

Zero-Emission Zones in the City: Don't Wait to Start with Freight!



Preface



Ms. Liane M. Randolph
Chair, California Air Resources Board
Chair, Transport Decarbonisation Alliance

Recent natural disasters have brought humanity face to face with the consequences of our greenhouse gas emissions. At the same time that floods in Pakistan left a third of the country underwater, parts of the Rhine and Yangtze rivers dried up. A week of heavy rainfall caused mudslides in South Africa, California has experienced record-breaking wildfires, and temperatures in India soared to levels not seen in a century.

Affected communities have had to cope with these disasters even as they are still in the midst of recovering from the COVID-19 pandemic. Despite its challenges, however, the pandemic provides us with an unprecedented opportunity to focus our recovery toward sustainable development. The Transport Decarbonisation Alliance (TDA) works to foster cooperation among countries, regions, cities, and companies toward carbon-free transport, accelerating action through synergy. A key focus for TDA is to advocate for and support the transition towards green freight, including Zero-Emission-Zones (ZEZs) and zero-emission truck deployments.

The first TDA How-to Guide for Zero-Emission Zones (ZEZ-Fs), released in December 2020, laid out comprehensive pathways for cities across the globe to reduce their carbon footprint. The updated guide presented here shares examples of zero-emission zones around the world that are at varied stages of implementation, along with detailed steps towards successful implementation of ZEZ-Fs. This guide also broadens the discussion to include the role of zero-emission truck deployment in establishing successful zero-emission zones and in other green freight applications.

According to the Multi-State Medium and Heavy Duty Zero Emission Vehicle Action Plan, published by the Northeast States for Coordinated Air Use Management (NESCAUM), “[r]egulatory programs requiring manufacturers to sell increasing percentages of zero-emission trucks and buses, such as California’s Advanced Clean Trucks (ACT) regulation, are one of the most effective tools available to rapidly advance the market for MHD ZEVs. Under the ACT regulation, manufacturers of Class 2b-8 vehicles must sell an increasing percentage of ZEVs.” California, Massachusetts, New Jersey, New York, Oregon, and Washington – representing 20% of the US truck market – have adopted the ACT regulation, which sets clear, aligned targets for the truck industry, EV charging providers, fleet operators, and investors. This regulation can serve as an example for other countries and regions across the world that are interested in accelerating the zero-emission truck market.

Developing a sustainable freight system by transitioning to zero-emission vehicles and establishing zero-emission zones is critical to our collective efforts to combat the climate crisis and protect public health. We hope that this guide will be a useful resource to jurisdictions around the world as they plan for and implement the shift to zero-emission zones and green freight.



Foreword



Ms. Sita Holtslag

*Europe Director CALSTART/Drive to Zero
Former Chair of the Community of Interest
on Urban Freight at the TDA*

The COVID-19 pandemic put a spotlight on our dependency on freight and especially the role of freight in urban centres. Thanks to raised awareness about freight related emissions - we're all talking about freight! And this is a good thing.

The transport of goods is not a goal in itself. It is the result of a customer or business order being delivered and therefore a means to an end. With growing urban populations and the increase in urban freight movement, cities are on the front lines of transport's harmful impacts. While high levels of airborne pollutants threaten quality of life, cities across the globe also face major challenges such as increasing GHG emissions, the safety of people in the streets, precarious working conditions and the economic burden of congestion. Most urban dwellers are exposed to levels of pollution well above recommended limits, and urban freight is a major cause. We - public sector, business and consumers-citizens - are all responsible for the increase in freight movements, and thus we have a responsibility to organise (or reorganise) this system in the most efficient and clean way possible. And this is not just a matter of replacing current fossil fuel-powered trucks and vans with zero emission alternatives, it requires a deep system redesign which will affect and include all stakeholders.

The transformation of urban freight needs commitment and action on all levels, uniting Countries, Cities, Regions, and Companies setting up a roadmap towards the common goal of Zero-Emission Urban Freight. ZEZ-F is one of the most powerful tools in this direction.

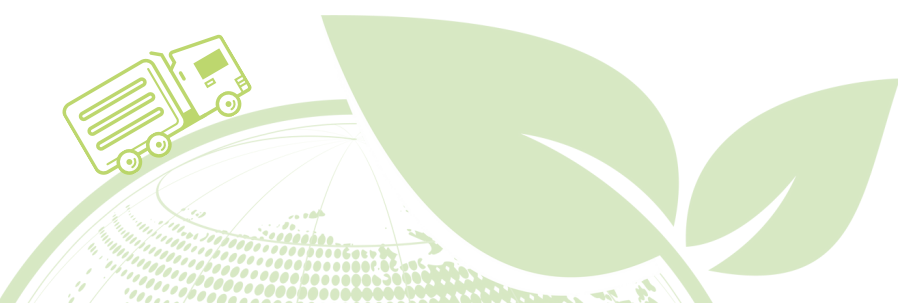
The impact of ZEZ-Fs should not be underestimated! It has a powerful ripple effect on businesses, cities, and the freight industry as a whole and is often named as the main cause for companies to move NOW instead of "later". If a company cannot enter the city with fossil fuel vehicles after a certain date, the investments toward smart, innovative, and zero-emission solutions becomes a business decision—not a "nice to have" but a "must have". Thus, making investments, scaling up innovation and defining new business models are key contributors to making a shift to Zero-emission zones more accessible for companies.

I am so very proud of this new version of the Zero-Emission Zone: How-to Guide and feel honoured to have seen the progress of this work since its inception. Let this guide serve as an inspiration and a resource to give you the needed tools and network to start or scale up today. Zero-emission freight- it can be done. It must be done. Are you in?



Table of Contents

Executive Summary	4
Zero-Emission Zones for Freight – a win-win for all partners	5
Toward a successful ZEZ-F: steps for Action	8
Hurdles - and How to overcome them	17
Examples and case studies of ZEZ-F	19
Examples and case studies from cities that are on their way toward ZEZ-F	32
Integrating ZEZ-F into the freight transport network	60
ZEZ-F and implications on the supply of alternative fuels, grids and energy supply	62
Authors	65
Partners behind this document	67
References	69



Executive Summary

The Need for ZEZ-Fs

Though less than 4% of vehicles on the road are trucks, it is estimated that they are responsible for 27% of road transport's CO₂ emissions. As urbanisation grows, absolute numbers of population, as well as population density, are continuing to rise in cities. Consequently, urban commercial transport is also increasing, exacerbating congestion and harmful emissions. Action is needed to improve strategies for transport and to reduce transport-related emissions: air pollution, noise pollution, and greenhouse gas emissions.

As cities around the world seek to reduce their carbon footprint, many are pursuing zero-emission zones (ZEZs) and other measures for mass transit and personal mobility. However, freight transport is often overlooked by city planners and in transport strategies. In 2020, the Transport Decarbonisation Alliance (TDA) of countries, cities, regions and companies, C40 Cities, jointly with the POLIS network of European cities and regions, released the Zero-Emission Zones: Don't wait to start with freight! how-to guide. The guide assists urban planners, transport officials, freight operators and other stakeholders to navigate the complex ecosystem of urban freight and develop zero-emission zones for freight, which can help cities decarbonise, clean the air, reduce congestion, improve environmental justice, increase efficiency of deliveries, and more.

Implementing a ZEZ-F in a city can be daunting and overwhelming. It can be helpful to consider the shift to zero-emission zones as a process of continuous improvement rather than a one-off project. This updated version of the how-to-guide incorporates the constructive and experience-based feedback received by the TDA and its partners on the first version of the guide. It adds further examples from cities of all sizes from all over the world. This guide is meant to inspire ideas for ZEZ-F in your city and to provide suggestions for first steps that will help city officials, transportation planners and consultants to get started with the implementation of ZEZ-F.

With the resulting hands-on guidelines, the route is clear for your city to join the frontrunners, so:

Don't wait to start with freight!



Zero-Emission Zones for Freight – a win-win for all partners

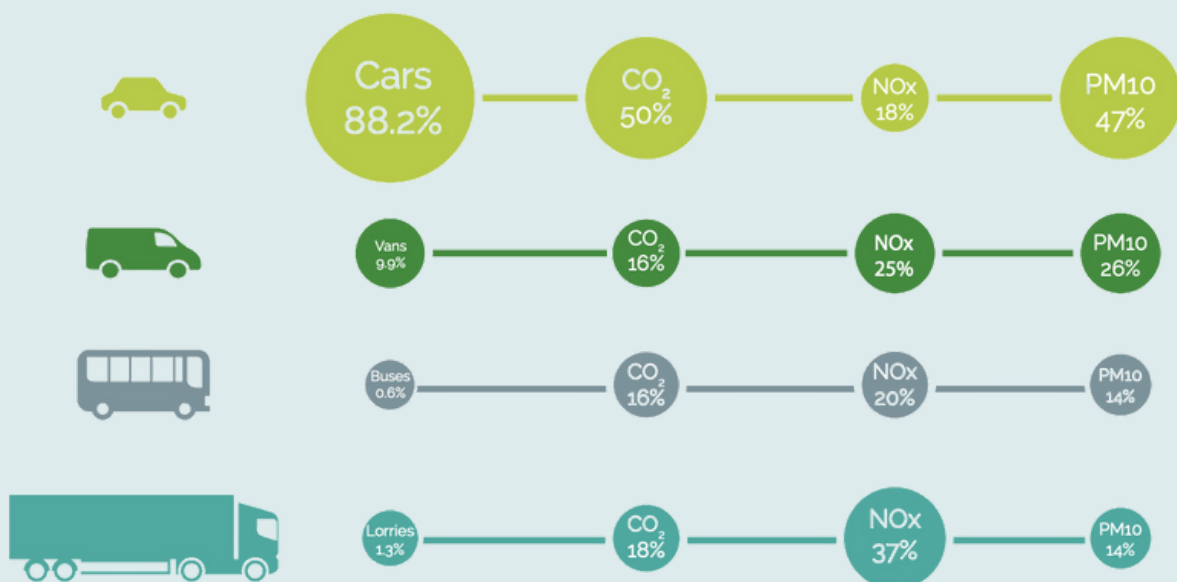
ZEZ-Fs contribute to a reduction of local emissions. They are an efficient, cost-effective and necessary step to reducing emissions in cities and can significantly contribute to decreasing traffic jams. All actors of city life benefit:

- Citizens benefit from less congestion, reduced emissions and improved air quality.
- Logistics providers benefit from improved efficiency and are able to offer better working environments, by reducing driver exposure to vehicle fumes and noise; these improvements have been mentioned time and again by drivers as stress-reducing and thus efficiency-improving in various surveys and projects.
- Local businesses benefit from increased attractiveness of city centres.
- Politicians, municipalities, and governments are able to meet emissions and air quality targets, supporting the healthy development of their cities. Ideally, a transition to zero-emission zones can be linked to an increasingly sustainable and independent energy supply.

The freight sector is a key element of vibrant cities, yet is disproportionately energy-intensive and polluting.

Freight transport constitutes a relatively small share of global on-road supply chains, yet it is responsible for substantial amounts of Greenhouse gas emissions: whilst only around 10% of all international tonne-kilometres of freight transport is taking place on a national level, it is responsible for 30% of the entire trade-related CO₂ emissions.¹ These transport accounts 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). Given the sector's continued reliance on diesel-powered vehicles, freight presents significant challenges for global, national and regional climate targets, as well as for air quality, health, noise and equity outcomes in cities.²

Figure 1. In more depth: role of freight transport in the context of urban emissions



Note: Proportion of vehicles in terms of traffic and emissions based on 2015 data from the city of Rotterdam

Ensuring a sustainable transport transition in cities is key to adhering to the 1.5-degree-warming goals of the Paris Climate Agreement, as well as protecting quality of life in cities. The urban freight sector has a significant role to play in this transition.

Around the world, cities have been at the forefront of the transition to a zero-emission future. More than 35 cities have committed to implementing zero-emission areas by 2030 or earlier, in line with C40's Green and Healthy Streets Accelerator in its 2011.³

The European Commission has highlighted the need to reach zero-carbon city logistics by 2030 as a major step in the continent's sustainable transition in its White Paper on Transport.⁴

It is important to make sure the transition to ZEZ-Fs is not seen as 'vehicle replacement' or a 'one-size-fits-all' intervention. Rather, ZEZ-Fs are an opportunity to encompass freight as part of the city's supply and transport system.

ZEZ-F creation is a process that requires a re-thinking of urban transport strategies. To successfully change the urban freight system, it is important to integrate all relevant stakeholders into the process. Urban logistics 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, infrastructure or related services, and they all have different business models.

In more depth: What are ZEZ-Fs?

ZEZ-Fs are areas in cities where only zero-emission delivery and freight transport vehicles may enter. Such access schemes not only reduce pollution and improve the health and liveability of urban areas, they can also improve efficiency.⁵ By establishing ZEZ-Fs, cities can accelerate the decarbonisation of transport while simultaneously encouraging more optimised freight service and distribution models.⁶

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 actors 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, 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 intermediaries between the national and regional governments and local fleets and companies. Notably, the aims of ZEZ-Fs 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.

Stakeholders to activate and engage include e.g. freight transporters, businesses in the city, grid providers, etc. (for a more detailed list see Figure 3 and Table 1 in the following chapter *Toward a successful ZEZ-F: steps for Action*) They can contribute information on depot requirements, charging infrastructure needs, regulatory requirements and limitations, etc.

The following chapter suggests how to activate these groups and key steps to initiating the pathway to ZEZ-Fs, based on the experience of cities that successfully started the journey.

In more depth: Why do cities need ZEZ-Fs?

ZEZ-Fs can:

- Address health and other inequalities from freight activity.
- Contribute to reducing costs related to the impact of noise and fume emissions on citizens' health, which significantly impact economies, also on a local levels.
- Stimulate the market for zero-emission freight vehicles.
- Keep cities alive as cultural and commercial centres.

The freight sector has immense potential to contribute to cleaner air for all. Furthermore, ZEZ-F can contribute to prioritise efforts in traditionally marginalised communities that have suffered most from high freight activity (e.g. near warehousing, ports)⁷. Research from the U.S. National Institutes of Health (NIH) and Harvard's T. H. Chan School of Public Health, 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% higher than in other areas.^{8, 9, 10, 11} ZEZ-Fs can contribute to addressing these existing health inequalities whilst at the same time helping to reduce resulting health costs and negative economic impacts.

Zero-emission technology solutions benefit freight workers, who experience worse health outcomes as a result of elevated PM2.5 and NOx concentrations and raised noise levels from diesel engines at logistics hubs and near highways¹².

ZEZ-Fs have the potential to create a sea-change in the availability of zero-emission freight vehicles. 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), even small initiatives have the potential to be far-reaching.

The growing demand for zero-emission freight vehicles incentivises Original Equipment Manufacturers (OEMs) to invest in the development of these vehicles. Initiatives such as EV100+, a global coalition launched by the Climate Group in 2022 to transition to electric medium and heavy-duty vehicles, can also bolster demand from companies and fleets for zero-emission vehicles, further incentivising OEMs.

Toward a successful ZEZ-F: steps for Action

The following list outlines steps cities should take to achieve buy-in and approval for ZEZ-Fs, which is key to their successful implementation. The order may vary from city to city, and in most cases, it is necessary to proceed in an iterative and cyclical process.

- Obtain necessary data and information on city issues.
- Identify an area as a starting point for your ZEZ-F.
- Engage stakeholders and gain their support.
- Define targets and link them to regional, national and international targets.
- Clarify regulatory powers.
- Identify an implementation pathway and strategy.
- Set an ambitious yet realistic target timeline.
- Test and pilot your innovations.
- Evaluate the tests and amend your pathway where necessary.
- Implement, monitor, fine-tune and aim higher.

Obtain necessary data and information on city issues

It is important to start by identifying the specific requirements and opportunities of your city regarding the implementation of a ZEZ-F; there is no “one-size-fits-all” approach for a successful shift. Understanding the needs, challenges, and interests of the various stakeholders and sub-communities is key to involving them in a collaboration for devising effective rules and incentives for ZEZ-Fs. Obtaining all necessary data is therefore an important first step.

Transparency and trust are key for obtaining the relevant data. Therefore, cities should clearly define the purpose for which they collect and analyse data, so as to entice the private sector to share information - especially since companies can be valuable partners. In the short term, cities might provide benefits and incentives for companies to share data, such as prioritised access. Cities - together with logistics operators - should also define specific use cases and a framework of principles for data sharing.

Furthermore, models are needed to understand and interpret the data for an effective, evidence-based, policy-making process.¹³ The World Business Council for Sustainable Development (WBCSD), in partnership with member companies, has released a position paper on emerging principles for data sharing in urban mobility.

National and subnational governments are also often in possession of vast amounts of transportation data. Integrating these with urban data collection and ensuring 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 transparency, and thereby the success of ZEZ-F planning and implementation efforts.

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

- 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 and in collaboration with all relevant city departments and agencies to maximise impacts and address knowledge gaps. Cities should work with other departments to get the more complete information as well as with chambers of commerce and industry representatives. Universities can be valuable partners in the data-collection process because they can act as neutral third parties, facilitating data collaboration with the private sector.

Identify an area as starting point for your ZEZ-F

Based on the needs of your city and the data analysis, you can identify an area as a starting point for your ZEZ-F. Once this location has been identified for the ZEZ-F, additional data specific to the area identified should be reviewed to customise and adjust the ZEZ-F design to the area's requirements. Such 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 trip data from companies.

Engage stakeholders and gain their support

In particular shop keepers in city centres often express concern that vehicle access-restriction schemes may lead to a decline in business for local shops, due to issues in deliveries as well as due to the fact that customers cannot come to the shops with their own car anymore. However, increasing evidence shows that these concerns are unnecessary. As part of the BuyZET Project, the cities of Rotterdam, Copenhagen and Oslo involved their suppliers, large and small, in an open, cooperative dialogue. This approach proved successful and an essential basis to define an inclusive procurement process while maintaining high environmental standards.¹⁴ This way, ZEZ-F could be implemented in the cities without any delivery issues, and at the same time the shopping experience for customers could be improved.

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: Logistics activities depend on the interaction between many stakeholders. It is important to identify all stakeholders in the urban freight sector which are directly or indirectly affected by logistics operations and the implementation of the ZEZ-F, such as government authorities, elected officials, shippers, carriers, receivers, logistics tech companies, researchers and non-profit organisations focused on industry, local neighbourhoods, safety/health/quality of life concerns, equity issues and more. 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.

Figure 3. Stakeholders in the urban freight sector.

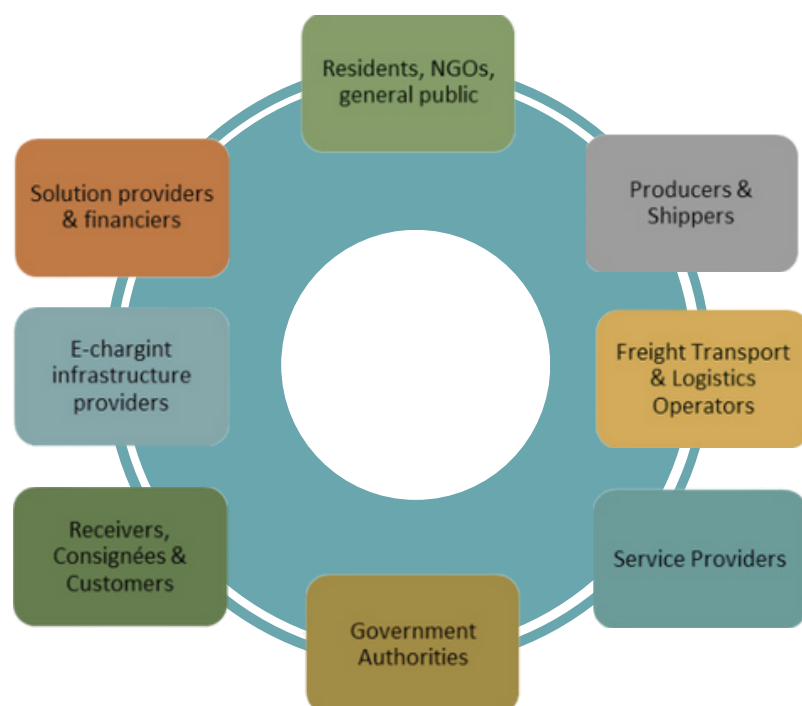


Table 1. In more depth: Mapping stakeholders: A spectrum of ZEZ-F stakeholders with their salient features and interests.

