EFFICIENT URBAN FREIGHT

Smart City
MISSION TRANSFORM-NATION

Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

Ministry of Housing and Urban Affairs
Government of India

ABOUT MINISTRY OF HOUSING AND URBAN AFFAIRS (MoHUA)

The Ministry of Housing and Urban Affairs is the apex authority of Government of India to formulate policies, coordinate the activities of various central ministries, state governments and other nodal authorities and monitor programs related to issues of housing and urban affairs in the country. The Smart Cities Mission was launched by the Ministry in 2015 to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions.

ABOUT ROCKY MOUNTAIN INSTITUTE (RMI)

Rocky Mountain Institute (RMI)—an independent nonprofit founded in 1982—transforms global energy use to create a clean, prosperous, and secure low-carbon future. It engages businesses, communities, institutions, and entrepreneurs to accelerate the adoption of market-based solutions that cost-effectively shift from fossil fuels to efficiency and renewables. RMI has offices in Basalt and Boulder, Colorado; New York City; Washington, D.C.; and Beijing. RMI has been supporting India's mobility and energy transformation since 2016.

Foreword

HARDEEP S. PURI
Honourable Minister of State
(Independent Charge),
Ministry of Housing and Urban Affairs

With a rapidly growing population and quickly evolving technologies and business models, there is a need to adopt new and fundamentally different pathways to develop a clean, cost-effective, and efficient transportation system to support the diverse needs of citizens. With initiatives like the Smart Cities Mission, Government of India has undertaken one of the most comprehensive planned urbanization programme in the world. Smart Cities represent the exemplars of urban development in India and are poised to lead the country in this transition. We envision Smart Cities to lead the adoption of smart solutions in provision of transportation infrastructure and services and are committed to support them in this endeavor. These capacity-building Policy Framework Documents are expected to enable Smart Cities in implementing electric mobility solutions for their cities, and in turn lead the way for the rest of the country.

I congratulate the authors of **"Efficient Urban Freight"** for their outstanding work, as well as for their dedication in helping India build strong, sustainable transportation systems. Let this be the next step in building cleaner, more sustainable, and more modern cities in India.

DURGA SHANKAR MISHRA
Secretary,
Ministry of Housing and Urban Affairs

The capacity-building Policy Framework Documents are an exciting step in the Smart Cities Mission to make cities more citizen-friendly and sustainable. Since the launch of the Smart Cities Mission in June 2015, the program has made remarkable progress in driving the implementation of impactful projects to support citizen needs. The recommendations outlined in this document are a step on the path towards building the cities of the future, capable of supporting a growing and thriving urban population.

I commend Rocky Mountain Institute on their strong work and insightful recommendations in **"Efficient Urban Freight".**

I look forward to seeing the recommendations outlined in these documents put into practice to further improve the health, sustainability, and vibrancy of Indian cities.

KUNAL KUMAR

Joint Secretary (Mission Director Smart Cities),
Ministry of Housing and Urban Affairs

The Ministry of Housing and Urban Affairs is committed to supporting the development of sustainable, accessible, efficient, safe, and clean urban transportation systems, and promoting electric mobility is of critical importance to this effort. The capacity-building Policy Framework Documents represent a step change in established practices and given the direct influence that the transportation system can have in our lives and environment, we believe it to be an essential change.

It gives me great pleasure to introduce **"Efficient Urban Freight"** as a new capacity-building Policy Framework Document to support the development of India's Smart Cities. It emphasizes the importance of transitioning to clean mobility alternatives to create healthier and more livable cities. It gives an overview of electric mobility and provides guidance to enable cities to transition to clean mobility solutions.

EFFICIENT URBAN FREIGHT

PART 1: POLICY FRAMEWORK

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Section outline

This document provides an introduction to urban freight with the dual purpose of positioning policymakers to reduce the costs of moving goods within a city while also mitigating negative consequences, which freight deliveries create for city livability. This document will introduce basic concepts and terminology, benefits of enhancing urban freight efficiency and an overview of urban freight policy landscape in India.

1.0 Importance

Urban freight is an essential part of an urban economy providing both urban residents and businesses with products they need on a daily basis. Everything from food for shops and restaurants, through e-commerce deliveries for urban residents, to the concrete and steel, which go into urban buildings and fixed assets collectively form the urban freight system. Ensuring that these goods reach businesses and consumers who need them reliably and at minimal cost is a fundamental requirement of a thriving urban economy. However, each one of these freight movements also generate vehicle travel that causes air pollution, congestion, traffic accidents and a host of other negative impacts on urban transportation systems. The fundamental objective of urban freight policy is to balance the competing objectives of delivering goods with minimum costs and maximum reliability and minimizing negative impacts on the urban fabric. If successfully implemented, sound urban logistics policies can support a dynamic urban economy while preserving a clean, healthy and safe urban environment with a smoothly functioning mobility system.

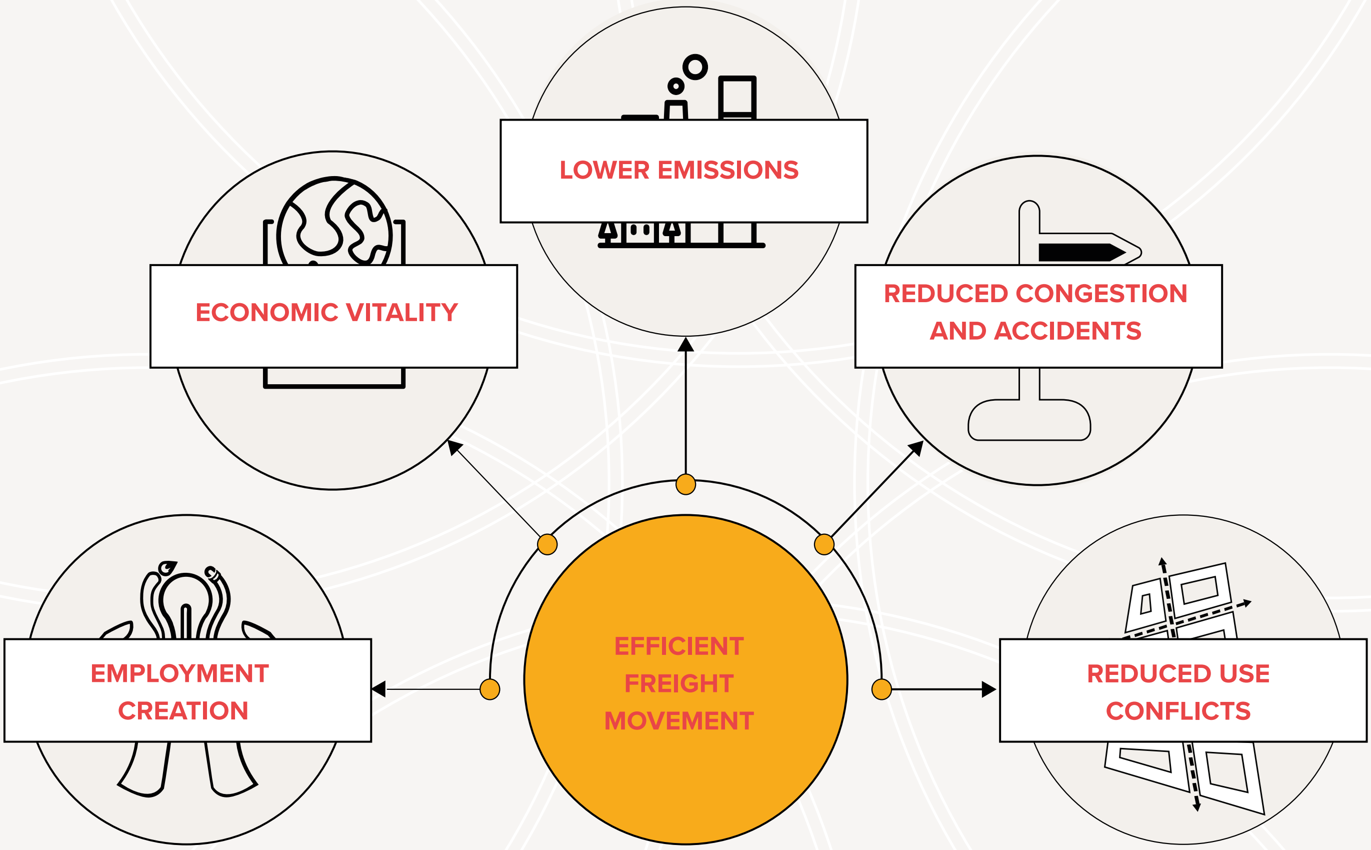


Figure 1: Efficient Freight Movement

1.1 Economic vitality and employment creation

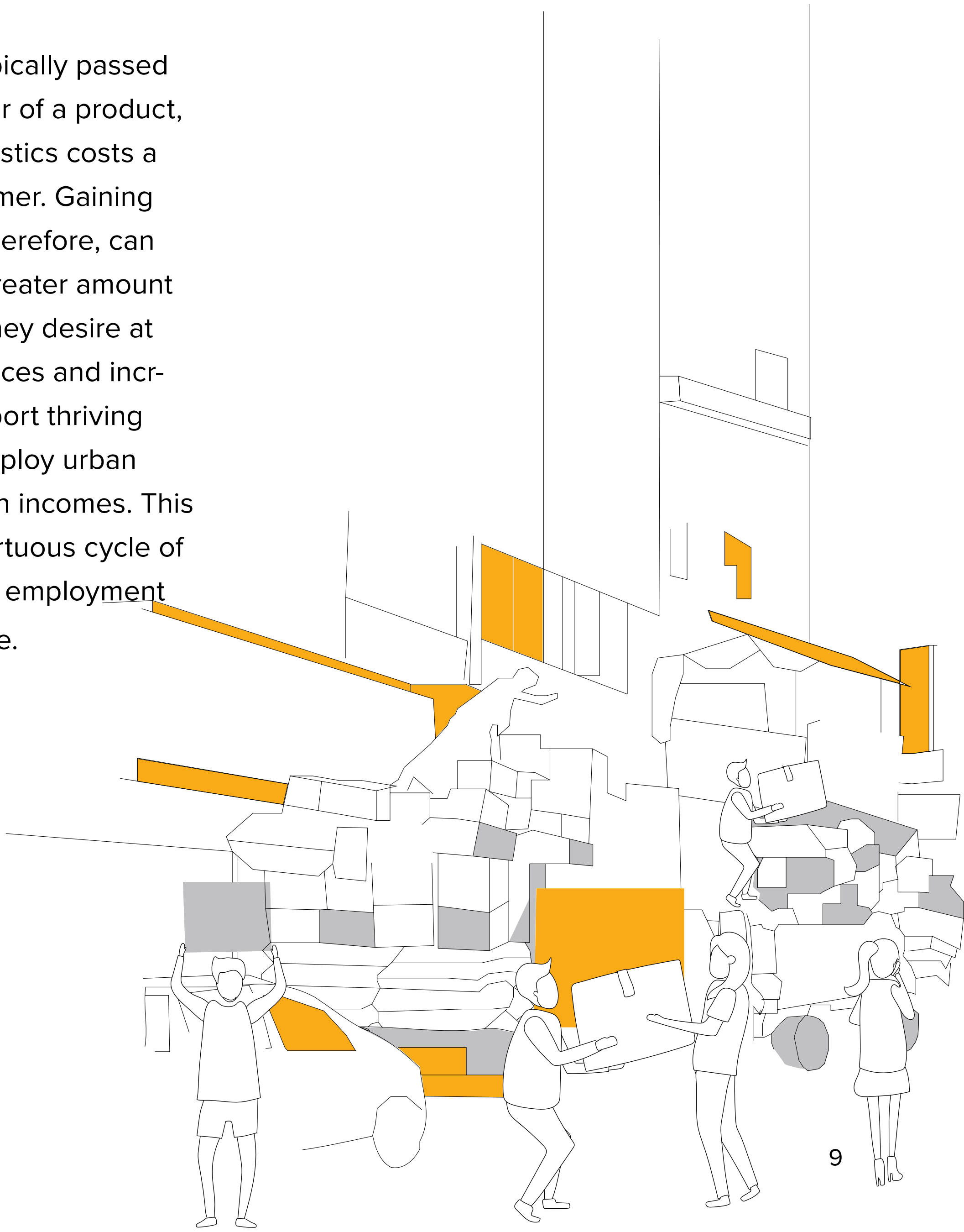
In global supply chains where goods can move thousands of kilometers at different stages of production, urban delivery is among the shortest of all stages of transport, often only consisting of a few kilometers. However, its impact on cost of goods is disproportionately large. For example, in many e-commerce supply chains, the final delivery to the consumer can involve over 50% of the total cost of moving the goods from its point of production to that of its final consumption.

Those logistics costs are typically passed directly to the final purchaser of a product, making any reduction in logistics costs a direct savings for the consumer. Gaining efficiency in the final mile, therefore, can provide consumers with a greater amount of the goods and services they desire at lower price points. Lower prices and increased demand, in turn, support thriving urban businesses, which employ urban residents and increase urban incomes. This lays the groundwork for a virtuous cycle of increasing income, demand, employment and again, increasing income.

1.2 Sustaining urban quality of life

The vehicles that move freight around the city can also negatively impact livability of the city through the externalities they produce.

Ensuring that goods are readily available to city residents while containing the side effects of moving those goods, is a fundamental objective of urban freight management.



ACCIDENTS

Trucks are out-sized contributors to injuries and fatalities in accidents

CONGESTION

Poorly managed delivery activities, especially illegal ones or improperly parked delivery vehicles, can reduce traffic fluidity and create congestion

AIR POLLUTION AND CARBON EMISSIONS

Trucks and other logistics vehicles are disproportionately large emitters of fine particulate matter (PM 2.5), Sulphur Oxides (SOx) and other air pollutants as well as greenhouse gases.

CONFLICTS WITH NON-MOTORIZED TRANSIT

Vehicles that are unloading and loading on sidewalks or bike lanes impede the ability of residents to walk or cycle safely.

Table 1: Negative impacts of freight movement

2.0 Key concepts

Understanding the types of goods moving in a city, the types of vehicles they move in and the organization of supply chains along which they move is critical for good policy formulation and effective infrastructure design.

2.1 Layout of urban supply chains

While each supplier chain is unique, some broad observations about urban supply chains and how they are laid out can still be effective in helping policymakers understand how and why goods move in certain patterns along certain routes. This high-level understanding can be useful in preliminary discussions to frame policy formulation and infrastructure provision. A conceptualization of the movement of a manufactured good is shown overleaf.

Urban logistics is typically focused on the points where a good enters the urban core, either on its way from a distribution center to a store for final sale or in businesses such as e-commerce, to a micro warehouse where it is staged for final delivery directly to the consumer. However, goods can also enter into urban or metro areas in stages of the production process, such as work in process if factories are in the metro area or as finished goods, depending on where distribution centers and warehouses are located. Policymakers must customize solutions to different types of freight traffic.

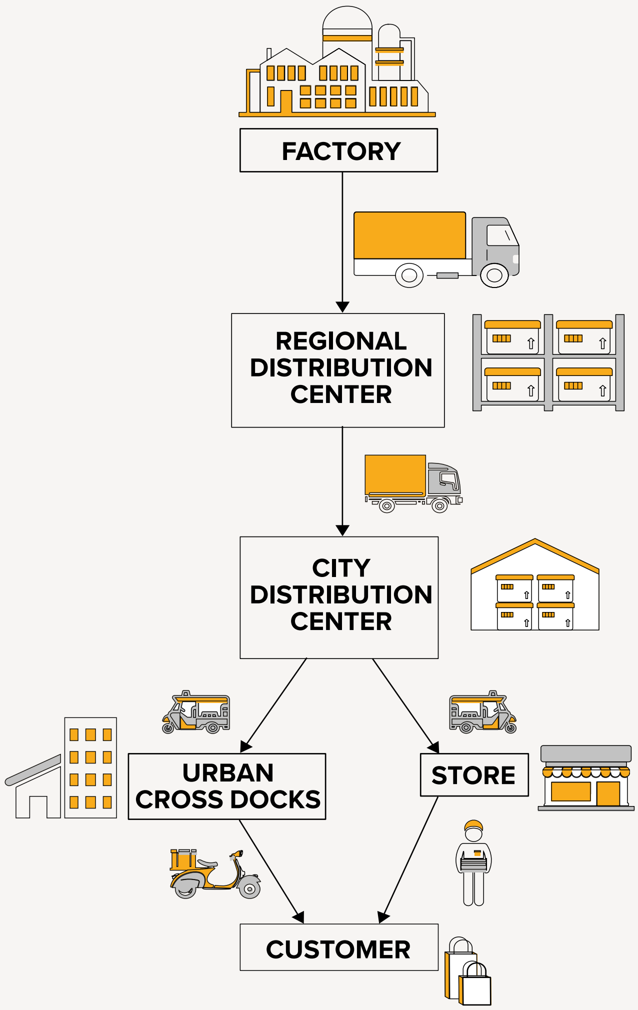


Figure 2: Urban Supply chain

2.2 Types of goods moving in cities

A simple framework to broadly segment types of shipments can be the first step in understanding which market segments exist and what challenges they present.

Heavy, bulk freight:
Goods such as gravel, sand, concrete, other building materials as well as industrial goods such as oil or petrochemicals are a significant component of urban freight, especially in cities that are still in the rapid growth phase. These types of freight are important for a city as they are needed to build infrastructure such as ports, roads or canals, create and maintain a city's building stock and cater to the industrial plants that are often engines of employment and GDP. While this type of freight is important for urban development, it is also problematic for cities. Low-value freight moving in large quantities carried by heavy trucks tend to produce high external costs, especially air pollution and traffic accidents. Furthermore, because handling requirements for the shipment of these types of products tend to be low, there are little barriers to entry for carriers.

Medium value, medium density freight:
Next on the spectrum are medium value goods, such as intermediate products that are inputs or outputs of a city-based light industry, because they still move on large trucks, they do create considerable strain on urban mobility systems. For these types of freight, policymakers must exercise caution on two fronts. The operation of such trucks can harm urban quality of life and the freight they haul is typically not directly consumed by urban residents, arguing for relatively strict regulation. These types of freight are critical for supply chains that eventually cater to the demand of city residents or create employment for them. For that reason, in order to avoid harming a city's economy or the ability of its residents to get the goods they need, the policy must be formulated and implemented with care.

B2B freight for urban consumption:
Further down the spectrum are the shipments of freight to shops, markets and restaurants that directly sell to urban residents. These types of shipments include fresh and packaged food, beverages as well as final products that are stocked on the shelves of urban stores. These types of freight typically move in light or medium trucks and require high levels of access to the urban core. While policymakers can seek to keep heavy trucks moving heavy goods off urban roads, strategies for restricting the movement of goods for consumption in the city itself are less viable. Any restriction typically will not reduce freight volumes but merely force them to move in less efficient ways.

B2C freight for urban residents:
Finally, at the bottom of the spectrum is B2C freight, which typically is of high value, has strict handling and delivery requirements and is transported in small vehicles (or even by bike or foot) directly to the final consumer. This category of freight includes things such as food deliveries, document shipments or small packets and parcels. Formerly a relatively small segment of urban freight, with the rise of e-commerce, these types of goods movements are now a critical issue for efficient urban logistics. While similar to B2B freight in the way that it directly caters to urban residents and that effective policymaking must focus on efficiency rather than demand management, B2C urban freight is different in a critical way.

2.3 Types of vehicles moving in cities

Closely related to the types of freight moving in cities are the types of vehicles carrying it. Understanding the types of freight moving in the city and the role they play in the urban economy, can help formulate an effective policy governing the movement of that freight. Similarly, understanding the types of vehicles being used to move that freight can help decisions on infrastructure and policy to maximize the efficiency of their use. Goods moving within the urban core will use light trucks, three wheelers, scooters or even non-motorized modes such as cycling or walking for the final-mile connectivity.

While the above is a useful rule of thumb, vehicle selection may vary across cities due to economic circumstances, policy differences or geography and topography. Policymakers must evaluate vehicle selection and travel within their own cities in order to craft effective regulation.

Heavy bulk freight will typically move in **dumpers or tankers**, depending on if the goods being moved are liquid or solid.

Manufactured goods or pallets traveling long distances to and from distribution centers or factories in a city will typically move in **heavy enclosed trucks or tractor-trailers.**

Non-perishables moving from distribution centers or wholesale markets to points of sale in the urban core will often be transp-orted in **medium or light trucks**, depending on the density of the goods.

Transportation within the urban core using **light trucks.** Transportation within the urban core using **scooters.**

Perishable goods may be transported in similar vehicles or in **light or medium duty refrigerated or climate-controlled ones.**

Final mile using non-motorized modes like **walking** and **cycling**.

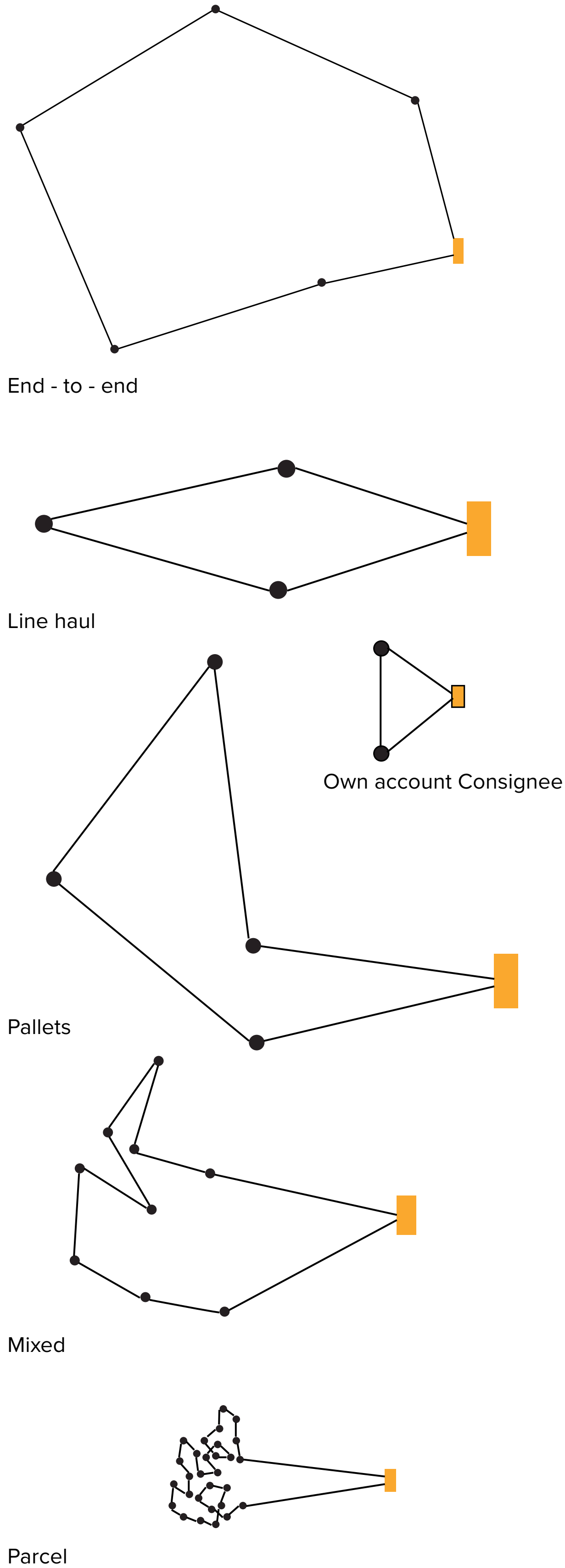


Figure 3: Operational patterns observed in urban logistics in Paris

Size of the vehicle

25 tons

2.5 tons

Duration of the operation

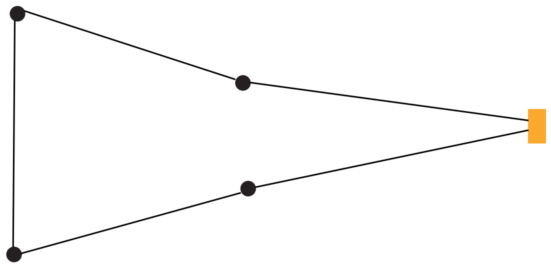
35 minutes

5 minutes

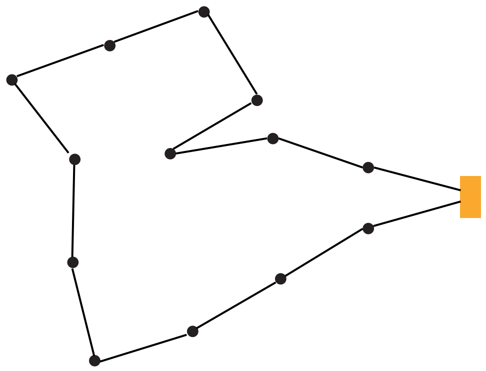
Distance

5 kilometers

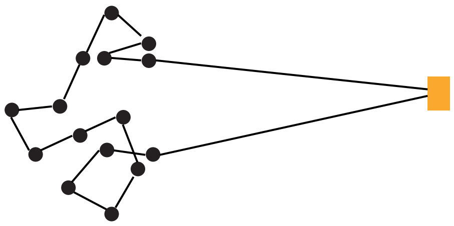
Source: Adrien Beziat, et al. Analysis of Different Types of Freight Routes according to Their Logistics Organization in the Paris Region.



