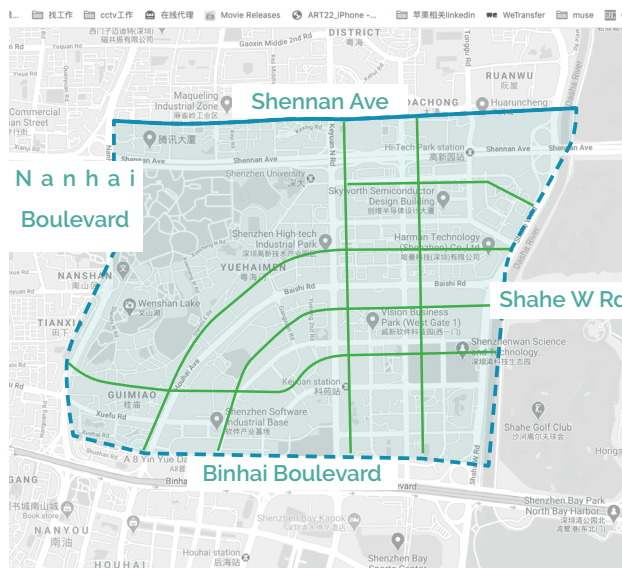
Table 4. Land coverage of the 10 Green Logistics Zones

	Futian Center	Luohu Renmin	Nanshan Tech Park	Yantian Center	Baoan Haixiu	London's Low Emission Zone
Area (square kilometres)	4.18	0.59n	5.29	0.37	1.87	1,580
	Longgang Longcheng	Shenzhen North Station	Pingshan Sports Center	Guangming Square	Dapeng Kuiyong	London's Ultra Low Emission Zone
Area (square kilometres)	5.4	0.89	0.5	2.0	1.24	21

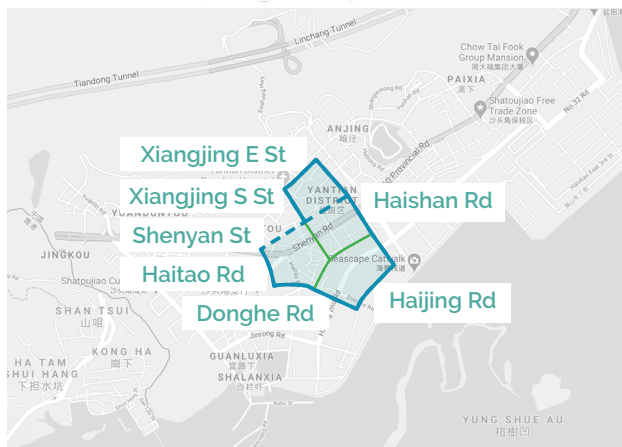
Figure 8: the outline of 3 of the Green logistic zones in Shenzhen



Nanshan Tech Park



Yantian Center



Evaluation

Next steps

The initial design of Green Logistics Zones is not perfect, and design and enforcement improvements will be needed after implementation. As the city opted for a trial-and-error approach, the focus will be on course-correcting the issues rather than setting out a fully fledged, long-term scheme for expanding the zones. Some challenges identified through evaluation of the results and consultation meetings remain to be addressed, including:

- **Upgrade the charging network:** Limited charging facilities available within the zones pose a challenge for the efficient operation of electric vehicles. Large shippers and logistics service providers indicate that the short battery ranges and increasingly higher charging power of logistics vehicles call for a more convenient charging network. Therefore, the city plans to equip 20% of kerbside parking spaces within the zones with charging facilities. Systematic planning of a fast-charging DC network is being considered.
- **Step up enforcement efforts:** With shippers and logistics service providers calling for longer lead times for phasing in the policy (the lead time was planned as approximately three months), the early stage of enforcement was warnings only, as opposed to penalties. Therefore, there was a high level of infringement. As electric logistics vehicles become increasingly mainstreamed, the city is considering when to tighten the rules. Tougher measures will be brought in by the Traffic Policy Department after the city has recovered from the impacts of COVID-19. Examples include monetary penalties, expanding the network of ANPR cameras, fine-tuning the boundaries for easier enforcement and increasing public education.
- **Improve vehicle quality:** Problems such as frequent breakdowns and malfunctions are particularly prominent with electric logistics vehicles, and have become some of the top concerns for logistics service providers. However, quality assurance of electric vehicles demands national governments' guidance and supervision of OEMs' warranty design and after-sales services. Shenzhen municipal governments have limited roles to play in this regard.