Producers and shippers	Freight transport and logistics operators
<p>Produce or aggregate goods some outsource transport and logistics operations, some operate their own fleet often located outside cities.</p>	<p>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.</p> <p>Behaviour reflects the need to meet customers' requirements.</p>
Service providers ¹⁵	Government authorities
<p>Services such as cleaning services, catering, plumbing, or locksmith services, which require the movement of people and goods.</p> <p>Tend to be locally owned, with lower financial flexibility, often using older and more polluting vehicles.</p> <p>Waste-collection service and reverse logistics, communal organisations, or contracted service providers.</p>	<p>Municipalities and local agencies from different sectors focus on the adoption of targets, regulations, and infrastructure supporting the shift to ZEZ-Fs.</p> <p>A balance between promoting sustainable urban development and fostering economic growth.</p> <p>National/regional governments can either support ZEZ-F adoption targets or be a barrier to implementation.</p>

Receivers	Residents/ Local communities/ NGOs
<p>Highly heterogeneous group: small retailers, construction sites, international retail chains, shopping centres, etc.</p> <p>Each segment has specific demands in terms of delivery time, transport conditions, pricing, etc.</p> <p>Expect high quality of service (reliability, flexibility, short transit times) at low prices Include public authorities with the potential to influence type of vehicles and modes used for their supplies.</p>	<p>This group includes private households, local community groups, as well as all forms of NGOs, including environmental justice groups and local community groups.</p> <p>May be receivers, through e-commerce expect access to a wide range of high-quality goods at affordable prices.</p> <p>Are at the same time affected by freight activity.</p> <p>Expect a good quality of life, e.g. clean air, security, a clean built environment, quiet green areas, and appealing leisure and shopping zones.</p>
E-charging infrastructure providers/operators	Solution providers and financiers
<p>Charge Point Operator (CPO) manages, maintains and operates charging stations.</p> <p>Mobility Service Provider (MSP) holds the contract for all services related to electric vehicle operation.</p> <p>Energy supplier, electric utility.</p> <p>Distribution System Operator (DSO).¹⁶</p>	<p>Investors, infrastructure and land or depot owners.</p> <p>OEMs, technology providers, are crucial to ensuring the widespread availability of zero-emission freight vehicles on the market at affordable price ranges.</p>

Note: 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. 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).

- Consulting stakeholders:** With all identified stakeholders, preliminary and regular dialogue needs to be initiated and maintained throughout the transition to the ZEZ-F. This is essential to understanding stakeholder needs, keeping them engaged, and informing them about key decisions with regard to ZEZ-F implementation and important adjustments. A lot of 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.

For the public-sector bodies directly responsible for implementing ZEZ-F schemes, engagement provides a meaningful opportunity to understand stakeholder needs. At the same time it offers the opportunity to revise, update, and receive guidance on ZEZ-F plans from other concerned parties. Each sub-segment of city logistics has different requirements regarding type of shipment, transported volumes, customer requirements, types of vehicles operated, number of stops, etc. Engagement allows officials to consider all segments of city logistics, integrate their different needs, and improve overall efficiency.

It is important to be aware of the role model position of city administrations themselves when motivating all other stakeholder groups: by setting zero-emission procurement criteria for goods and services delivered to municipal buildings and organisations, public authorities can demonstrate a firm commitment to zero-emission freight, raise their credibility, and influence the market significantly. Such a commitment by the public sector is especially important given the degree to which public authorities are also heavily engaged with logistics activities. The European Commission estimates that public procurement accounts for 14% of EU gross domestic product (GDP)¹⁷ ranging from waste collection to cleaning services, and maintenance of public spaces to catering services for schools.¹⁸

In more depth: Engaging the private sector for ZEZ-Fs

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 example, EV100+ members have committed to transition their fleet of vehicles over 7.5 tonnes, known as medium- and heavy-duty vehicles (MHDVs), to zero emission by 2040 in OECD markets, China and India. 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.

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 response 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.

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)¹⁹ or 'green deals' (Rotterdam, Amsterdam)²⁰ and 'charters for sustainable logistics' (Paris)²¹ or a forum such as the 'LoCITY Forum (London).²² Logistics Living Labs, described later in this paper, 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 businesses²³ 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.

Define targets and link them to regional, national and international targets

Clearly defined targets and objectives are key for a successful implementation of ZEZ-Fs. Therefore, it is important in a next step to clearly identify the issues that the ZEZ-F aims to solve, to establish their existing baseline and then to define a clear set of objectives, goals and key performance indicators (KPIs) to be achieved by the ZEZ-F scheme, against the existing baseline, e.g. CO₂, pollution or noise reduction, percentage of zero-emission goods movements, aimed for reduction of congestions, etc., All this needs to be accompanied by a timeline, and objectives, targets and the timeline need to be communicated to all stakeholders.

Furthermore, reaching targets of the Paris' agreement should be made an official priority by regional or national governments in support of cities. A successful example is the Green Deal in the Netherlands where 30 - 40 cities committed to implementing a ZEZ by 2025. This target has been adopted by the National Climate Agreement, a binding law, which ensures political commitment for implementation.

Collaborating with neighbouring cities, regional and national governments can help facilitate ZEZ-F planning. Establishing a common approach or common principles for the zones, as well as coordinating public outreach and other communications create a predictability that helps companies make the business case for zero-emission solutions. Since many companies operate across multiple cities and neighbouring regions, they need a common approach and consistent implementation timelines to plan and invest with greater confidence. National harmonisation is important to achieve a higher acceptance rate, as drivers should not encounter different rules and regulations in each city.

Commitments on a national or even international level, aligned policy, and financial support boost uptake of ZEZ-Fs. Local governments remain responsible for implementing and managing their own ZEZ-F, including deciding where it will be located while the national or regional government is responsible for the goals, harmonisation, starting date, road signage, enforcement (laws and national regulations), and incentives for businesses.

Clarify regulatory powers

Each city's ZEZ-F will be unique - the size, shape and management depending on the city's specific situation and vision, the stakeholders and the governing authority. It is therefore important to identify the regulatory powers and limitations. Furthermore, roles and responsibilities for the implementation and realisation of the targets need to be allocated clearly, based on the identified regulatory powers, as some measures might have to or should be realised on a regional or national level, rather than city-level. In some regions, cities may have limited power to regulate vehicle accesses and may need to set up solid governance schemes in cooperation with local boroughs and/or national agencies.

Some European countries have national low-emission zone plans and frameworks in place, substantially easing the process of implementing low-emission zones and ZEZ-F at the city level. In China, based on the national 13th Five-Year-Plan, low-emission zones have been established in cities such as Beijing and Shenzhen. In the US, cities are often federally preempted from implementing access control regulations on environmental grounds. However, they are often allowed to implement incentive-based programmes to reduce congestion. Cities also control the curb and can set specific rules and pricing for curb usage, providing preferential treatment to zero-emission freight vehicles.

Announcing a ZEZ-F is a cornerstone policy in itself. It is important that this step is accompanied by complementary measures to ensure its effectiveness.²⁴ These can either be enforcements or financial incentives and subsidies, e.g. to reduce upfront vehicle costs. The purpose is to "encourage behaviour change of operators, shippers, or receivers, offering various additional services, facilities or incentives".

Which incentives a city chooses will be defined by the regulatory powers of the different policy levels, as some incentives are better supported by national or regional governments, e.g. national subsidies and incentives schemes, such as registration tax exemptions, tax deductions and a reduced rate on truck levies.

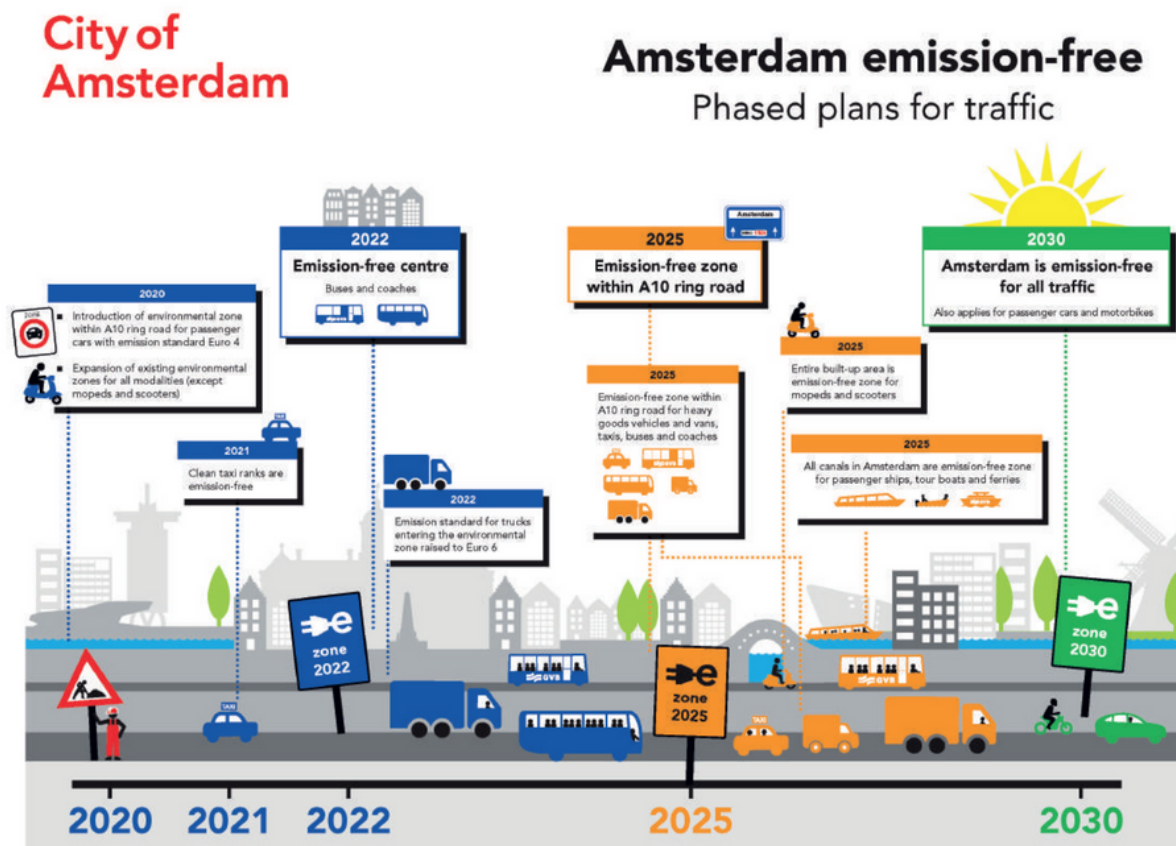
Identify an implementation pathway and strategy

Developing an implementation strategy is the next key step, which should cover the parameters, such as the specific location(s) for the ZEZ-F, incentives related to the shift, rules and regulations to accompany the shift, infrastructure requirements, development, and installation (charging points, signage, tech), steps for enforcement, information, education and announcement as part of a communication concept, integration with other transportation and logistics plans and strategies of the city, etc. (Please see also the example of Oslo in the chapter of Examples and Case Studies On the route to ZEZ-F for further specifications and specific application)

Set an ambitious yet realistic target timeline

All key timelines, milestones, and long-term goals need to be agreed and 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 Plan.²⁵



Test and pilot your plans and innovations

Tests and pilots in selected areas help introduce a ZEZ-F. These can be limited to a single road or a set of streets. When designing the test or pilot, key guiding questions are

- How will this pilot be financed?
- How long will it run?
- When starting with individual roads or very limited changes: how can the elements implemented so far be scaled up?
- Will this concern different stakeholders at different stages?
- At which point does research need to be included, e.g. for surveys, evaluation, etc.?
- What is the benefit of a pilot, a living lab, and further roll-out? Which starting point is the best for your specific city?

Test, implement, and enforce the measures taken within the pilot on an ongoing basis.

Evaluate the tests and amend your pathway where necessary

It is important to evaluate tests, pilots, and living labs, including re-evaluating the plan with all identified stakeholder groups at each milestone. Cities should also undertake an impact analysis to identify which measures trigger the best results in relation to the KPIs and targets.

Topics that need to be analysed include

- Charging infrastructure development.
- Availability of zero emission vehicles.
- Limited grid capacity.

These topics have proven to be challenging and of key relevance for the successful introduction of the ZEZ-F. They need to be addressed early on in the transition to ZEZ-Fs. Any observed or likely shortcomings need to be identified and solutions or alternatives need to be found. Furthermore, it is important that cities give these topics the necessary priority and support related initiatives by identifying the needs in cooperation with the stakeholders and committing all necessary resources. Incentivizing the installation of loading optimization software and of charging points could contribute to overcoming such challenges. Joining activities such as CALSTART's Drive-to-Zero initiative is another possibility for emphasising policy advocacy for ZEZ-F.²⁶

In more depth: Charging infrastructure

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.²⁷

An effective charging strategy for urban logistics depends mainly 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.

Electricity utilities, too, need to be engaged. Transport & Environment's Recharge EU Trucks paper,²⁸ 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 found similar results – 78%, 16% and 6% respectively.²⁹ Home charging is less relevant for truck operators since trucks typically charge overnight at a depot.

However, the same study found that in Amsterdam commercial vans largely charge at home (45%) or at a depot (44%), while their use of fast charging (due to costs and time) and top-up opportunities at the delivery point is limited 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.

Figure 4. Where vans and trucks will charge³⁰

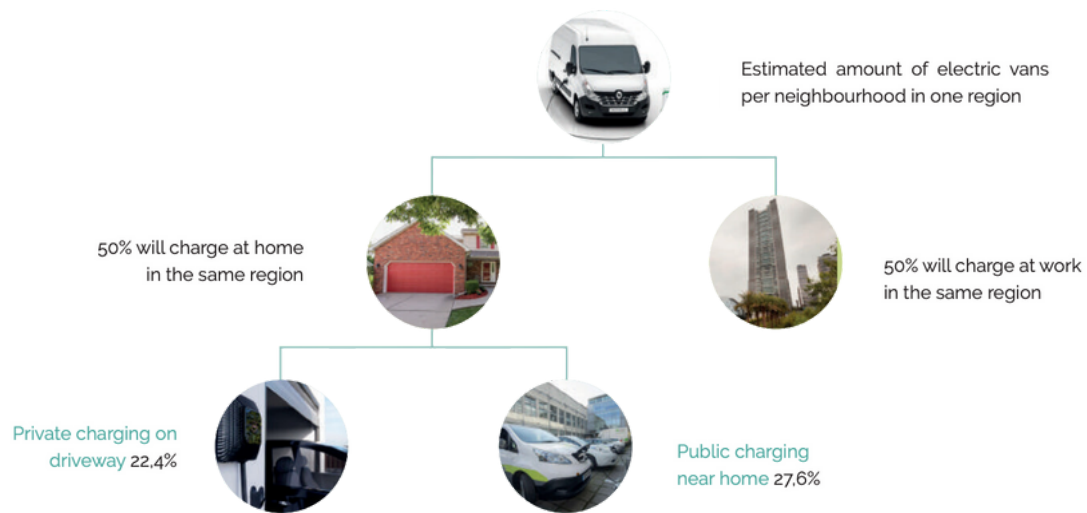
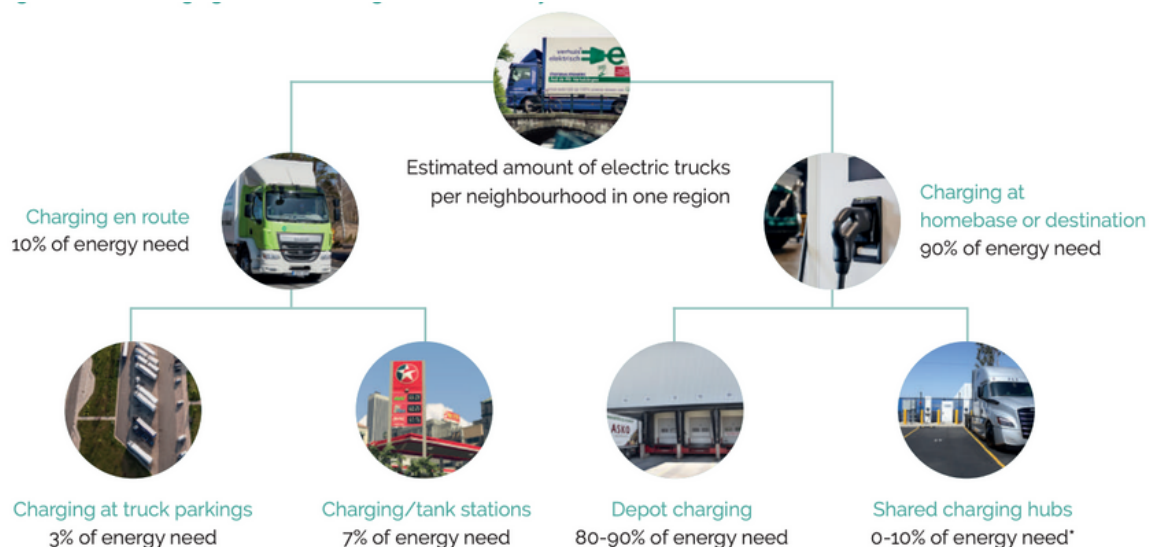


Figure 5. Truck charging needs³¹



*This amount is expected to rise

Given this analysis, depots (for trucks) and homes (for vans) require major charging infrastructure investments, while most public charging points 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 incorporate the different charging needs of operators while developing ZEZ-F strategies to advance the electrification of fleets.

Implement, monitor, fine-tune and aim higher

Once pilots and tests have been evaluated, insights gained build the basis for further adjustments of targets and measures on the pathway to ZEZ-F. The data collected during pilots and tests should validate and enrich the original data set. The insights gained need to be included in the continuous consultation, evaluation and decision-making process, in collaboration with the relevant stakeholders. This iterative process ensures that the city's ZEZ-F plan develops with and responds to the knowledge gained from pilots and other tests on one side, as well as with the changing developments of the city itself and its transport system on the other side. Such a close and ongoing monitoring enables the necessary fine-tuning of the implementation plan.

And finally, it is important to continue the development of the ZEZ-F zone. When the first changes are implemented successfully in one street or one area, it is important to "aim higher" by enlarging the area. Doing so will require the integration of the ZEZ-F into broader urban mobility and ZEZ concepts. It will also require in-depth planning to connect the ZEZ-F to the regional freight transport network, to ensure a well connected sustainable freight system on a regional scale. The development of a ZEZ-F is a continuing process though and once a first level is reached, aim higher.

Hurdles - and How to overcome them

ZEZ-Fs are an ambitious goal, and therefore very challenging, especially given the fact that the change in urban transport and logistics needs to happen quickly to reach climate targets. Many cities and countries aim to introduce ZEZ-s during the coming decade as part of their climate plans.

In order for the implementation of urban vehicle access regulation (UVAR) schemes to be effective and successful, it is necessary not only to determine the final targets and objectives, but also to agree and set the intermediate steps to ensure that all stakeholders, from the largest to the smallest are included and involved,, and to cover all aspects of the freight sector. One way to achieve this is by sharing a clear roadmap which lays out a timeline. Such a shared timeline allows for the progressive implementation of measures and enables operators and stakeholders adequate time to make all necessary adjustments (see the case of Rotterdam).

With this in mind, the following areas have proven to be critical, potentially causing obstacles, when introducing ZEZ-F

Framework and enforcement

Operators typically complain about a lack of coherence and coordination both in the timing and in the methods of implementation of these schemes, and the measures connected to them. The definition of zones, procedures and vehicle access is not standardised internationally, e.g. across Europe, and legal frameworks vary across countries and cities. Therefore, it is challenging , in particular for international logistics companies, to understand access rules and to develop solutions applicable in different cities. At the same time, such an understanding is necessary for them to make investments in their fleets and solutions, and realise economies of scale. National frameworks are needed to expand best practices and align timeframes and procedures (see case of the Netherlands).

Furthermore, schemes, when already in place, are not always properly enforced. Enforcement is key to having a level playing field: regulation without enforcement is counterproductive as it only impacts those in compliance with the rules.

Solid data basis for decision making

Many cities carry out surveys for the general traffic system through traffic counts and cameras, as well as dedicated reports on UVAR schemes and related emissions. Some surveys have been conducted over several years to detect traffic flows, but they quickly become outdated. Moreover, data collection activities are often slow and expensive, for example, when carried out through manual vehicle counts. Knowledge building should be based on a holistic approach, which focuses on stakeholder engagement and consultation, as well as on the collection of information from both traditional sources and innovative ones, for example GPS and Floating Car Data (FCD). Simulation models that quantify impacts, based on the city's specific data, can support the decision process in logistics and are valuable ways to understand the effects of UVAR schemes.

Furthermore, shared methodology for defining and analysing urban logistics indicators is key. Clearly defined indicators can provide clarity. They help to identify necessary interventions as well as those with the best leverage in improving the overall transport strategy of a city.

Sufficient charging infrastructure and vehicle supply

The introduction of ambitious schemes for moving to ZEZ-Fs should develop concurrently with the availability of vehicles and charging infrastructure.

Institutions must work together to eliminate the inconsistency in governance between different levels. Common approaches and policies for the provision of zero emission vehicles and charging infrastructure must be defined. Furthermore, charging plans must include on-road charging, charging at loading zones and depot/warehouse charging to facilitate overnight charging (see chapter ZEZ-F and implications on supply of alternative fuels, grids and energy supply).

Although the Total Cost of Ownership (TCO) for electric vehicles can often provide savings over diesel or fuel powered vehicles, small- and medium-sized companies, who tend to buy used vehicles, struggle to shift to electric or zero-emission vehicles due to their high upfront cost and a still limited market for used vehicles. Incentives, bonuses and public funding plans will be decisive in this case to help these companies capture the benefits of the shift to zero emission vehicles.