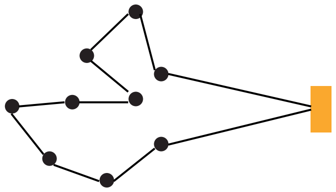
Intermediary products



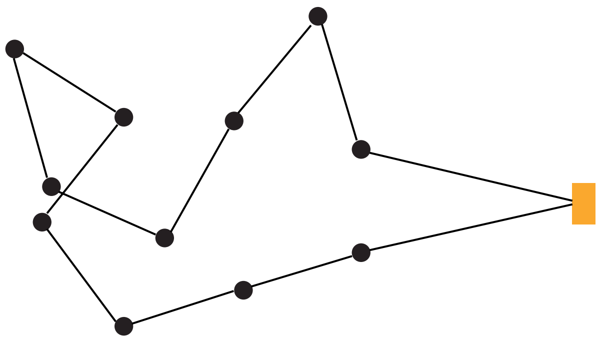
Finished products



Dry food



Beverages



Fresh food

2.4 Putting it together—travel patterns in urban logistics

Bringing together supply chain layouts, types of freight shipments and vehicles used to ship them, give a view on the key questions of urban logistics. How do goods move in a city and how can policymakers best support both healthy development of the sector and the city?

Understanding goods movement is critically important for effective policymaking because it informs what tools a policymaker should bring into play. For example, a city which sees large amounts of bulk, intermediate products, pallets or line-haul shipments occurring on urban roads may prioritize demand management as the most important pathway to increase efficiency. On the other hand, a city that sees primarily finished products, food, beverages or parcel shipments occurring on its roads may prefer to focus on path-ways to enhance the efficiency of those deliveries.

The image on the left is a visualization of how goods move in the city of Paris—what types of vehicles a given type of goods uses, how deliveries are spaced, how long deliveries take, how far delivery points are from distribution centers, etc.

3.0 Root causes of inefficiency in urban freight

Segmenting the problem of inefficiency in urban freight into broad constituent categories can help policymakers understand the problem in a methodical way, which positions them to effectively address the problem.

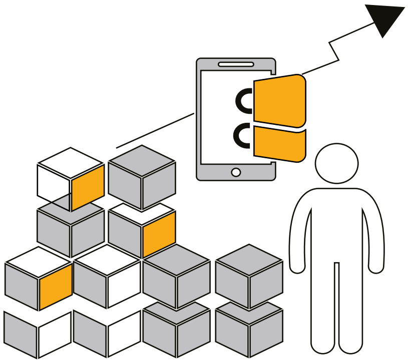
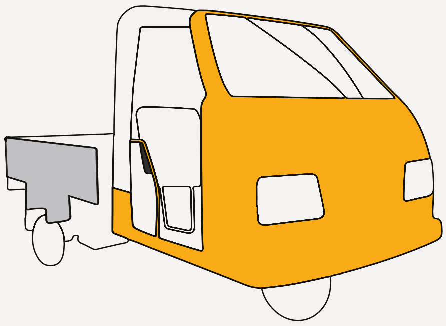
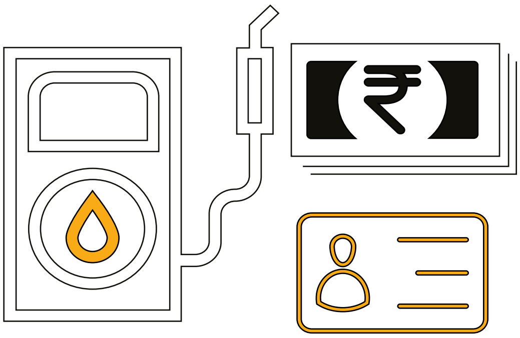
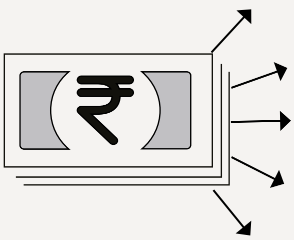
EXCESS DEMAND	
	Any freight movement that doesn't directly benefit urban residents. • Through freight that moves through the streets of a city but whose shipment neither originates nor terminates within the city • Freight which originates in a city but is typically not consumed in the city
EXCESS VEHICLE TRAVEL	
	Potential causes of excess travel can be grouped into: • Excess trip creation • Excess trip distance
EXCESS INTERNAL COSTS	
	• Fixed costs: Driver wages, insurance, permits and licenses, financing charges and vehicle depreciation • Variable costs: Fuel, maintenance, tires, etc..
EXCESS EXTERNAL COSTS	
	• Safety: injuries and accidents caused by urban freight vehicles • Emissions: freight vehicle emissions • Congestion: traffic congestion caused by freight vehicles • Space-use conflicts: Occupying space dedicated to other urban functions such as sidewalks and bike lanes

Table 2: Causes of inefficiency in urban freight

4.0 Landscape of urban freight

In order to effectively regulate urban freight, municipal policymakers need a basic understanding of relevant policies and players.

4.1 Main stakeholders

Urban logistics is a complex ecosystem with many players—both in private and public sectors.

PRIVATE SECTOR

SHIPPER

The owner of the goods being transported, for example an e-commerce firm or consumer goods company whose products are destined for sale within the city

LOGISTICS PROVIDER

The firm to which the shipper outsources logistics functions

RECEIVER

The purchaser of the goods being shipped, also referred to as the consignee

OEMs

Although not under the jurisdiction of urban policymakers, the manufacturers of delivery vehicles are key stakeholders in the overall systemic efficiency

CARRIER

The transport company operating the delivery vehicle carrying the shipped goods

TECH PROVIDERS

Providers of technologies like urban delivery route optimization software or intelligent transport systems, can greatly enhance systemic efficiency even if they are not directly under the jurisdiction

In order to make an effective urban logistic policy, city practitioners must coordinate with a broad spectrum of stakeholders in both public and private sectors. In public sector, urban logistics involves many different overlapping government bodies at national, state and city levels. Coordination between these policymakers can avoid contradictory and redundant regulations. Logistics policymaking and infrastructure development affects a wide spectrum of private sector players. Effective engagement and consultation with these players can help city practitioners get a whole systems perspective and enhance the efficiency of the entire urban logistics system.

PUBLIC SECTOR

TRANSPORT POLICYMAKERS

Government officials, whether elected or appointed, who are responsible for creating rules governing urban transport systems

LAW ENFORCEMENT

Police or other bodies responsible for enforcing the laws governing the mobility system

LAND-USE PLANNERS

Government officials, whether elected or appointed, who are responsible for planning and zoning decisions that affect urban form

TECHNICAL STAFF

Engineers, software designers and other technical staffs

VEHICLE REGULATORS

Authorities with the responsibility to decide what types of vehicles are suitable for urban travel

4.2 Existing policies

The Government of India has several relevant policies and plans in place or drafted that pertain to urban freight.

National Urban Transport Policy (NUTP): This policy focuses on staggering freight and passenger transport so that the infrastructure is best utilized. Some of the suggested guidelines for efficient management of urban freight in NUTP 2014 include: using off-peak hours for urban freight transport; restricting entry of heavy vehicles in the city during the day; building bypasses through public–private partnerships in order to create alternate route for freight traffic; building truck terminals and parking infrastructure outside city limits; using digitization and intelligent transport services for freight traffic management and adopting cleaner fuels.

Unified Metropolitan Transport Authorities (UMTA): NUTP proposed integrated planning of large cities by setting up a committee of relevant stakeholders called Unified Metropolitan Transport Authority (UMTA). UMTAs are expected to streamline and holistically integrate the functioning of various agencies associated with passenger and freight mobility in the cities, as well as develop integrated land-use plans, schedule intramodal and intermodal services and create an integrated common platform for planning, financing, monitoring and operational agencies to coordinate with each other. Currently, there are four UMTAs in India in Ahmedabad, Bangalore, Hyderabad and Kochi.

City-level practices: Many cities in India have introduced efficient urban freight management practices based on land-use policy measures, vehicle restrictions, taxation and infrastructure development. Metro cities such as Mumbai have time and route restrictions on freight vehicles (based on size, weight and emissions) to reduce congestion during peak traffic hours. Incentives for off-hour deliveries and switch to non-motorized transport or two-wheelers is also a popular mechanism to alleviate congestion. Cities also have no parking zones for heavy vehicles. Many cities such as Chennai are planning to have truck terminals and parking zones on the periphery of the city. Central, state and city governments are also planning to expand bypass roads and ring road networks to reduce urban freight movement. Depending on the type of vehicle, cities have tolls and taxes to manage freight traffic interaction within the city.

5.0 Charting a path forward

DATA ACQUISITION AND ANALYSIS

Without data, policymakers are unable to understand the types of freight moving in their cities and the efficiency with which they are moving

PRIVATE SECTOR ENGAGEMENT

A close working relationship with logistics system users is critical to ensure that the policy is both effective and in line with the needs of industry

PERFORMANCE EVALUATION AND CONTINUOUS IMPROVEMENT

Through standing collaboration with private sector and monitoring of high-level KPIs, policymakers can maintain awareness of the system performance and ongoing system needs

SOLUTION IDENTIFICATION AND PRIORITIZATION

Based on the data collected and in consultation with private sector partners, policymakers must identify and prioritize measures to enhance the system performance

6.0 Resources

Urban logistics

Purpose: Understand principles of sustainable urban logistics

TU Delft

» Name : Sustainable Urban Freight Transport: A Global Perspective
»Type: Online course
» Link: https://www.edx.org/course/sustainable-urban-freight-transport-a-global-perspective

Mobility Academy

» Name : City Logistics
»Type: Online course
» Link:https://www.mobility-academy.eu/course/view.php?id=67

European Union -CIVITAS Initiative

» Name : Making urban freight logistics more sustainable from theory to practice
»Type: Webinar
» Purpose: Understand principles of sustainable urban logistics
» Link:https://www.mobility-academy.eu/course/view.php?id=67

» Name : Sustainable Urban Freight Transport
»Type: Online course
» Link: https://civitas-learningcentre.talentlms.com/catalog/info/id:145

IFFSTAR

» Name : City Logistics
»Type: Webinar
» Link:https://www.youtube.com/watch?v=wiNS12Kho6o

Electric vehicles in urban logistics

Purpose: Understand pathways and challenges to electrifying final-mile delivery

Mobility Academy

» Name : How to encourage increased electric mobility in the logistics sector
»Type: Online course
» Link: https://www.mobility-academy.eu/course/view.php?id=11

European Commission - FREVUE project

» Name : Technical Assessment of Electric Urban Freight Vehicles (EU Perspective)
»Type: Webinar
» Link: http://frevue.eu/wp-content/uploads/2017/03/FREVUE-Webinar-Technical-assessment-.-.-.-vrijdag-17-maart-2017-11.00.13.mp4?_=1

» Name : The environmental benefits of electric freight in urban areas (EU Perspective)
»Type: Webinar
» Link: https://frevue.eu/newsroom/video-recordings-frevue-webinars-available-now/

» Name : The economics of electric urban logistics
»Type: Webinar
» Link: https://frevue.eu/newsroom/video-recordings-frevue-webinars-available-now/

Supply chain management

Purpose: Understand fundamentals of supply chain management from private sector perspective

MIT
» Name : Supply Chain Fundamentals
»Type: Online course
» Link: https://www.edx.org/course/supply-chain-fundamentals-0

Rutgers University
» Name : Supply Chain Logistics
»Type: Online course
» Link: https://www.coursera.org/learn/supply-chain-logistics

Green vehicles in urban logistics

Purpose: Understand options for green vehicles in final mile delivery (EU perspective)

European Union -CIVITAS Initiative
» Name : Green vehicles for urban freight delivery
»Type: Webinar
» Link: https://www.youtube.com/watch?v=kLoIR7tKrRE

International experience in sustainable urban logistics

Purpose: Understand experiences and outcomes of urban logistics projects in the EU

European Commission - SUGAR Initiative
» Name : City Logistics Best Practices: A Handbook for Authorities
»Type: Case studeis - multiple types
» Link: http://www.sugarlogistics.eu/pliki/handbook.pdf

» Name : BESTFACT – Best Practice Factor for Freight Transport (Urban Freight Cluster)
»Type: Case studeis - multiple types
» Link: http://www.bestfact.net/category/urban-freight/

Congestion management in urban logistics

Purpose: Understand fundamentals of supply chain management from private sector perspective

MIT
» Name : Supply Chain Fundamentals
»Type: Online course
» Link: https://www.edx.org/course/supply-chain-fundamentals-0

EFFICIENT URBAN FREIGHT

PART 2: POLICY WORKBOOK

Smart City
MISSION TRANSFORM-NATION

Ministry of Housing and Urban Affairs
Government of India

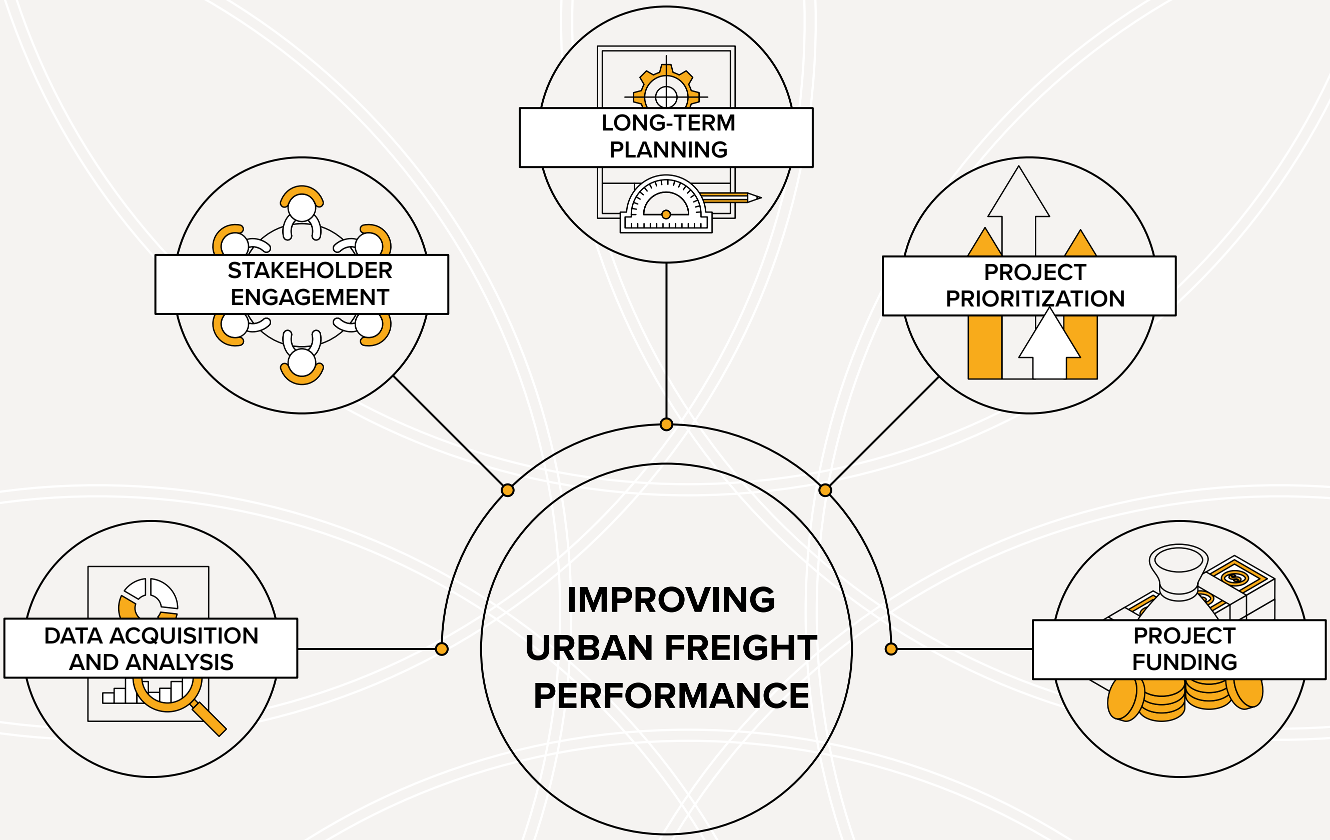
Section outline

This section is intended to give municipal transport policymakers high-level guidance on how to improve the efficiency of urban freight. It follows a checklist approach that builds on the logic and methodology explained in the urban freight Policy Framework Document. Municipal policymakers can evaluate where they stand in the process of building an effective urban freight system, what actions they can take to improve urban freight efficiency and how to best prioritize those actions.

In order to improve urban freight performance in both short and long terms, policymakers must be able to not only identify and resolve problems that currently exist but also understand the development trajectory of their city and its associated future logistics needs.

To do so, five categories of activities are needed:

1. Data acquisition to identify problems and quantify their severity
2. Stakeholder engagement to understand the needs of logistics system users and create public-private partnerships to enhance system performance
3. Long-term planning to set a guiding vision for industrial and logistics development in medium and long terms
4. Framework to prioritize solutions to ensure a maximum value from system investments
5. Capital to enable project implementation



Action plan for improving urban freight performance

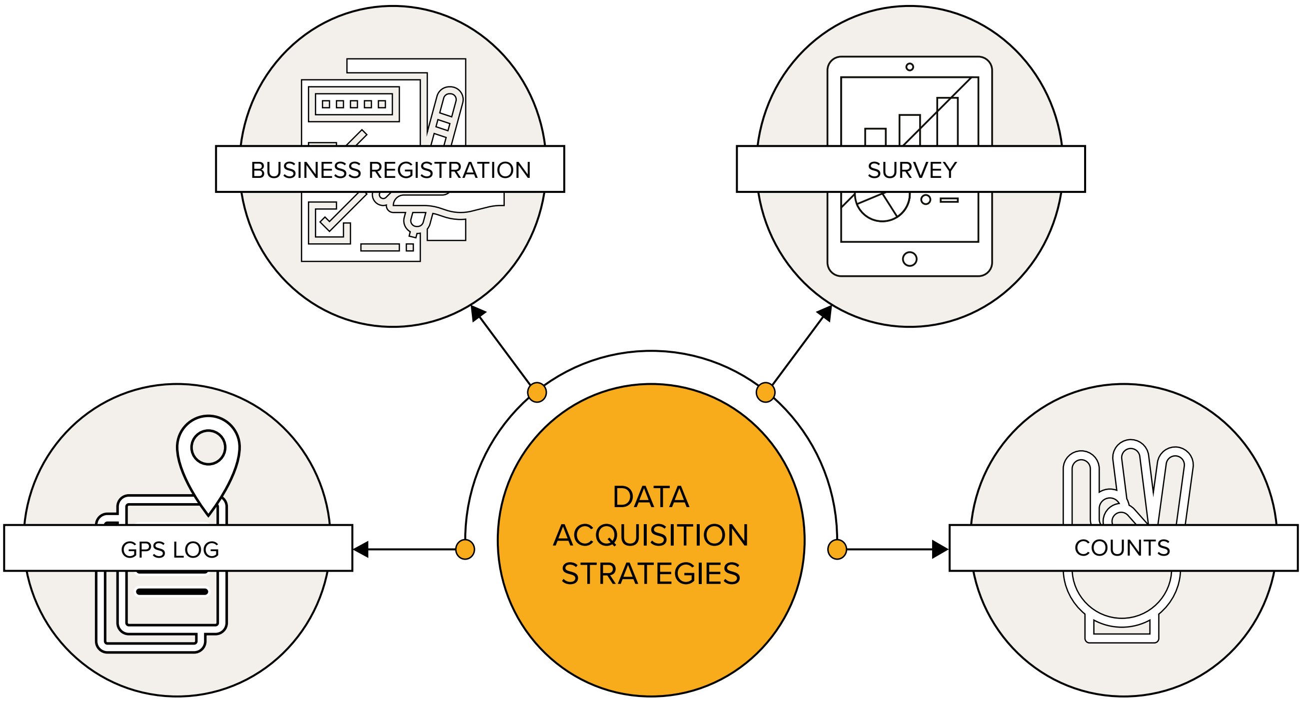
1.0 Data acquisition

The first step in resolving inefficiencies in urban logistics is understanding how freight is moving within a city. To understand freight movement, policymakers must have a data collection strategy. They should understand what problems they are attempting to resolve and deploy appropriate data collection tools to understand the problem dynamics and effectively address them. Several types of data are particularly important for evaluation of urban logistics efficiency: GPS logs, delivery vehicle logs, business registrations, surveys and manual counts.