London: From “ultra low” to zero-emission zones

Background

London is planning a series of progressively larger ZEZs to support the Mayor’s goal that, by 2050, London will be a “zero carbon city” and enjoy the best air quality of any major city in the world.

London currently operates two concentric pricing zones that regulate and charge daily for vehicle access on the basis of their emissions, thus incentivising less-polluting vehicles.

The inner cordon, 22 square kilometers in central London, is the Ultra Low Emission Zone (ULEZ). Introduced by London Mayor Sadiq Khan in 2019, it is the same area covered by London’s Congestion Charge. The outer cordon is the city-wide Low Emission Zone (LEZ), which applies to trucks and covers almost the entire area of Greater London.

The zones charge for entrance at all times. Vehicles meeting strict emissions standards enter gratis, although they may still need to pay the Congestion Charge. This is particularly relevant for freight, where many companies still lack sufficient incentive to adopt electric vehicles in their day-to-day operations.

Electric, hydrogen and (until 2021) plug-in hybrid vehicles are permitted free of charge (providing the hybrid vehicles meet the emissions standard for their petrol engine) in the Ultra Low Emission Zone and also avoid the Congestion Charge. Thus, zero-emission vehicles effectively operate for free within this area.

Table 5: Example of graduated charges for vehicles within Central London (07:00–22:00)

	Congestion Charge	ULEZ charge	Total daily charge
Vehicles < ULEZ standard	£11.50	£12.00	£22.00
Internal combustion vehicles >= ULEZ standard	£11.50	Not subject to charge	£11.50
Electric, hydrogen and compliant plug-in hydrogen vehicles	100% discount applies	Not subject to charge	£0

Scheme

The mayor has announced plans to tighten the standards for the Low Emission Zone, affecting all freight vehicles over 3.5 tonnes gross vehicle weight" starting from 1 March 2021. In 2021 the ULEZ will be expanded to a larger area representing an 18-fold increase in the size of the inner cordon for cars, motorcycles, and freight vehicles up to 3.5 tonnes gross vehicle weight. This has substantial implications for logistics operations in inner London.

Evaluation

An impact evaluation of the ULEZ six months after it was launched indicated that 13,500 fewer polluting cars were driven into Central London every day. There was also a significant drop in harmful air pollution. The impact on freight is not quantified directly but is likely significant given the decline in NOx pollutants seen in the statistics below (freight is a major driver of these emissions):

- Roadside nitrogen dioxide (NO₂) pollution had reduced by 36 per cent in the zone. This was measured from the date the mayor publicly confirmed the policy and people started to prepare for the scheme. The reduction in NO₂ pollution solely attributable to the ULEZ is 29%.
- There was no increase in NO₂ pollution at the ULEZ boundary roads.
- A large reduction in the number of older, more polluting, non-compliant vehicles was detected in the zone: some 13,500 fewer on an average day, a reduction of 38%.
- Within the zone, 77% of vehicles now meet the ULEZ emissions standards rather than pay the charge.
- In May and September 2019, there was a reduction in traffic flows in Central London of between 3% and 9% when compared to 2018. This indicates the wider benefits of the ULEZ in encouraging people to switch to walking, cycling or using public transport.
- After six months, carbon dioxide emissions from road transport in the central zone were 4% (9,800 tonnes) lower than if there was no scheme. When compared to 2016 levels, this equates to an expected 13% reduction in carbon dioxide emissions if the current compliance rates continued over the course of this year.

The mayor's air quality programme, including the introduction of the ULEZ, had already contributed to a reduction of 44% in roadside NO₂ levels in Central London between February 2017 and January 2020. Following the government announcement of coronavirus-related travel restrictions, traffic levels on TfL roads fell by as much as 60% and harmful NO₂ levels was down by around 50% on some of London's busiest roads. This shows that proportional policies such as the ULEZ are extremely effective tools for mitigating congestion, improving air quality and managing freight.