Rethinking the urban logistics paradigm with an integrated approach

Switching to zero-emission logistics does not only mean replacing polluting vehicles with clean ones: it is, above all, a matter of rethinking the management of movements related to goods and services. Furthermore, logistics movements and the movement of people in cities must always be considered holistically. Jointly, they form one interrelated transportation system, and the inefficiencies of one element impact the efficiency of the others (e.g., congestion, double parking and poor public transport make urban logistics less efficient).

Exchanging experiences, learning from each other

Each city is unique, and therefore objectives and measures must be defined locally and with local community input. However, some steps and key elements are consistent across cities. Exchanging experiences, learning from other cities, and working with industry stakeholders, and cooperation are key to success.

Examples and case studies of ZEZ-Fs

Rotterdam: a zero-emission zone for freight by 2025

Location of city	The Netherlands
Number of inhabitants	655.468 (2022)
Description of city-structures	Rotterdam is a dense city near the largest sea port of Europe. The Maas river flows through the centre of the city. The Port brings a lively economy with a challenging balance between accessibility and livability. Traffic related air quality and noise are a big topic and social and societal participation can be challenging due to the river separating certain parts of the city. The city has big plans to improve urban mobility by reducing the car kilometres and improving the use of bicycles and public transport. The focus of the mobility transition is on economic viability, health improvement and an attractive city to live in.
Description of Sulp and Sump	Rotterdam does not have a formal Sump or Sulp, but there is a very elaborate plan in place to improve sustainable urban mobility and logistics. ³² This Urban Traffic Plan Rotterdam, for the period 2016-2030+, has used the methods of Sumps. The focus points are accessibility, air quality, noise quality and participation. The plan has both a short-term and a long-term vision and has different scenarios. The main difference with this plan and a Sump is that this plan does not include concrete measures for implementation.
The motivation of efforts for moving towards ZEZs and objectives	<p>The health of Rotterdam residents comes first. This means that the infrastructure network in the urban area does not facilitate any unnecessary unclean traffic. They can only guarantee the future proofness of the transport network in terms of accessibility and quality of life by emphasising the importance of increasing the flexibility and density of the city's and the region's interconnected transport network. This involves making the most efficient use of the existing network through traffic management, influencing behaviour, improving the quality of public spaces and using market forces. In short, it means guaranteeing a sustainable and robust urban and regional transport network in the long run.</p> <p>This has led to the following 8 policy decisions in the Rotterdam Urban Traffic Plan (2017):</p> <ul style="list-style-type: none"> • Fewer car kilometres within the Ring: priority for bicycles and public transport. • An interconnected regional and urban network: roads and public transport in balance. • Regional and urban river crossings: create new ones and transform existing ones. • An appealing and vibrant city and centre: City Lounge boosted. • Boosting new modes of transport: water transport and Last Mile. • Eliminating transport poverty: social and community participation boosted. • A healthy living environment: boosting spatial quality and zero emissions. • Smart mobility: technological innovation and IT. • Areas outside of the Ring: sustainable connections with the areas within.

- In the Netherlands National Climate Agreement (2019), it was agreed that 30-40 cities would implement a Zero-Emission Zone for Freight. Abovementioned policy decisions of Rotterdam were well streamlined with this national agreement and was a good motivation to work towards a zero-emission zone in Rotterdam.

Efforts made to move towards Zero-emission-zones

The City of Rotterdam currently has a Low Emission Zone in place that impacts freight vehicles and on 1 December 2020, the municipality, together with a large and growing number of stakeholders, signed the Zero Emission City Logistics Covenant (ZECL) Rotterdam.³³ By signing this covenant, the parties endorsed the necessity to introduce a zero-emission zone for city logistics (ZECL-zone) and committed themselves to carrying out the actions required to achieve this.

The 66 covenant partners have together drawn up 364 actions to contribute to the joint target of zero inefficient journeys, zero emissions and zero congestion. These actions contribute to knowledge sharing, vehicle development, hubs and bundling, charging infrastructure, cooperation in financing models, and zero emission tendering and procurement. developing.

The municipality has its own action plan with 34 actions that include traffic measures that make sufficient space available for the required logistics functions and developing Ecostars, a rating system to show how far business owners have progressed. It is working to encourage the development of logistics hubs, has created a knowledge sharing platform for covenant members via "Logistiek 010", and is working to transition the City's own fleet to zero-emission.

Rotterdam closely cooperates with the national government of the Netherlands in drawing up a monitoring plan for city logistics together with the participating parties. This plan determines what will be monitored nationally, regionally, and locally. The national government annually reports the feasibility (availability of emission-free vehicles, logistic charging infrastructure) and affordability (trends in purchase prices, user costs, financing possibilities such as subsidies) of emission-free transport.

The Municipality of Rotterdam is also working with other parties on a national City Logistics Implementation Agenda for the Netherlands. The Implementation Agenda, in which the municipalities cooperate with, among others, the Ministry of Infrastructure and Water Management (I&W) and the logistics sector, is working towards the introduction of ZECL zones in thirty to forty Dutch cities by 2025.

Obstacles encountered during development and implementation

Like other cities in the Netherlands, Rotterdam faces several challenges regarding the Zero Emission Zone for freight:

- It is currently very difficult to enforce foreign vehicles, as the enforcer does not have access to licence plate information of foreign vehicles (i.e. to know whether the vehicle is zero-emission or not).
- Small entrepreneurs have limited time to access information and limited money to invest in zero-emission solutions.
- Microchip shortage and supply problems have led to a longer lead time of zero-emission commercial vehicles.
- COVID-19 has led to uncertainty for many businesses which delayed their decisions to switch to zero-emission solutions.

Objectives realised	The current mobility plan of Rotterdam aims for a CO2 emission reduction of 49% by 2030 and 100% by 2050. The percentage of emission-free delivery vans currently entering the existing low emission zone is 1.20%. This may not seem much, but it is already more than twice as high as in 2019. An increase was particularly noticeable in the last months of 2021. This is probably due to the national purchase subsidy for vans (SEBA), which means that the total cost of ownership (TCO) is positive in ever more cases.
Strengths and weaknesses of the solution	StrengthsCovenants agreed by many parties.Close collaboration with the national government which leads to harmonisation of Zero-Emission Zones for road users.
Summary and outlook	Rotterdam has ambitious, clear targets accompanied by a strategy developed in a process that engaged stakeholders. The targets have been communicated along with a timeline in a most transparent way. The programme towards ZEZ-F is an integrative part of the cities overall strategy towards reaching climate goals and it is embedded in the national programme for the environment and economics. First steps could be realised already, and the city of Rotterdam is positive about reaching the next steps.

Shenzhen: green logistic zones

Location of city	China
Number of inhabitants	17.63 million at the end of 2020, a 3.1% increase from 2019. ³⁴
Description of city-structures	<p>Shenzhen is a southeast, first-tier city of China, connecting Hong Kong, China, and mainland China. At the end of 2020, the city had a population of 17.63 million and an area of 1,997 square kilometres.³⁵ Although its population size is ranked 6th among Chinese cities, it experienced the most rapid growth in net population inflows in the past decade among all Chinese cities. As a powerhouse of Southern China, the city's annual GDP in 2020 was 388.6 billion USD[3], surpassing its neighbour, Hong Kong, China (343 billion USD).^{36, 37}</p> <p>As a young Chinese city, Shenzhen is almost entirely newly built. Further, unlike many Chinese cities, Shenzhen has a typical polycentric urban layout, with a few major urban centres scattering along a linear corridor bordering Hong Kong and some emerging urban centres along corridors connecting the city to the surrounding cities. To effectively connect the existing and emerging urban centres, the city embraced the TOD concept in the 1996 Shenzhen Urban Master Plan, where the mass transit system was viewed as the backbone to catalyse urban integration.³⁸</p> <p>To rein in rapid motorization, Shenzhen introduced the car purchase restriction policy in 2014 that limits the number of new vehicle registrations at 100,000 cars each year. Since then, the growth of private cars has slowed. By 2021, Shenzhen had 3.72 million automobiles, with an annual growth rate of 1.1% during 2015 and 2020 (the lowest rate among all cities within Guangdong Province).³⁹</p>

	<p>Due to the car purchase restriction policy and tremendous investments in the metro system, Shenzhen is a city reliant on public transport and non-motorized transit. In 2019, green transport (including walking, e-biking, public transport, and bicycling) accounted for 78% of the city's mode share.⁴⁰ According to Shenzhen's 14th Comprehensive Transport Plan, the city aims to increase the green transport mode share to 81% by 2025 and to 85% over the long term.⁴¹</p> <p>Transport is the largest source of Shenzhen's energy-related carbon emissions, representing around 52% of the city's CO₂ emissions in 2015.⁴² The transport sector is also the primary source of PM 2.5 emissions, accounting for 41% of the city's total PM 2.5 emissions. Within the transport sector, private cars and trucks are the main sources of CO₂ emissions, respectively representing 55% and 18% of the transport-related emissions.⁴³</p> <p>By 2021, Shenzhen had over half a million zero emission vehicles, representing 14% of the total automobile fleet. The number of electric logistic vehicles was 94,000, larger than its electric bus fleet size (78,900).⁴⁴</p>
Description of SULP and SUMP	<p>The city does not have a formal SUMP/SULP; instead, it has a few five-year plans outlined the prioritised areas for policy interventions with the goal of building a prosperous, accessible, and low-carbon city:</p> <ul style="list-style-type: none"> • Shenzhen Comprehensive Transport 14th Five-year Plan (Feb 2022):⁴⁵ Following the "Strong Transport Nation Strategy" outlined by the Ministry of Transport, P.R., China, Shenzhen's Comprehensive Transport 14th Five-year Plan sets out to transform the city into a global logistic hub and an accessible city for local residents. • To achieve the goal of a global logistic hub, the city aims to improve the efficiency of the city's seaport, airport, and railway system for improved connectivity; it also aims to construct around 30 urban logistic centres and numerous distribution centres (for last-mile delivery) to improve inner-city logistic efficiency. • Shenzhen New Energy Vehicle Promotion Work Plan (2021-2025) (Oct 2021):⁴⁶ The plan aims to secure Shenzhen's place as a global EV frontrunner by setting the following targets: by the end of 2025, new energy vehicles will account for 60% of newly registered vehicles (not including replaced ones) and the city will have one million zero-emission vehicles 0.79 million AC chargers and 43,000 DC chargers then.
The motivation of efforts for moving towards ZEZs and objectives	<p>The objectives for Shenzhen in implementing the Green Logistic Zones are To improve air quality to achieve the goal set up by the provincial and the municipal governments. To avoid the adverse impacts on the city's economic vitality, shipment activities of the seaport (Shenzhen has one of the world largest container seaports), and the living costs of local residents.⁴⁷</p>
Efforts made to move towards Zero-emission-zones	<p>Overview of the Green Logistic Zones Following the national campaign to curb air pollution in 2017-2018, the General Office of the Municipal People's Government of Shenzhen issued the "Shenzhen Blue" Sustainable Initiative in May 2018, aiming to reduce air pollution in short time so that the annual concentration of PM 2.5 would drop below 26 µg/m³ by the end of 2018 from 28~29 µg/m³ in early 2018.</p>

Efforts made to move towards Zero-emission-zones

Green Logistic Zones are among one of the countermeasures that the Municipal Government devised to deliver this “quick win.” Other countermeasures, apart from the Green Logistic Zones, also expand the ways to increase adoption of ZEZs, including:⁴⁸

- Scrapping at least 20,000 diesel light-duty logistic vehicles by the end of 2018 and encouraging all the newly-added operating light-duty logistic vehicles (mainly for-hire fleet) to be electric, through economic incentives.
- Installing 13,400 charging facilities evenly covering different districts by the end of 2018.
- Allowing locally-registered electric light-duty logistic vehicles to enter the city freely (except for the Shennan Street, the main corridor) at any time of the day, effective from July 2018. By contrast, ICE light-duty logistic vehicles face more access restrictions.
- To implement the Green Logistic Zone policy, the Municipal Environment Bureau and the Traffic Police Department had been working on several items.
- Identifying the locations of the zones-- the goal is that each of the eleven urban districts will have a green logistic zone identified through emissions hot-spot analysis (that is, highly polluted areas in city centres with significant traffic).
- Identifying the vehicle category—light-duty logistic vehicles are targeted because
 - They consisted of 59% of the city’s logistic vehicle fleet and accounted for 19% of the city’s NOx and PM 2.5 emissions.⁴⁹
 - Zero emission technology is relatively ready for light-duty logistic vehicles compared to heavy-duty trucks.
 - Targeting light-duty logistic vehicles will not greatly affect the city’s economic vitality, especially the seaport’s shipments which are carried out by heavy-duty trucks.
 - Further, light-duty logistic vehicles that are more difficult to electrify, such as temperature-controlled vehicles and HAZMAT vehicles, are exempted.
 - Conducting stakeholder consultations to finalise the specific boundaries of the zones.
 - The Traffic Police department took on the role of implementing and enforcing the policy.
 - Additionally, the Environment Bureau performed post-evaluation and impact analysis to ensure the scheme delivers on its emission-reduction goal.

China has legislative grounds for ZEZs. According to the “Road Traffic Safety Law of P.R. China” (Article 39), traffic police can take measures to regulate and restrict the traffic of motor vehicles (and non-motor vehicles) considering the specific road conditions. Therefore, Shenzhen was able to introduce the ZEZs in a few months.

It is noteworthy that in addition to ZEZs, Shenzhen also offered significant economic incentives supporting electric logistic vehicle purchase, operation, and scrappage. For example, carriers with logistic vehicle fleets over 300 and electric logistic vehicles over 100 can receive up to 10,000 USD⁵⁰ operation subsidies per each electric logistic vehicle. Altogether, Shenzhen has spent more than 720 million USD during 2018 and 2020 to support the scrappage of high-polluting vehicles and adoption of electric vehicles (not limited to electric logistic vehicles).⁵¹

	<p>Although the city has no plan to expand the Green Logistic Zones, it is working on electrifying heavy-duty vehicles (such as dump trucks and sanitary vehicles) to further reduce transport-related air pollution.⁵²</p>
<p>Obstacles encountered during development and implementation</p>	<p>The ZEZ enforcement has been weak. The Traffic Police department does not enforce the policy regularly; instead, it organises special operations against the infringements of ZEZs on quarterly basis due to Carriers pleading for longer lead time for phasing in the policy. ZEZs were introduced in only three months, which was insufficient to adapt operations. The Traffic Police department wanted to mitigate the negative impacts from the ZEZs on the daily supply of life essentials in residential communities. COVID and lockdowns having temporary impacts on the city's logistic supply chain and cash flows of local carriers. Light-duty logistic vehicles with daily operating mileage over 200 kilometres often still experience difficulties in electrification due to insufficient battery ranges, charging time losses, and payload penalties. Small carriers are not entitled to Shenzhen's electric light-duty logistic vehicles' operation subsidy that are designed for large operators. Some of the carriers illegally use delivery vans purposely as passenger cars for freight. They are particularly unwilling to replace their ICE licence plate with an EV licence plate (ICE licence plate is a rare resource due to Shenzhen's restriction on car purchase), nor could they purchase a second car (still due to the restriction on car purchase). Limited charging facilities available within the zones pose a challenge for the efficient operation of electric logistic vehicles.</p>
<p>Objectives realised</p>	<p>By the end of 2018, Shenzhen had attained its air quality target with an annual concentration of PM 2.5 at 26 µg/m³. By the end of 2020, its annual concentration of PM 2.5 had dropped from 24 µg/m³ in 2019 to 19 µg/m³ with the air quality ranking increased from the 9th to 6th among Chinese cities.⁵³</p> <p>Shenzhen's light-duty electric logistic vehicles increased from 33,400 in 2017 to 62,800 in 2018, and by the end of 2021, the number of electric logistic vehicles reached around 94,000, consisting of 22% of the city's light-duty logistic vehicles.⁵⁴</p> <p>Motivated by Shenzhen, other cities in China, such as Dongguan, have also introduced or considered introducing Green Logistic Zones.</p>
<p>Strengths and weaknesses of the solution</p>	<ul style="list-style-type: none"> • The increased adoption of electric logistic vehicles helps boost Shenzhen's vehicle manufacturing related industries, which in turn help the local government in GDP growth and tax collection. • Shenzhen avoided emissions "leakage" from a large ZEZ: a large zone lacking diversion routes can detour through-traffic, causing longer routes and thereby actually increasing emissions. • The rush to implement the policy in a short time span affects the effectiveness of the policy with weak enforcement. • The policy may have a fairness issue on small carriers with limited engagement and limited public support.
<p>Summary and outlook</p>	<ul style="list-style-type: none"> • Following China's goal of carbon peaking before 2030 and carbon neutrality before 2060, Shenzhen is also developing a city-level decarbonization goal, and it could possibly peak road transport's carbon emissions before 2025 and be zero emissions much earlier than 2060.

Summary and outlook	<ul style="list-style-type: none"> Shenzhen aims to increase the number of electric logistic vehicles to 113,000 by the end of 2025⁵⁵ (approximately 1/3 of the logistic vehicle fleet) and fully electrify the logistic vehicle fleet as soon as possible. It is also working on electrifying heavy-duty vehicles (such as dump trucks and sanitary vehicles) to further reduce transport-related air pollution and carbon emissions.
---------------------	--

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

Location of city	UK
Number of inhabitants	9,541,000, a 1.22% increase from 2021 ⁵⁶
Description of city-structures	<p>The Global City Power Index (GCPI) has ranked London as the most magnetic global city for its ability to attract people, capital, and enterprise from around the world, and it has held this top position since 2012. London's population in 2022 is 9.32 million, it ranks as the 37th populous urban agglomeration in the world, and has a total area of 1,572 sq. km.⁵⁷</p> <p>The main topographical feature of London is the Thames River, which crosses the city from the east to the southwest. The Thames has many tributaries, most of which are now underground as they flow through London. The Thames is also a tidal river, and London is thus vulnerable to flooding. Because of this, a barrier called the Thames River Barrier has been built across the river.</p> <p>London has a total of 1,204 high streets distributed outside the centre of London, and over half of London's jobs are spread across 600 high streets. The Mayor's ambition is for high streets to accommodate a wider mix of uses, including some of London's new housing. With help, many of London's high streets can become more exciting centres of life, full of economic and cultural energy.⁵⁸ In 2021, 18.5 billion vehicle miles of traffic were travelled across the 9.2 thousand miles of roads in London.⁵⁹ The total emissions in 2021 were 14.80 megatonnes/year of CO₂ emitted total in 2021, of which 2.2 megatonnes CO₂ was emitted due to increased congestion (referred to as the cost of congestion). During the same year, the fleet total included 785 electric buses,⁶⁰ 22 fuel cell buses, and 3,854 hybrid buses. The fleet was 35.6% gasoline vehicles, 59.6% diesel vehicles, 0.4% hybrid vehicles and 4.4% electric vehicles.</p> <p>Between 2015 and 2041, daily trips in London are expected to climb to 32 million trips daily, and 70% of them will be by public transport and active modes, but without further action, traffic will increase cars on the road. This growth will place pressure on the transport network.</p> <p>In the coming years, London aims to achieve transport goals such as: 1) Delivering mode shift from the car to walking, cycling, and public transport; 2) Supporting growth through the provision of new public transport capacity to employment hubs; 3) Ensuring new housing areas are developed in a way that makes it easy for people to choose sustainable transport modes; and 4) Keeping up and ensuring technological advances deliver a better London.⁶²</p>

<p>Description of SULP and SUMP</p>	<ul style="list-style-type: none"> • London Transport Strategy (March 2018): It sets out London Mayor Sadiq Khan's plans to transform London's streets, improve public transport, and create opportunities for new homes and jobs. To achieve this, Mayor Khan wants to encourage more people to walk, cycle, and use public transport. • Freight action plan for London (March 2019): A plan to work with boroughs, businesses, and the freight and servicing industries to transform how deliveries are made in London. A part of the Freight and Servicing Action plan, which was presented by the Mayor of London and Transport for London (TfL).⁶³ • Sustainable Transport, Walking and Cycling guidance (September 2021): London Plan Policy T3 Transport capacity, connectivity and safeguarding require development plans and proposals to protect existing land for transport and support the enhancement of public transport, walking and cycling networks to enable London's growth.⁶⁴
<p>The motivation of efforts for moving towards ZEZs and objectives</p>	<p>Obligation under EU law to improve air quality that aims to improve ambient air quality and tackle air pollution, to protect the environment and human health.</p> <p>Objectives:</p> <ul style="list-style-type: none"> • Reduce the number of premature deaths and illnesses caused by air pollution. • Reduce pollution pressure on ecosystems and biodiversity.⁶⁵
<p>Efforts made to move towards Zero-emission-zones</p>	<p>Overview of the Low Emission Zone (LEZ), the Ultra Low Emission Zone (ULEZ) and Congestion Charge</p> <ul style="list-style-type: none"> • LEZ operates to encourage the most polluting heavy diesel vehicles driving in London to become cleaner. The LEZ covers most of Greater London and operates 24 hours a day, every day of the year. • The LEZ is separate from the Ultra Low Emission Zone (ULEZ). • ULEZ (covers central) To help clean up London's air, the ULEZ operates 24 hours a day, every day of the year, except Christmas Day (25 December). The zone now covers all areas within the North and South Circular Roads. The North Circular (A406) and South Circular (A205) roads are not in the zone. • Most vehicles need to meet the ULEZ emissions standards or owners must pay a £12.50 daily charge to drive inside the zone. This includes <ul style="list-style-type: none"> ◦ Cars, motorcycles, vans and specialist vehicles (up to and including 3.5 t) and mini buses (up to and including 5 t). ◦ Residents of the Congestion Charge area (the 100% discount of the daily ULEZ charge has ended). ◦ Lorries, vans or specialist heavy vehicles (over 3.5 t) and buses, mini buses and coaches (over 5 t) do not need to pay the ULEZ charge. They will need to pay the LEZ charge if they do not meet the LEZ emissions standard. ◦ The Congestion Charge (covers most of Greater London) Since February 2003, motorists wanting to drive into London at peak times on weekdays have had to pay a Congestion Charge for the privilege. Failure to pay the charge results in a fine of £160, reduced to £80 if paid within 14 days. It operates 07:00-18:00 Mon-Fri, 12:00-18:00 Sat-Sun and bank holidays. There is no charge between Christmas Day and New Year's Day bank holiday (inclusive).