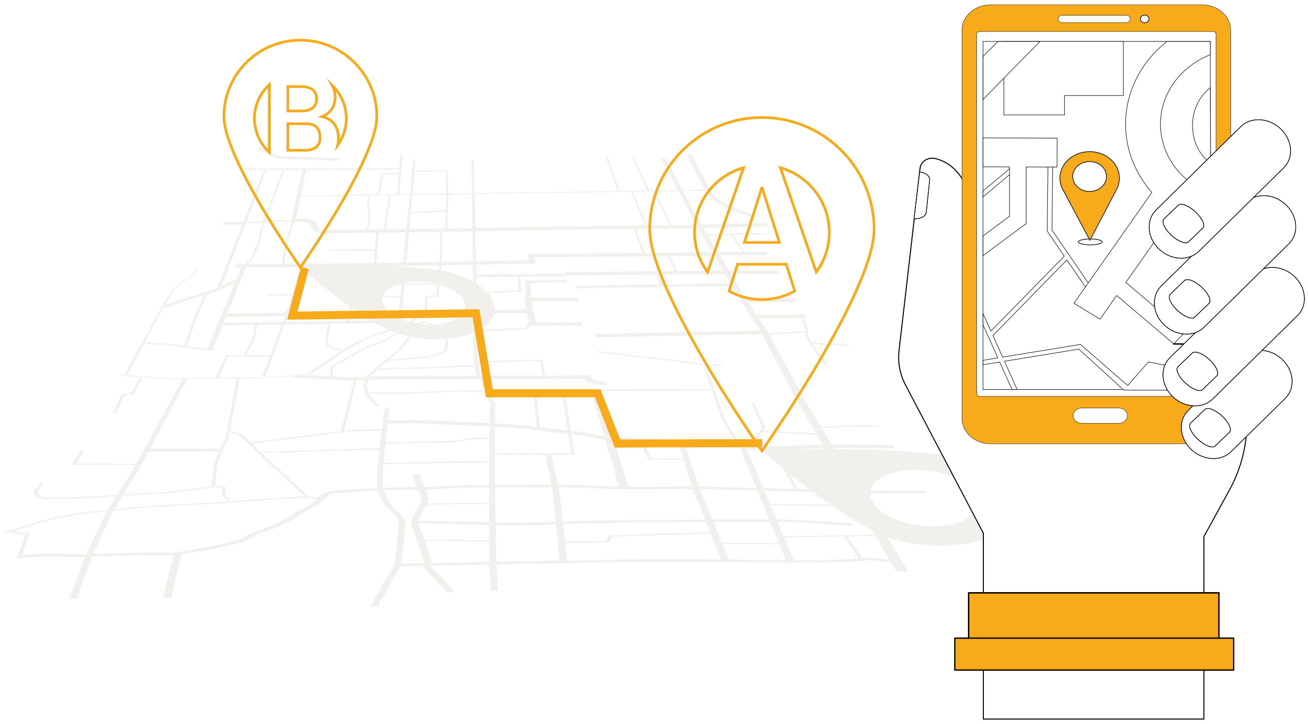
However, no single type of data can deliver a full understanding of how an urban logistics system is functioning. Various data types must be collected, analyzed and interpreted together in order to gain a clear picture. Table 1 shows different types of data that can be collected on urban logistics and their relative strengths and weaknesses.

	Driver survey	Vehicle diary	Establish-ment survey	Delivery space observation	GPS survey
Length of route	+	++			+++
Duration of route	+	++			+++
Number of stops	++	+++			++
Location of stops	++	+++			++
Type of operation	++	+	+	+++	+
Nature of the freight	+	+	+++	+	
Type of package	++	+	+++	+++	
Type of carrying tools	+++	+	+++	+++	
Usage of truck equipment	+++	+++	++	+++	
Nuisance to the environment		+			+++
Parking infractions	+	+		+++	
Stopping maneuvers	+			++	
Data collection costs	+++	+	+++	+++	++
Data processing costs	++	+++	++	++	+
Non-response rates	++	+++	++	++	+
Privacy issues	++	++	++		+++

Table 1: Urban logistics data types and uses[1] I Source: Pluvinet, Pascal, et al. “GPS Data Analysis for Understanding Urban Goods Movement,” 2012 I Note: Table displays suitability of different data collection approaches for different applications (+++ most suitable; –least suitable)



1.1 GPS logs



» Description:	GPS can provide a picture of logistics vehicle locations at highly granular time intervals. For example, GPS data can show where delivery vehicles drive, stop, spend the night and charge (for electric vehicles).
» Uses:	GPS data is among the most powerful types of data to analyze the patterns of vehicle movement, including routing patterns, the effects of congestion on freight deliveries, parking patterns, etc. However, GPS is limited in its ability to describe other aspects of logistics vehicle behavior such as what type of freight the vehicle is carrying, the size of a load, etc.
» Barriers:	There are two main barriers to the collection of GPS data. The first is technical—delivery vehicles (or drivers) must be equipped with GPS-enabled devices, typically either on the driver’s phone or the telematics device in the vehicle

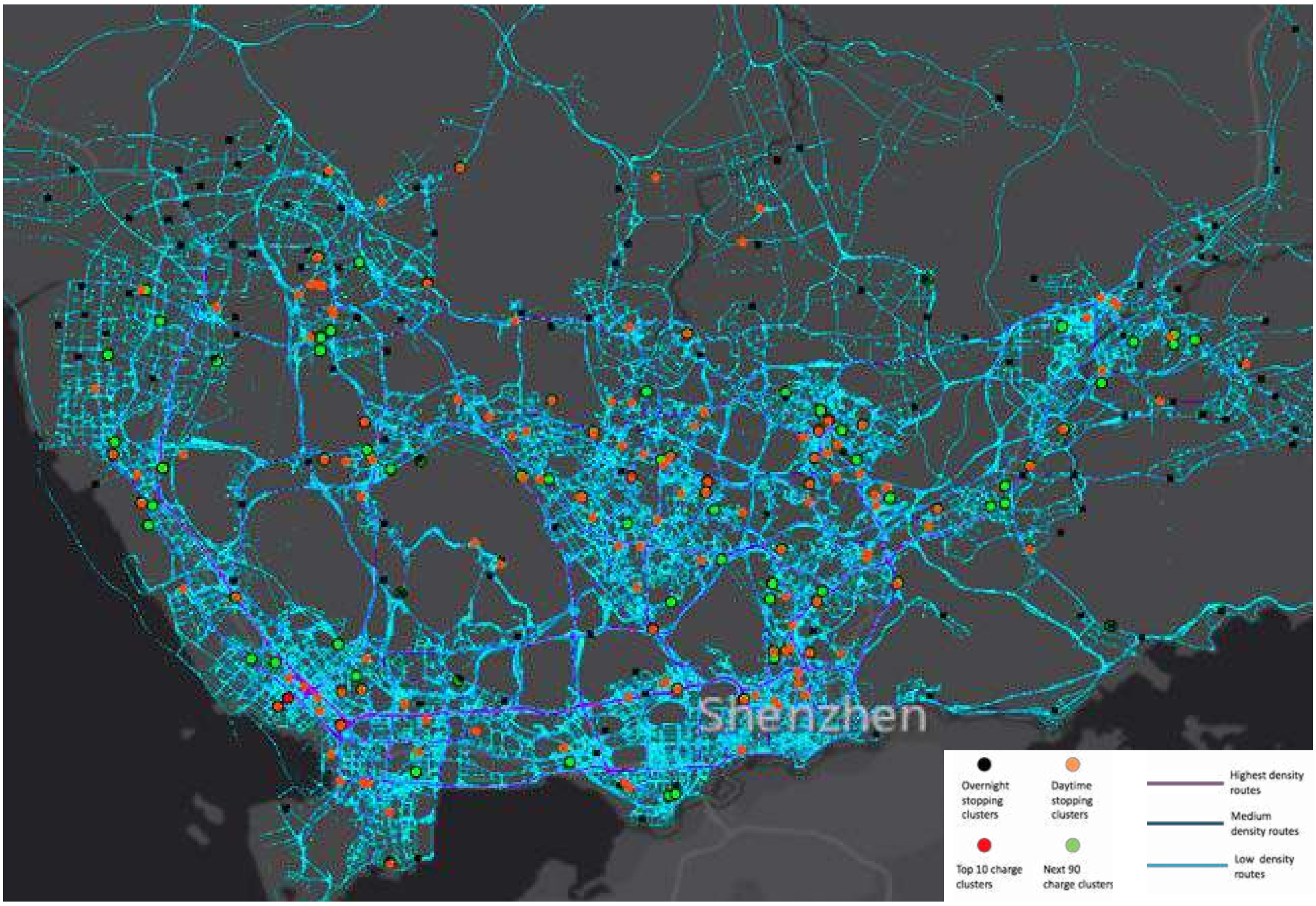


Figure 1: e-truck GPS data for Shenzhen, China | **Source:** Rocky Mountain Institute Analysis

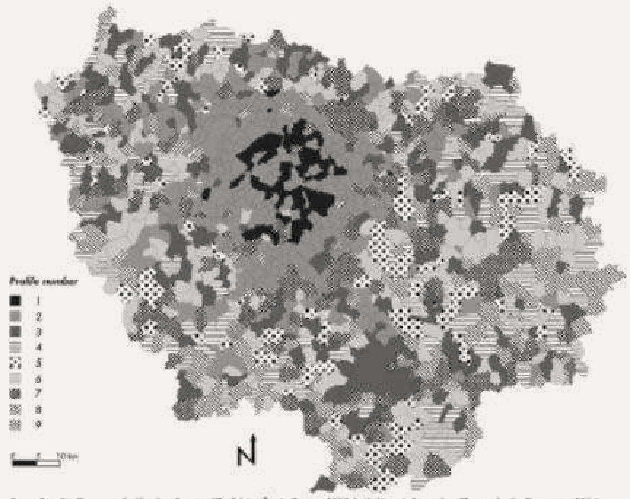
itself and that data must be transmitted to a database where it can be combined with data from other vehicles, analysis. The second barrier is privacy. GPS logs can provide a detailed look at driving and delivery patterns. In order to acquire and use GPS logs, it is critical to agree with private sector data owners on procedures to protect, anonymize and aggregate data in such a way that firms do not lose competitive advantage from sharing the data.

» Case Study

Aggregated and anonymized GPS data for electric delivery vehicles in Shenzhen, China is displayed in Figure 1. In this example, data are collected in a central data clearing house.[2] All e-trucks in the city are required to be equipped with telematics boxes that transmit GPS data through cellular networks to the data clearing house. The ability of governments to gather such data varies across countries, regions and cities.

1.2 Business registrations

» Description:	When businesses open, they typically register with municipal and/or tax authorities. Included in that registration is information such as business type, address, number of employees, etc.
» Uses:	Understanding the types of businesses operating in different areas of the city can help policymakers understand how freight flows within a city and plan infrastructure and land-use to support those flows. Business registration data must be combined with other data sources that describe an establishment's propensity to generate goods movement as well as how vehicles link various establishments.
» Barriers:	Typically, information about business registrations is collected by governments for tax and other regulatory purposes. So barriers to obtain that data are typically low.



Data : Enquête Transport de Marchandises en Ville Région Île-de-France, 2011 | Making : Laboratoire d'Économie des Transports, 2014

Type	Name	Characteristics	No of municipalities	Surface area (km²)
1	High density	Dense, shops	75	341
2	Commuter belt	Non differentiated fabric	315	2,500
3	Commercial towns	Small retail	191	1,899
4	Industrial municipalities	Industry	93	976
5	Peripheral towns craft	Rural, craft	127	1,288
6	Predominance of wholesaling on outskirts	Wholesaling, industry	210	2,045
7	Predominance of large warehouses	Logistics activities	141	1,560
8	Green desert	Agriculture	122	1,221
9	Presence of hypermarkets	Hypermarkets	26	237

Figure 2: Logistics typologies of different districts in the metro Paris region | **Source:** Toilier, Florence, et al. "How Can Urban Goods Movements Be Surveyed in a Megacity? The Case of the Paris Region," 2016.

However, if those data are not collected from business establishments or if the government agencies, who collect the data are unable or unwilling to share them, transportation authorities are unlikely to be able to generate those data sets independently.

» Case Study

As part of a broad urban goods movement survey in the Paris Metropolitan region, researchers analyzed business registrations and classified them according to various typologies, which described the composition of businesses within specific districts of the area (Figure 2). This data, when combined with a set of surveys descr-ibed in the following section, allowed researchers to gain an understanding of metropolitan freight flows and make projections related to logistics vehicle trip generation, vehicle use and delivery patterns within the metro region.

1.3 Surveys

» Description:	Surveys are questionnaires to gather data from logistics system players such as shippers, receivers, haulage companies and truck drivers. This allows for detailed knowledge of how goods move within the city, including details such as truck size, number of deliveries per tour, load size, route, how the delivery truck spends its time, etc.
» Uses:	When combined with establishment data, goods movement surveys allow for a granular understanding of urban goods movement patterns. This understanding can be used to project trip generation, parking requirements, congestion, emissions, etc.
» Barriers:	The first barrier is expense. The second is properly designing and executing the survey. Because all surveys involve sampling, the results are only robust to the extent that they are representative of the sampled population.

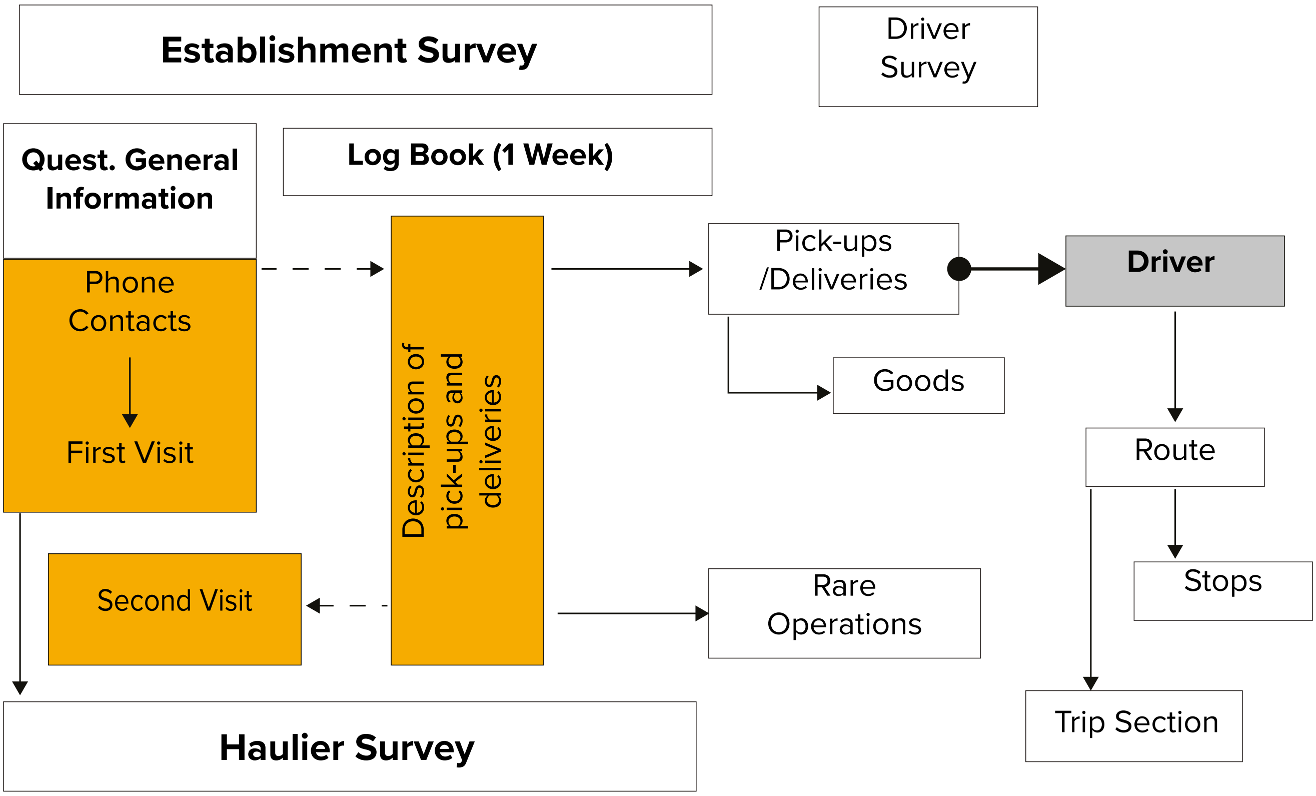


Figure 3: Survey methodology for French Urban Goods Movements surveys | Source: Toilier, Florence, et al. "How Can Urban Goods Movements Be Surveyed in a Megacity? The Case of the Paris Region," 2016.

» Case Study

Figure 3 describes the survey methodology for French Urban Goods Movements surveys, which is considered the gold standard of urban freight data collection. Surveys were carried out for establishments, both shippers and receivers, truck drivers and haulage companies to gather data about every stage of the delivery process. This allowed researchers to identify how different types of goods moved between different businesses in a detailed manner.

Results from French Urban Goods Movement surveys were used to create and calibrate a freight traffic simulation tool, FRETURB. FRETURB has been used in European cities beyond France to simulate logistics travel and guide policy and infrastructure planning.[3]

1.4 Counts

Figure 4a: Estimated delivery activity in central Santiago, Chile. **Source:** Winkenbach & Merchan. "Developing Sustainable Urban Freight Infrastructure." MIT Megacity Urban Logistics Lab. 2015.

» Description:	Counts involve collecting data about the vehicle travel and behavior at a specific place. They can be carried out manually, by having an observer physically count vehicles or by devices such as scales on a road or by analysis of video collected by traffic cameras. Two main types of counts are used to collect urban logistics data—(i) vehicle counts on roads as they move (ii) parking counts, which focus on how vehicles park.
» Uses:	Counts are typically used to monitor performance and demand at critical spots in an urban logistics network. Two common uses of count data are for parking and delivery patterns in dense areas in the urban core or vehicle travel patterns at key entry points into the city and along key logistics corridors.

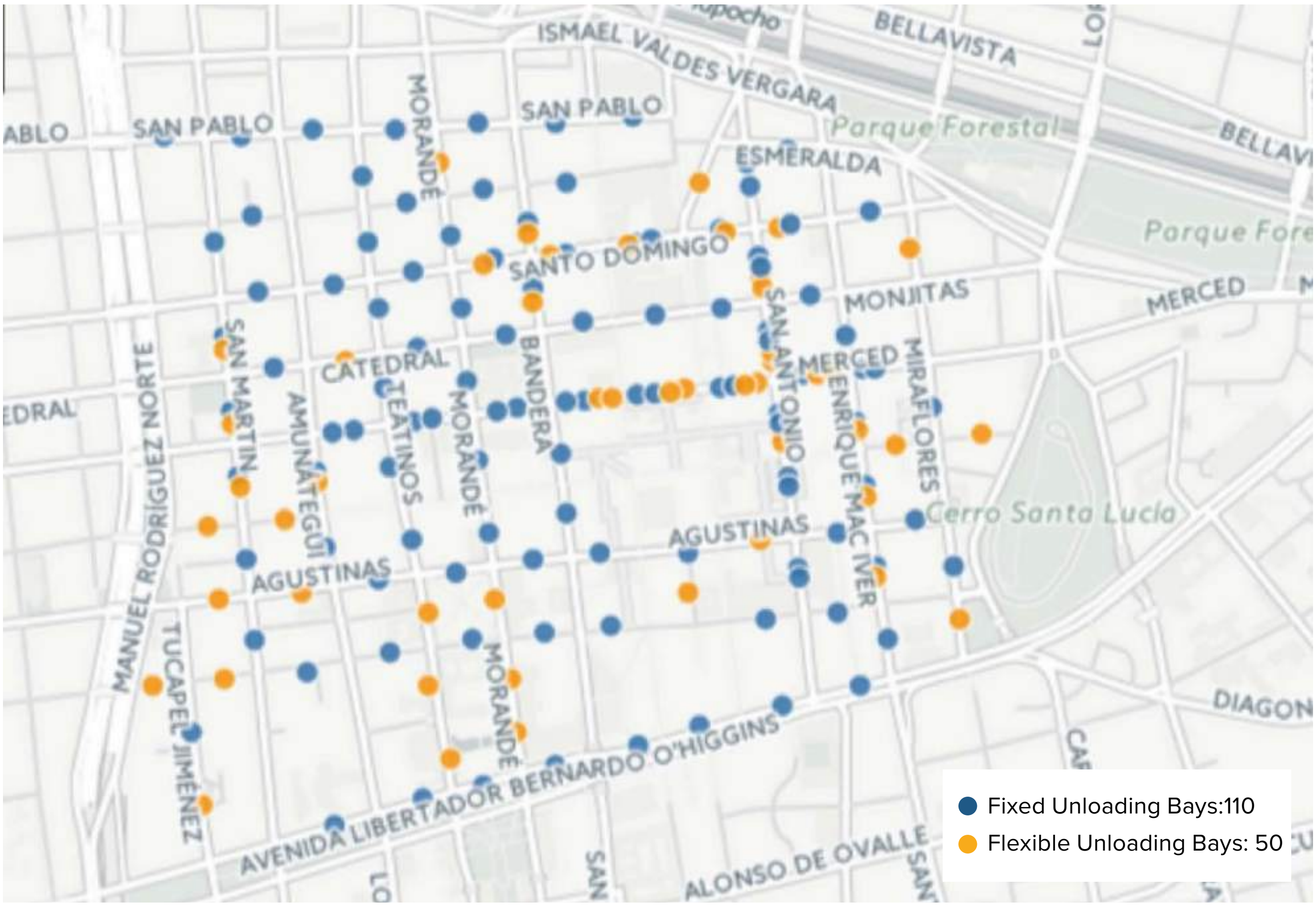


Figure 4b: Proposed parking infrastructure in central Santiago, Chile. **Source:** Winkenbach & Merchan. “Developing Sustainable Urban Freight Infrastructure.” MIT Megacity Urban Logistics Lab. 2015.

» Barriers:	Counts are typically a relatively easy way to gather data. Since they describe use at a single point in the network, the counts cannot describe the entire logistics system. Instead, they describe use at a single point in the network.
» Case Study	In Santiago, Chile, delivery vehicle parking was disrupting traffic flows and deteriorating air quality in the commercial district at the city center. Increased logistics parking infrastructure was needed to accommodate deliveries but it was not clear how much was needed or where it should be placed. To resolve those issues, authorities studied how vehicles parked and simulated network performance, including traffic flow deterioration due to illegal delivery truck parking under different parking configurations (Figure 4). An optimal solution of permanent logistics parking and variable, mixed-use parking was identified based on those counts and the simulations that were used to calibrate.

1.5 Data and performance measurement

KEY PERFORMANCE INDEX (KPI)	CALCULATION METRIC	TYPE OF DATA REQUIRED TO MONITOR KPI
Freight Intensity of GDP	Ton/$GDP	Truck counts, carrier surveys
Through freight share of total freight	Tons through freight/total tons	Truck counts, carrier surveys
Truck loading capacity	Tons	Truck counts, carrier surveys and vehicle logs
Net load factor	Ton-km/km	Carrier surveys and vehicle logs
Delivery productivity	Deliveries/hour	Carrier surveys and vehicle logs, GPS
Logistics sprawl	KM to barycenter	Zoning maps by establishment code, GPS
Routing efficiency	Deliveries/km driven	GPS, Carrier surveys & vehicle logs
Travel time index on truck lanes	Time during peak congestion/free flow	GPS, police and traffic data
Truck-related casualties	Injuries and fatalities/KM driven	Police department data
Truck emissions	Gm/km (CO_2, SO_x, NO_x, PM, VOC, 0_3, etc.)	Truck counts, registration data, Carrier surveys, pollution studies
Unit costs	$/km	Carrier surveys

Table 2: Type of Data required to monitor KPIs for assessing urban freight performance

No single data type is fully capable of describing urban logistics efficiency. As a result, a key element in evaluating overall urban logistics performance is assembling and effectively deploying a multitude of data collection methodologies. In the accompanying performance measurement document, a set of KPIs is introduced that describe key sources of inefficiency in urban logistics. However, to effectively deploy that KPI system, policymakers also must collect data to quantify performance on each metric. Table 2 suggests data collection approaches and data types, which can be used to assign values to those KPIs.