Plan to achieve zero-emissions areas (ZEA) from 2020

The Mayor's London Environment Strategy (2018)¹⁰⁴ and the Mayor's Transport Strategy (2018)¹⁰⁵ set out his goal that by 2050 London will become a 'zero carbon city' and will have the best air quality of any major world city, going beyond the legal requirements to protect human health and minimise inequities.

Since the ambition for a zero carbon London by 2050 can only be achieved if all vehicles are zero-emission by that date, the Mayor's Transport Strategy sets out a roadmap to achieving zero-emission transport and to encourage the uptake of ultra low and zero-emission technologies.

The Mayor's Transport Strategy also sets out a commitment to introduce zero-emission zones in London, including for freight, while supporting the city's boroughs in delivering local zones from 2020.

"Proposal 35

The Mayor, through TfL and the boroughs, and working with Government, will seek to implement zero-emission zones in town centres from 2020 and aim to deliver a zero-emission zone in central London from 2025, as well as broader congestion reduction measures to facilitate the implementation of larger zero-emission zones in inner London by 2040 and London-wide by 2050 at the latest."

—Mayor's Transport Strategy¹⁰⁶



To further this support, in 2019 TfL published guidance for boroughs on zero-emission zones to enable them to take forward the proposal in a consistent London-wide approach.¹⁰⁷ The guidance covers different approaches to delivery, suggested standards and possible exemptions. It also provides advice in relation to managing and engaging with freight operators and businesses in developing a ZEZ-F. The guidance will be reviewed and updated every three years.

London's mayor is working with other delivery partners to implement a ZEA

To date, two London boroughs are working with the mayor to deliver zero-emission areas:

Hackney

In 2018, the boroughs of Hackney and Islington in London established a zone made up of five streets that are restricted to walking, cycling, and permitted vehicles during peak hours (Monday to Friday, 07:00–10:00 and 16:00–19:00, enforced via cameras). Permitted vehicles include electric and hydrogen vehicles and some of the cleanest, least polluting hybrid vehicles. The zone is locally referred to as ultra-low emissions streets (ULEV streets).¹⁰⁸ The scheme had strong support (70%) from residents.

City of London

In 2019, the City of London Transport Strategy included a proposal to support and champion a Central London zero-emission zone (ZEZ) by 2024.¹⁰⁹ It seeks a phased introduction of ZEZ restrictions with the aim of ensuring that 90% of motor vehicles entering 'the Square Mile' are zero-emission capable by 2030. This is likely to be achieved through a combination of street access restrictions and charging for non-zero-emission capable vehicles.

Key support for zero-emission alternatives

Financial concerns: Given the costs of switching to zero-emission alternatives, the city has introduced a scrappage scheme that supports businesses, charities and low-income residents to overcome barriers to investing in zero-emission capable vehicles. There is a scheme for cars and motorcycles,¹¹⁰ and a separate scheme for vans and minibuses.¹¹¹ Freight operators have benefited from this programme. A scrappage scheme for heavy trucks has also recently been launched.

Furthermore, the mayor established an Electric Vehicle Charging Infrastructure Delivery Taskforce. This brings together representatives from business, energy, infrastructure, government and London boroughs to publish recommendations around how, when and where to increase London's electric vehicle infrastructure up until 2025. A key output¹¹² is London's Electric Vehicle Charge Point Installation Guidance by TfL.¹¹³ The guidance aims to inform city planners, engineers and other interested parties on how best to implement and deliver charging infrastructure across London.



Santa Monica: A voluntary zero-emissions delivery zone

Background

In April 2020, the Los Angeles Cleantech Incubator (LACI), guided by goals and objectives set by its multi-stakeholder Transportation Electrification Partnership (TEP),¹¹⁴ partnered with the city of Santa Monica, a medium-sized city in the County of Los Angeles, to pilot a voluntary zero-emissions, last-mile delivery zone, the first of its kind in the United States, for a period of one to three years.¹¹⁵

Scheme

Intended outcomes of the pilot Zero-Emissions Delivery Zone (ZEDZ) in Santa Monica include:

- Develop a blueprint for cities to adopt ZEDZs for last-mile delivery and demonstrate best practice for other zero-emission zones
- Provide ahead-of-the-curve learnings to delivery companies for ZEDZ operations by working hand in hand with the project implementation team
- Provide immediate benefits to the local community, such as reduced air pollution, greenhouse gas emissions, noise and congestion, as well as improved safety
- Provide economic opportunity to small businesses and individuals through access to zone benefits.