	<ul style="list-style-type: none"> • If you drive within the Congestion Charge zone during these times you need to pay the Congestion Charge, even if you meet the ULEZ and LEZ emissions standards or have paid those daily charges.⁶⁶ • London Mayor calls for 'pay-per-mile' driving charge: London Mayor Sadiq Khan has called for the introduction of a pay-per-mile driving charge in the UK capital, along with a daily fee of up to £2 (US\$2.70) for "all but the cleanest vehicles".⁶⁷
<p>Where applicable: Changes since last publication</p>	<ul style="list-style-type: none"> • Release of the Potential for Urban Logistics Hubs in Central London (December 2020):⁶⁸ The central finding of this study is that urban logistics hubs have an important role to play in promoting clean and efficient freight activity in London. The use of such hubs directly supports the rationalisation of goods and the use of low and zero-emission vehicles. In turn, this supports a reduction in the number of delivery vehicle trips, better management of congestion at peak times, and a reduction in harmful emissions. • Direct Vision Standard and HGV Safety Permit - London - TfL (March 2021):⁶⁹ To help to save lives and prevent life-changing injuries, the scheme requires owners of heavy goods vehicles (HGVs) weighing more than 12 tonnes to apply for a free permit to drive in London. The permit rates vehicles on how much the driver can see through their cab windows. Around 117,000 zero-star-rated HGVs have now had safe systems fitted. • Ultra Low Emission Zone London-wide Expansion (October 2021):⁷⁰ This would help to protect Londoners and the economy from the damaging impact of air pollution and carbon emissions while keeping the number of people affected by any new charge to an absolute minimum as the cost of living increases. • Stratford Metropolitan Masterplan (February 2011):⁷¹ This guides future regeneration, encourages a diverse economy and improves the street environment, public transport access and links across Stratford High Street. A new master plan is in progress developing from this previous work.
<p>Obstacles encountered during development and implementation</p>	<ul style="list-style-type: none"> • The UK's exit from the European Union interrupted the flow of funds and today the government must reallocate new resources to upgrade the transport network. • The UK is now looking for backing from the UK Infrastructure Investment Bank (IIB), the state-owned financial institution tasked with supporting infrastructure investment. • The government presence and growing role of the IIB will not, however, suffice on their own to reach the 2050 target, when the UK aims to be a net-zero emissions country. • The private sector, currently a minority player in financing major works, will have to increase its role in the industry and support the construction of strategic works. One of these is the High-Speed North, the reconstruction of the old Northern Powerhouse Rail, the railway that will connect the main cities to the North of England, i.e., Manchester, Liverpool, Leeds, Sheffield, Hull and Newcastle-upon-Tyne. • It is recognized that London could benefit from more sophisticated types of technology to introduce this kind of simple, fair road user charging scheme and has therefore asked Transport for London to start exploring how it could be developed.⁷² • However, it's clear the technology to implement such a scheme is still years away from being ready.⁷³

<p>Objectives realised</p>	<ul style="list-style-type: none"> • Transport for London (TfL)'s Healthy Streets programme Results: Healthy Streets Officers (HSOs) supported more than 700 schools to encourage pupils to walk, scoot, or cycle to school. More than half of the School Streets in London had support from HSOs. Healthy Streets Officers set up 11 cargo bike schemes, which replaced more than 3,000 miles of car and van journeys.⁷⁴ • Ultra Low Emission Zone London-wide Expansion Results: On average there were 44,000 fewer diesel cars driving in the zone each day – a 20% decrease since the weeks before the ULEZ expanded. All monitoring sites on the boundary of the expanded zone have seen reductions in NO2 concentrations, with an estimated 17-24% reduction in pollution on the boundary compared to a scenario without the ULEZ. Large and heavy vehicles, which fall under the London-wide LEZ, have a compliance rate of 96%, up from an estimated 48% in February 2017, and traffic flows are around 2% lower than the weeks before the expansion launched.⁷⁵
<p>Strengths and weaknesses of the solution</p>	<ul style="list-style-type: none"> • Congestion Charge provides a significant and long-term funding stream for implementing measures. • Split in competences between the Mayor of London and 32 local boroughs complicated area-wide action (e.g. local boroughs decide on parking and local cycle lanes). • Uncertainty about post-Brexit infrastructure funding.
<p>Summary and outlook</p>	<ul style="list-style-type: none"> • In the city that has grown up alongside its “Tube”, transport means development, investment and having a vision for the future – today more than ever. To emerge from the COVID-19 crisis, the UK has decided to focus primarily on sustainable mobility, beginning with its capital. • By 2041, London Mayor Sadiq Khan aims for 80% of all Londoners’ trips to be made by foot, by cycle, or by public transport. • Vehicle emissions can blight streets, harming health and contributing to climate change. London must meet legal air quality limits as soon as possible. • Creating streets and routes that encourage walking, cycling, and public transport use will play a major role in reaching this goal. • Transport for London (TfL) will deliver on this goal by using the Healthy Streets Approach to guide all of its decision-making. • For those vehicles that remain, it is essential to reduce emissions as soon as possible and switch them to zero-emission technologies. • The Mayor is working to ensure London’s entire transport system is zero emission by 2050. • TfL will deliver its approach following widespread public consultation and building on the introduction of the Local Zero Emission Zones, Ultra Low Emission Zone, and the Congestion Charge. This includes delivering central London and town centre zero emission zones from 2025, creating a zero emission zone in inner London by 2040 and a London-wide zone by 2050.

Location of city	California, United States
Number of inhabitants	3.85 million (2021) ⁷⁶
Description of city-structures	<p>Los Angeles, California is a world-renowned cultural and entertainment metropolis, famous for its beaches, celebrity citizens, sports teams, and mild, Mediterranean climate. Located within a desert basin on the southern California coastline, Los Angeles encompasses 472 sq miles and is called home by nearly 4 million people.⁷⁷</p> <p>Despite a growing public transportation system and continuous city efforts, Los Angeles has some of the worst air pollution in the United States, contributed to by its shipping industry and commuter and commercial vehicle traffic.⁷⁸ The city's geographic location traps and exacerbates local air pollution via recurring marine inversions and the bowl-like basin that is surrounded by the San Gabriel mountains.⁷⁹</p> <p>In addition to contributing to local air pollution, the transportation sector also accounts for 19% of the city's greenhouse gas emissions.⁸⁰ Los Angeles has implemented and agreed to numerous plans that target the transportation sector, including urban freight and delivery activity, and set goals to mitigate its negative environmental impacts. For example, in 2019, the city created its own Green New Deal, which included ambitious sustainability targets for different economic sectors, including the transportation sector.⁸¹</p>
Description of SULP and SUMP, if existing	<p>As a comprehensive sustainability plan, Los Angeles' Green New Deal includes targets for all sectors of society, including energy production, transportation, food systems, and housing and development. Specifically, regarding the transportation sector, the city has set targets to grow public transit ridership and expand micro mobility options, electrify 100% of Metro (transit agency) and and the Los Angeles Department of Transportation (LADOT) buses by 2030,⁸² and increase the percentage of zero-emission vehicles in the city to 100% by 2050.</p> <p>As a signatory of the C40 Cities' Green and Healthy Streets Accelerator, which was launched in 2017, Los Angeles has also committed to designating an area of the city to be zero-emission by 2030.⁸³ This was also reiterated within the Green New Deal.⁸⁴</p>
The motivation of efforts for moving towards ZEZs and objectives	<p>Los Angeles' commitment to implement a zero-emission area within the city follows its years-long campaign to mitigate persistent air pollution and greenhouse gas emissions. Many of the latest city and regional sustainability goals are tied to the upcoming 2028 Olympic and Paralympic games which are to be held in Los Angeles.⁸⁵ When finalised and implemented, the zero-emission area will be a part of a suite of solutions intended to promote zero-emission vehicles and alternative modes of travel and delivery.</p>

In 2021, the city passed a new curbside management ordinance, which allows for the creation of five zero-emission commercial loading zones.⁸⁶ These zones were installed by the city on Clean Air Day 2021, and they are only to be used by zero-emission commercial vehicles for loading and delivery purposes.⁸⁷

These loading zones are intended to support the transition to zero-emission delivery by specifically reserving valuable curb space for zero-emission delivery vehicles.

A relatively affordable solution, the policy cost about \$2,000 per loading zone for the appropriate signage, curbside paint, and pavement marking.⁸⁸ The zero-emission commercial loading zones were placed in areas characterised by:⁸⁹

- High density.
- Subject to high commercial loading zone demands.
- Disproportionately burdened by air pollution.
- Under LADOT's administrative authority to install, enforce, and monitor.

Due to the small scale, it is unlikely the policy will have a significant impact on local zero-emission vehicle adoption, greenhouse gas emissions, or air quality. However, the city hopes to expand to 100 loading zones in the coming years, which would produce measurable benefits.⁹⁰ [HS1] [V(2)]

Obstacles encountered during development and implementation

The city had to go through the city council for approval and adoption of the ordinance, which enabled the policy to be enforceable like any other curbside regulation. With the policy consisting of only five loading zones, there was minimal opposition, but that could increase should the city government decide to expand the policy throughout Los Angeles.

Objectives realised

Due to the recent implementation of the policy and its small scale, no information has been made available by the city on whether these zero-emission commercial loading zones are encouraging zero-emission vehicle adoption or producing environmental benefits. However, LADOT is reportedly monitoring zone compliance, dwell times, curbside congestion, and local emissions reduction.⁹¹

Strengths and weaknesses of the solution

Unlike a traditional zero-emission delivery zone that would prohibit the through traffic of fossil fuel delivery vehicles, Los Angeles' policy does not directly impact the road access of polluting vehicles. Due to the policy's small scale, there remain plenty of alternative parking options for delivery vehicles. With polluting delivery vehicles allowed to drive around uninhibited and park in non-reserved loading zones, their negative environmental and health impacts will continue to persist.

Three features of Los Angeles' policy are crucial for its future success:

- Low cost: As a simple, low-cost curbside solution instead of a large zoning policy, the zero-emission commercial loading zones can be quickly scaled up by the city to create a de facto zero-emission delivery zone. If most of the parking and loading zones in an area were only for zero-emission delivery vehicles, carriers would be incentivized to change their fleets to avoid fines or other penalties by the city.

Locating zones in polluted areas: Prioritising loading zones in highly polluted areas, the city can produce maximum local air quality benefits, especially if the solution is scaled up. Prohibiting fossil fuel vehicle use and incentivizing zero-emission vehicle adoption will mitigate residents' exposure to harmful air pollutants like particulate matter and nitrous oxides while reducing greenhouse gas emissions.

Enforcement Mechanism: The policy's enforcement capabilities enable the city's parking enforcement to disincentivize violators by issuing fines and citations, which is crucial for the policy's success. Without enforcement powers, Los Angeles would be unable to prevent fossil fuel vehicles from parking in these loading zones, which would eliminate the city's ability to induce zero-emission vehicle adoption.

Summary and outlook

Efforts are underway in Los Angeles to promote sustainable transportation modes and accelerate the shift to zero-emission vehicles. The city's zero-emission commercial loading zones are the latest city strategy to incentivize this transition. If brought to scale, these loading zones could produce significant environmental benefits while advancing the zero-emission vehicle market. However, Los Angeles has a suite of climate policies, and this new policy is just one of the many necessary to achieve the city's ambitious climate and environmental goals.

Examples and case studies from cities that are on their way towards ZEZ-F

Oslo

Location of city	Norway
Number of inhabitants	699.027 ⁹²
Description of city-structures	<p>Oslo is a Nordic capital city located by a fjord and surrounded by mountains and nature areas. The small city centre area within Ring Road 1 is around 180 ha (1,8 km²), and currently in transformation towards car-free urban life. The larger central area within Ring Road 2 is about 13 km². In 2020 Oslo municipality adopted the "Climate Strategy for Oslo towards 2030". Transport is one of 16 priority areas. In 2020 transport represents 52% of GHG emissions. Urban freight alone is 16%.⁹³</p> <p>Among the four climate goals for transport in 2030 are</p> <ul style="list-style-type: none"> • All vans will be emission-free. • All heavy transport in Oslo will be emission-free or use sustainable renewable fuel by 2030."⁹⁴ <p>The city does not have a formal SUMP. The city is currently preparing a SULP (see below). Zero-Emission Zones are considered as part of the SULP, among many other components.</p>
Description of SULP and SUMP	<p>A pre-SULP planning document has been completed in April 2022.⁹⁵ The first five out of 11 SULP stages have been addressed. The two first stages (including analysis of today's situation) were completed as part of this project.</p> <p>The document is comprehensive. Even before the current SULP process, the city of Oslo has adopted multiple measures to promote sustainable logistics, including planning for Oslo City Hub for low-emission vehicles,⁹⁶ as well as a public procurement strategy emphasising low and zero-emission transport.⁹⁷</p>
Motivation of efforts for move towards ZEZs and objectives	<p>The key goals are to accelerate the shift towards zero emissions vehicles, move the city faster towards zero CO₂ emissions, and help deliver the climate and air quality goals of the city by 2030. Specific project objectives for the ZEZ project are To improve air quality and reduce CO₂ emissions. To operate ZEZ's effectively. To ensure fair competition.</p>
Efforts made to move towards Zero-emission-zones	<p>The first political decision to prepare for a pilot ZEZ was taken in April 2020. The city administration was requested to develop alternative models for ZEZs that could deliver a minimum 5,000 ton CO₂-reduction and other results. The administration delivered its first proposal in October 2020.</p>

	<p>The city council decided that preparations should continue for a model with two ZEZs</p> <ul style="list-style-type: none"> • An inner zone (1.8 ha) to be introduced in 2022 (light vehicles) and expanded to all vehicles in 2023. • An outer zone (13.5 ha) to start from 2026. <p>The administration has since been working on several items</p> <ul style="list-style-type: none"> • Analysis of expected CO2 emission effects (delivered).⁹⁸ • Stakeholder consultation involving 54 businesses and organisations (delivered).⁹⁹ • Implications for EV-charging for HDVs (delivered).¹⁰⁰ • Details for vehicle categories/exceptions (delivered).¹⁰¹ • Impact on logistics (in progress). • Socio-economic and other impact (in progress). Preparing for government approval (in progress). <p>In January 2023 the city administration presented an updated proposal taking into account time that has passed awaiting the national legislative process, which makes the original concept no longer tenable. Instead of a model with two steps for a smaller and then a larger zone, the proposal is to aim directly for the larger zone within the 13 km2 Ring 2 area. The ZEZ is to be implemented in two steps, when the legal framework is in place. By 2025 at the earliest for vans and trucks. By 2027 for passenger cars, with exception for dwellers within the zone until 2030. Both assuming that legal preconditions are adopted during 2023. An alternative solution in the form of a payment zone is also considered, although as a temporary step.</p>
<p>Obstacles encountered during development and implementation</p>	<p>Norwegian municipalities are not allowed to introduce ZEZs today. In 2020 the national government declared a plan to allow ZEZs by using a regulation (§7) in the Norwegian Road Act which permits the government to ban certain vehicles. Since then legal analysis has been going back and forth between the department of Transport and the Road Agency. It is as of yet not clear if changes to the Road Act are needed (requiring adoption by a majority in Norwegian Parliament), or if existing legislation will allow at least a form of ZEZ pilot to proceed.</p> <p>This creates uncertainties for all actors involved.</p> <p>Other factors that have proven important/critical include</p> <ul style="list-style-type: none"> • Market availability of Zero Emission HDVs. • Availability of fast charging infrastructure for HDVs. • Size of ZEZs (larger zones offer more predictability). • Fairness for both large and especially small operators.
<p>Objectives realised</p>	<p>None yet</p>
<p>Strengths and weaknesses of the solution</p>	<p>The proposal builds on extensive technical analysis, covering multiple dimensions and criteria (climate, logistics, economy, environment, business, infrastructure, etc.), as well as stakeholder engagement. The now proposed specific solution that includes only one zone introduced in two steps has some advantages over the earlier plan for two zones.</p>

Strengths and weaknesses of the solution

The Ring 2 zone delimitation is clearly recognizable and logical for road users. It will also have a major result on emission reduction, far exceeding the 5,000 ton CO₂ minimum required. The impact of the larger zone is likely to reduce emissions in a much wider area within and also beyond the municipal borders. The ZEZ is now being incorporated in a Sulp-strategy which will provide several supporting measures with similar goals as the ZEZs.

A key weakness is that the ZEZ strategy is dependent on national government approval, which is hampered by complex legal issues and potential need for top level political processing. Also some uncertainties remain with regard to a national road passing through the ZEZ and for certain areas (e.g. Oslo central station inside the proposed zone).

Summary and outlook

Oslo is generally well on the move toward a zero emission city by or before 2030, thanks to multiple national and local initiatives. The ZEZ is considered a key element in helping to speed up the shift to ZE vans and trucks and hence delivering the city's climate goals. However, at this point it is not possible to foresee if the proposed model and the associated timeframes can be fulfilled, due to the pending legal clarifications. It is no longer considered feasible to introduce a zone as early as for 2022 /2023. But two years notice for vans/trucks are considered acceptable since the associated businesses are now well informed and quite prepared.

Businesses in Oslo generally accept the green vision of the Zero Emissions Zone. However, while larger businesses can cope, smaller ones may not be able to afford a shift on short notice.

Business stakeholders ask the municipality to ensure that regulations and incentives make the transition pay off, by:

- Providing for charging infrastructure.
- Providing financial support for the transition for small businesses.
- Taking some responsibility for transshipment facilities/areas.

Businesses see a need for early involvement so concerns of stakeholders are considered before final decisions are made.

Most documents and the map of the proposed zone below can be found at:<https://www.oslo.kommune.no/slik-bygger-vi-oslo/nullutslippssone/#gre>




Aarhus, Karditsa and Ravenna – insights from the SURF Project on routes to ZEZ-Fs for small to medium sized cities



In 2021, taking lessons from the first edition of this How-To Guide, Environmental Defense Fund Europe sponsored a project to help cities run pilots in preparation for the creation of ZEZ-Fs. POLIS, the network of European cities and regions working together on innovative mobility solutions, served as manager of this program titled SURF (Sustainable URban Freight). The SURF Project developed an online course focused on how to create, implement and operate a ZEZ-F. This course is aimed to support policymakers, practitioners, entrepreneurs and operators with the skills and knowledge required to make ZEZ-Fs successful. Anyone can participate at their convenience.

In addition to the online course, SURF supported three Instant Projects. An open call was conducted asking cities to apply and provide a proposal for a project that would help them on their journey towards the development of a ZEZ-F. Three cities - Aarhus, Karditsa and Ravenna - were chosen and awarded funding to conduct these projects over the course of a few months. Each city was assigned two experts from the freight sector (researchers and practitioners) to support their work. More information can be found in the SURF Final Report.

These three cities are just at the beginning of preparing for a Zero Emission Zone for Freight. With the support of the SURF project, they will be able to reach their goal of implementing a ZEZ-F by the year 2030.