2.0 Stakeholder engagement

Data collection is only the first step in diagnosing problems in urban logistics. Robust engagement, both with industry players and with other government stakeholders, is critical to understand how the logistic system is performing, and more crucially, what steps may be taken to improve overall performance.

Because urban logistics systems involve a multitude of players, both public and private and because they are physically linked to larger national transport networks, multiple types of stakeholder engagement at multiple geographic levels are required.

2.1 Freight quality partnerships

Figure 5: Cities with freight quality partnerships | **Source:** Brown and Lindholm. Freight Quality Partnerships: An international Study. 2014

» Description:	Freight quality partnerships are a forum for logistics players to interface with municipal policymakers on issues that affect logistics efficiency in the urban core. Freight quality partnerships are typically composed of commercial players, who are heavily affected by final mile inefficiency. This type of public sector engagement with industry can assist policymakers in minimizing costs while protecting the public from externalities associated with urban delivery. These types of bodies are becoming common globally in major cities, especially in Europe, (Figure 5) and have been a useful tool for public-private partnership to enhance the efficiency of urban logistics.
» Focus areas:	Freight quality partnerships typically focus on the needs of commercial players who operate in the urban core. As such they focus on infrastructural topics such as parking availability, access policies such as entry restrictions, congestion pricing or low emissions zones and other policy areas that influence operational efficiency of the final-mile delivery.

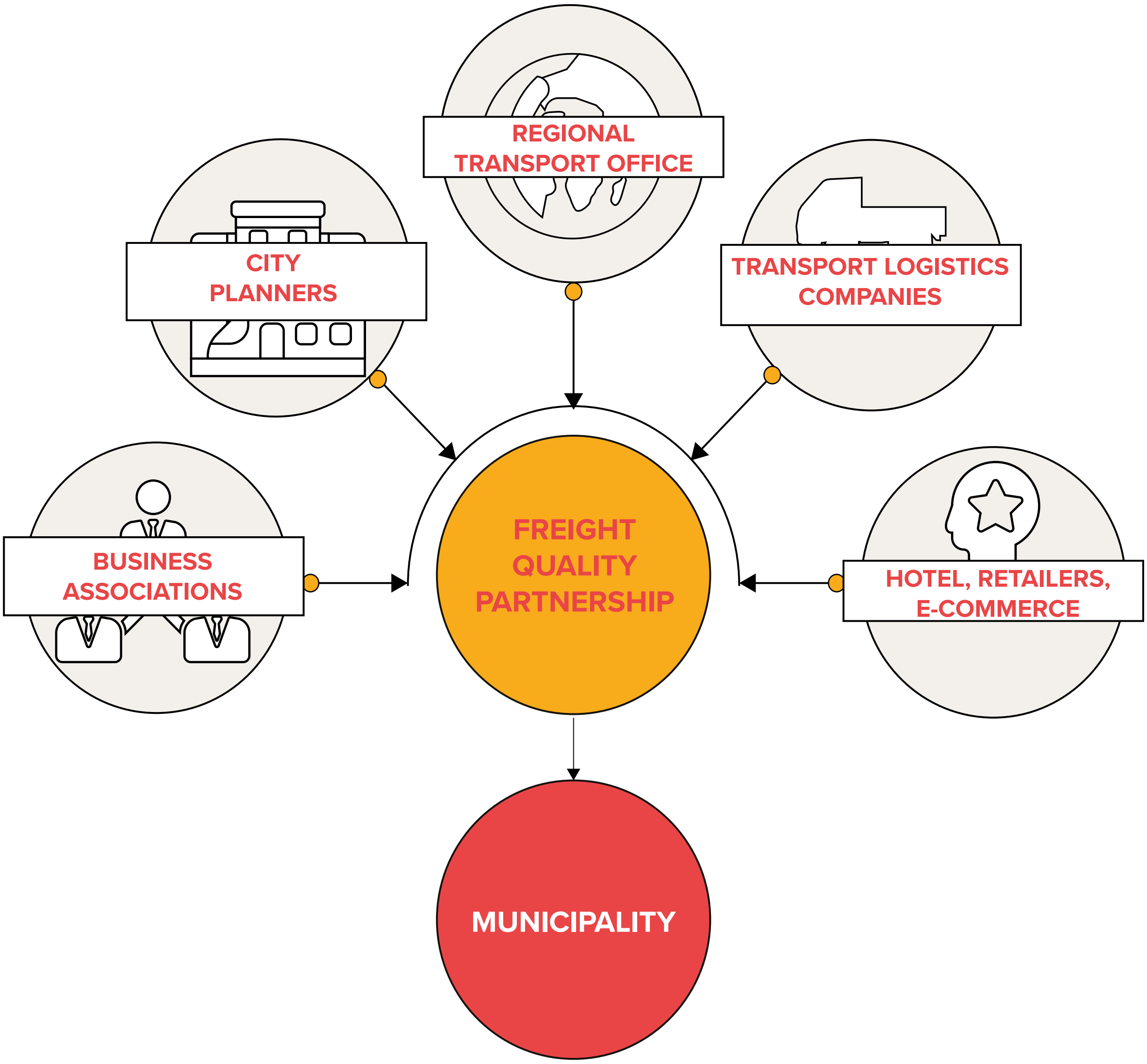


Figure 6: Freight quality partnerships.

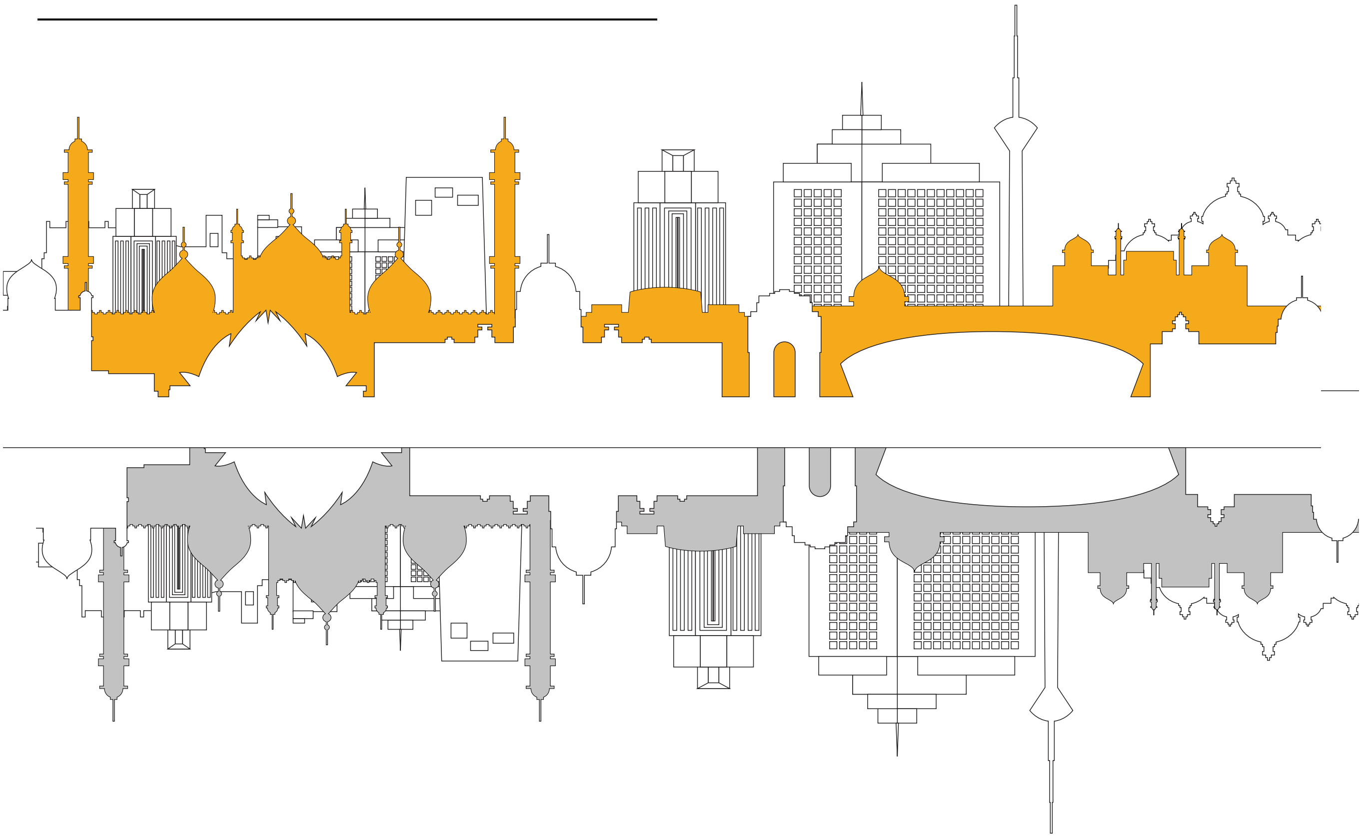
» Case Study

An example of robust freight quality partnership is the Central London Freight Quality Partnership. It consists of policymakers, logistics companies, industry associations for various types of retailers, university departments specializing in urban transport and more. This partnership has offered industry feedback to policies such as congestion charges, low-emissions zones, changes to traffic management policies, time restrictions on logistics activities such as loading and unloading, as well as other policy moves relevant to logistics performance.[4]

TOPIC	NO. OF FQPs MENTIONING THIS
Lorry routing	22
Overnight parking	20
Signing	19
Loading and unloading provisions	19
Good practice in freight operations	16
Out of hours deliveries	16
Urban consolidation centers	15
Vehicle access (times or weights/sizes)	14
Rail freight work	14
Reducing the number and impacts of deliveries	14
Loading and unloading restrictions and fines	13
Traffic information	13
Strategic planning	12
Low-emissions zones/emissions regulations	11
Environment-friendly vehicles	11
Conflicts between goods vehicles and other road users	10
Enforcement issues	10
Congestions	9
Water freight issues	8
Lorry lanes	7
Vehicle utilization	6
Driver training	5
Home deliveries	5
Bicycle delivery	5
Telematics	4
Road pricing	1

Table 3 : Topics addressed by FQPs in the UK. | **Source:** June & Allen, J & Browne, M & Piotrowska, Marzena & Woodburn, Allan. (2010). Freight Quality Partnerships in the UK–an analysis of their work and achievements.

2.2 Metropolitan planning organizations



» Description:	Because urban freight systems are integrated into national transport networks, a coordinated policy response by multiple levels of the government to urban and metropolitan freight issues is a critical element of efficient logistics. For this, intergovernmental coordination is also a critical element of urban logistics policy formulation. In the US, Metropolitan Planning Organizations (MPOs) exist to coordinate transport policymaking issues, including freight on a metropolitan level. They typically include elected representatives or political appointees such as leaders or municipal transportation departments, city employees such as traffic engineers and permanent MPO staff to handle admin and other functions.
» Focus areas:	MPOs serve as the forum to create a fair and transparent transportation development plan for an urban area. They would typically work towards two main outputs: a long-term transportation plan, with a 20 to 30-year time horizon,

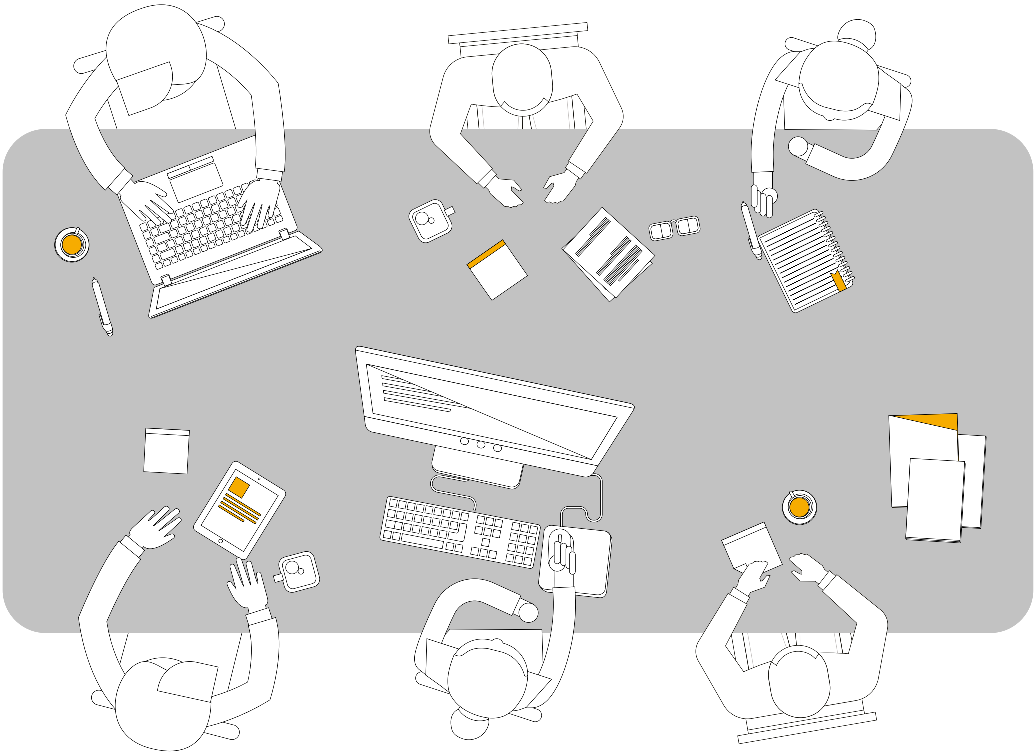
Figure 7: Hoboken city redesign | **Source:** New York Metropolitan Transportation Council

for people and goods that prioritize system performance and quality of life, as well as a shorter term plan, which looks to meet the most immediate needs.

» Case Study

The New York Metropolitan Transportation Council (NYMTC) is the MPO for the New York Metropolitan area. Investment in freight specific infrastructure is a key focus area for the NYMTC. Freight projects pursued by the NYMTC include feasibility studies of regional intermodal logistics parks/freight villages, analysis of the sufficie-ncy and performance of truck rest stops and service areas, feasibility studies on the use of ferries and roll-on roll-off (RoRo) trucking and reducing congestion on chokepoints such as bridges and tunnels as well as numerous surveys and studies to analyze demand for and performance of freight services in the greater New York area.

2.3 Freight advisory committees



» Description:	Because urban freight flows typically originate outside of the urban core, often in other jurisdictions from the city itself, coordinating urban logistics development with broader networks is also a critical factor in the overall urban freight efficiency. To achieve it public-private-partnerships with regional, state and national stakeholders must also be created. Freight Advisory Committees (FACs) need to provide multi-stakeholder input in policy and infrastructure planning. Engagement with these types of bodies allow municipal policymakers to participate in the decision-making process for policies and infrastructure over which they do not have direct control but which influence logistics efficiency within their cities.
» Focus areas:	Topics that FACs commonly advise on and that are relevant to municipal authorities may include corridor improvement, multimodal integration or regional transportation and land-use master planning.

Figure 8: NYMTC Freight Transportation Working Group meeting | **Source:** New York Metropolitan Transportation Council

» Case Study

The Freight Transport Working Group (FTWG) is the FAC associated with NYMTC, discussed above in the MPO section. It is composed of regional logistics stakeholders such as shippers, receivers and carriers, MPOs in neighboring cities, elected officials and civil society groups.

This group collaborates with NYMTC to develop its regional freight plan, raise the profile of freight development in the policymaking process and provide the MPO with data and insight to effectively manage and improve the network.[6]

3.0 Long-term planning

Data collection and stakeholder engagement are effective tools for identifying and remedying current issues in urban logistics. However, if urban logistics policy is ever to be more than a series of ad hoc responses to problems as they appear, a long- term vision for the evolution of freight policy and geography must exist. To develop such a vision, city transport policymakers must understand how economic development and population growth will affect their cities and plan accordingly. This long-term planning consists primarily of two elements. Development and land-use planning, how the city's economy and urban form will evolve in medium to long term and urban freight master planning, the infrastructure and policies to meet freight demand as the city grows and matures.

3.1 Development and land-use

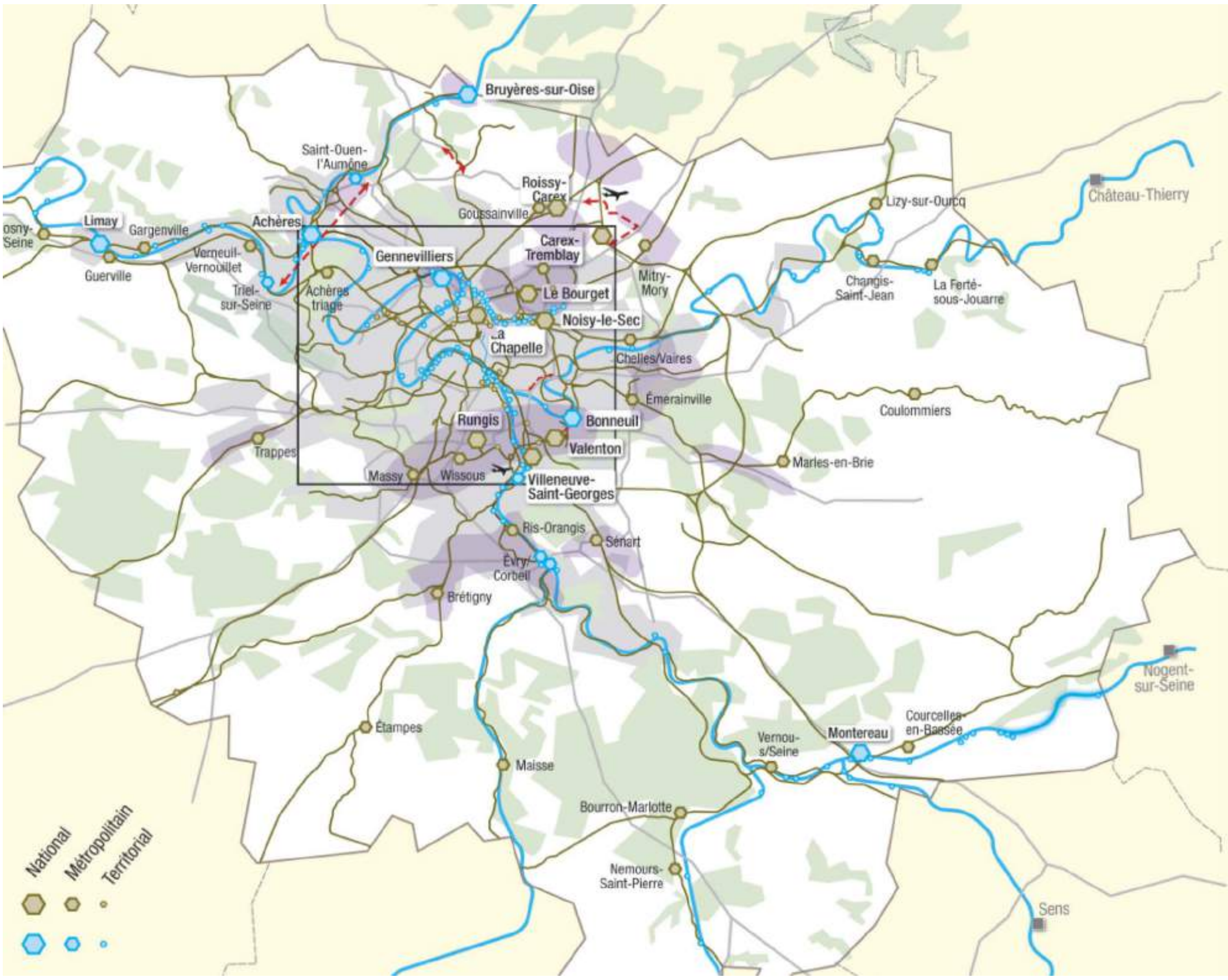


Figure 9: Paris industrial master plan
Source: Conseil régional d'Île-de-France. Île-de-France 2030 Defis, Projet Spatial Regional et Objectifs. 2013.

» Description:	In many cases, land-use planning does not take into account the logistics needs of a city or metropolitan area as the city develops. If allowed to proceed in a disorganized manner, this process of evolution and change can result in a city being locked into an irrational urban form and underperforming infrastructure, which do not meet the needs of logistics players. For this reason, it is important to identify land in the metropolitan area that is suitable for freight generating establishments such as distribution centers or industrial facilities and ensure that development progresses in coordination with planned infrastructure investments.