Stakeholder involvement

The ZEDZ in Santa Monica is developing a project support team composed of a Leadership Team and Advisory Committee. The two groups will work together to design, implement and operate the zone with involvement from key stakeholders. On the Leadership Team, LACI leads project management, with the Santa Monica and Southern California Association of Governments (SCAG)¹¹⁶ in supporting roles for all tasks. The Leadership Team is responsible for project planning and execution; goal setting; outreach and communications; data tracking and analysis; and convening the Advisory Committee.

The Advisory Committee is made up of local, regional and commercial stakeholders such as the city of LA's Urban Movement Labs (UML),¹¹⁷ the area utility Southern California Edison,¹¹⁸ and local transit agency Los Angeles Metro,¹¹⁹ local Business Improvement Districts (BID), and community-based organizations. It will meet monthly to review, offer guidance and support the activities in the zone. The Leadership and Advisory teams will evaluate metrics and progress on a quarterly basis to course-correct and amplify best practices, as needed.

Beyond the local BID participation, the Advisory Committee will incorporate corporate interests, namely major in-kind sponsors like OEMs that donate vehicles for use in the zone, and delivery companies committed to participating in the zone.

Delivery company engagement

The ZEDZ in Santa Monica is specifically focused on parcel, food and furniture last-mile deliveries typically made by light and medium-duty vehicles. As the Santa Monica Zone will be voluntary, delivery companies have the unique opportunity to work hand in hand with LACI, the city of Santa Monica and other key stakeholders to design, deploy and implement technologies and policies in the zone. Delivery companies that commit to good-faith efforts to achieve 100% zero-emission last-mile deliveries will have representation on the Advisory Committee. This will give them the opportunity to actively shape the implementation and operations of the zone, and evaluate supportive technologies first-hand in a limited-risk environment.

Zone selection and characteristics

The Santa Monica ZEDZ was selected in a collaborative process with key regional stakeholders and delivery companies. The LACI-led process began with an Expression of Interest call whereby interested cities and Business Improvement Districts in the LA region could propose a one- to three-square-mile area for a pilot zone. Proposals included commercial and residential characteristics, mobility challenges and pain points faced by the community, and ideas for zone deployment. Furthermore, the Expression of Interest called for partnerships and collaboration with community-based organisations and real estate to encourage essential buy-in from residents and business.

LACI, TEP partners and delivery companies evaluated Expression of Interest proposals to determine the best fit for last-mile delivery operations, city cooperation and transportation department flexibility, diverse and dense last-mile delivery needs, and scalability.

Santa Monica Zone

As the selected community, Santa Monica proposed approximately one square mile of the city that includes key commercial districts such as Main Street and Third Street Promenade, as well as 15,850 residents. The specific boundaries are noted by the red dashed line in Figure 10. This diverse representation of residential and commercial makes the zone an appropriate place to test applications for food and parcel delivery using different modalities.