Aarhus

Location of city	Denmark
Number of inhabitants	300.000
Description of city-structures	<p>For the past 30 years, the oldest part of the city centre has been a limited traffic zone. The boundaries continue to expand since its creation.</p> <p>Aarhus is the country's second largest city and is located on the eastern coast. The neighbourhood around the main train station (Aarhus H) will be redeveloped in the coming years by building a new bus terminal and light rail corridor.</p>  <p> — Aarhus H: Main Railway Station — Banegårds-kvarteret: Train Station District </p>

	<p>A SUMP already exists and plans for the development of a SULP can be found in the “Mobilitetsplan Aarhus Midtby” (Mobility Plan Central Aarhus)</p>
<p>Description of SULP and SUMP</p>	<p>Expected freight plans for consideration include:</p> <ul style="list-style-type: none"> • Urban Consolidation Centres • Off-peak deliveries • Traffic regulations including vehicle restrictions
<p>Motivation of efforts for move towards ZEZs and objectives</p>	<p>Aarhus’s Climate Action Plan 2021-2024 includes commitments from the City to reduce the use of fossil fuels in commercial vehicles (trucks, ships and aircraft) by 30% and evaluate opportunities to reduce freight transport including potential efforts for joint deliveries across multiple businesses.</p> <p>In 2022, Aarhus was chosen as one of the Cities Mission (EU Mission for 100 climate-neutral and smart cities by 2030). The Cities Mission receives Horizon Europe funding to support the efforts aimed at reaching climate neutrality.</p>
<p>Efforts made to move towards Zero-emission-zones</p>	<p>The City received a €10.000 SURF grant for an Instant Project and the support of two experts.</p> <p>The goal of the Aarhus Instant Project was to create a freight plan for businesses surrounding the main train station (Aarhus H) as the neighbourhood will undergo redevelopment in the coming years and deliveries will have to continue.</p>
<p>Obstacles encountered during development and implementation</p>	<p>City staff did not realise how much of their current plans for freight were actually making deliveries more difficult. During the project they were educated on the biggest issues facing the freight industry through direct interactions with carriers and ride-alongs with drivers during deliveries.</p> <ul style="list-style-type: none"> • What was believed to be an acceptable loading zone was actually very difficult to use as it required drivers to traverse over cobblestone with pallet equipment in order to move items from their truck to the receivers. This creates a lot of noise and can even damage items being transported. Without a ride-along, the staff would have remained convinced that simply having a loading zone present in the vicinity of these businesses was sufficient. But after speaking with drivers and experiencing the deliveries first hand, they were able to better contextualise the biggest challenges faced by logistics staff; recognizing that road materials and distance are important considerations. • The staff saw that the city infrastructure in the central district has been damaged by goods movement because there is not enough space for manoeuvring. <div style="display: flex; justify-content: space-around; margin-top: 10px;">   </div>

	<ul style="list-style-type: none"> Through interviews, the municipality discovered the successful consolidation of waste at the city mall. Because of this, the City has created a new internal workforce within the municipality to review opportunities for garbage collection and sorting throughout Aarhus.
Objectives realised	<p>With the help of their experts, the City conducted interviews, meetings and ride-alongs with relevant businesses including vendors, logistics companies and more. Over 1500 local companies were categorised and CO2 for freight in the area was calculated.</p> <p>The City learned that a lot of nuisance exists in urban freight and also what needs to be considered for day to day logistics planning before even considering the development of a ZEZ-F.</p>
Summary and outlook	The City is working on the creation of a stakeholder forum to discuss challenges for deliveries and looking for better solutions for municipal garbage collection.

Karditsa

Location of city	Greece
Number of inhabitants	40.000
Description of city-structures	<p>Karditsa is a flat city about 3.5 km in diameter and is considered the “Greek city of cycling”, winning the 2019 European Mobility Week award. There is one bicycle for every two residents. The municipality is a certified cycle friendly employer by Bike2Work and the European Cyclists’ Federation. Even the municipality’s logo includes a cyclist:</p> 
Description of SULP and SUMP	Karditsa has launched a SUMP as well as a SECAP (Sustainable Energy and Climate Action Plan). Findings and recommendations from the SURF project were included in the updated SECAP and SUMP which were approved at the end of 2021.

<p>Motivation of efforts for move towards ZEZs and objectives</p>	<p>The City joined the Covenant of Mayors committing to reducing CO2 emissions by at least 40% by 2030. There is also a long-term goal to decarbonise the delivery sector specifically by encouraging the use of cargo and e-cargo bikes. There is also an interest in microhub and smart locker networks.</p>
<p>Efforts made to move towards Zero-emission-zones</p>	<p>The City received a €10.000 SURF grant for an Instant Project and the support of two experts. The goal of the Karditsa Instant Project was to encourage modal shift, making quick commerce deliveries using shared cargo bikes and e-cargo bikes. In order to achieve a reduction in CO2 emissions, more deliveries will need to be switched from the more commonly used motorcycle to electric bicycle.</p>
<p>Obstacles encountered during development and implementation</p>	<p>Electric bicycles (and cargo bikes in particular) are incredibly expensive. With a small budget, only five regular electric bikes were able to be purchased for this project.</p> <p>An additional challenge is that there are a limited number of bike shops within the city capable of servicing e-bikes.</p> <p>While the delivery staff were very receptive to using electric bikes, they still prefer motorcycles in bad weather as they navigate more easily over speed humps.</p>
<p>Objectives realised</p>	<p>The project trained 40 people on safe and green deliveries by e-bike. The pilot used the Strava movement app to better understand the routes used by delivery workers and whether or not routes were optimised. Total distance, average speed and maximum speed was calculated.</p> <div data-bbox="703 1122 1259 1364" data-label="Image"> </div> <p>This Instant Project was so successful there was a waitlist to join the program at its conclusion. Businesses can learn more and apply for a free trial on the city's website.</p>
<p>Strengths and weaknesses of the solution</p>	<p>As electric vehicles can be very expensive, this project helps businesses who can't afford to buy an e-bike on their own. In order to have a successful sharing program, there needs to be good coordination between shops for order and route optimisation.</p>
<p>Summary and outlook</p>	<p>E-bikes provide an attractive mode for delivery and businesses and drivers are willing to make the shift.</p> <p>The two SURF experts assigned to Karditsa helped develop a scale up support strategy. This includes:</p> <ul style="list-style-type: none"> • Self assessment - checklist • Transferable lessons from European Cities • Existing framework on cycle logistics • Potential sectors for scale-up • Recommendations for scale-up • Shared (e)cargo bike systems

Ravenna

Location of city	Italy
Number of inhabitants	160.000
Description of city-structures	<p>There are 8 UNESCO monuments in the city centre of Ravenna, in the Emilia-Romagna region. It is home to the only commercial and tourist port in the region and is part of the TEN-T network. In addition, there is a big chemical industry in the city.</p> <p>A SUMP was approved in 2019 and it includes a plan to decarbonise freight. Focus groups were held in 2022 to guide an update to the plan also known as the PUMS (Ravenna Urban Mobility Plan) including a focus on urban logistics.</p>
Description of SULP and SUMP	<p>The main aims of the SUMP is to focus on planning for people, improve public space and urban quality of life, improve air quality, reduce energy consumption and noise while providing sustainable motility.</p> <p>The City's General Urban Traffic Plan is made up of four smaller plans:</p> <ol style="list-style-type: none"> 1. Cycling Mobility Plan 2. Parking Policies Plan 3. Urban Road Safety Plan 4. Public School Transport Plan
Motivation of efforts for move towards ZEZs and objectives	<p>Currently there is a Limited Traffic Zone and pedestrian only areas within the city centre.</p> <p>Ravenna is involved with PAIR Air Quality Integrated Plan (the improved air quality plan for the Emilia-Romagna Region).</p>
Efforts made to move towards Zero-emission-zones	<p>The City received a €10.000 SURF grant for an Instant Project and the support of two experts.</p> <p>The goal of the Ravenna Instant Project was to create a Freight Quality Partnership (FQP), a permanent participatory process tool for stakeholders.</p> <p>The City and their SURF experts identified key logistics stakeholders and hosted virtual meetings around the possibility of implementing a ZEZ-F along Via Cavour, a major commercial corridor. Businesses along that street were surveyed and interviewed. Meetings were conducted with a variety of stakeholders including trade associations, retailers, logistics operators and different municipal departments.</p>

- Each meeting covered different topics such as
- The complexity of introducing zero-emission vehicles
 - Defining the location of the ZEZ-F
 - Delivery problems and current regulations
 - Possible measures and consolidation

Cargo bicyclists from Parma and Bologna as well as couriers from DHL participated in meetings as special guest presenters.



Obstacles encountered during development and implementation

It was difficult to get shops along Via Cavour to participate in a survey about implementing a ZEZ-F.

Strengths and weaknesses of the solution

Because this project happened during COVID, all meetings took place virtually. This may have allowed for more participation though the quality may have suffered. This was just the first step in the development of a bigger and more detailed engagement strategy.


The stakeholder conversations helped the City better understand the concerns of the industry and identify additional issues they had not foreseen including problems around freight parking.

FQPs are necessary in order to have successful freight plans. However, a lot of time is required to build relationships.

Summary and outlook

The City created an action plan with strategies for additional engagement, an analysis of the costs and opportunities of e-vehicles, research on e-commerce trends and plans for testing measures. Next steps will include an analysis of cargo bike and e-vehicle costs, new surveys with results included in the SUMP update, and pilots of other measures for sustainable freight such as loading zone reservations.

Madrid

Location of city	Spain
Number of inhabitants	3.3 million (6.8 million at regional level).
Description of city-structures	<p>Madrid is the capital of Spain and the most populated city in the country. It is also the second most populated Functional Urban area in the European Union. The city surface is 605.77 km². Madrid is a dense city (54 people/hectare). It includes 21 districts and 128 neighbourhoods. Madrid plays a key role in the country's economy (12% of total GDP). The City belongs to two Ten-T corridors.</p> <p>Madrid has a central axis road running from north to south, Paseo de la Castellana-Paseo del Prado. Madrid also has seven radial motorways leading in and out of the city, linked by three major ring roads.</p> <ul style="list-style-type: none">• M-30: it surrounds the centre of Madrid city. It has the characteristics of a motorway. It is 32.5 km long.• M-40: it is a ring motorway, with a length of 62 km and a radius of 10 km.• M-50: it is a ring road around Madrid and its metropolitan area. It is 85 km long and has a radius of 13.5 km.  <p>12 million journeys are made every day in the Madrid region. Rush hour, from 8:00 h - 9:00 h, means congestion on access roads to the city and saturation of public transport.</p> <p>Madrid counts on a wide and well-functioning public transport system: municipal buses (223 lines and a fleet of 2,109 buses), metro network (294 km long and 302 stations), commuter train (370 km long and 90 stations), regional buses (219 lines and a fleet of 2,107 buses), taxis (16,000 units), and a public and private transport sharing scheme: public e-bicycles, private e-bicycles, electric mopeds and e-scooters, shared electric cars, etc.</p> <p>Madrid presented its Madrid 360 Strategy in September 2019. The Strategy was created to reduce the city's pollutant emissions with the aim of complying with EU limits.</p>

<p>Description of city-structures</p>	<p>The Strategy will allow Madrid to carry out a sustainable transition in a socially equitable way and transform Madrid into a more environmentally, territorially and economically sustainable city.</p> <p>The Strategy is the building base from which the different policy blocks will be developed. The following regulations have been approved: Air Quality and Sustainability Ordinance (approved in March 2021), the Sustainable Mobility Ordinance (approved in September 2021) and the New Sustainable Mobility Plan approved in July 2022.</p> <p>Additionally, Madrid City is currently working on the development of a Strategy for the urban distribution of goods, which develops and better defines measures from the Madrid360 Strategy and the Mobility Plan.</p>
<p>Description of Sulp and Sump</p>	<p>Madrid approved its SUMP in July 2022. The most important measures are: promotion of public transport and renovation of urban buses, improvement of transport infrastructures, promotion of active mobility and intermodality, and encouraging a shift to more sustainable modes of transport.</p> <p>Madrid began implementing low-emission zones on 1 January 2022, see below sections for more details.</p> <p>Madrid is also working on the optimization of the urban freight distribution, providing technological solutions to enable more sustainable deliveries, and promoting micro hubs where freight is delivered by e-cargo bikes.</p> <p>Madrid City is currently working on the development of a Strategy for the urban distribution of goods, which develops and better defines the measures from the Madrid360 Strategy and the Mobility Plan. This new Strategy makes a series of proposals, among which the following should be highlighted.</p> <ul style="list-style-type: none"> • The creation of a framework for the location of loading and unloading areas (depending on land use, equidistance, type of trade, etc.), with the aim of improving what is currently in place and unifying criteria for the definition of loading and unloading areas. • Promotion of last-mile logistics centres located in markets, car parks, plots of land, multimodal platforms, etc. • Creation of parcel lockers for e-commerce in public car parks and intermodality hubs. • Promotion of night-time DUM. • Technological improvement of vehicles. • New home delivery model using autonomous cars. • Proposals for improvements in pedestrian zones and ZBEDEPs.
<p>Motivation of efforts for move towards ZEzs and objectives</p>	<p>Madrid's main goal is to reduce the city's pollutant emissions with the aim of complying with the EU limits.</p> <p>Madrid City Council is making a great effort to improve citizens quality of life through the improvement of mobility and a more environmentally sustainable city.</p> <p>In the framework of the World Summit of Mayors, of the 94 member cities of the C40, Madrid City Council has committed itself to analyse the opportunity to develop zero-emission zones in the different neighbourhoods of Madrid.</p>

The objective is to implement 21 Zero Emission Zones (one per district) by 2030, with a budget of 100 million euros. This means almost 8.5 km of new zero emission zones and 180,000 m² free emission areas. These actions will remove 14.6 million vehicles per year (40,000 vehicles per day).

This measure forms part of the SUMP.

To date, 15 of the 21 zero emission zones have been implemented. The remaining will be implemented between now and 2030.

A detailed list of the zero-emission zones to be implemented is given in the table below.



Efforts made to move towards Zero-emission-zones

District	Street	Pedestrian Area (m ²)	Street Area (m ²)	Length (m)	Open (✓)	
1	Centro	Puerta del Sol	18488	9702	1447	✓
2	Arganzuela	Guillermo de Osma Market - Alonso Carbonell	2326	1676	185	✓
3	Retiro	Angel Gavinet - Averroes and Homero	2325	2343	238	✓
4	Salamanca	Recoletos Street	2307	2316	218	✓
5	Chamartín	Emilio Campion - Gómez Ortega	2029	2651	222	✓
6	Tetuán	Tenerife	1741	1226	240	✓
7	Chamberí	Olavide Square	26766	14036	631	✓
8	Fuencarral-El Pardo	Historic Centre	1412	1153	136	✓
9	Moncloa-Aravaca	Historic Centre	4716	3485	488	
10	Latina	Tirso de Molina Market - Doña Urraca and Laín Calvo	6601	2708	343	✓
11	Carabanchel	Laguna St, Arévalo St, Albatros and Sabanero	4586	6271	351	✓
12	Usera	Dolores Barranco Street	8080	8611	859	
13	Puente de Vallecas	Hermanos Carpi - Puerto de Tarancón	1276	1106	135	✓
14	Moratalaz	Oberón Steet	3039	3036	146	✓
15	Ciudad Lineal	Ministerios Street	14058	8443	640	✓
16	Hortaleza	Historic Centre	2762	2445	355	✓
17	Villaverde	Historic Centre	1483	1125	171	✓
18	Villa de Vallecas	Agustín García Malla St.	1946	1946	133	
19	Vicálvaro	Historic Centre	2205	2205	217	
20	San Blas - Canillejas	Boltaña St.	3373	2832	207	
21	Barajas	Historic Centre	68491	16771	1103	
TOTAL			180010	96087	8465	

Obstacles encountered during development and implementation	Some difficulties encountered have been loading-unloading, garage entrances, commerce problems, and merchants complaints.
Strengths and weaknesses of the solution	The creation of zero-emission zones reduces the presence of highly polluting vehicles, while simultaneously improving the quality of life of neighbourhood residents.
Summary and outlook	Air quality and the fight against climate change are a priority for Madrid City Council. For this reason, Madrid presented its Madrid 360 Strategy in September 2019. With 200 measures, Madrid 360 will enable us to reduce 1,563 tons of NOx (nitrogen oxide) per year through three main axes of transformation: the city, mobility, and the Administration.

Bologna

Country	Italy
Number of inhabitants	391,686 (2020)
Description of the city's structure	Bologna has been selected by the European Commission to join the EU Mission: 100 Climate-Neutral and Smart Cities by 2030. The city of Bologna is located in the centre-north of Italy, covers 141 km ² and had 391,686 inhabitants in 2020. Its central location makes Bologna Italy's most important railway and highway hub, and the city's airport, G. Marconi, is experiencing rapid growth. Bologna is strategically located in the TEN-T corridors network, being the crossroads of three important corridors: the Scandinavian-Mediterranean, the Baltic-Adriatic, and the Mediterranean. Considering its prestigious university (the oldest in Europe), the numerous enterprises, the low capacity of the narrow streets in the mediaeval city centre, and 300,000 commuters, Bologna requires a high level of varied mobility, and its urban area suffers severe congestion and pollution levels. In order to face these challenges, Bologna formally approved a SUMP and SULP in 2019. They were developed together and are interconnected. The Zero-Emission Zone for Freight vehicles was introduced through the SULP.
Description of SULP and SUMP	The SUMP and the SULP were created together and formally approved by the Metropolitan City of Bologna (in collaboration with the municipality) in 2019. The main goal of the SUMP is to reduce greenhouse gas emissions by 40% by 2030 compared to 1990 levels. This objective includes five general elements: accessibility, climate protection, air pollution reduction, and road safety, which together contribute to the fifth objective of making the metropolitan city more attractive and liveable.

Description of Sulp and Sump

Therefore, the main strategy of the SUMP is to reshape the future of metropolitan mobility in Bologna, by achieving a significant reduction in car traffic, promoting a more sustainable and active modal split, and ensuring better service from the new metropolitan public transit (MPT). The Sulp sets out strategies for the sustainable mobility of goods, both for distribution logistics in urban areas and industrial logistics at the metropolitan level. The plan aims to create a freight transport system capable of meeting the widespread needs of the metropolitan city, while increasing the sustainability of logistics and transport operations, especially for key urban areas, starting with the capital (which has a zero carbon by 2030 target for urban distribution).

Motivation of efforts for move towards ZEZs and objectives

The main objectives for introducing ZEZ for trucks in the Bologna urban area are improving air quality and reducing CO2 and polluting emissions, thus improving liveability in the urban area. It has been calculated that the simple change from polluting to electric engines saves 3.75 tonnes of CO2 emitted daily into the atmosphere. Reducing noise pollution. It has been calculated that electric vehicles can reduce noise emissions by up to 27% compared to diesel vehicles.

Efforts made to move towards Zero-emission-zones

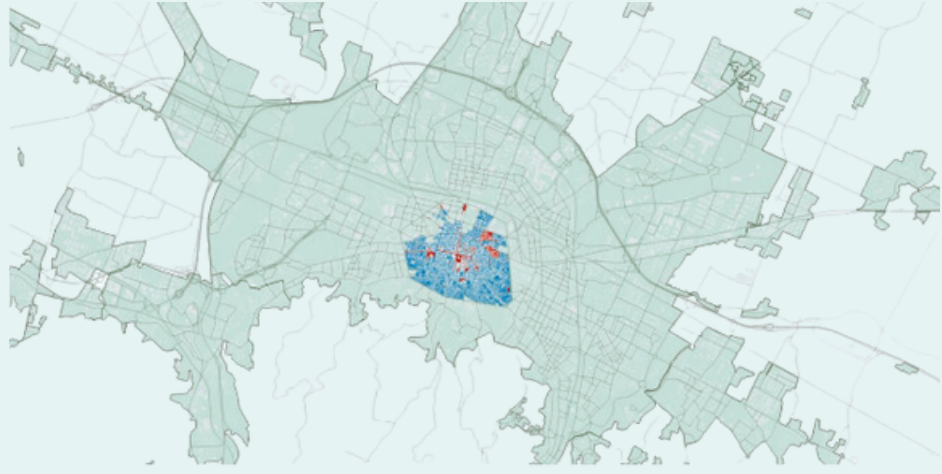
In the implementation of the ZEZ for trucks, the city plans to engage stakeholders as early as possible, especially commercial activities affected by the measure. The goal for the transition is to be gradual, to allow for sufficient time for adaptation. The stakeholder engagement will also be useful to publicise the measures accompanying the new regulations and thus explain possible alternatives to "traditional" implementation. The implementation of the below measures will take place gradually with the aim of having only electric trucks in the entire urban area by 2030.