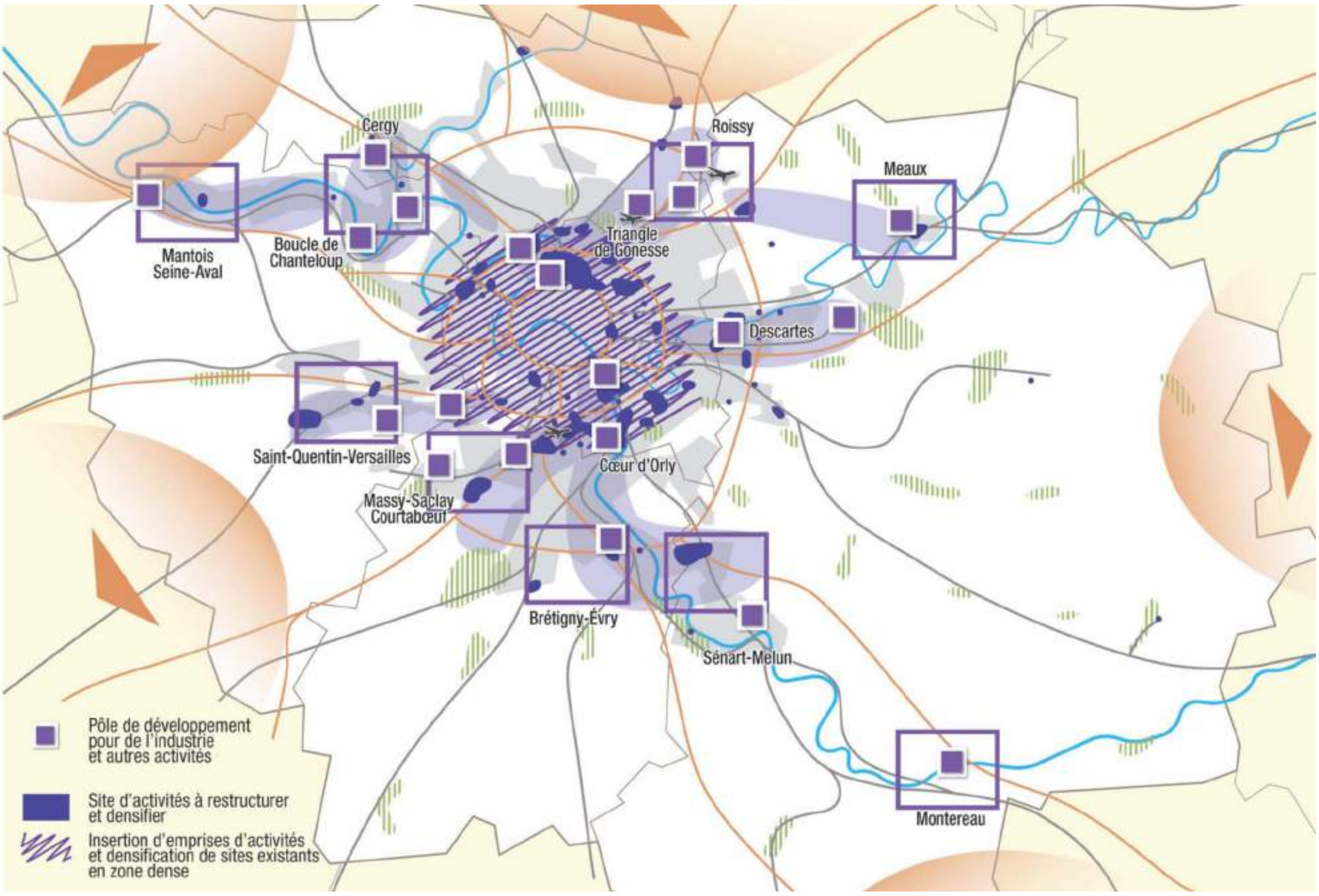


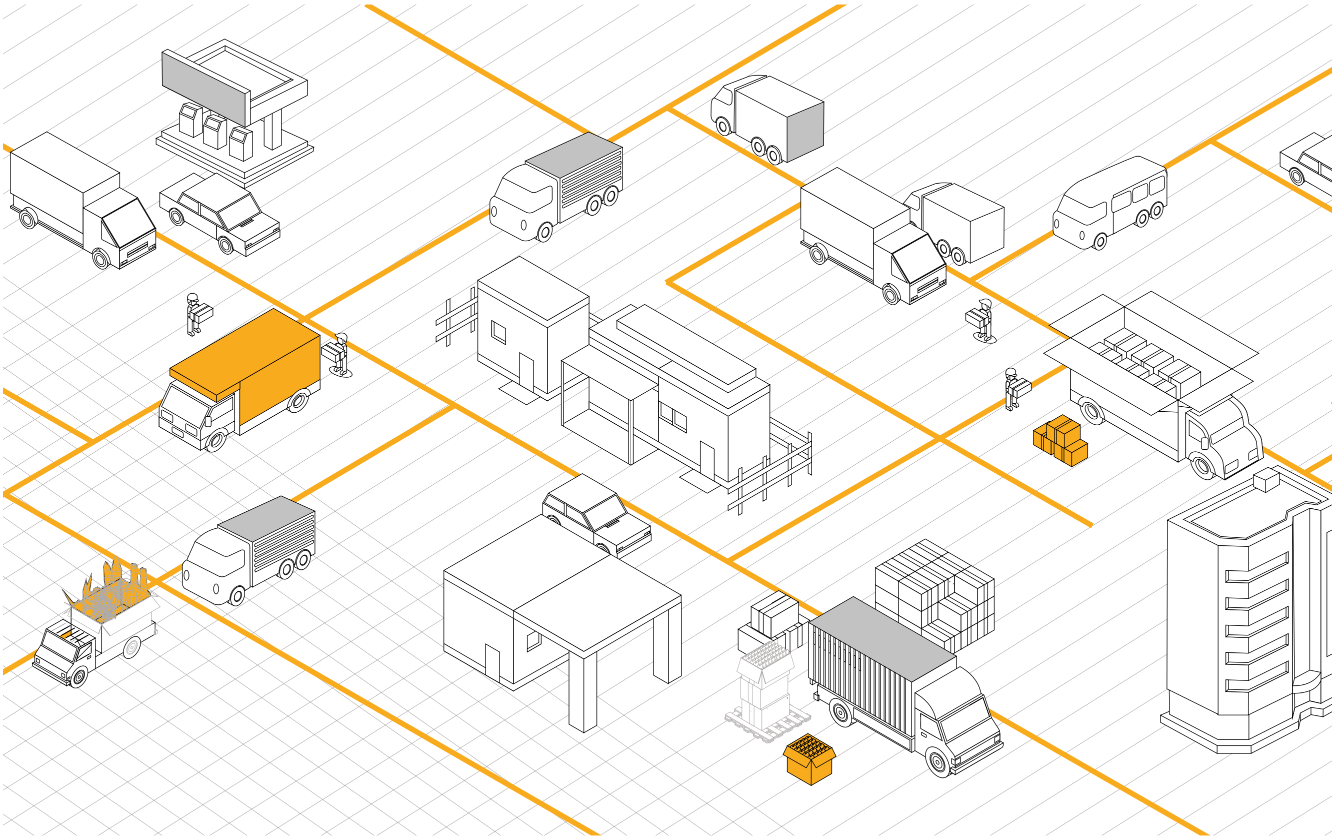
Figure 10: Multimodal development zones coordinated with industrial clusters
Source: Conseil régional d'Île-de-France. Île-de-France 2030 Defis, Projet Spatial Regional et Objectifs.2013.et Objectifs. 2013.

» Case Study

In parallel with planned industrial development, infrastructure was planned to meet the freight demand those industrial zones were projected to create. Specifically, industrial clusters (solid purple squares in Figure 9) were located in zones targeted for intermodal development (rectangles outlined in purple).

In the Paris Metro region, known as Ile De France, a long-term industrial development planning was carried out to support projected economic growth in the region for the next several decades. Identified land for industrial use (purple shading in Figure 8) was well outside the urban core and well-served by water transport infrastructure (blue lines and circles) and rail transport infrastructure (brown lines and circles) as well as road networks (grey lines).

3.2 Freight master planning



» Description:

As land-use, urban form and economic output into the future become clear, it becomes possible to project what freight volumes will be moving through a city and what infrastructure they will require. Projecting future freight volumes and land-use changes allow policymakers to assess what stresses the system will experience and plan how to mitigate them —before they start to cause problems. Master planning freight infrastructure for future development can ensure economic vitality and high urban quality of life for residents well into the future.

2014

Gather information on conditions

- Interviews
- Survey
- Advisory committee
- District councils
- Freight advisory board
- MICs

2015

Input to draft network

- Advisory committee
- Modal advisory boards
- Open houses
- District councils
- MICs
- Business associations
- Community councils and industrial associations

2016

Public review draft master plan

- Advisory committee
- Modal advisory boards
- District and community councils
- MICs
- Comment period

Input to final plan

Figure 11: Public engagement process for Seattle's Freight Master Plan
Source: Seattle Department of Transportation City of Seattle Freight Master Plan. 2016.

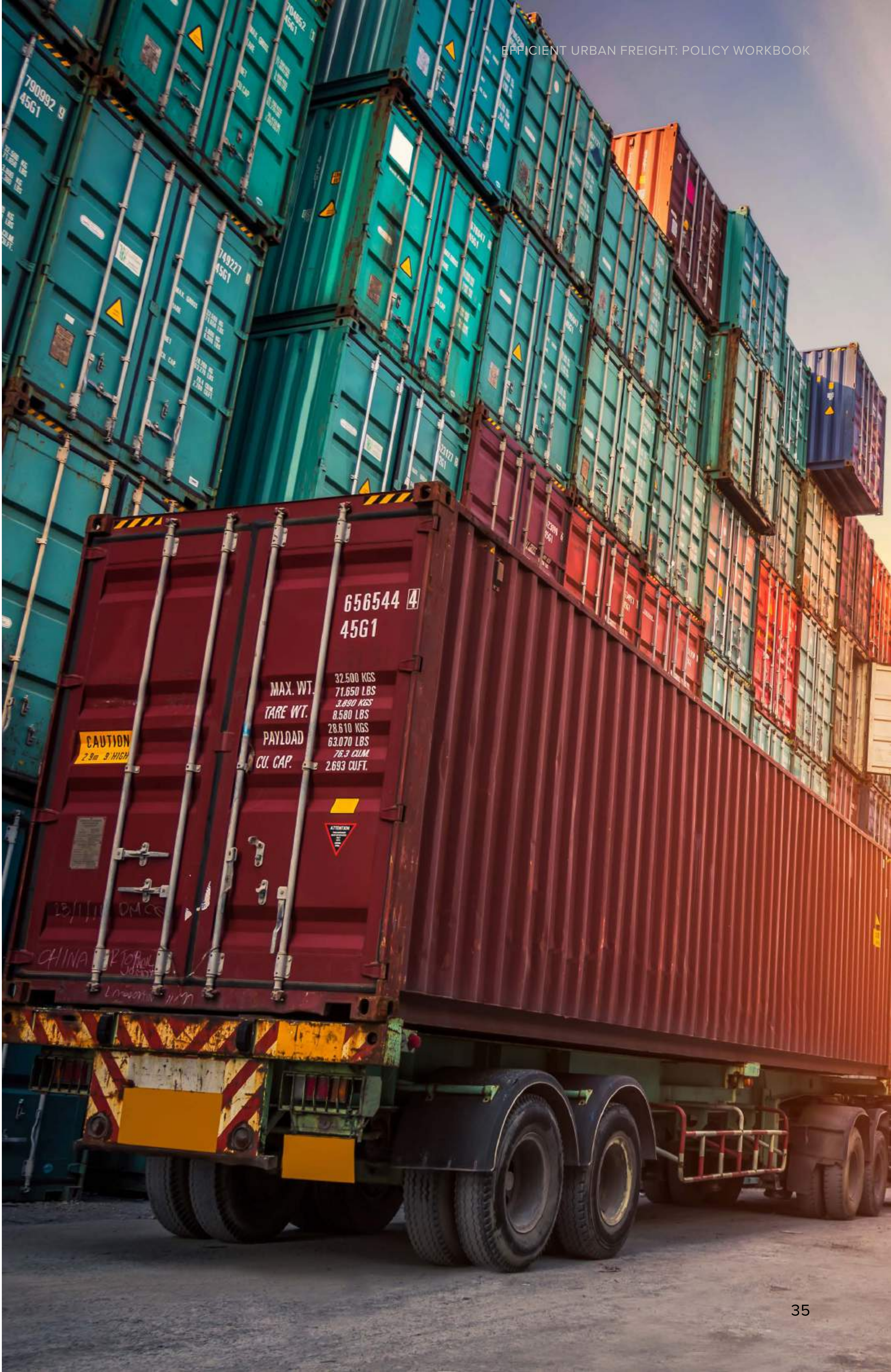
» Case Study

The city of Seattle undertook a long-term freight planning initiative to ensure that it would be able to meet the freight demands of the next generation of industrial and commercial enterprises in the city. There were two major phases of planning, the first was stakeholder engagement and consultation; the second was the creation of specific strategies and action items to address needs identified through the consultation process.

After consultation, the final result was a plan that included over 90 actions that could improve the performance of its urban freight system. The table on the next page shows specific actions for urban delivery, a subsection of strategies to promote economic vitality in the city.

STRATEGIES	ACTIONS
Develop an urban goods delivery strategy	» Establish a minimum distance for loading opportunities from any business address, either in on-street, alley or off-street locations; maintain or reassign loading development projects
	» When alleys are vacated, identify and address loading and circulation impacts to adjacent and nearby properties
	» Improve enforcement of commercial vehicle load zones
	» Expand commercial vehicle load zone hours to 24 hours a day, 7 days in a week in selected locations
	» Review the commercial vehicle load zone permit process to consider more effective use of price to manage demand, access and types of user
	» Consider potential expansion of the Downtown Traffic Control Zone in a manner that improves daytime street network reliability but still provides sufficient urban goods delivery access
	» Evaluate and recommend on- and off-street tactics to enable bicycle, non-truck and small truck deliveries in dense areas
	» Evaluate new curb designs to increase flexibility and opportunities to share space
	» Develop a pilot program for off-hours delivery in areas with a mix of residential and commercial land-use to facilitate truck movement
	» Explore freight demand management strategies to consolidate freight delivery trips and ensure vehicles are right-sized for an urban environment
	» Identify and employ innovative uses of technology to guide urban goods deliveries to destinations and manage access to loading locations
	» Develop a data collection plan and seek funding to regularly monitor on and off-street commercial loading locations and gather user input
	» Explore best off-street loading practices, including loading dock development and use standards
	» Work with other city departments to re-evaluate and update design requirements in new developments to accommodate increased online delivery package storage

Table 4: Actions to support efficient urban delivery identified in Seattle's Freight Master Plan. | **Source:** Seattle Department of Transportation. City of Seattle Freight Master Plan. 2016.


656544 4
45G1
MAX. WT.
32.500 KGS
71.650 LBS
TARE WT.
3.890 KGS
8.580 LBS
PAYLOAD
28.610 KGS
63.070 LBS
CU. CAP.
76.3 CU.M.
2.693 CU.FT.
CAUTION

4.0 Project prioritization

Prioritizing projects requires a methodology to evaluate difficult trade-offs between competing goals such as safety, employment, quality of life, cost, etc. in consultation with urban stakeholder groups. To do so, policymakers can identify goals that they believe urban freight system should be achieving in their city and the relative importance of each goal.

Based on that they can create categories with an associated score. Each project can be scored on each goal and the overall project score would be the sum of the scores for each category. In the below example, the city of Seattle identified five goals for the urban logistics system (safety, mobility, economy, state of good repair, and equity and environment) which were all deemed to be of equal importance. Projects can receive a maximum of 20 points for each category for a total score of up to 100 points. The total point value for each project is an important factor in determining its priority relative to other projects competing for resources.

As the city evolves, the goals, relative scores and project slate may change. For that reason, policy-makers should continuously evaluate the slate of projects under consideration as well as the goals and relative weight of each goal to ensure that investment into the urban logistics system is maximizing benefit to the city's residents and its economy.

» Data collection, private sector engagement and long-term planning, all can help cities understand which projects are needed to enhance urban logistics efficiency. «

PRIORITIZATION PROCESS—QUANTITATIVE		
GOAL	**MEASURE**	**SCORE**
Safety	» Location has high number of collisions » Location has high potential for bicycle and/or pedestrian interaction with freight	**20**
Mobility	» Connects manufacturing and industrial centers and business districts with regional freight network » Promotes efficient truck movement in areas with high truck volumes	**20**
Economy	» Improves freight movement by addressing bottlenecks in the system » Improves connection to dense commercial land use	**20**
State of good repair	» Pavement condition (pavement coefficient index) » Heavy haul network, over-legal network	**20**
Equity and environment	» Areas with high number of jobs linked to freight » Investment would mitigate impacts to adjoining area and is in the area with minority and low-income populations	**20**

Table 5 I Prioritization process—quantitative **Source:** Seattle Department of Transportation. City of Seattle Freight Master Plan. 2016.

5.0 Project funding

5.1 Public-private partnership

» Description:	Urban logistics projects, as with many infrastructure projects, should be paid for by users in proportion to the benefit derived from them. Because the benefits of such projects typically accrue to both private operators, through greater operational efficiency and lower cost, as well as to the public, through congestion reductions, reduced use-conflicts, increased employment and economic growth, public-private partnerships (PPP) are typically an effective way of financing urban logistics projects. Under PPP arrangements, both government and industry would contribute capital to the execution of a project in proportion to the benefit derived.

CREATE PROGRAM BENEFIT TYPE			
GOAL	**MEASURE**	**YEARLY AVG.**	**30-YR TOTAL**
Increased rail system capacity/ avoided truck traffic	Travel-time savings	$1032 M	$13939 M
	Safety benefits	$141 M	$1908 M
	Sustainability	$18 M	$232 M
	Logistics cost savings	$668 M	$9016 M
	Avoided pavement damage	$392 M	$5297 M
	Passenger train delay savings	$17 M	$254 M
	Freight train delay savings	$30 M	$525 M
Grade Separation	Travel-time savings	$15 M	$237 M
	Safety benefits	$7 M	$115 M
	Sustainability	$1 M	$20 M
Total		**$2.3 B**	**$31.5 B**

Table 6: CREATE Program. | **Source:** 70 Projects to CREATE Chicago's Transportation Future.

» Case Study

CREATE is a set of 70 freight rail projects in the Chicago metropolitan area, which are designed to increase capacity on rail lines at a critical choke point in the national rail network and decrease conflicts with road users.

The projected benefits over 30 years from those projects are over $31.5 billion at an upfront cost of $4.4 billion. That upfront capital was contributed via a PPP composed of all parties who derived benefit from the projects, including US Dept. of Transport, the State of Illinois, Cook County, the City of Chicago as well as passenger, freight and commuter rail companies.

Figure 12: The Heartland Corridor | **Source:** Norfolk Southern

» Case Study

A robust effort to fairly attribute value and cost to parties of a PPP is often critical to its success. For example, the Heartland Corridor is a railline connecting ocean ports in Virginia with Chicago and Columbus, Ohio. By elevating clearances on 29 tunnels, double stack rail intermodal service between those ports and Chicago could be undertaken, reducing route distance by over 200 miles and travel time by over 24 hours versus the best existing options, reducing cost by $450-$600 per container.[7]

While that clearly reduced rail-road costs, it also improved the competitiveness of Virginia ports, increasing their revenues, generating employment at logistics parks built along the route and lowering costs for shippers. Due the multiple sources of value creation and uncertainties around the cost, an independent study team was formed to investigate those issues. That study team found that primary beneficiaries of the project would be the railroads and shippers, with the ports of Virginia capturing a smaller share of the value.

INVESTMENT IN ROAD SECTOR

	TENTH PLAN (2002–07)			ELEVENTH PLAN (2007–12)		
	IN RS.* (CR)	IN USD* (MN)	% SHARE	IN RS.* (CR)	IN USD* (MN)	% SHARE
Centre	71,536	17,884	46.87%	155,367	38,842	42.94%
State	68,143	17,036	44.65%	134,246	33,561	37.10%
Private	12,937	3,234	8.48%	72,209	18,052	19.96%
Total	**152,616**	**38,154**	**100%**	**361,822**	**90,456**	**100%**

Table 7: Investment in road sector (10th and 11th plan) | **Source:** Gajendra Haldia. Public private Partnership in National Highways: Indian Perspective. International Transport Forum. April 2013. https://www.itf-oecd.org/sites/default/files/docs/dp201311.pdf

» Case Study

Since shippers were not party to the PPP, the US federal government contributed that portion of the cost under the assumption that the extra value created would be eventually recaptured through increased income taxes.[8] As a result, the nearly $200-million rail upgrade was financed with 43% of the capital coming from the federal government, 52% from Norfolk Southern Railways and the remaining 5% coming primarily from the State of Virginia.[9]

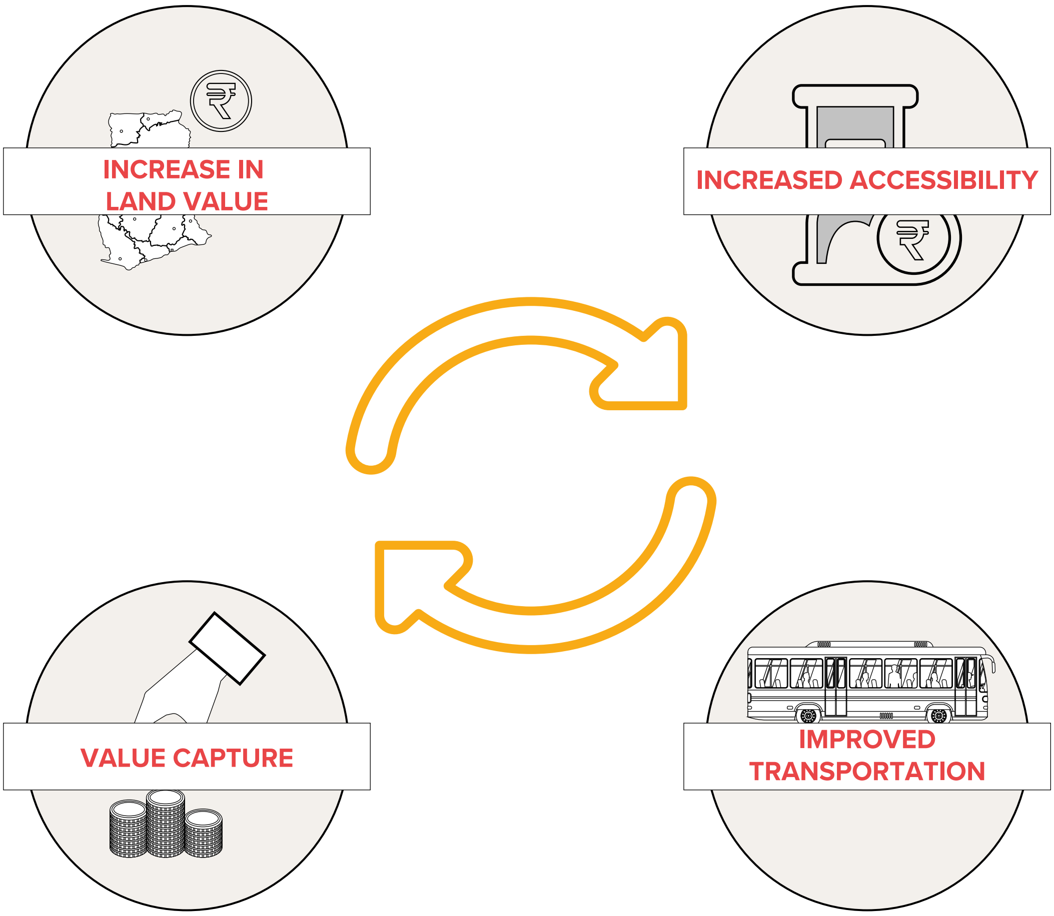
PPP models exist in India as well. National Highways in India are funded by public private partnership (PPP) with the cost recovery coming in two forms: toll and annuity models.[10] In the toll model, a concessionaire builds the infrastructure and recovers his investment by charging tolls from highway users. In the annuity model, the concessionaire gets returns on his investment in the form of annuity payments from the government. PPP Investment into Indian National Highways during 10th and 11th plan between 2002 and 2012 is as in Table 7.

5.2 User fees and project finance

Figure 13: Alameda Corridor

» Description:	Project finance uses revenues created by the use of a piece of infrastructure over the course of its lifetime to pay back a loan for its upfront cost. Project finance or related securitization approaches can be used for projects with very high upfront costs where the groups deriving the benefit are not in a position to provide such a large amount of capital at once. Project finance can be used in conjunction with PPPs.
» Case Study	The Alameda corridor is a high-capacity, below-grade, container rail line connecting the Port of LA and Long Beach with the United States' class 1 freight rail networks. It was built because the existing rail system was both short of capacity, which created substantial urban truck traffic and also had many level crossings, which interfered with urban traffic fluidity. The project is a PPP with the state of California contributing capital as well as the ports that the railway served. The largest share of capital, however, is from the bonds guaranteed by use revenue. Each container passing along the corridor is subject to a $48 fee, which creates a revenue stream to service the debt used to finance the project.

5.3 Value capture



» Description:	Transportation projects often enhance the value of real estate in their vicinity. Capturing some of that value appreciation, typically through property taxes or fees charged to developers, can be used to fund the transportation project, which provided that appreciation. The majority of examples of value capture financing come from passenger transport investments. However, the same principle could be applied to the value of commercial and industrial land that is more efficiently connected to logistics networks or to real estate that sees its value rise due to the resolution of use conflicts created by logistics activity.