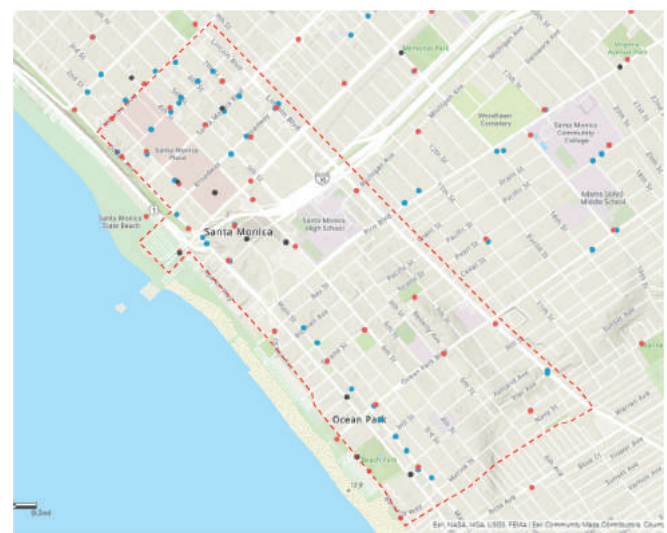
Furthermore, the identified zone already has substantial infrastructure in place to support various zero-emission modalities, including a robust network of electric vehicle charging (Figure 11) for light- and medium-duty vehicles, and a bike lane network for e-cargo bike delivery (Figure 10). The pilot will use this pre-existing infrastructure to its advantage in order to test new supportive technologies for a zero-emission last-mile delivery zone.

Figure 9. Santa Monica ZEDZ boundary



- Proposed ZEDZ Boundary Separated and Protected Bike Ways
- Designated Bike Routes Bike Lanes/ Buffered Bike Lanes

Figure 10. Santa Monica ZEDZ modalities



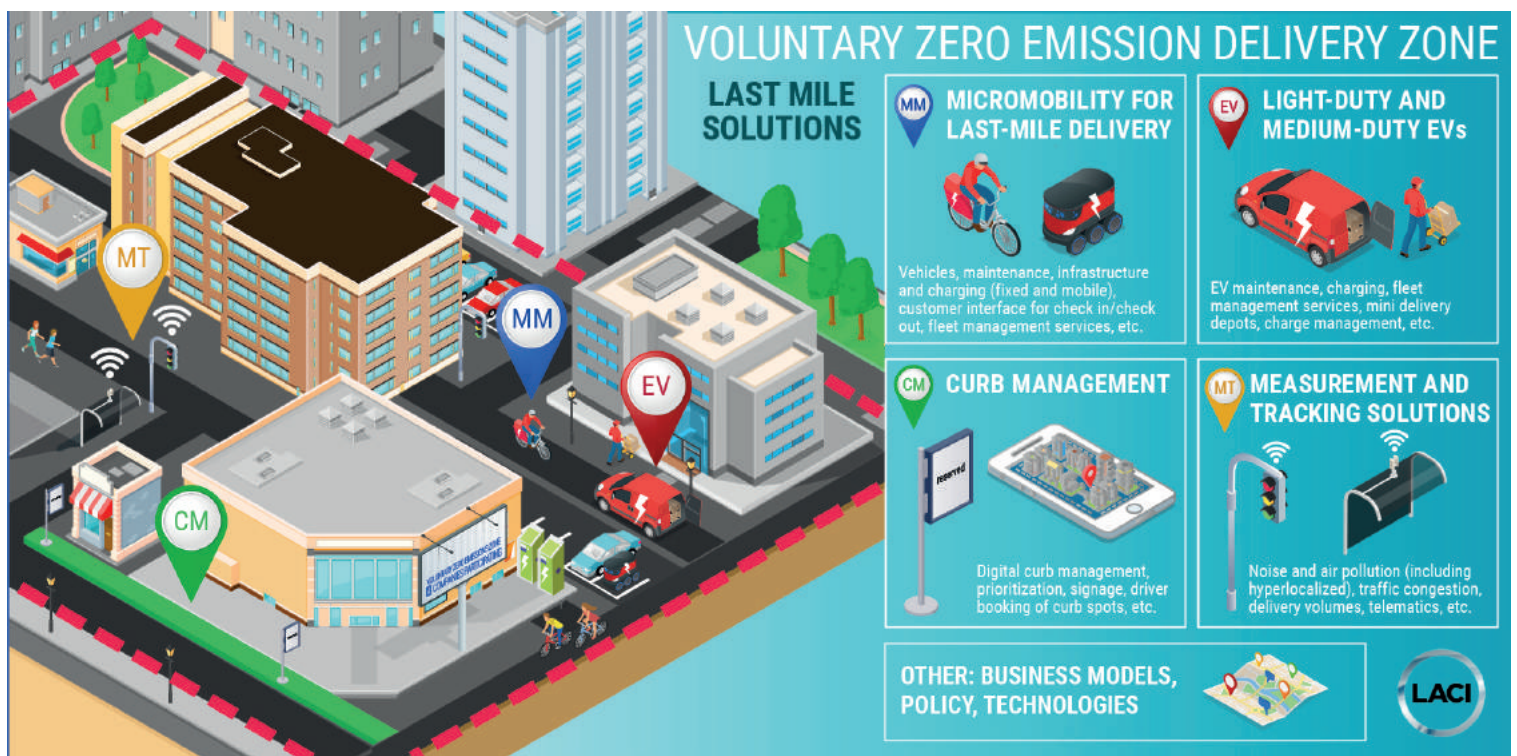
- Proposed ZEDZ Boundary ● Breeze Bike Share Stations
- EV Chargers ● Shared Mobility Drop Zones