		Gas/ diesel vehicles	Hybrid, LPG, NCG vehicles	Electric/ZE Vehicles	Cargo bike, pedestrians
1	Urban Area	Euro5+ 24h	Ok 24h	Ok 24h	Ok 24h
	Regular LTZ	Euro 5+ Forbidden only highest peak hours	Ok 24h	Ok 24h	Ok 24h
	Special LTZ	Forbidden all peak hours	Forbidden only highest peak hours	Forbidden only highest peak hours	Ok 24h
2	Urban Area	Euro 6+ 24h	Ok 24h	Ok 24h	Ok 24h
	Regular LTZ	Euro 6+ Forbidden only highest peak hours	Forbidden only highest peak hours	Ok 24h	Ok 24h
	Special LTZ	Forbidden all peak hours	Forbidden all peak hours	Forbidden only highest peak hours	Ok 24h
3	Urban Area	x	x	Ok 24h	Ok 24h
	Regular LTZ	x	x	Forbidden only highest peak hours	Ok 24h
	Special LTZ	x	x	Forbidden all peak hours	Ok 24h

	<p>Where: Urban area: the whole urban area of Bologna Regular LTZ: the actual Limited Traffic Zone (3.8 km²), covering almost the inner city centre, where access is controlled by a camera system based on the vehicle's emission level. Specialised LTZ: areas and roads within the LTZ, where freight vehicle access requirements are tighter (e.g., pedestrian roads). EURO5+ (6+): allowed vehicles EURO5 (EURO6) or more. Forbidden only highest peak hours: access allowed, but not in the very highest peak hours. Forbidden all peak hours: access allowed only in off-peak hours.</p>
<p>Obstacles in development and implementation</p>	<p>The shift to electric vehicles is going slowly in Bologna (and generally in Italy). In 2019, the share of electric vehicles (including all vehicles, not just freight vehicles) was estimated at less than 2% of the total number of vehicles operating in Bologna.</p>
<p>Realised objectives</p>	<p>Not yet measurable (see "Motivation of efforts to move towards ZEZs and objectives" for foreseen improvements).</p>
<p>Strengths and weaknesses of the solution</p>	<p>Measures will be implemented gradually in several steps/zones, and this has several advantages. This provides sufficient time for adaptation, and even the smallest change can be tested in a limited territorial context to find any corrective measures, thanks in part to cooperation with individuals and stakeholders.</p> <p>The strategy uses a camera-based access control technology that has been used in the city for years, which means the system is already well known to logistics operators (and citizens).</p> <p>However, extending the scheme to the entire urban area poses a challenge from a technological point of view (vehicle access to a larger number of roads will have to be controlled by cameras) and from the point of view of public acceptance. Strong political commitment is essential to support and sustain the development of this type of approach.</p>
<p>Summary and outlook</p>	<p>Regulations on access to the LTZ (and traffic throughout the urban area) of Bologna will be updated in several steps until 2030. The aim is to make logistics in the urban area pollution-free. Fossil-fuel vehicle traffic will be gradually banned in the LTZ (and subsequently in the urban area), in favour of ZE means such as electric vehicles, cargo bikes, and pedestrians.</p> <p>The time windows for entering the LTZ have been proposed based on the peak hours of private traffic. Moreover, the fact that electric vehicles are allowed to circulate always provides an additional incentive for freight operators to use these vehicles.</p> <p>Implementing this strategy will be a major challenge. There are very few electric trucks to begin with and the potential for stakeholder pushback is significant. Raising awareness and collaborating with stakeholders will be essential to achieve the desired benefits of reducing air and noise pollution caused by logistics in the urban area.</p>

The three areas involved in upcoming ZEZ-F in Bologna

- Grey: urban area.
- Blu: regular Limited Traffic Zone.
- Red : Specialised Limited Traffic Zones.



Kevadia: India's first electric vehicle city

Location of city	India
Number of inhabitants	6,788 (2011)
Description of city-structures	Kevadia is home to the world's tallest statue- 'Statue of Unity'. The Statue of Unity Area Development and Tourism Governance Authority (SOUADTGA), a state entity established in 2019, is leading this effort to develop India's first electric-vehicles-only area in the city.
Description of Sulp and Sump	N/A
Motivation of efforts for move towards ZEZs and objectives	The city aims to minimise air and noise pollution by reserving the space exclusively for electric cars in the region.
Stakeholder's engagement and expectations	N/A

<p>Efforts made to move towards Zero-emission-zones</p>	<p>Only electric cars will be permitted to operate inside this established region in Kevadia, with tourist buses also running on battery power rather than diesel. Additionally, local residents living near the Statue of Unity will receive financial assistance to purchase electric vehicles, per the authority's plan for Kevadia. This funding will be provided by Gujarat Energy Development Agency (GEDA) and SOUADTGA, and the plan will enable Kevadia residents to invest in EVs for personal use.¹⁰²</p> <p>SOUADTGA has collaborated with ETO motors to deploy 400 electric vehicles in the region, with 50 electric rickshaws (three-wheeled electric vehicles) already permitted in the zero emission zone under the authority's jurisdiction since December 2021.¹⁰³ Women drivers are given precedence when it comes to driving these e-rickshaws in this equity-based vehicle transition. Women are encouraged to drive these e-rickshaws for their livelihood and receive free training at the Kevadia Skill Development Center. In addition, the fuel will be low carbon, given that Kevadia has two hydroelectric power plants that provide electricity for this ZEZ endeavour.</p>
<p>Obstacles encountered during development and implementation</p>	<p>In April 2019, the Indian Government approved the Phase II of Faster Adoption and Manufacturing of Electric Vehicles (FAME) Scheme. This phase aims to generate demand for electric vehicles by way of supporting 7000 electric buses, 500,000 electric three-wheelers, 55,000 electric four-wheeler passenger cars, and 1 million electric two-wheelers by March 2024.¹⁰⁴</p> <p>The FAME scheme is far from achieving its targets, however. As a result, urban vehicle access restrictions like ZEZs and LEZs could prove to be helpful solutions for faster deployment of electric vehicles in the country.</p>
<p>Impact assessment and findings until today</p>	<p>Not available due to the recency of the project.</p>
<p>Outlook and next steps towards ZEZ for Freight</p>	<p>While Kevadia is the first electric vehicle zone in India, zero- and low-emission zones are not a brand new concept for the country. In Matheran, another small town in western India, all motorised vehicles are prohibited by the Indian Government as it declared the area as an "eco-sensitive zone" in 2003. Along with the vehicle ban, the Matheran Municipal Council only permits establishing non-polluting, non-hazardous, small-scale and service industries, agriculture, floriculture, horticulture and agro-based industries.¹⁰⁵ The Taj Trapezium Zone (TTZ) authority banned all petrol and diesel vehicles within a 500 metre radius of the Taj Mahal to protect the historic monument as well as to improve the region's air quality.¹⁰⁶ Therefore, zero- and low-emission zones are not a brand new concept for India.</p>
<p>Summary and outlook</p>	<p>SOUADTGA is working towards replacing the petrol and diesel-powered vehicles in the area with EVs. The aim of reserving the space exclusively for electric cars in the region is to minimise air and noise pollution, while also adding to the allure of this one-of-a-kind tourist attraction.¹⁰⁷</p>

This project in Kevadia is an important step toward establishing vehicle-access restricted areas in India and mainstreaming such policy measures to use as an example for future ZEZ projects in the country.¹⁰⁸

Taoyuan City

Location of city	Chinese Taipei
Number of inhabitants	<p>The total area of Taoyuan City is 1,220.95 km². The population is spread in 13 districts. The population is of 2,272,391 inhabitants and the population density is 1861 inhabitants/km². Taoyuan has developed from a satellite city of the Taipei Metropolitan Area into the fourth-largest metropolitan area, and fifth-largest populated city in Chinese Taipei.¹⁰⁹</p>
Description of city-structures	<p>Located in the northwestern part of the island, Taoyuan City has an industrial value of 84 billion Euros (17.5% of the Gross Domestic Product (GDP) with 3,696 ha of non-urban industrial land and 3,131 ha of urban industrial land.</p> <p>Taoyuan is a quite compact city, with mixed-use commercial and residential areas developed in the past 50 years. Most inner city streets are quite narrow. Around 40% of streets have marked on-street parking spaces used also for loading and unloading.</p> <p>Taoyuan is a highly motorised city served by 167 inner city bus routes, representing only 4.7% of the modal split. Taoyuan's public transportation system counts on an intercity public transportation of high speed rail, buses, and taxis.</p> <p>Taoyuan City is the most important logistics hub in Chinese Taipei, which supports Chinese Taipei's electronic, medical, and manufacturing industries. Taoyuan is home to 1,800 logistics operators, including international enterprises such as UPS and FedEx.</p> <p>Trucking represents almost 50% of the share along with another 10% of auxiliary services.</p> <p>As a rapidly growing city with high motorization rates, urban freight comes with economic benefits and negative externalities like air and noise pollution, congestion and road safety concerns.</p> <p>Autonomous Regulations to develop Taoyuan City as a low carbon emission and green city (LCGC)</p> <p>The 2017 Autonomous Regulations provide a series of strategies for the development of Taoyuan City as a low carbon emission and green city (LCGC), which focus on decarbonizing the transport infrastructure, improving air quality, and recycling materials for road construction.</p>

Responsibilities for freight management and planning were decentralised to different city departments until 2019 when a central coordination body was introduced.

Taiwan Logistics Alliance (Economic Development Bureau)

The Green Alliance, established in 2016, aims to improve freight partnership and consists mainly of private companies and stakeholders. Besides enhancing partnership, the Alliance aims to share resources, and institutionalise exchange and long-term planning with the city.

Air Quality Protection Zone Label (Environmental Bureau)

A voluntary labelling system was established to inspect and rate diesel vehicles. Polluting vehicles are prohibited from entering the air quality protection zone (or low emission zone). The regulation also prohibits vehicles at parking lots, roads (excluding expressways), and transfer stations from idling for more than three minutes. This does not include refrigerated trucks during loading/unloading operations.

Incentives and subsidies (Economic Development Bureau)

Under the Taoyuan City Service Industry, the Smart Power Adoption and Green Transportation program subsidises the businesses to invest in high-efficiency electric vehicles certified by the Ministry of Economic Affairs. The LCGC Implementation Plan allocates subsidies to replace two-stroke vehicles and incentivize electric two-wheelers.

On-street loading/unloading (Urban Planning Department)

Centralised planning layout for loading/unloading is done to increase loading turnover and improved safety. To meet the loading/unloading demand, dual-use public parking lots and transfer stations are established to collect and redistribute freight. The lack of warehousing space and redistribution space due to the high land cost and regulatory prohibitions result in illegal warehouses' proliferation. If the land zone is changed for transportation land use, it is mandated to provide a portion of the space for freight purposes.

Adoption of EcoLogistic 8 principles and 6 demonstration projects

Against this background of increasing freight demand driven by e-commerce and the need to have a coherent and cross-departmental approach in addressing freight issues in Taoyuan, the city decided to establish the EcoLogistics Community Chair Office in 2019 in collaboration with ICLEI – Local Governments for Sustainability. The office was set up with representatives from different city departments, a concerted effort to implement pilot projects and strategic long-term EcoLogistics planning. 8 EcoLogistics Principles: A Pathway to Sustainable Urban Freight, as part of the transport decarbonization strategy, are adopted.

One of the mandates of the EcoLogistics Chair Office is to pioneer 6 living labs to test innovative solutions and the potential for scalability and replication.

The 6 living labs are the Daxi Business District, Shalun Green Warehousing Park, Chunghua Post Logistics and Huaya Science and Technology Park, Qingpu Green Energy Logistics Cluster, Airport Cargo Terminals and Logistics Area, Yangmei Smart Sharing Warehouse.

Simultaneously, a series of workshops and consultations with the stakeholders are held to collectively set vision and objectives for Taoyuan's long-term Sustainable Urban Logistics Plan (SULP), which is currently under development.

The development of EcoLogistics Indicator System

Through the ongoing living labs (2020 - 2022), the city can proactively identify and collaborate with the stakeholders in data collection and facilitate conversations for resource sharing among logistics providers. Taoyuan's EcoLogistics Indicator system is classified into 3 categories: environmental sustainability, social equity, and operational efficiency.

Most of the operators focus on streamlining and automation of the warehousing and distribution process; developing renewable energy (wind and solar energy) to power the consolidation centre or the warehouse; building stakeholder alliances for resource sharing and collaboration; and creating self-labelling tools. The indicators aim to incentivize low emission and electric vehicles and optimising warehousing processing.

Description of SULP and SUMP

Taoyuan's long-term Sustainable Urban Logistics Plan (SULP), named locally "Taoyuan EcoLogistics White Paper," will be released by the end of 2022. The vision of the Taoyuan's EcoLogistics goal is "a health, safety, people-centred, and zero emission urban ecologistics system towards a sustainable and liveable Taoyuan."

Taoyuan's SULP aims to balance environmental protection and economic development, mainly focusing on the plans for the sustainability of the logistics industry and land use planning for urban logistics systems.

Five major driving forces are included: comprehensive smart logistics, new technology in route planning, utilisation of smart and low emission storage and cold chain, recycling and waste reduction, and efficient land use.

Ultimately, aligning with Taiwan's national 2050 net zero emission roadmaps, the Taoyuan SULP provides guidelines to achieve the net zero goals for urban logistics.

Motivation of efforts for move towards ZEZs and objectives

Fast urban growth and rising income levels in Taoyuan have been accompanied by a rapid increase in the number of motor vehicles on the road. From 2016 to 2020, the number of registered motorised vehicles in Taoyuan increased rapidly, and reached 21.17 million vehicles, among which 14.6 million were motorcycles and 6.77 million automobiles. (Taoyuan Transportation Bureau, 2022). More vehicles also bring more accidents. The traffic accident fatalities and injuries in Taoyuan have also increased in recent years. The average accident fatalities is 256 people annually over the past 5 years.

To address the local concerns of air quality, noise and road safety, since 2015, Taoyuan has set goals to increase low emission zones, locally known as Quiet Traffic Zones, to improve air quality, noise, road safety and life quality in commercial and residential areas.

	<p>Four pillars were introduced to the low emission zones plan</p> <ul style="list-style-type: none"> • Setting low emission zones with a vision towards ZEZ. • Setting clean air quality points nearby public parks and green spaces. • Installing solar panels on public buildings. • Forbidding heavy vehicles from entering these zones.
<p>Efforts made to move towards Zero-emission-zones</p>	<p>Taoyuan's efforts towards Zero Emission Zones are part of the city's Net Zero Strategies by 2050. As of June 2022, 68 low emission streets and 156 clean air quality points have been implemented in Taoyuan.</p>
<p>Obstacles encountered during development and implementation</p>	<p>Stakeholder engagement is one of the local challenges to ensure community and local businesses buy-in. The city organised a series of consultations in school districts, public meetings with the residents and local businesses sharing and exchanging on the city's vision, and policy and living labs to gather the community and business' feedback. These meetings required a lot of organisation and lengthy consultations.</p>
<p>Strengths and weaknesses of the solution</p>	<p>Just as in many Asian cities, there is no single authority in Taoyuan to govern logistics issues and often the private sector is expected to self-regulate.</p> <p>The introduction of the EcoLogistics Chair Office in Taoyuan has supported the city in introducing data collection, implementing demonstration projects, and working toward zero emission zones.</p> <p>There are opportunities to further refine and improve the approach in Taoyuan.</p> <ul style="list-style-type: none"> • It's essential for cities to develop an efficient and convenient urban freight delivery, while strengthening sustainability goals to achieve net zero goals and improve their livability. • Fueled by COVID-19 and changing consumer behaviour, the needs of e-commerce delivery (including cold chains) will continue to accelerate and become a key factor of the carbon reduction of the urban logistics system. • The legal and regulatory framework needs to be up-to-date and favourable to innovations and sustainable development. Sustainable logistics must be a high priority in the local and regional political agenda for long-term urban planning. • Multi-stakeholder partnerships can be enabled if stakeholders look beyond the present boundary and interests and search for solutions through collaboration and resource-sharing.
<p>Summary and outlook</p>	<p>Taoyuan City, also known as the "Global Gateway City," is strategically located in East Asia and is home to 1,800 logistics operators, including international enterprises such as UPS and FedEx. Trucking represents almost 50% of the share along with another 10% of auxiliary services.</p>

<p>Summary and outlook</p>	<p>Thanks to smart technology and digitalization, the e-commerce market is a 38.92-billion-dollar industry with a five-year growth rate of an average of 7%.</p> <p>Taoyuan needs to balance its logistics development and the good life quality of its inhabitants. To address the local concerns of air quality, noise and road safety, since 2015, Taoyuan has set goals to increase low emission zones, locally known as Quiet Traffic Zones, to improve air quality, noise, road safety and life quality in commercial and residential areas.</p> <p>Four pillars are introduced to the low emission zones plan</p> <ul style="list-style-type: none"> • Setting low emission zones with a vision towards zero emission zones. • Setting clean air quality points nearby public parks and green spaces. • Installing solar panels on public buildings. • Forbidding heavy vehicles from entering these zones. <p>To align with national 2050 net zero emission goals, Taoyuan is moving forward a sustainable and liveable city, with elements of health, safety, people-centred, and zero emission. Taoyuan is planning to steadily increase its low-emissions streets with the ambition to turn them into zero-emissions zones.</p>
----------------------------	--

Seoul

<p>Location of city</p>	<p>Korea</p>
<p>Number of inhabitants</p>	<p>9,732,617 (Seoul Metropolitan Government, 2022)</p>
<p>Description of SULP and SUMP</p>	<p>SULP: 3rd Seoul Logistics Basic Plan (2018-2027)[2] ¹¹⁰</p> <p>The 3rd Basic Plan further developed the concept of “CT-Logistics” (Convergence of City, Transport and Logistics) from the 2nd Basic Plan. CT-Logistics is the concept of an efficient Seoul-type urban logistics system that combines the purpose and function of logistics into urban transportation and environment. In the 3rd Basic Plan, the city plans to</p> <ul style="list-style-type: none"> • Create soft infrastructure of logistics. • Expand the close-to-life logistics system. • Maintain logistics infrastructure • Establish logistics operation space. • Strengthen logistics services for industrial support. • Improve competitiveness of urban logistics.

Key Logistics Laws	National Master Plan	Local Master Plan
Framework Act on Logistics Policies	5th National Logistics Basic Plan (2021-2030).	3rd Seoul Logistics Basic Plan (2018-2027).
	Both Plans are drafted every five years covering the next ten years; sub plans are released annually.	
Sustainable Transportation Logistics Development Act	2030 National Basic Plan for Sustainable Transport-Logistics Development.	Local Plan for Sustainable Transport-Logistics Development.
	Both Plans are drafted every ten years covering the next ten years.	
Act on Development and Management of Logistics Facilities	Comprehensive Plans for Development of Logistics Facilities.	N/A

SUMP: Sustainable Urban Mobility Plan: Seoul Transport Vision 2030¹¹¹

In 2013, the Seoul Metropolitan Government (SMG) announced its Seoul Transport Vision 2030, with the goal of shifting the city's mobility system to a people-centric transport system by prioritising public transport, pedestrians, and cyclists. With the slogan of "Seoul, a livable place without relying on cars," the long-term plan aims to double the surface area of sidewalks in downtown and expand the public bicycle rental service in Seoul called "Ddareungyi" (따릉이). The proposal is built upon the three core values of People, Sharing, and Environment.

Core value	Key tasks
People	<ul style="list-style-type: none"> • Create a pedestrian-first traffic environment. • Create a bicycle-oriented living environment. • Transition to a traffic-safe metropolitan city. • Provide barrier-free transportation environment and services to the general public, disabled and elderly.

Sharing	<ul style="list-style-type: none"> • Establish an efficient public transportation system based on railways. • Provide fast and convenient public transportation services. • Activate shared transportation (implementation of a “complete street” where pedestrians, bicycles and vehicles coexist).
Environment	<ul style="list-style-type: none"> • Transition to a “mobile-reducing society” that reduces unnecessary movement. • Improve eco-friendliness of transportation means and facilities. • Establish an unblocked and uninterrupted road environment. • Create a citizen-led advanced city of transportation culture by communicating with citizens.

As of 2022, the grade 5 vehicles, which are small- and medium-sized diesel cars made before July 2002 or a gas-powered vehicle made before 1987, are limited from entering the GTZ from 6AM to 9PM every day. Vehicle owners that violate the rule pay a fine of 100,000 South Korean Won (77 USD) with the exception of emergency cars, disabled, and national basic livelihood recipients.

Motivation of efforts for move towards ZEZs and objectives

In the 2010s, the significant increase in car ownership led to serious traffic congestion as well as air pollution issues. In 2014, 52% of ultrafine particles of Seoul originated from the transport sector. To be more specific, most of the NOx emissions originate from diesel cars (67%), followed by gasoline cars (12%); compressed natural gas (CNG) vehicles (10%); and liquified petroleum gas (LPG)-fueled vehicles (9%) (SMG, 2014).

In 2020, Seoul pledged to achieve carbon neutrality under the “2050 Greenhouse Gas Reduction Strategy through the Promotion of Green New Deal.” In the 2050 Seoul Climate Action Plan, transport is one of the five key sectors identified with the goal of transitioning all vehicles to zero emission vehicles by 2050.