Figure 14: Denver Union Station. | **Source:** City of Denver

» Case Study

Denver Union Station is a multimodal hub for public transportation with access to bus, light rail and commuter rail. It is surrounded by mixed-use, transit-oriented development, including commercial and residential areas. The redevelopment of Denver Union station was partly funded by loans from Railroad Rehabilitation & Improvement Financing (RRIF) and Transportation Infrastructure Finance and Innovation Act (TIFIA). For repayment of the loans, the city council created a Tax Increment Financing (TIF) district on the properties that benefited from the project around the station and in the surrounding 20 acres. The revenue collected from the TIF was used towards loan repayment.

Similarly, Bangalore is also using a value capture mechanism to finance its city metro project.[11] Construction of metro line increases the value of the surrounding land. A portion of that value will be captured as an additional land tax to fund the construction of metro stations.

6.0 References

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EFFICIENT URBAN FREIGHT

PART 3: EVALUATION METRICS

Smart City
MISSION TRANSFORM-NATION

Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

Section outline

This document describes key performance metrics (KPIs) for monitoring a city's progress towards making its urban freight system more efficient.

1.0 Introduction to freight performance measurement

1.1 Purpose and logic of performance measurement

Many different causes, which are often mutually interdependent, contribute to the overall efficiency of urban logistics. For that reason, rather than trying to isolate and measure every potential cause of inefficiency, we suggest a set of metrics that are easy to understand and collectively describe key elements of urban freight efficiency that are amenable to action by policymakers.

This KPI system is designed to help policymakers understand, at a high level:

- What goods must travel on city roads
- How much vehicle travel to move those goods can be reduced
- For vehicle travel that must occur how much cost, both internal and external, can be removed from the system.

This metric system identifies and quantifies a limited set of drivers for excess freight movement on urban roads, excess vehicle travel per unit of freight demand and excess cost, both external and direct, per unit of vehicle travel. Further explanation of metric definition and potential pathways to improvement are discussed below.

1.2 Caveats on interpretation

Care must be exercised when interpreting this KPI system: analysis of any single metric in isolation is not meaningful. Many of these metrics are inextricably tied together and any change to affect one metric can have knock-on effects on many others. For example, a change in an average truck size would have knock-on effects on many other metrics such as load factor, number of trips, cost per kilometer, delivery productivity, etc. Furthermore attempting to use this KPI system to use one city as a benchmark against another is not possible. It is best interpreted as a time series for a single city.

While some lessons may be learned from looking at other cities, especially at how they have improved metric performance, strict comparison is misleading. Many exogenous factors such as size, geography, composition of the economy and even climate and weather patterns will affect the metric performance. Furthermore, when evaluating performance, robust engagement with logistics players, as outlined in the Policy Workbook Document, can help policymakers interpret why metrics have changed and whether the overall evolution of the system was positive or negative.

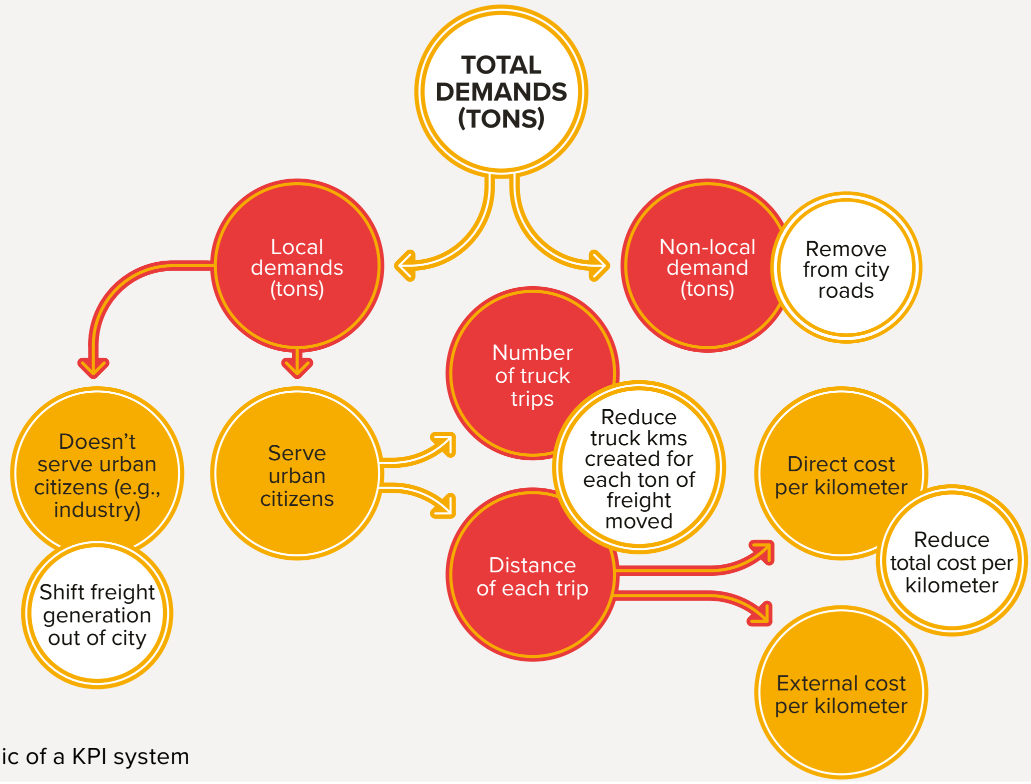


Figure 1: Logic of a KPI system

INEFFICIENCY CATEGORY	SUB-CATEGORY	KEY PERFORMANCE INDEX (KPI)	CALCULATION METRIC
Demand	Local	Freight intensity of GDP	Ton/Rs. GDP
	Through	Share of total freight demand	Ton-through/total tons
Vehicle travel	Trips	Vehicle loading capacity	Tons
		Net load factor	Ton-km/GVWR*km
		Delivery productivity	Deliveries/hour
	Trip distance	Logistics sprawl	Km to barycenter
		Routing efficiency	Deliveries/km driven
External cost	Congestion	Travel time index on freight lanes	Time during peak congestion/free flow
	Safety	Truck-related casualties	Injuries and fatalities/km driven
	Pollution	Freight-related emissions	Gm/km (CO_2, SO_x, NO_x, PM, VOC, 0_3, etc.)
Direct cost	Fixed + variable	Unit costs per kilometer	Rs/km

Table 1 : Metric system

Note: GVWR—gross vehicle weight rating

2.0 Metric discussion

2.1 Freight intensity of GDP

TRUCK FREIGHT GENERATED BY ACTIVITIES (IN TON-KM)

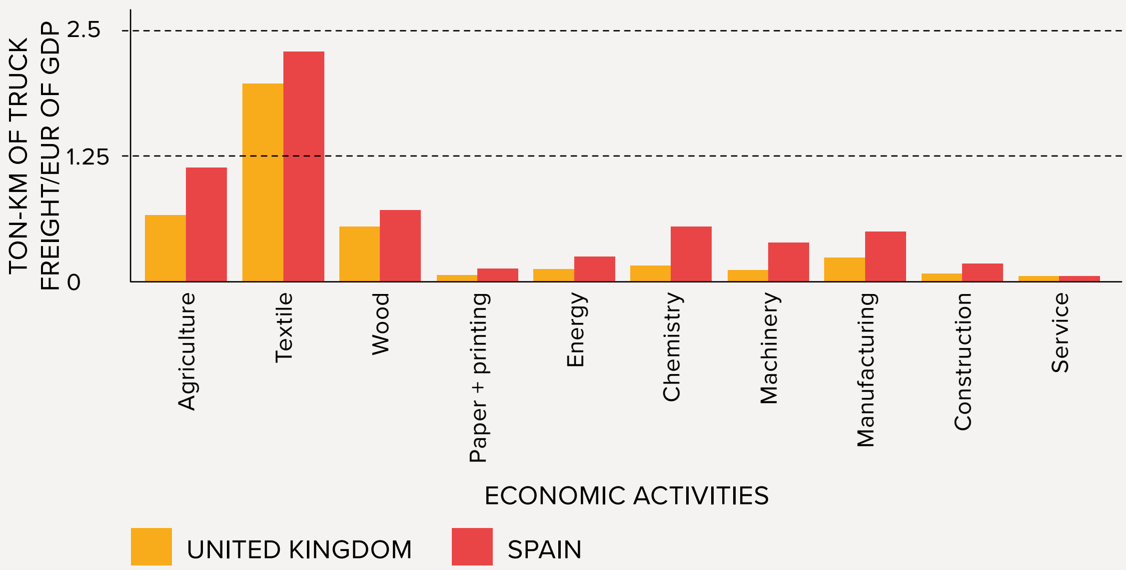


Figure 2: Ton-km of truck freight/EUR of GDP generated by different types of economic activities in the UK and Spain[1]

» Description

Producing goods and to a lesser extent, services entail the movement of freight. However, different economic activities tend to produce different amounts of freight movement. For that reason, the size and composition of the economy, especially the share of the tertiary sector in a city's GDP, heavily influence how much freight demand is created in a city. Broadly speaking, the tertiary sector produces far less demand for freight movement than other sectors. Low value-added manufacturing and heavy industry, on the other hand, tend to produce relatively high freight demand per unit of GDP.

FREIGHT IN GLOBAL MEGACITIES (IN TONS/ GDP)

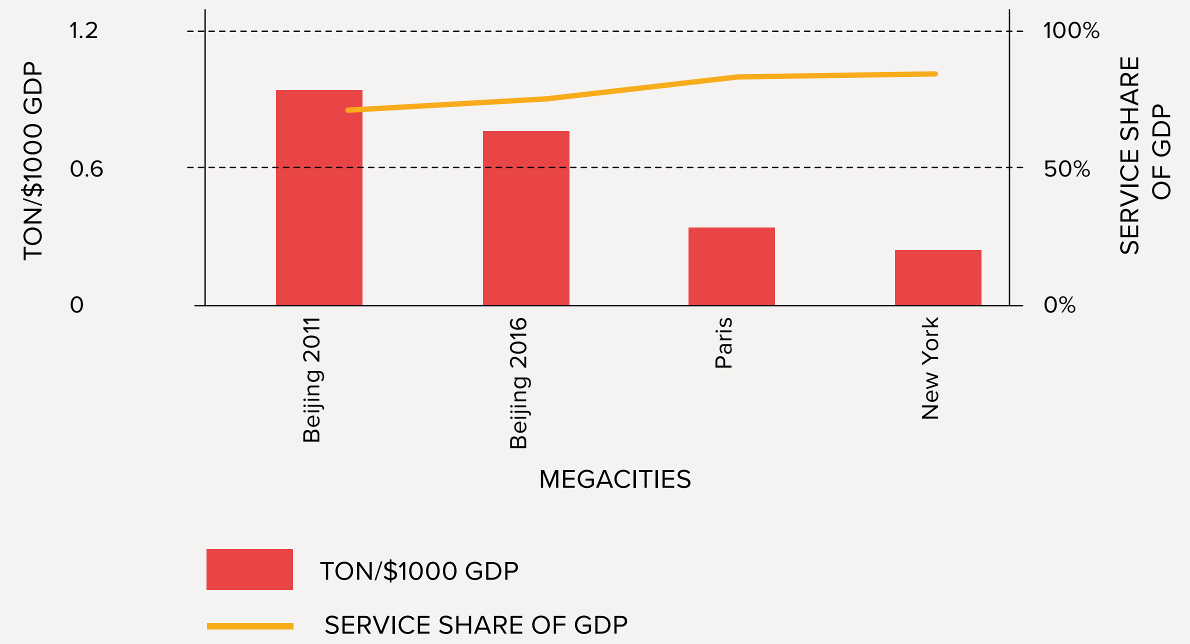


Figure 3: Tons of freight/$1000 GDP in global megacities. Service-based economies generate less freight per unit of GDP

» Pathways to improvement

To the extent possible, urban freight should consist of products consumed by urban residents, rather than inputs for industrial or manufacturing processes. Therefore, the primary pathway to improving freight intensity of GDP is to create policy, which encourages urban GDP to consist of economic activities that directly serve the needs of urban consumers. However, the composition of GDP is only partly in control of policymakers. Many other elements such as land prices, infrastructure layout, access to suppliers, etc. all affect where businesses choose to locate.

Furthermore, at certain stages of urban development, freight intensive activities such as fixed asset formation, infrastructure build-out and building stock creation are unavoidable. Therefore, policymakers must view reduction of freight demand as a long-term endeavor, which requires holistic planning well beyond transportation authorities and also is subject to the city's need to invest in fixed assets such as building stock and infrastructure.

2.2 Through-freight share of total demand

Through freight movement in a city

» Description

Goods moving through a city or metropolitan area, which are neither produced nor consumed in the area, are referred to as through-freight. Through-freight generates truck traffic and associated costs in metropolitan areas without bringing in significant economic benefit. It is typically the product of national transportation network planning, over which municipal policymakers have little control. Furthermore, if municipal policies disrupt national logistics activities, it can be detrimental to the economy as a whole.

In cities that have ports and other logistics network nodes, which concentrate national or global freight flows in a single metropolitan area, through-freight can become a major issue for policymakers to manage. For example in Chicago, which is a major hub in American freight rail networks, through-freight accounts for approximately 32% of the tonnage moved by trucks in the metropolitan area[2] and 49% of the tonnage moved by rail.[3] Similarly in Los Angeles County, truck trips to and from the Los Angeles

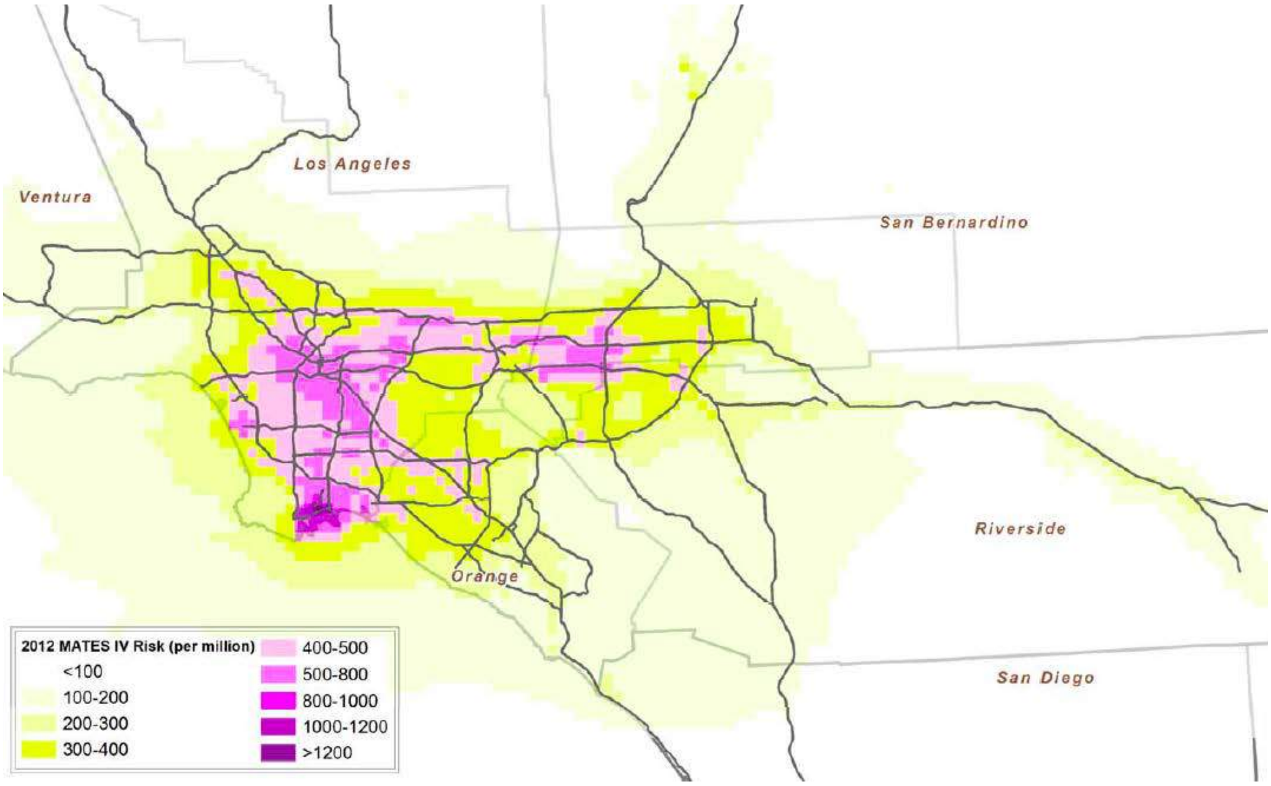


Figure 4: Cancer risks along the 710 freeway in L.A., due to air pollution
Source: South Coast Air Quality Management District Draft Multiple Air Toxics Exposure Study IV (October 2014)

Long Beach port complexes generate nearly 8% of total truck trips in the county.[4] Furthermore, because these trips are carried out by heavy-truck concentrated routes, they tend to produce high external costs. For example, in LA, the corridor that serves the ports is known as the 'diesel death zone' due to the markedly higher cancer risks experienced by residents living along the corridor.

» Pathways to improvement

Infrastructure such as ring roads or bypasses, can route through-freight around cities rather than through it. When a trade node that is not easily relocated such as a port is in a city, policymakers can build infrastructure such as portside rail, which reduces truck travel generated by through-freight. City policymakers can collaborate with national-level policymakers on infrastructure creation to reduce the burden, which through-freight puts on cities, without undermining national logistics systems.

2.3 Truck loading capacity

DELIVERY VEHICLES WEIGHT RATING (IN GVWR)

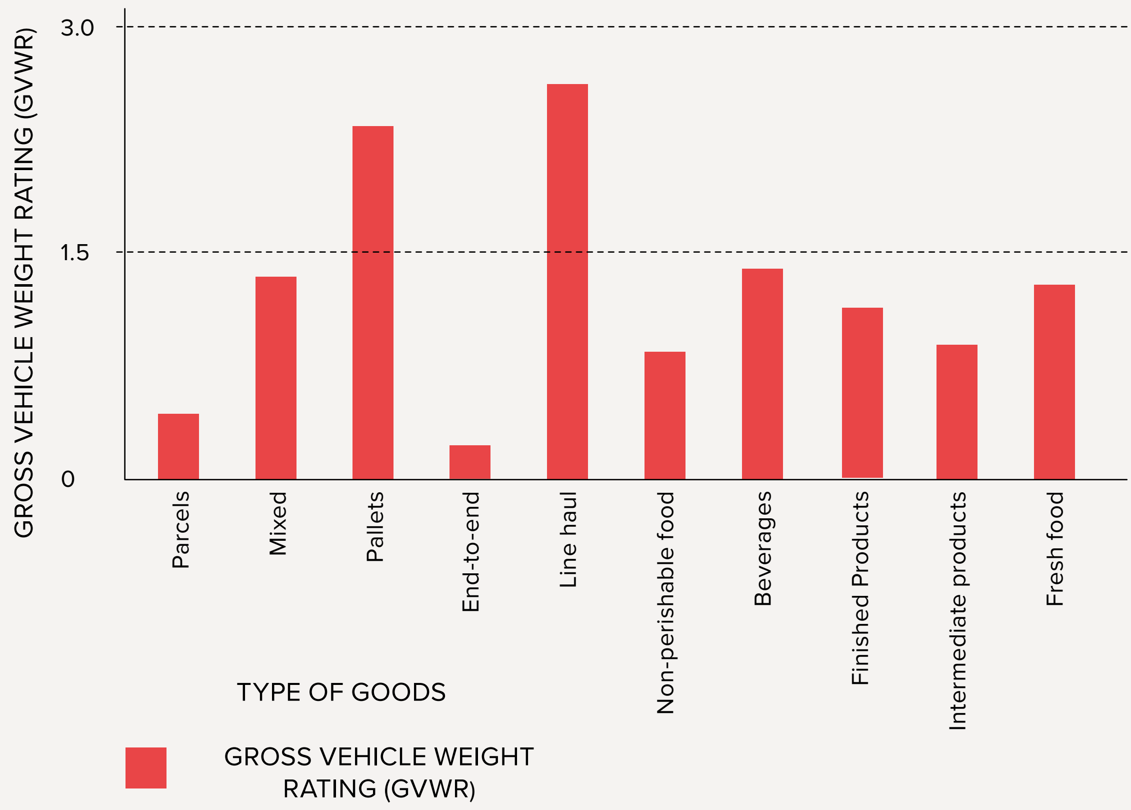
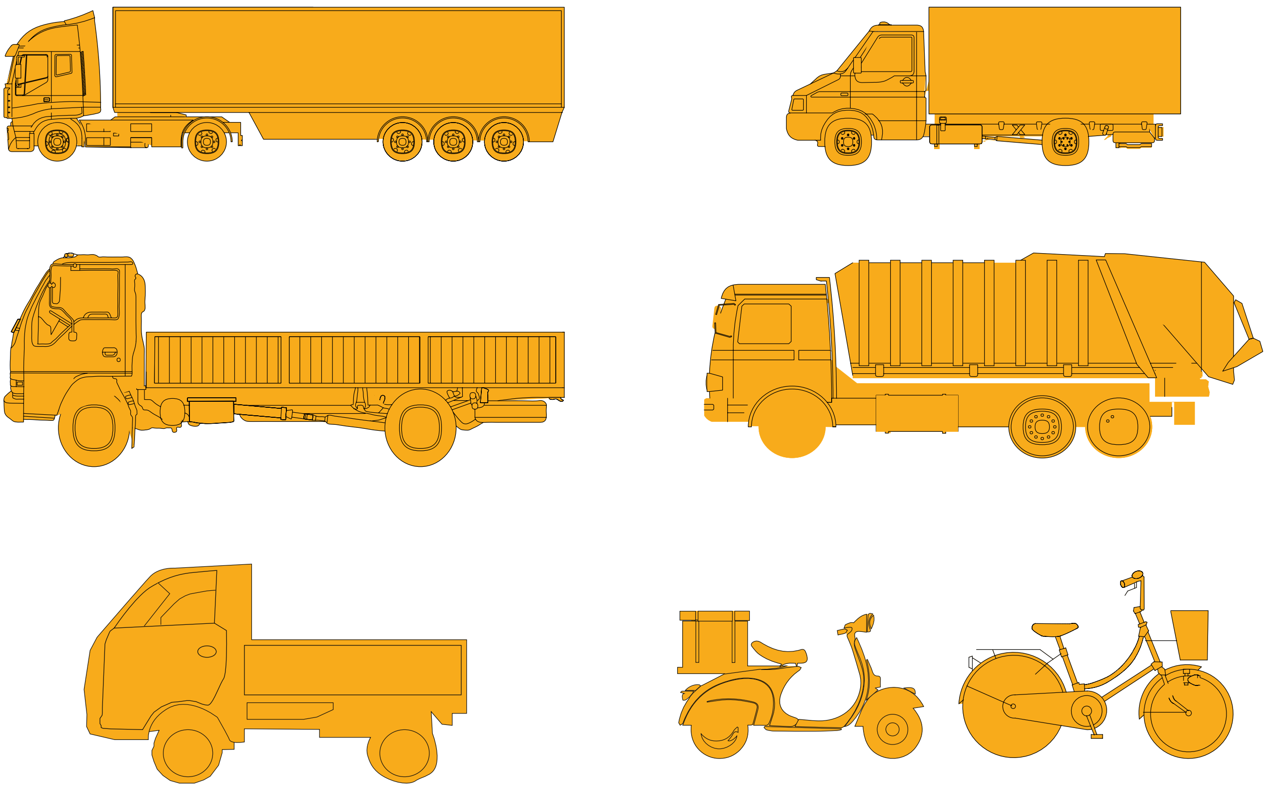


Figure 5: Gross vehicle weight rating (GVWR) of Delivery Vehicles in Paris[5]

» Description

The right size of delivery vehicles is a thorny question with multiple factors influencing the decision. Broadly speaking, however, truck size influences the overall urban logistics efficiency in two ways, trip generation and creation of external costs. If a truck is too small to carry a load, it may be split into multiple loads and create extra trips, arguing for larger delivery trucks. However, larger trucks are often much more disruptive to urban quality of life on a per-kilometer basis than smaller vehicles. The goal of truck size regulation should be to minimize the overall systemic cost, looking at both trip generation and unit costs, direct and external, per kilometer of vehicle travel.