Technology deployment

The pilot will deploy technologies and services such as:

- E-cargo bikes and other micro-mobility devices for last-mile delivery of parcels, groceries and food: vehicles, maintenance, infrastructure and charging (fixed and mobile), customer interface for check-in/check-out, fleet management services, etc.
- Kerb management, including digital kerb management, prioritisation, signage, driver booking of kerb spots, enforcement, etc.
- Light-duty and medium-duty electric vehicles used for last-mile delivery of parcels and furniture: vehicles, electric vehicle maintenance, charging (fixed and mobile), fleet management services, mini delivery depots, charge management, etc.
- Measurement and tracking solutions for noise and air pollution (including hyper localised), traffic congestion, delivery volumes, telematics, enforcement, etc.
- Other innovative solutions that can help a voluntary last-mile delivery zone to succeed (business model solutions, policy solutions, technology solutions, information and best practice sharing platforms or clearinghouses, etc.).

Figure 11. Voluntary Zero Emission Delivery Zone



Evaluation

In May 2020, LACI released a Request for Information seeking technology and service solutions. As of July 2020, the ZEDZ in Santa Monica was still in the design phase of the pilot, but was quickly progressing. At the end of June, LACI received over 85 applications to the ZEDZ Technology Request for Information, and was set to evaluate zone and delivery partner needs for applicant fit over the summer for implementation in the autumn. An initial launch of kerb management and micro-mobility solutions for the ZEDZ is anticipated in late 2020, with follow-on and additional technology deployments for 2021 and 2022.



ZEZ-Fs should not be seen as 'vehicle replacement' or 'one-size-fits-all' interventions. Rather, they can encompass a new way of seeing freight as a system.

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First Name	Last Name	Organisation
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Himanshu	Raj	ICLEI
Tu My	Tran	ICLEI
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First Name	Last Name	Organisation
Kelly	Schmandt Ferguson	LACI
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Anja	Huber	McKinsey & Company, Inc.
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Luis	Filipe	
Nerea	Rojas	MLC
alejandra	madero	Norwegian Public Roads Administration
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Jasmeet	Khurana	WBCSD
Maya	Ben Dror	WEF
Lulu	Xue	WRI

Content editing | Carole Douglis

Copy editing | Alision French

Design | Alice Yu



Partners behind this paper

This paper was co-created and co-written and by the following three organisations:

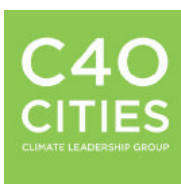


Transport Decarbonisation Alliance (TDA)

The TDA brings together representatives of countries, cities and regions, and companies—the “3Cs”—to accelerate action to decarbonize transport worldwide.

www.tda-mobility.org

Coordinator: **Sita Holtslag**, Sita.Holtslag@rvo.nl



C40

C40 is a network of the world's megacities committed to addressing climate change. C40 supports cities to collaborate effectively, share knowledge and drive meaningful, measurable and sustainable action on climate change.

www.c40.org

Coordinator: **Cristina Miclea**, cmiclea@c40.org



POLIS

POLIS is the leading network of European cities and regions working together to develop innovative technologies and policies for local transport.

www.polisnetwork.eu

Coordinator: **Giacomo Lozzi**, GLozzi@polisnetwork.eu

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