Efforts made to move towards Zero-emission-zones

Green Transportation Zone (GTZ) in Seoul

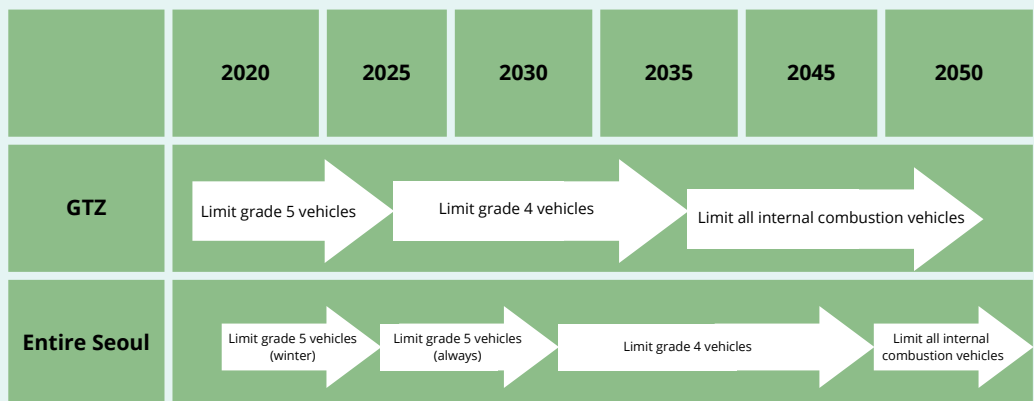
SMG operates a GTZ for the development and promotion of green transportation. The GTZ area of the 17.7 square kilometres of Hanyang City Wall is specially managed under the Sustainable Transport Logistics Development Act to curb traffic congestion and carbon emissions, and was designated as the first GTZ in Korea in March 2017. As of 2022, the grade 5 vehicles, which are small- and medium-sized diesel cars made before July 2002 or a gas-powered vehicle made before 1987, are limited from entering the GTZ from 6AM to 9PM every day. Vehicle owners that violate the rule pay a fine of 100,000 South Korean Won (77 USD) with the exception of emergency cars, disabled, and national basic livelihood recipients.

Subsidy

There are mainly two forms of subsidies that encourage eco-mobility, which are an early scrap car subsidy and an emissions reduction device subsidy. In 2019, residents of the GTZ and low-income vehicle residents of Seoul received a subsidy of up to 3 million Korean won (2,290 USD) if they scrapped a grade 5 vehicle.¹¹² An additional 2 million won (1,527 USD) was supported for buying a low-emission car and 1 million won (763 USD) for a LPG car. Also, SMG helped cover 90% of the expense of emissions reduction devices for grade 5 vehicle owners of the GTZ residents (SMG, 2019).¹¹³

Expansion of the GTZ plan

The city plans to expand and operate GTZs to Gangnam and Yeoido as the next pilot zone. The Ministry of Land, Infrastructure and Transport and local governments of Gangnam district have discussed about the plans of establishing GTZs in Gangnam and Yeouido. The plans have been reviewed by the Land, Infrastructure and Transport Committee.



Seoul GTZ Roadmap (Seoul Climate Action Plan 2050, 2021)

From 2035, all cars with internal combustion engines will be restricted in the GTZ. Seoul will restrict all internal combustion engine vehicles to the whole city by 2050.

Obstacles encountered during development and implementation

Not identified yet

Objectives realised

The implementation of the operation restrictions in December 2019 showed a visible effect of reducing traffic volume and reducing greenhouse gas emissions.¹¹⁴

- Compared to July 2019, total traffic volume decreased by 12.8% and Class 5 traffic volume decreased by 45.9% as of September 2020.
- It is estimated that about 2 tons of PM 2.5 will be reduced every year due to the effect of reducing air pollutants such as fine dust due to the decrease in traffic.

Objectives realised	Traffic volume	Grade 5 Vehicle Traffic Volume				
	July 2019	September 2020	All grade 5 vehicles		Vehicles with no emission reduction device	
			July 2019	September 2020	July 2019	September 2020
	778,302	679,0915	15,113	8,183	8,740	1,096
<i>(Seoul Urban Transportation Office Transportation Policy Division, 2020)</i>						
	<p>In addition, through the reorganisation of road space, the walking space increased and the traffic volume decreased.</p> <ul style="list-style-type: none"> Existing roads such as Toegy-e-ro and Sejong-daero Forest Road were reorganised into green spaces to enable walking, bicycles, and trees. As a result, traffic volume is expected to be reduced by 5.7%, and the floating population is expected to increase by 38%, resulting in an economic effect. 					
Strengths and weaknesses of the solution	<p>Strenghts:</p> <ul style="list-style-type: none"> Economic instruments (subsidy) to provide incentives. Comprehensive policy which takes into account people with reduced mobility and national basic livelihood recipients by providing exceptions. <p>Weakness:</p> <ul style="list-style-type: none"> Works under the rule of punishment and reward system, which is not enough for people to associate with the environmental problems. 					
Summary and outlook	<p>With the national goal of achieving carbon neutrality and removing all internal combustion vehicles in Seoul by 2050, the GTZ serves as an important cornerstone of a green mobility transition. The effects of implementing the GTZ have been significant in terms of reducing traffic volume as well as air pollution level.</p>					

Quito

Location of city	Ecuador
Number of inhabitants	2.8 million
Description of city-structures	<p>The Historic Center of Quito (HCQ) comprises an urban area of 3.75 km², with a population of approximately 40,000 inhabitants. Declared by UNESCO as one of the first World Heritage Sites in 1978, it is considered one of the most important historical sites of Latin America. Even though the HCQ has been losing residents for the past 3 decades, during the daytime it still attracts important influxes of locals and foreigners because of its commercial and touristic importance. According to the Municipal database, there are approximately 2,000 businesses in the area, of which more than 80% are wholesale and retail trade activities and 14% accommodation and food service activities.</p> <p>Despite the provisions of Ordinance No. 147, which regulates logistics in the Historic Centre, night loading and unloading schedules are not compatible with the business dynamics of the territory, and the infrastructure is deficient (IMP, 2019). According to a survey conducted in 2018, which targeted the residents and business owners in the HCQ, 58% of respondents identified congestion problems as the main barrier for provisioning for their businesses. In fact, 93% of businesses get supplies at least once a week, while 28% receive daily deliveries. (Secretaría de Movilidad, 2018).</p> <p>Moreover, due to its location in the centre of a long and narrow city as Quito, the HCQ is an obligatory crossing point for all the commuters from the southern area of the city that go to the Central Business District (CBD) to work and study. However, the colonial urban structure, which remains unchanged, has no capacity to withstand the current flows of vehicles, generating high levels of congestion, as well as air and noise pollution. The air pollutants and the constant vibration threaten not only the health of the people that work and live in the area but also the vulnerable structures of the old colonial buildings (MIDUVI, 2013).</p>
Description of SULP and SUMP	<p>Considering the national regulatory framework of Ecuador and in compliance with the international commitments to which the Municipality of Quito adhered in the past years, in 2020 the Municipality of Quito issued its Climate Action Plan for Quito (PACQ by its Spanish acronym). With the PACQ, Quito commits to reducing GHG emissions by 30% in comparison to 2015 by 2030 and achieving climate neutrality by 2050. Given that the transport sector has been identified as the largest generator of GHG emissions in the city, being responsible for 40% of them, actions to mitigate its impact need to be prioritised.</p>

	<p>Thus, the PACQ defines the following mitigation actions for a sustainable urban mobility:</p> <ul style="list-style-type: none"> • Zero emissions public transport • Zero emissions Historic Centre • Integrated and efficient public transport • Active mobility • Low carbon freight transport <p>In this context, the Municipality works on various fronts to promote and advance sustainable mobility in general and electric mobility in particular. The Mobility Master Plan is under development, which will integrate the various initiatives underway and will promote the additional initiatives necessary to achieve the current goals in terms of both sustainable mobility and the environment.</p>
<p>Motivation of efforts for move towards ZEZs and objectives</p>	<p>The status of World Heritage Site, the current situation in the area, and the commitments made by Quito to contribute to the mitigation of the global climate crisis led to the decision of turning the area into a Zero Emissions Zone (ZEZ) by 2030 and thus starting the pedestrianisation of several streets in the core of the HCQ.</p>
<p>Efforts made to move towards Zero-emission-zones</p>	<p>In relation to the Historic Center of Quito (HCQ), which according to the PACQ should be Zero Emissions by 2030, nine streets in the main area of the HCQ have been turned into pedestrian zones since 2015.</p>
<p>Obstacles encountered during development and implementation</p>	<p>The main challenge encountered in the pedestrianisation of the area has been the resistance of business owners, who were used to being able to load and unload in front of their businesses.</p>
<p>Objectives realised</p>	<p>On average, 280,000 people on weekdays and 315,000 on weekends walk in the pedestrian streets. Moreover, the concentration of air pollutants such as PM 2.5 and CO decreased by 30% and 60%, respectively, after the pedestrianisation.</p>
<p>Strengths and weaknesses of the solution</p>	<p>Despite the improved accessibility, road safety, and air quality experienced by pedestrians, this measure has made the distribution of goods difficult in the area.</p>
<p>Summary and outlook</p>	<p>This new setup in the HCQ poses a series of challenges for logistics, but at the same time, it creates important opportunities to transform the high pollutant, disruptive and inefficient logistics in the area. This is where international cooperation projects such as the EU-funded project SOLUTIONSplus and the Global Environmental Facility projects (GEF-7) are supporting the Municipality in the consolidation of the low-carbon urban logistics in the area with locally designed and assembled Light Electric Vehicles (LEV).</p>

Integrating ZE-Z Into the Freight Transport Network

The Netherlands

The Netherlands Knowledge Platform for Public Charging Infrastructure (NKL) 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 roadmap 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 the smart-charging innovation centre ElaadNL. These scenarios include detailed maps of which infrastructure is needed and where it is needed, including challenges likely to arise.

California

Though ZE-Zs can play a critical role in achieving widespread zero-emission urban goods movements, policymakers must view these zones as one component in a broader action plan to decarbonize transport. ZE-Zs can serve to lower emissions and improve quality of life in urban areas, yet freight transport is rarely confined to a single zone. In order to amplify the impact of adopting ZE-Zs the Community of Interest (CoI) on Urban Freight¹¹⁵ advocates for the following coordinated approaches

- National and regional governments should set enforceable zero-emission medium- and heavy-duty truck policies. Setting manufacturer regulations to transition to zero-emission medium- and heavy-duty trucks sends a clear message to manufacturers about where the market is heading, ensures that affordable zero emission trucks are made available for fleets, and provides confidence to infrastructure providers that the trucks will be deployed.
- Companies should set short-, medium-, and long-term targets to transition their medium- and heavy-duty commercial vehicles to zero-emission. Many zero emission trucks are already achieving cost parity against their combustion counterparts. Planning for the transition now will ensure that these companies are able to plan for the vehicle purchase and infrastructure installation and remain globally competitive in the future.
- National, regional, and city governments should create Electric Vehicle Infrastructure Deployment Plans. Preparing these documents will enable officials to address potential challenges and important implementation considerations when planning for the deployment of charging infrastructure that is necessary for zero-emission freight vehicles.
- All leading cities should have ZE-Zs by 2025. This action will significantly reduce pollution and improve quality of life and will be a strong signal to the automotive industry to produce zero-emission vehicles and drive companies to shift to a data-driven way of transporting goods.
- Countries should sign CALSTART's Global Memorandum of Understanding (MOU) on Zero-Emission Medium- and Heavy-Duty Vehicles.¹¹⁶ Signatories of this MOU support the implementation and deployment of zero-emission medium- and heavy-duty vehicles to reach 100% zero-emission new truck and bus sales by 2040, with an interim goal of hitting 30% zero-emission sales by 2030. Signing this MOU will send a clear signal to the truck manufacturers to increase investment in the manufacturing and sales and fleets to plan for a future with zero-emission medium- and heavy-duty vehicles globally.

Several jurisdictions have begun exploring and adopting progressive policies that support the electrification of trucks. This includes regulatory actions – like vehicle sales mandates for OEMs and/or tailpipe CO₂ emission standards – and subsidies that encourage and accelerate the deployment of zero-emission trucks.

California has already implemented these approaches and, in doing so, has helped deploy nearly 2,000¹¹⁷ zero-emission trucks and catalysed 43 in-state manufacturers of clean trucks and related equipment. In 2020, Governor Newsom signed Executive Order N-79-20,¹¹⁸ which sets a target of 100% zero-emission truck sales by 2045. This is a clear, long-term target for cities, truck manufacturers, and fleet operators.¹¹⁹

To accomplish the executive order, California has implemented the ACT¹²⁰ regulation, which sets increasing production requirements as a percentage of truck sales for Original Equipment Manufacturers (OEMs). Importantly, the regulation is a clear declaration of intent which signals how many zero-emission vehicles manufacturers must produce. This goal also serves as a schedule to which companies can align their environmental targets.

California's zero-emission truck policies have set a precedent for other US jurisdictions. The ACT regulation has now been adopted by five other states including Oregon, Washington, New Jersey, New York, and Massachusetts.

These states alone account for 20% of the country's trucking fleet, and five additional states have indicated plans to adopt the regulation. As additional states adopt ACT within the United States, the economics on zero-emission trucks will improve, the technology will advance faster, and more air quality benefits will be attained. California is further developing a new regulation (The Advanced Clean Fleets Regulation) that would end the sale of combustion trucks – and specifically would require 100% of all medium- and heavy-duty trucks sold into the State be zero emission by 2045.

Global efforts

The initiation of policy to advance truck electrification is not unique to California; jurisdictions around the world are now adopting their own medium- and heavy-duty truck regulations. In 2021, Chile established the Energy Efficiency Law,¹²¹ which is the first heavy-duty vehicle standard in Latin America. It requires vehicle manufactures that sell in Chile to meet energy efficiency standards for their vehicles. These standards begin in 2026 for medium-duty vehicles and in 2028 for heavy-duty vehicles.

In 2019, the European Union adopted their own tailpipe emission standards¹²² for heavy-duty vehicles. This standard requires manufacturers to attain 15% fleet-wide average emission reductions starting in 2025 and 30% fleet-wide average emission reductions starting in 2030. These standards will be enforced, and financial penalties are established for fleets that are not in compliance. This regulation also includes an incentive mechanism for early manufacture deployment of zero- or low-emission heavy-duty vehicles. This standard is expected to be updated in the near future and could be further strengthened to provide greater incentive to truck manufacturers to increase the percentage of zero-emission truck sales.

Additionally, California is among a coalition of seventeen states, D.C., and Quebec, who have signed a memorandum of understanding¹²³ to pledge 100% truck electrification by 2050. This coalition has also released an action plan,¹²⁴ including strategies and recommendations for policymakers, which will ease OEM compliance and create predictability for companies that can help incentivize zero-emission vehicles. This coordinated approach is designed to foster a broad market for zero-emission trucks.

Alongside regulations, a multitude of jurisdictions incentivize the purchase of zero-emission trucks by providing subsidies. Recently in January 2022, Finland expanded their current subsidy for purchasing low-emission vehicles to include electric vans and trucks.¹²⁵ With this subsidy the Finnish government will pay up to 6,000 Euros for an electric van and will pay anywhere from 6,000 to 50,000 Euros for an electric truck, depending on the size of the vehicle. Many countries have established similar subsidies to accelerate the deployment of zero-emission trucks including the Netherlands, Germany, Sweden, France, Spain, Austria, and Canada.¹²⁶

A comprehensive approach to transition to zero-emission goods movement is necessary, with a focus on progressive policies and regulatory tools that support the electrification of medium- and heavy-duty trucks.

ZEZ-F and implications on supply of alternative fuels, grids and energy supply

Cities play a key role as facilitators and can convene multiple stakeholders to ensure that charging infrastructure works for all classes of freight vehicles. Cities also need to strategize 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.

The three main 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 optimise 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.

In more depth: Managing grid impact

Vans have similar power requirements to passenger cars and can use the same charging infrastructure. However, 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.¹²⁷

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 modernization strategies. The company formed a partnership with UK Power Networks (the electricity distribution network operator for southeast England) as well as Cross River Partnership and the UK Office for Low-Emission Vehicles. 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.

Most European cities see favourably the deployment of alternative fuelled vehicles. However, charging infrastructure is a major hurdle for them and several barriers are hindering a full implementation at large scale.

In order to develop a coherent and dedicated strategy together with charging infrastructure and logistics operators, it is necessary to consider the specific needs of each category, as well as the balance between public and private infrastructure.

Policies addressing air pollution, congestion and safety directly affect the delivery of goods and services in urban areas worldwide. To set up the scene for a large-scale deployment of EVs, both for public transport and freight needs, it is important that cities set coherent strategies to define the implementation plans for fast charging infrastructures and to follow their roadmaps towards sustainable mobility.

The ASSURED project – funded under the Horizon 2020 Programme of the EU – aimed at boosting the electrification of urban commercial vehicles and their integration with high power fast charging infrastructure, evaluating several infrastructures in different cities across Europe. The project started in October 2017 and completed in March 2022, with the aim of developing and testing high-power solutions for full-size, urban, heavy-duty applications. To achieve grid stability, ASSURED tested six public transport buses, two garbage trucks, one delivery truck, and one light commercial delivery vehicle with fully automated fast charging. The charging solutions included different types of pantographs, plug-in and wireless charging.

Within the ASSURED project, the following findings on charging infrastructure have been identified:

- Upscaling: challenges with the energy grid and lack of space (conflicting usages).
- Use coupling: combine smart energy use and renewable energy strategies.
- On-street infrastructure design of fast chargers: consider needs of freight (position, power, etc.) and added value for drivers.

As possible users of relevance with heavy-duty fleets the following groups could be identified:

- Public transport operators/ public transport authorities.
- Logistics companies (e.g. delivery, retail).
- Public utility companies (e.g. service vehicles, wastewater, etc.).
- Commercial fleets (e.g. craftsmen/ craftswomen).
- Municipal fleets (e.g. garbage trucks, clearance).
- Building sector.

Most strategic plans for e-charging do not yet include freight, due to lack of clarity of needs of logistics companies, especially for heavy-duty vehicles. Local authorities often assume that many companies have or will have their own chargers in their depots in the industrial areas. However, this approach is likely to cut out SMEs and craftsmen (although for these further considerations should be made on the opportunity to use van sharing or third-party services).

When implementing a ZEZ-F, it is necessary to take into consideration investments in energy supply infrastructure. It is challenging for a municipality to forecast the extent of fleet electrification of each company and their energy needs. However, given the size and uncertainty of the investment, the grid operator will not take the initiative to explore new business models, nor will the logistics operators take such an initiative, since this does not represent their core business. Therefore, the government and the municipalities should drive the cooperation and push for it. At European level, a new EU policy framework for alternative fuels infrastructure (AFIR) and the funding mechanisms currently discussed in the European Green Deal are the two cornerstones to deliver an ambitious EU recharging infrastructure master plan. These European policy measures aim also to tackle two critical issues highlighted by some freight stakeholders, which are interoperability and cross-border continuity of services.

As highlighted during the ASSURED Final Conference (Brussels, 21 March 2022), capacity issues of the grid can hinder a full implementation of e-freight services and operations at cross-border level. This view has been confirmed by the city representatives present at the event, highlighting the central role of grid capacity in the future.

The growing number of EVs requires unprecedented challenges both regarding energy supply and spatial planning. In fact, the size of cities is not expected to change, and available space in urban areas is limited. A regulatory framework that allows feasible business models needs to be defined to promote efficient deployment of public charging infrastructure. This implies a step-by-step approach, to acquaint stakeholders with each other first and discuss potential cooperation – before starting to implement and install charging infrastructure.

Authors

This document was developed in co-creation of many different organisations and individuals. We would like to thank the following experts, who actively contributed to the content of this publication:

CRAMER, Rosemarie is Advisor Sustainable Mobility for the Netherlands Enterprise Agency and works for the Netherlands Ministry of Infrastructure and Water Management on the international aspects of Urban Freight. Rosemarie.cramer@minienw.nl

EHRLER, Verena (coordinator and contributing author of the revised edition) is Professor of International Supply Chain Management & Logistics at IÉSEG School of Management, Lille & Paris, France. Her research focuses on the improvement of efficiency and sustainability of supply chains and logistics; Verena was coordinator of the TDA Community of Interest “Urban Freight” 2020 to 2022. v.ehrler@ieseg.fr

GUDMUNDSSON, Henrik is Senior Consultant in the Mobility program of CONCITO, Denmark’s green think tank. His research focus is Transport Decarbonization Strategies and Local Climate Action Plans. hgu@concito.dk

ITTNER, Catherine is the Senior Programme Manager for Zero Emission Freight at C40 Cities. She works with her team to deliver peer-to-peer knowledge sharing on zero emission freight solutions for C40 cities, including managing a North American curbside management working group. cittner@c40.org

KOTHARI, Vishant is a Manager on the Electric Mobility team at WRI, focusing on e-bus technical assistance, urban freight policy analysis, charging infrastructure accessibility, and EV battery circularity. Contact: vishant.kothari@wri.org

LOPEZ, Katherine is a communications and design specialist at the Transport Decarbonisation Alliance (TDA) She leads the management of the overall communications between TDA members, Partners and Collaborators on the different initiatives developed by the alliance. katherine.lopez@tda-mobility.org

LOZZI, Giacomo is project & research manager at the Transport Research Lab of Roma Tre University. He coordinates the activities of the Living Lab Logistics of Rome for the co-creation of innovative solutions for urban logistics. He deals with research on transport governance and public policy at the EU level.trelab@uniroma3.it

MARQUIS, Robyn is the Director of Innovative Mobility at CALSTART, a nonprofit organisation working nationally and internationally with businesses and governments to develop clean, efficient transportation solutions. Her work aims to improve the affordability and accessibility of zero-emission options, while reducing overall vehicle miles travelled. rmarquis@calstart.org

ROTHBARD, Sandra is the Founder and Principal of Freight Matters, an urban planning consulting firm focused on city logistics. She helps develop policies and plans related to green, efficient and safe last-mile deliveries and is an advocate for the inclusion of freight in urban planning and transportation efforts. She served as project manager for the SURF (Sustainable URban Freight) Project hosted by POLIS and funded by the Environmental Defense Fund Europe. sandra@freightmatters.org

SARODE, Shruti is a Climate Change Research Fellow at the Center for Law, Energy, & the Environment at University of California, Berkeley. Shruti’s research focuses on climate change policy, with an emphasis on the challenges of decarbonizing our transportation & energy systems and moving promising climate solutions to policy and scale. shrutisarode@berkeley.edu

STEIMER, Hamilton is a Research Analyst on the Electric Mobility team at WRI, focusing on zero-emission delivery zones, vehicle-grid integration and electric utility program evaluation in the United States. hamilton.steimer@wri.org

TRAN, Tu My is the Head of Sustainable Mobility and Global Coordinator at ICLEI-Local Governments for Sustainability. Tu My oversees the implementation of the EcoLogistics project, promoting low-carbon freight in 9 cities in Colombia, Argentina, and India, and the EcoLogistics Community, a global knowledge-sharing platform for front-runner cities and regions committed to a sustainable urban freight future. ecologistics@iclei.org.