Types and sizes of vehicles that carry urban freight

» Pathways to improvement

There is no one-size-fits-all answer for what the right-sized vehicle is and how it should be regulated. Such decisions must be made with a view towards the requirements of logistics system users and also the capability of infrastructure to handle different types of vehicle traffic. That entails both improving infrastructure to allow heavy vehicles where appropriate and banning them where they are inappropriate. Designing a flexible system, which allows heavy truck travel in suitable corridors but restricts it in sensitive areas and at sensitive times, can help cities achieve efficient use of all types of vehicles. As infrastructural capabilities on key corridors improve, policymakers can continuously evaluate regulations on vehicle size, how the trade-off between trip generation and external cost creation is playing out and can adjust the policy accordingly.

2.4 Net load factor

» Description	Net load factor is the average share of vehicle loading capacity that is productively used. That encompasses two factors: the share of rated loading capacity, which is used when a vehicle is loaded and the share of driving, which a vehicle does when it is not loaded. Vehicles that run empty or partially loaded generate extra travel and associated costs, without generating commensurate economic value. Operators typically will seek to maximize net load factors in order to maximize operating margins and the role of policymakers in improving this metric is secondary. The relevance of the metric to policymakers is to evaluate whether infrastructural and regulatory factors are imposing constraints on operators that increase total systemic costs or whether operators are achieving high net load factor at the cost of society, for example through overloading. In either case, policymakers can adjust regulation and enforcement practices to maximize efficiency.

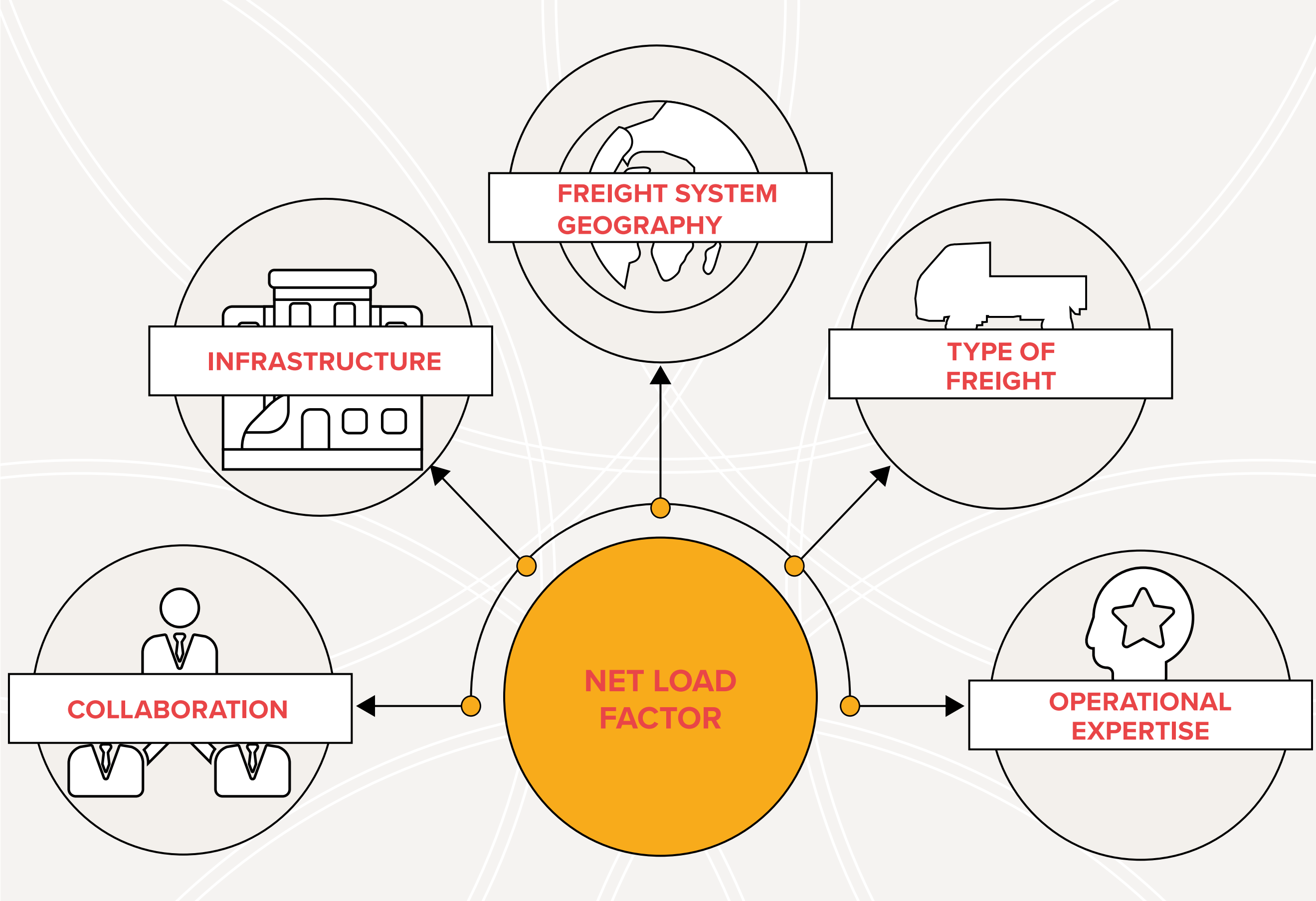


Figure 6: Factors that affect net load factor

» Pathways to improvement

Why vehicles are underloaded or why they run empty are complex questions, which are influenced by diverse factors such as freight type, freight system geography, infrastructure, operational expertise and the willingness to collaborate with competitors. Broadly speaking, policymakers should consult with industry players to identify factors that are decreasing load factors in a way that creates a net value loss to the city. Many times, resolving those issues will enhance the revenue and profitability of industry players. In other cases, where excessive travel due to low load factors is imposing unacceptably high costs on society, policymakers can also consider mandating measures such as required consolidation to improve load factors.

2.5 Delivery productivity

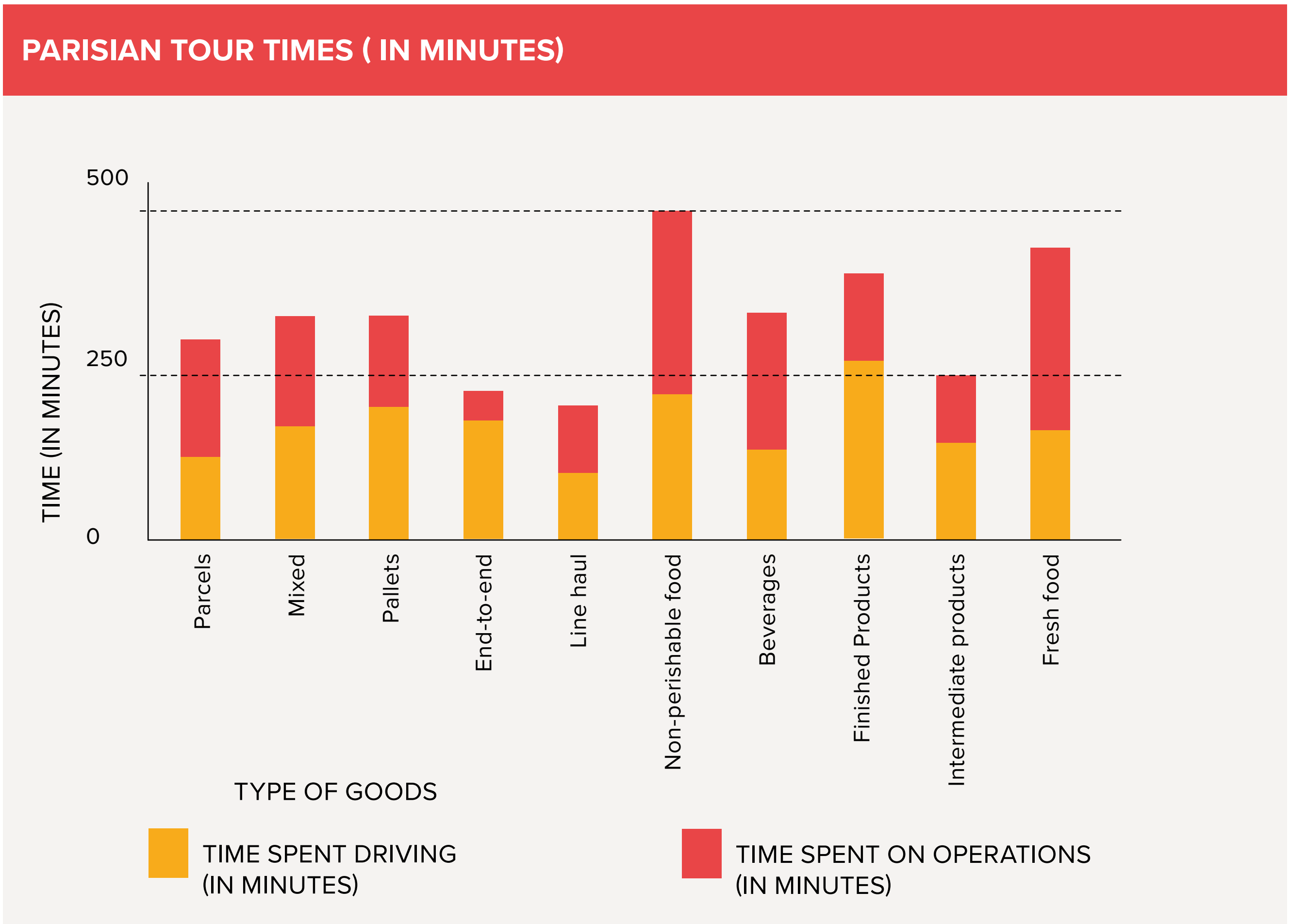


Figure 7: Parisian Tour Times and Their Composition (minutes)[6]

» Description

Delivery productivity measures how many deliveries a vehicle can accomplish in a day. It is closely related to load factor and in that it seeks to shed light on how the efficiency of vehicle use influences trip generation. Delivery vehicles typically only load as much freight as they can deliver on a single day. The time that delivery vehicles spend driving to and from the distribution center to the first delivery point, the time they spend on each delivery and the time they spend driving between deliveries, all influence how many deliveries they can make in a given day. In many cases, greater delivery productivity could lead to larger loads and fewer trips reducing overall urban driving.

Figure 8: Loading and unloading of trucks

» Pathways to improvement

As with other metrics that primarily measure operational efficiency such as net load factor, policymakers can consult with the industry to identify policy or infrastructural causes of low-delivery productivity and work to resolve them. Common causes of lowered productivity include congestion on freight routes, lack of access to convenient parking for delivery trucks and long or circuitous travel distances between stops.

For this reason, poor delivery productivity can often be addressed by a portfolio of measures that also influence other metrics in the KPI system such as congestion, routing efficiency, logistics sprawl, etc.

2.6 Logistics sprawl

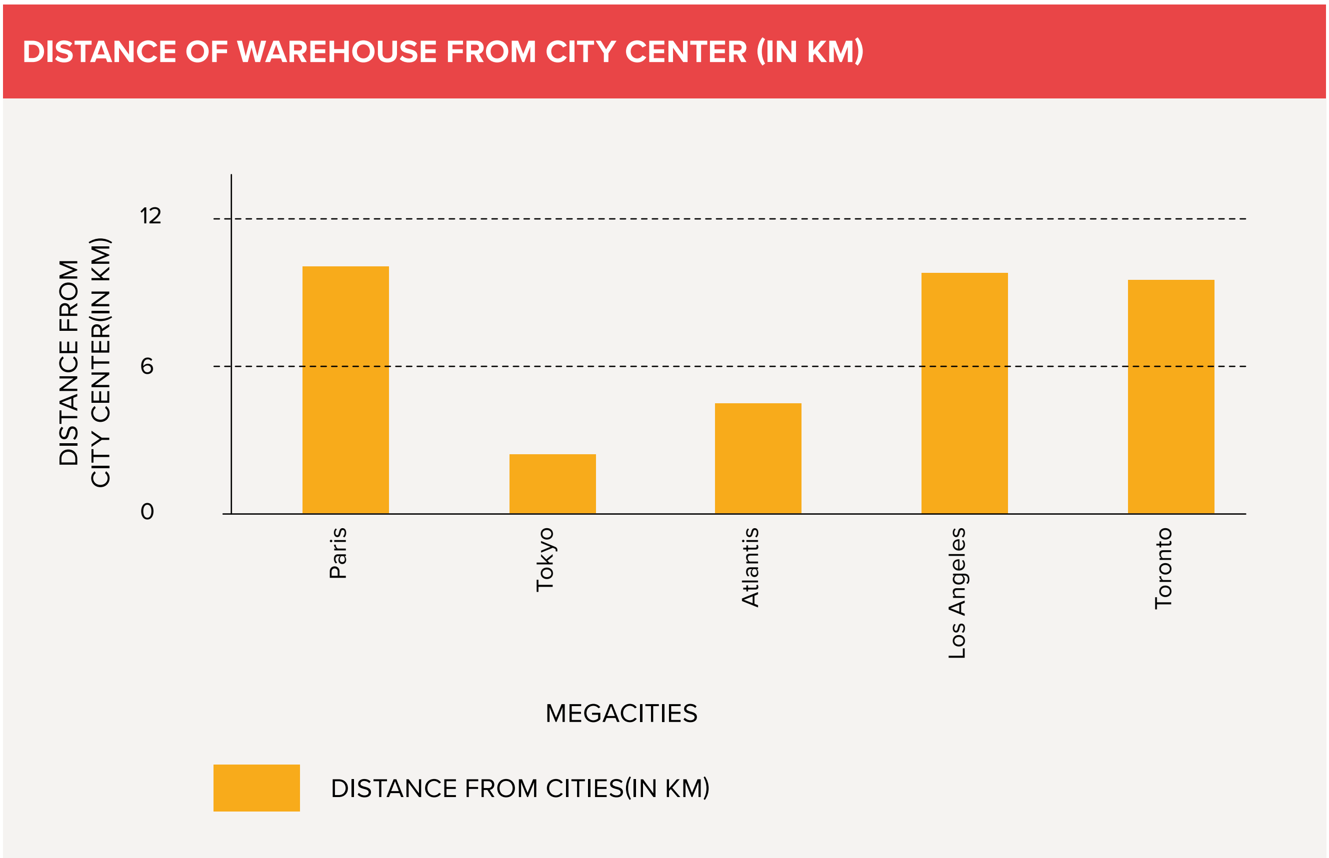
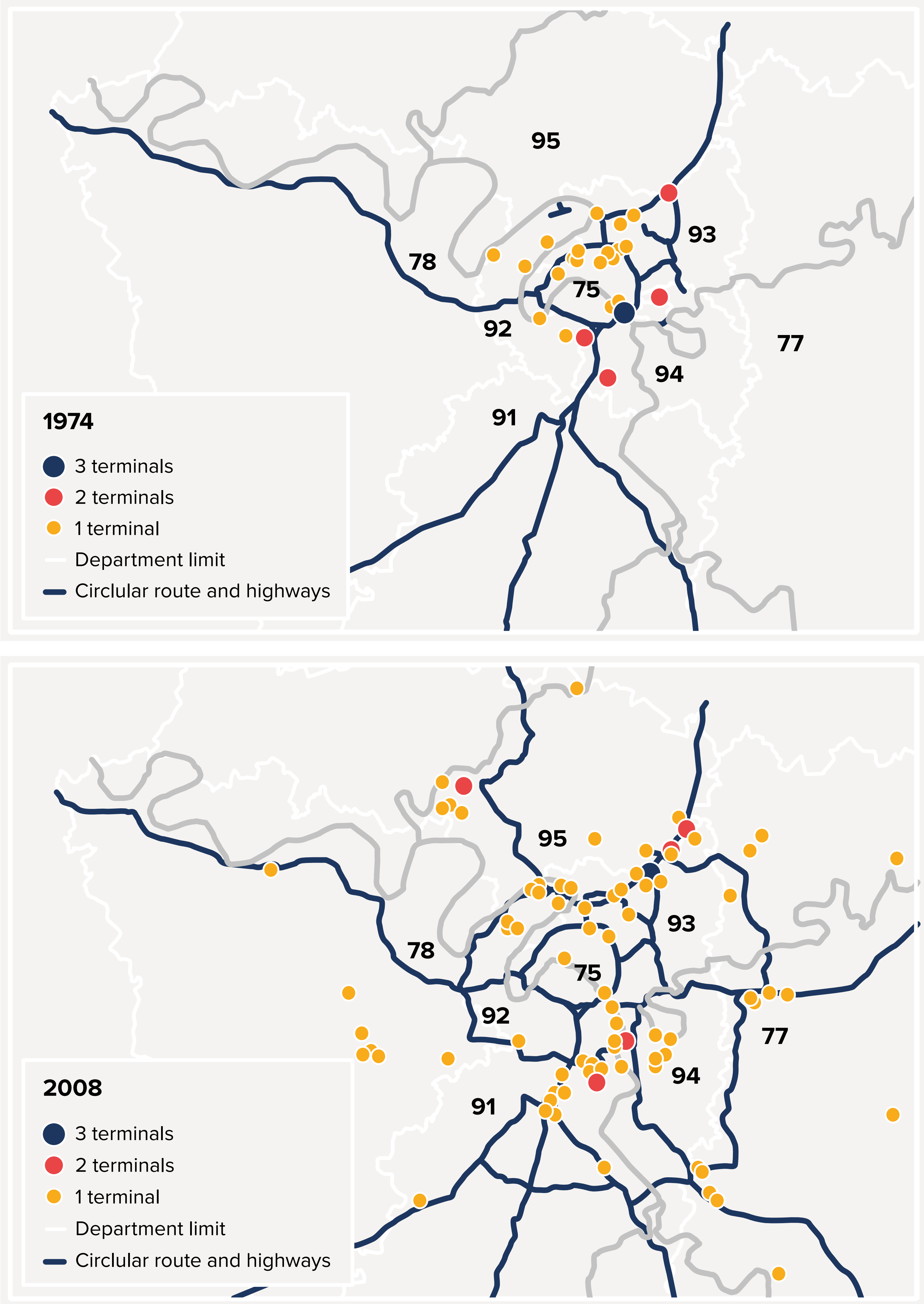


Figure 9: Average change warehouse distance from city center (kilometers) in select global cities

» Description

Logistics sprawl is the propensity for the distribution centers, which serve urban freight demand to move progressively further from the city center. The immediate effect of logistics sprawl is that each trip from a distribution center grows longer, increasing vehicle kilometers required to meet freight demand. Two main causes of logistics sprawl exist – increasing land prices in urban cores, which price out logistics uses and the changing land-use regulations, which zone out logistics facilities. In some cases, when logistics establishments generate large volumes of heavy truck travel, their exit from the urban core may be a net positive. However, for goods consumed in the city such as food and consumer goods, if logistics sprawl increases total vehicle travel and forces the use of larger delivery vehicles, it is typically a net negative.