VERGNANI, Raffaele is Project Manager and Coordinator of the Working Group on Urban Freight at POLIS. He works in Horizon 2020 funded projects focusing on multimodal mobility and logistics. He was co-author of transport-related policy studies issued by the EU Commission and the Transport and Tourism (TRAN) Committee of the EU Parliament. Rvergnani@polisnetwork.eu.

XUE, Lulu is the Urban Mobility Manager of WRI China Sustainable Cities Program. Her research focuses on policy and technological solutions that catalyse transport decarbonization. Lxue@wri.org

Acknowledgments

WRI would like to thank the City of Los Angeles, for sharing insights with the authors while researching for their paper on zero-emission delivery zones in the US.

CONCITO would like to thank the City of Oslo for providing valuable information.

ICLEI thanks María Rosa Muñoz B. from Wuppertal Institute for Climate, Energy, and Environment, Beatrice Chng and Jungseong Park from ICLEI East Asia, and Dr. Chinghui Liao, EcoLogistics Coordinator in Taoyuan.

All content is by responsibility of the authors and not exemplified cities or other entities.

Content editing was completed by March 2023

Copy editing by Center for Law, Energy & the Environment (CLEE) - Berkeley Law

Design by Transport Decarbonisation Alliance (TDA)

Partners behind this document

California Air Resources Board

The California Air Resources Board is the primary state agency responsible for actions to protect public health from the harmful effects of air pollution. From guiding the activities of 35 local air pollution control districts, to leading our states efforts to address global climate change, the CARB has pioneered many of the approaches now used worldwide to address air quality problems. ww2.arb.ca.gov

CALSTART

CALSTART works with its member companies and agencies to build a high-tech clean transportation industry that creates jobs, cuts air pollution and oil imports, and curbs climate change. We work with the public and private sectors to knock down barriers to innovation, progress and drive the transportation industry to a clean and prosperous future. CALSTART accelerates the pace of technology and is a market building organisation. calstart.org

C40

C40 is a network of nearly 100 mayors of the world's leading cities working to deliver the urgent action needed right now to confront the climate crisis and create a future where everyone, everywhere can thrive. Mayors of C40 cities are committed to using a science-based and people-focused approach to help the world limit global heating to 1.5°C and build healthy, equitable and resilient communities. www.c40.org

CONCITO

CONCITO is Denmark's leading climate think tank founded in 2008. We aim to translate relevant knowledge into climate action and thereby accelerate the green transition in Denmark and internationally. Through scientific and knowledge-based analyses and information, the aim is to show how it is possible to create a climate-neutral and climate-resilient society. www.concito.dk

Freight Matters

Freight Matters works with public, private and nonprofit clients on sustainable and resilient city logistics initiatives and supply chain innovation. The company conducts research, develops and implements stakeholder engagement strategies and manages projects related to distribution, consolidation, curb management, multimodal delivery and more. www.freightmatters.org

ICLEI

ICLEI Local Governments for Sustainability is a global network working with more than 2,500 local and regional governments committed to sustainable urban development. Active in 125+ countries, we influence sustainability policy and drive local action for low-emission, nature-based, equitable, resilient, and circular development. iclei.org

Transport Decarbonisation Alliance (TDA)

A unique international collaboration to accelerate the worldwide transformation to net-zero-emission mobility before 2050. The TDA's core contribution is to foster cooperation among countries, cities and regions and companies toward net zero transport, accelerating action through synergy. tda-mobility.org

Transport Research Lab (TRElab) is a cross-disciplinary grouping of leading academics focusing on transportation research at Roma Tre University. TRElab provides data, information and knowledge to help cities and regions create an evidence-based ground to define their innovative mobility policies and measures. www.trelab.it

**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

World Resources Institute (WRI)

WRI is a global research organisation that works with governments, businesses, multilateral institutions and civil society groups to develop practical solutions that improve people's lives and ensure nature can thrive. www.wri.org

References

1. The Carbon Footprint of Global Trade, <https://www.itf-oecd.org/sites/default/files/docs/cop-pdf-06.pdf>.
2. International Council on Clean Transportation (ICCT) (2019) Prospects for Fuel Efficiency, Electrification, and Fleet Decarbonization (Working Paper 20), Global Fuel Economy Initiative, Current Policies Scenario. <https://www.globalfueleconomy.org/media/708302/gfei-working-paper-20.pdf>.
3. Publications Office of the European Union (2011) White Paper on transport. https://ec.europa.eu/transport/sites/transport/files/themes/strategies/doc/2011_white_paper/white-paper-illustrated-brochure_en.pdf and <https://www.c40.org/what-we-do/scaling-up-climate-action/transportation/green-and-healthy-streets/>
4. Publications Office of the European Union (2011) White Paper on transport, https://ec.europa.eu/transport/sites/transport/files/themes/strategies/doc/2011_white_paper/white-paper-illustrated-brochure_en.pdf
5. C40 (March 10, 2019) Green and Healthy Streets Declaration, https://www.c40knowledgehub.org/s/article/Green-and-Healthy-Streets-The-C40-Fossil-Fuel-Free-Streets-Declaration?language=en_US
6. Currently, the only technologies on the market that are zero-GHG- emission at tailpipe are battery-electric vehicles (BEVs) and hydrogen-fuel-cell (HFC) vehicles. Although lifecycle emissions from both BEVs and HFC depend on how the electricity and hydrogen are generated, they offer the potential for a dramatic reduction in lifecycle emissions as electricity generation is decarbonised. Other sustainable modes of travel that do not create tailpipe GHG emissions (e.g. electric cargo bikes) are also within scope.
7. Grobar, L (2008) The Economic Status of Areas Surrounding Major U.S. Container Ports: Evidence and Policy Issues. *Growth and Change*, Volume 39, Pages 497–516, <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1468-2257.2008.00435.x>
8. Jones, M R, Diez-Roux, A V, Hajat, A, Kershaw, K N, O'Neill, M S, Guallar, E, Post, W S, Kaufman, J D, & Navas-Acien, A (2014) Race/ethnicity, residential segregation, and exposure to ambient air pollution: the Multi-Ethnic Study of Atherosclerosis (MESA). *American Journal of Public Health*, Volume 104, Issue 11, Pages 2,130–2,137, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4202969/>
9. Goldsmith, J R (1991) Lung cancer's persistent association with population density in Los Angeles County communities. *Public Health Rev*, Volume 19, Issue 1–4, Pages 147–161, <https://pubmed.ncbi.nlm.nih.gov/1844262/>
10. Pratt, G C, Vadali, M L, Kvale, D L, & Ellickson, K M (2015) Traffic, air pollution, minority and socio-economic status: addressing inequities in exposure and risk. *International Journal of Environmental Research and Public Health*, Volume 12, Issue 5, Pages 5,355–5,372, <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4454972/>
11. Wu, X, Nethery, R C, Sabbath, B M, Braun, D, & Dominici, F (April 24, 2020) Exposure to air pollution and COVID-19 mortality in the United States. medRxiv 2020.04.05.20054502 – <https://projects.iq.harvard.edu/covid-pm>
12. Lee, B K, Smith, T J, Garshick, E, Natkin, J, Reaser, P, Lane, K, & Lee, H K (2005) Exposure of trucking company workers to particulate matter during the winter. *Chemosphere*, Volume 61, Issue 11, Pages 1,677–1,690 <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1450253/>
13. Enabling data-sharing: Emerging principles for transforming urban mobility, https://docs.wbcsd.org/2020/01/WBCSD_Enabling_data_sharing_Emerging_principles_for_transforming_urban_mobility.pdf
14. BuyZET Project (May 2019), <https://www.polisnetwork.eu/project/buyzet/>
15. BuyZET Project (May 2019) Procuring zero-emission delivery of goods and services – The BuyZET Handbook, <http://www.buyzet.eu/wp-content/uploads/2019/05/BuyZET-Handbook.pdf>.
16. European Commission (2017) Engagement of stakeholders when implementing urban freight logistics policies: Final report, <https://www.greendealzes.nl/wp-content/uploads/2019/04/Engagement-of-stakeholders-when-implementing-urban-freight-logistics-policies.pdf>.

17. European Commission, Public Procurement, https://ec.europa.eu/growth/single-market/public-procurement_en.
18. BuyZET Project (May 2019) Procuring zero-emission delivery of goods and services – The BuyZET Handbook, <http://www.buyzet.eu/wp-content/uploads/2019/05/BuyZET-Handbook.pdf>.
19. WBCSD (October 5, 2019) The first-ever Corporate Mobility Pact – catalysing corporate action to transform mobility, <https://www.wbcsd.org/Programs/Cities-and-Mobility/Transforming-Mobility/News/The-first-ever-Corporate-Mobility-Pact-catalyzing-corporate-action-to-transform-mobility>
20. Green Deal ZES, <https://www.greendealzes.nl/en/participants/>.
21. UEMI (2017) Factsheet: Forums, portals, certification schemes, http://www.uemi.net/uploads/4/8/9/5/48950199/uemi_factsheet_forums_portals.pdf.
22. LoCITY, <https://locity.org.uk/>.
23. These are craftsmen, small to medium-sized enterprises offering maintenance, cleaning services, etc., or small shop owners who use their own vehicles for supplies.
24. C-LIEGE project, <http://www.c-liege.eu/home/>.
25. Amsterdam Clean Air Action Plan, <https://www.amsterdam.nl/en/policy/sustainability/clean-air/>.
26. Global Agreement On Zero-Emission Trucks And Buses
27. Qiyu Liu et al. Putting Electric Logistics Vehicles to Work in Shenzhen 2020, Rocky Mountain Institute.
28. Transport & Environment (February 2020) Recharge EU trucks: time to act! A roadmap for electric truck charging infrastructure deployment .
29. CE Delft et al (August 2019) Charging infrastructure for electric vehicles in city logistics.
30. Elaad Outlook Q2:2020El:: ektrisch op bestelling - De ontwikkeling van elektrische bestelvoertuigen in Nederland t/m 2035, https://elaad.nl/wp-content/uploads/2022/05/20Q2_ElaadNL_Outlook_E-bestelvoertuigen_V1.0
31. Elaad Outlook Q2:2020El:: ektrisch op bestelling - De ontwikkeling van elektrische bestelvoertuigen in Nederland t/m 2035, https://elaad.nl/wp-content/uploads/2022/05/20Q2_ElaadNL_Outlook_E-bestelvoertuigen_V1.0.pdf
32. Rotterdam | SUMP.nl
33. City of Rotterdam (2021) State of ZECL. Progress of Zero Emission City Logistics in Rotterdam 2021.
- 34, 35, 36, 37, 40. Shenzhen Bureau of Statistics (2021). <https://www.macrotrends.net/cities/22860/london/population>
38. Economic and Trade Information on Hong Kong
39. Shenzhen Urban Planning and Land Resources Bureau (2008)
41. Shenzhen Urban Transport Planning Center (2020)
42. Shenzhen Transport Bureau (2022)
43. Harbin Institute of Technology(2019), http://www.szzx.gov.cn/content/2021-09/29/content_24612297.htm
44. Shenzhen Xieli Innovation Center (2022)
45. Shenzhen Transport Bureau (2022)
46. Shenzhen Development and Reform Commission of Shenzhen Municipality (2021)
47. Municipal People's Government of Shenzhen (2018)
48. Shenzhen Municipal Government (2018)
49. Shenzhen Environment Bureau (2018)
50. Shenzhen Transport Bureau (2018)
51. Shenzhen Environment Bureau (n.d.)
52. Shenzhen Development and Reform Commission (2018)
53. Shenzhen Environment Bureau (2021)
54. Shenzhen Xieli Innovation Center (2022)
55. Shenzhen Xieli Innovation Center (2022)
56. London, UK Metro Area Population

57. London Population
58. High Streets in Grain Britain
59. London Traffic Report
60. Bus Fleet Data & Audits
61. London Traffic Index
62. Mayor's Transport Strategy
63. New Freight Action Plan for London
64. Sustainable Transport, Walking and Cycling Guidance
65. The EU aims to improve quality.
66. Healthy Streets for London
67. London's Mayor calls for 'pay per mile' driving charge
68. The Potential for Urban Logistics Hubs in Central London
69. Direct Vision Standard and HGV Safety Permit.
70. Mayor announces plan to expand Ultra Low Emission Zone London wide.
71. Stratford Metropolitan Master Plan.
72. London Public Transport aims for Sustainability.
73. London Net Zero 2030 - An Updated Pathway.
74. Healthy Streets Officers Programme in London.
75. Expanded Ultra Low Emission Zone- Six Month Report.
76. U.S. Census Bureau QuickFacts: Los Angeles city, California, <https://www.census.gov/quickfacts/losangelescacitycalifornia>
77. Facts About Los Angeles | Discover Los Angeles, <https://www.discoverlosangeles.com/media/facts-about-la>
78. Air Pollution In Los Angeles | Earth.Org, <https://earth.org/air-pollution-in-los-angeles/>
79. How an inversion over L.A. Basin acts like a lid on a pot - Los Angeles Times (latimes.com), <https://www.latimes.com/california/story/2021-11-11/how-an-inversion-over-la-basin-acts-like-a-lid-on-a-pot>
80. Green New Deal for LA | LADOT (lacity.org), <https://ladot.lacity.org/projects/livable-streets/green-new-deal-la>
81. pLAN_2019_final.pdf (lamayor.org), https://plan.lamayor.org/sites/default/files/pLAN_2019_final.pdf
82. Targets | pLAN (lamayor.org), <https://content.tfl.gov.uk/mts-challenges-and-opportunities-report.pdf>
83. Green & Healthy Streets - C40 Cities, <https://www.c40.org/what-we-do/scaling-up-climate-action/transportation/green-and-healthy-streets/>
84. pLAN_2019_final.pdf (lamayor.org), https://plan.lamayor.org/sites/default/files/pLAN_2019_final.pdf
85. GND_Annual_Report_2022.pdf (lamayor.org), https://plan.lamayor.org/sites/default/files/GND_Annual_Report_2022.pdf
86. KM_224e rm 800-20210609141353 (lacity.org), https://clkrep.lacity.org/onlinedocs/2021/21-0147_ord_187117_08-07-21.pdf
87. GND_Annual_Report_2022.pdf (lamayor.org), https://plan.lamayor.org/sites/default/files/GND_Annual_Report_2022.pdf
88. 21-0147_rpt_dot.pdf (lacity.org), https://clkrep.lacity.org/onlinedocs/2021/21-0147_rpt_dot.pdf
89. 21-0147_rpt_dot.pdf (lacity.org), https://clkrep.lacity.org/onlinedocs/2021/21-0147_rpt_dot.pdf
90. Steimer, Kothari, Cassius 2022. doi.org/10.46830/wriwp.22.00022
91. 21-0147_rpt_dot.pdf (lacity.org), https://clkrep.lacity.org/onlinedocs/2021/21-0147_rpt_dot.pdf
92. City of Oslo Statistics, <https://statistikkbanken.oslo.kommune.no/webview/>.
93. City of Oslo (2022) Klimagassregnskap for Oslo, 2009–2020.
94. City of Oslo (2020) Climate Strategy for Oslo towards 2030 (2020).
95. City of Oslo (2022) Forprosjekt bylogistikkplan Sustainable Urban Logistic Plan (SULP).
96. Ørving (2019) Evaluation of Oslo City Hub -The planning and establishment of a depot for transshipment of goods. Transport Economics Institute, Oslo.
97. City of Oslo (2019) Standard klima- og miljøkrav til transport for Oslo kommunes varer- og tjenester anskaffelser (Byrådssak 1123/19).

98. City of Oslo (2021) Utredning av behovet for ladeinfrastruktur for tyngre kjøretøy og buss.
99. Halogen et al (2022) Medvirkningsprosess for nullutslippssone i Oslo kommune.
100. Norconsult (2021) Utslipp Effekter av nullutslippssoner i Oslo.
101. City of Oslo (2023). Utredning og faglige anbefalinger til innføring av lavutslippssone i Oslo.
102. Business Standard, Country's first e-vehicles-only area to be developed in Gujarat's Kevadia (2021), https://www.business-standard.com/article/current-affairs/guj-country-s-first-e-vehicles-only-area-to-be-developed-in-kevadia-121060600553_1.html.
103. Machine Maker, 'ETO Motors deploys 50 3W EVs in Kevadia; India's first Electric Vehicle City' (2021), <https://theicct.org/kevadia-a-launch-pad-for-a-new-era-of-urban-vehicle-access-regulations-in-india/>.
104. <https://www.themachinemaker.com/news/eto-motors-50-electric-vehicles-1012>.
105. Ministry of Heavy Industries Government of India, 'FAME India Scheme Phase II' (webpage), <https://fame2.heavyindustries.gov.in/>.
106. Times of India, 'Matheran declared eco-sensitive zone' (2003), http://timesofindia.indiatimes.com/articleshow/38008065.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.
107. Economic Times, 'Petrol, diesel vehicles have been banned within 500 metre of Taj Mahal: Union minister' (2017), <https://auto.economictimes.indiatimes.com/news/industry/petrol-diesel-vehicles-have-been-banned-within-500-metre-of-taj-mahal-union-minister/59675708>.
108. Kazam, Kevadiya In Gujarat Will Become An Electric Vehicle Metropolis (2021), <https://www.kazam.in/category/news/kevadia-in-gujarat-will-become-an-electric-vehicle-metropolis>.
109. <https://www.ris.gov.tw/documents/data/en/3/Table-6-y2021.xls>.
110. <https://opengov.seoul.go.kr/mediahub/22105773>.
111. https://www.metropolis.org/sites/default/files/seoul_metropolitan_rapid_transit_english.pdf.
112. <https://www.klnews.co.kr/news/articleView>.
113. <https://news.seoul.go.kr/traffic/archives/10327>.
114. <https://mediahub.seoul.go.kr/archives/1258312>.
115. <http://tda-mobility.org/wp-content/uploads/2019/05/TDA-Zero-Emission-Urban-Freight.pdf>.
116. <https://globaldrivetozero.org/>.
117. <https://cleantechnica.com/2022/08/19/nearly-2000-zero-emission-trucks-buses-on-california-roads-new-data/>.
118. <https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf>.
119. <https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-trucks-fact-sheet>.
120. <https://www.ttnews.com/articles/six-states-adopt-clean-truck-rule>.
121. <https://theicct.org/chile-latam-lvs-leg-en-apr22/#:~:text=In%20this%20context%2C%20Chile%20has,will%20all%20be%20zero%2Demission>.
122. https://ec.europa.eu/clima/eu-action/transport-emissions/road-transport-reducing-co2-emissions-vehicles/reducing-co2-emissions-heavy-duty-vehicles_en#target-levels.
123. https://www.energy.ca.gov/sites/default/files/2020-08/Multistate-Truck-ZEV-Governors-MOU_20200714_ADA.pdf.
124. <https://www.nescaum.org/documents/multi-state-medium-and-heavy-duty-zev-action-plan.pdf>.
125. <https://valtioneuvosto.fi/en/-/act-on-purchase-and-conversion-subsidies-for-low-emission-vehicles-into-force>.
126. <https://www.acea.auto/figure/interactive-map-electric-vehicle-purchase-incentives-per-country-in-europe-2021-update/>.
127. While charging will largely be done at the bases of the freight vehicles' fleets (often distribution centres outside the city), some public charging will also be needed. Increasingly, operators are also looking to set up distribution centres and micro-hubs at central locations, which will also require charging stations.