Figures 10 & 11: Logistics Sprawl in Parisian Parcel Distribution Centers in 1974 and 2008[8]

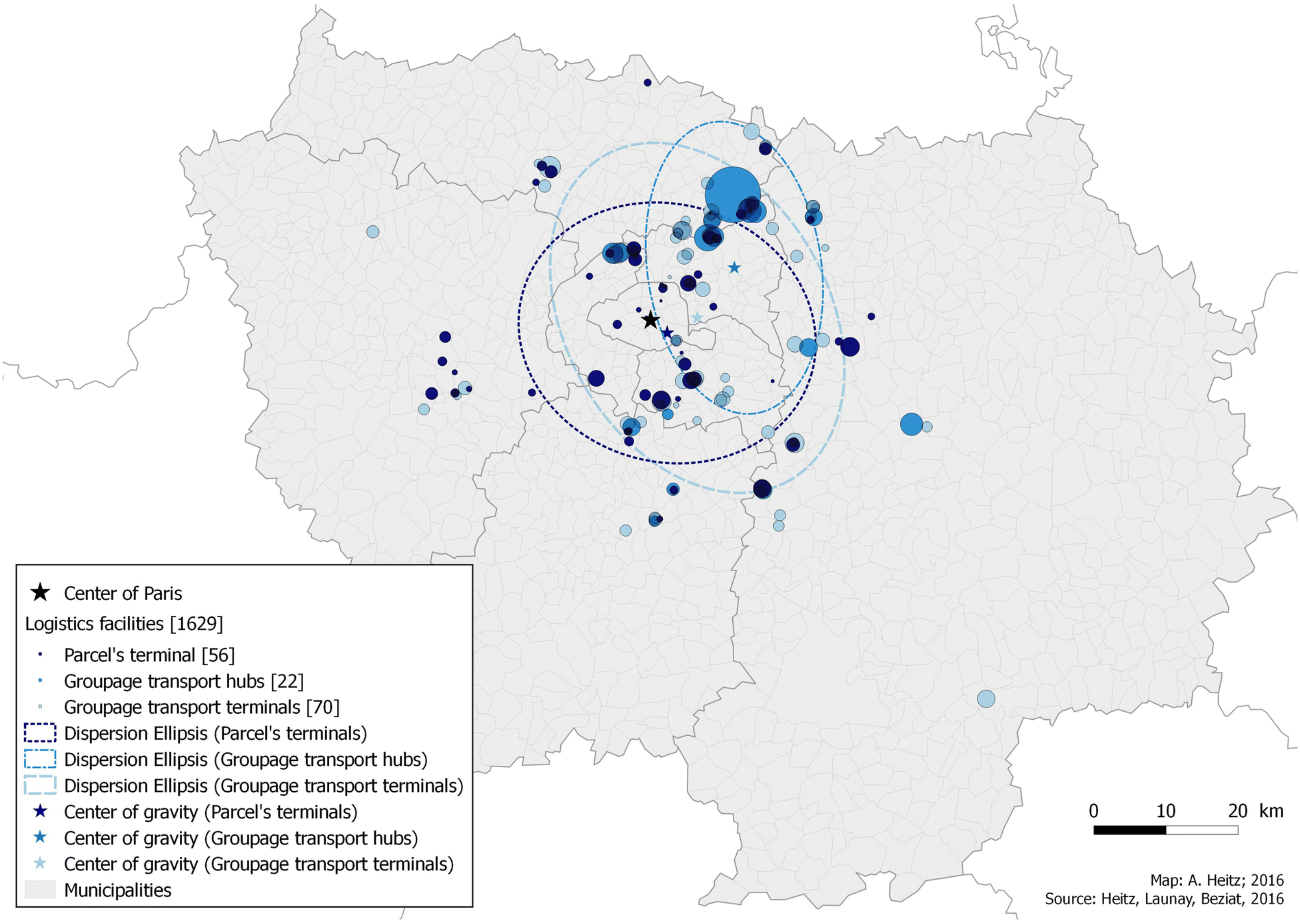
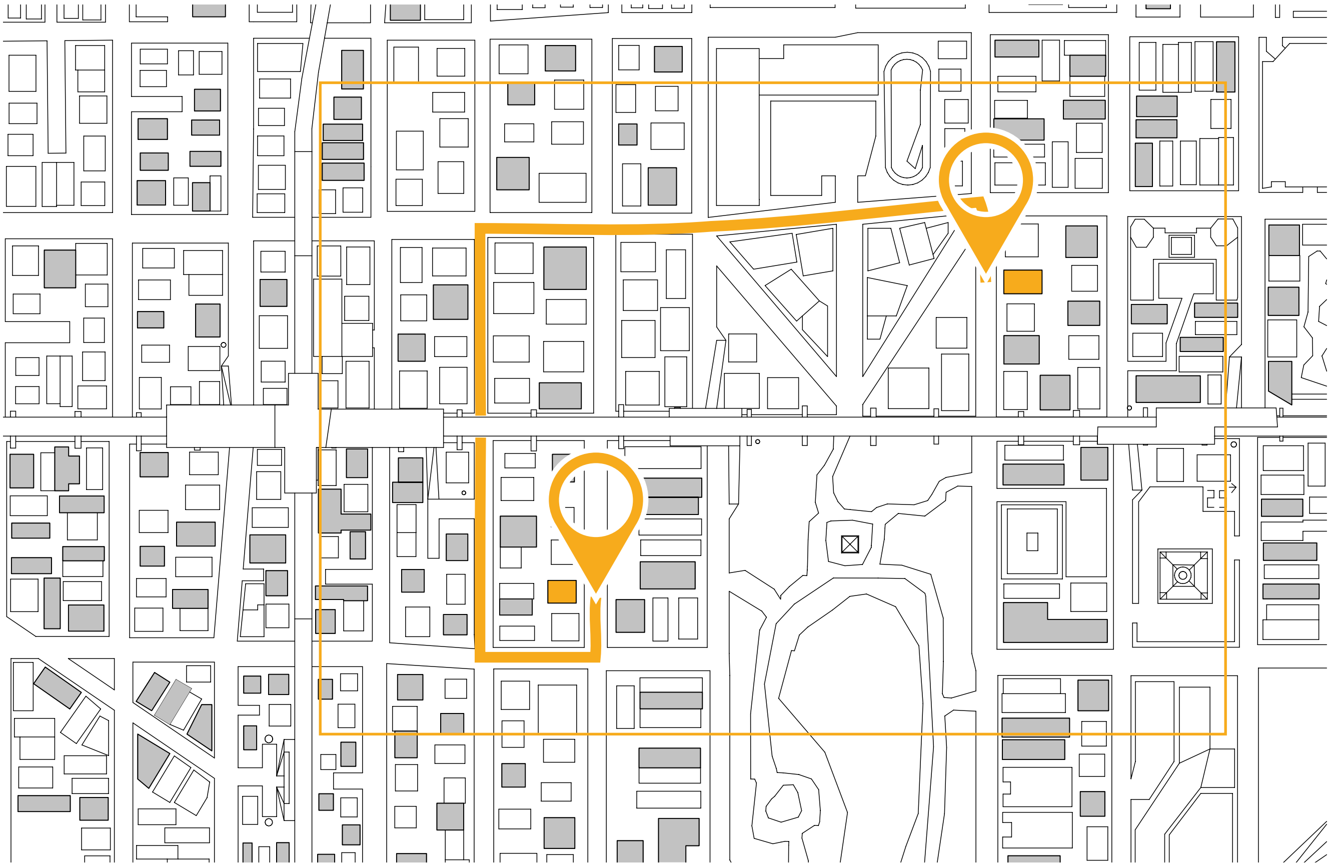


Figure 12: Spatial distribution of groupage network of hubs and terminals
Source: Heitz, Adeline, Pierre Launay, and Adrien Beziat. "Heterogeneity of logistics facilities: an issue for a better understanding and planning of the location of logistics facilities." European Transport Research Review 11.1 (2019): 5.

» Pathways to improvement

The primary pathway to combat logistics sprawl is to identify sectors of urban delivery, which serve the demand of urban consumers such as inventory restocks to shops and restaurants or e-commerce deliveries and actively seek to keep warehousing infrastructure serving that demand in the urban core. Measures may include preferred pricing of brownfield land for logistics development or modifications to planning and zoning laws that encourage logistics use of suitable land in the urban core.

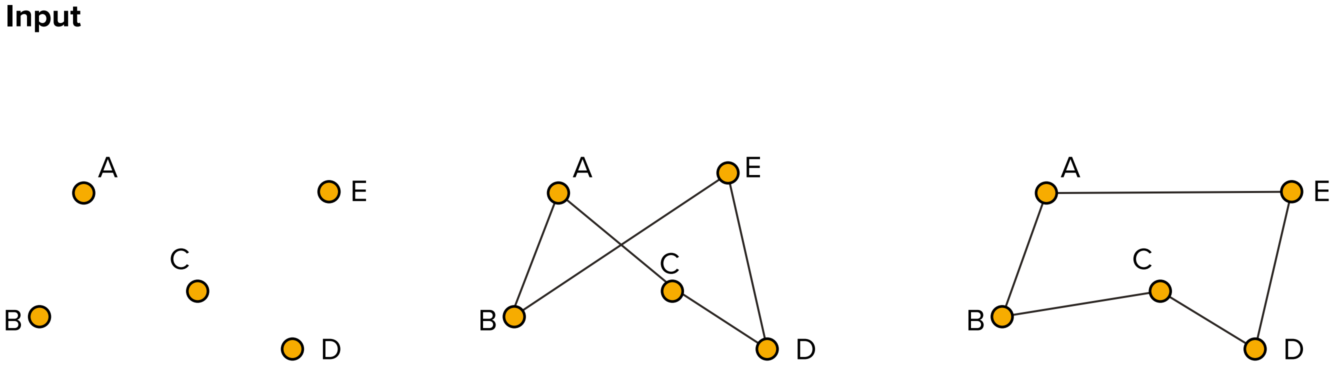
2.7 Routing efficiency



Efficient deliveries minimizing vehicle travel

» Description

Routing efficiency is closely related to delivery productivity and focuses specifically on one aspect of delivery productivity— how efficiently operators string together various stops on a delivery tour and therefore their ability to minimize vehicle travel while making deliveries. While arriving at the optimal sequence of deliveries to minimize total driving is a private sector concern, policy decisions can constrain the solution space. For that reason, policymakers should seek to understand how elements of infrastructure, urban planning and vehicle access policy all influence the ability of private sectors to optimize their activities.



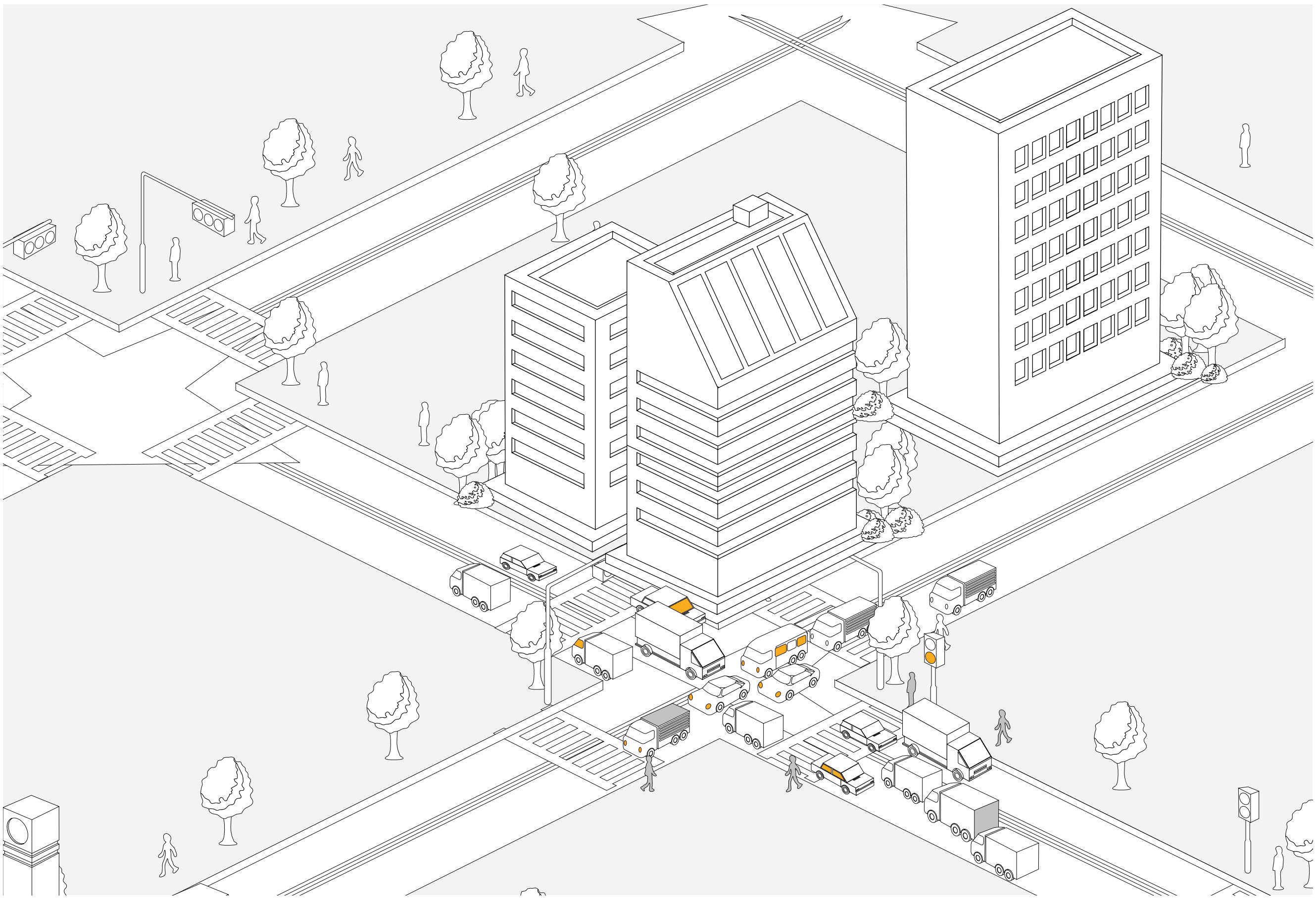
A sub-optimal tour

The optimal tour

Figure 13: Optimal and sub-optimal routes on delivery tours.

» Pathways to improvement

For policymakers, the goal for routing efficiency is to create a system that enables maximum routing efficiency for logistics operators without compromising on the quality of life for urban residents. To that end, policymakers can examine infrastructure or policies, which force operators to choose suboptimal routes. As with vehicle size, however, policymakers must keep an eye on minimizing total systemic cost, not merely maximizing metric performance. Other circumstances where policymakers can positively influence routing efficiency is when operators are lacking either the information or scale to route trucks efficiently themselves. In such cases, provision of information, for example through either intelligent transportation systems (ITS) or the provision of infrastructure such as consolidation centers, can enhance routing.



2.8 Travel time index on freight lanes

» Description

Logistics uses can cause congestion by illegal parking and by using vehicles that are poorly suited to urban roads. Both hurt traffic fluidity. However, delivery vehicles also suffer from congestion. The costs that congestion imposes on logistics operators, which typically are directly passed on to consumers, are often under appreciated. For example, in US cities, the cost of congestion per vehicle hour is estimated at $94.04, much higher than the $17.67 cost per vehicle hour for passenger vehicles[9]. For this reason, efficient urban logistics must focus not only on reducing congestion caused by logistics uses but also seek to mitigate the effects of congestion on delivery vehicles themselves.

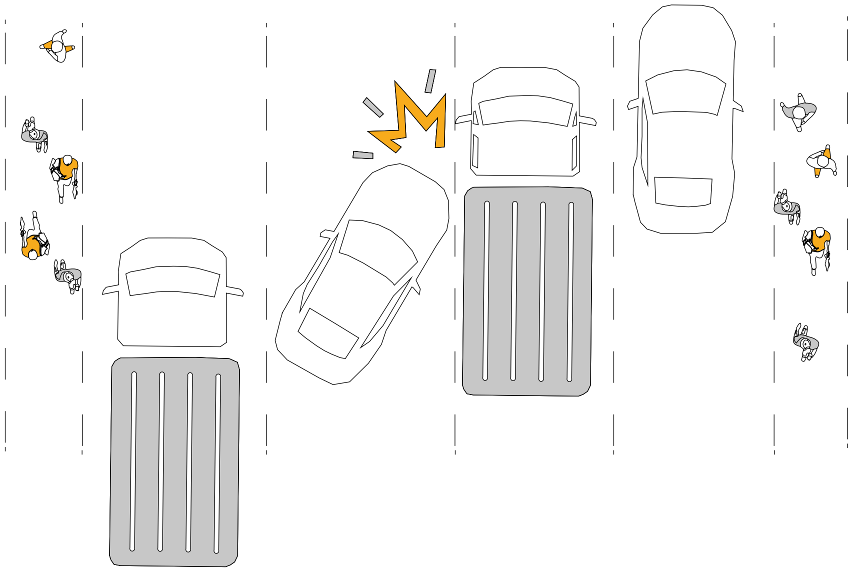
Intelligent transport systems

» Pathways to improvement

Restricting truck access to certain routes can ensure the smooth functioning of urban mobility systems. However, concentrating logistics uses onto certain corridors also increases the cost of congestion in those corridors. As policymakers reduce the flexibility of delivery vehicles to certain corridors, they must pay particular care to the performance of those corridors.

Policies such as congestion pricing and tolling, regular maintenance of road surfaces, ITS to provide real-time updates on corridor conditions, access restrictions for incompatible uses such as walking, cycling or other slow-moving vehicles and high priority resolution of traffic bottlenecks along freight corridors can all reduce congestion in key freight corridors.

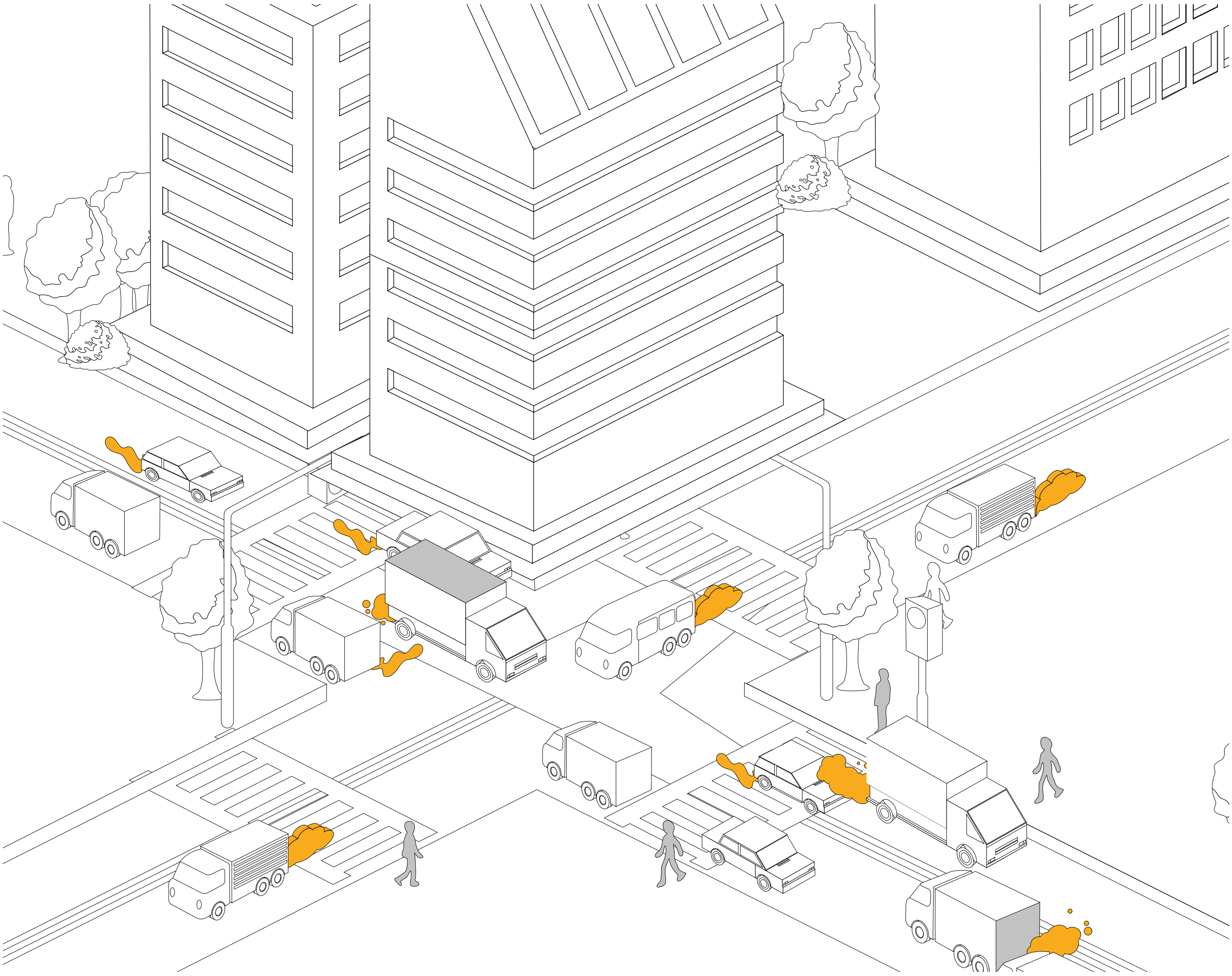
2.9 Truck-related casualties



Traffic injuries and fatalities

» Description	Logistics vehicles, in particular heavy trucks, are disproportionately responsible for traffic injuries and fatalities. This is especially true when they are mixed with non-motorized, two and three-wheeler traffic. Heavy vehicles with poor maneuverability, large blind spots and long braking distances tend to produce very destructive collisions.
» Pathways to improvement	In order to mitigate safety problems without undermining the efficient functioning of urban distribution systems, policymakers can develop truck routes, which concentrate truck travel onto suitable high capacity roads where conflicts with other types of vehicles are minimized. Policymakers can also enhance enforcement of illegal overloading and poorly maintained vehicles. Furthermore, regulations such as speed limits should be robustly enforced to protect vulnerable user groups where infrastructure must be shared. Similarly, system design decisions, for example signal timing or robust physical barriers separating vehicular traffic from non-vehicular traffic, can be adjusted to favor the safety of pedestrians.

2.10 Truck emissions



Tailpipe emissions from truck

» Description	Logistics vehicles, especially diesel trucks, account for a disproportionately large amount of transport emissions, both air pollutants and greenhouse gases. These pollutants reduce livability of cities and take years off the lives of their inhabitants.
» Pathways to improvement	Policymakers can restrict access to cities for trucks that do not comply with the required emissions criteria. In the most ambitious cases, policymakers can require zero emissions logistics vehicles such as electric ones for all urban deliveries.

2.11 Unit costs

» Description

Unit costs are the direct costs incurred by delivery vehicles per kilometer that they drive. Unit costs typically consist of fixed and variable costs. Fixed costs do not vary with vehicle use. They are composed of vehicle costs, financing costs, basedriver wages and items such as insurance and registration fees. Variable costs on the other hand, vary linearly with vehicle use and consist of fuel, maintenance, tires and any variable driver wages. Cost reduction is at the core of competitiveness and therefore is mostly a commercial matter.

» Unusually low-unit costs can be an indicator that operators are externalizing costs onto urban residents such as through overloading, the use of low-quality fuel or the use of obsolete or non-compliant trucks. «

However, the metric is of interest for policymakers for two reasons:

01 Policymakers should always evaluate the effect policy changes will have on operator costs because urban logistics costs are typically entirely passed on to the consumer; increased costs to logistics players represent a direct burden to the urban economy and that impact should be understood.

02 Policymakers should be on the lookout for unusually low-unit costs; it can be an indicator that operators are externalizing costs onto urban residents such as through overloading, the use of low-quality fuel or the use of obsolete/ non-compliant trucks.

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EFFICIENT URBAN FREIGHT

PART 4: BEST PRACTICES

Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते
Ministry of Housing and Urban Affairs
Government of India

ROCKY MOUNTAIN INSTITUTE

Section outline

1.0 Introduction

A logistics performance measurement system is only useful to the extent that it can position policymakers to take action to improve the efficiency of the logistics system. To that end, we share here a non-exhaustive list of actions, which policymakers can take to improve performance on key KPIs along with a set of case studies to illustrate the actions. While best practices are categorized according to the metric that they most strongly influence, it is important to note that most will influence more than one KPI. For example, measures to mitigate congestion are likely to influence delivery productivity, measures to influence net load factor may have knock-on effects on vehicle size and measures to influence truck safety may have knock-on effects on routing efficiency. These effects on secondary metrics may be positive. For example, congestion resolution can enhance delivery productivity. However, they may also have negative effects. For example, truck routes to reduce use conflicts and enhance safety can reduce routing efficiency or low-emission zones to decrease external costs may increase direct costs for logistics operators. For that reason, policymakers must evaluate any solution holistically and in consultation with logistics system users in order to gain an in-depth understanding of the costs and benefits of any given solution. The following table summarizes the case studies discussed in this section.

KEY PERFORMANCE METRICS	BEST PRACTICES	CASE STUDY	LINK(S) FOR INFORMATION
Freight intensity of GDP	Industrial planning	Puget Sound region in U.S.A. has created a metropolitan land-use plan called Vision 2040, which allocates land for manufacturing and industrial uses, without negatively impacting outdoor recreation activities and knowledge-based economic activities for Seattle. Delhi Development Authority has developed Delhi Master Plan, Vision 2021, which divides the urban region and periphery into residential, commercial, industrial areas.	https://www.psrc.org/vision-2040-documents https://dda.org.in/planning/mpd-2021.htm
Through freight share of total freight tons	Bypasses and ring roads — Modal shift of port truck traffic	Bypasses and ring roads on the periphery of Mumbai and Delhi have routed through traffic, typically heavy trucks, around the city and reduced congestion at the urban core. California, CalTrans, had identified a need to bypass a severe truck bottleneck in their interstate system. — Alameda Corridor, a high capacity below-grade rail line, has eliminated around 12 million truck trips of through freight per year. Port of Rotterdam handles approximately 8.2 million containers per year.	http://www.caltrans.ca.gov/ — http://www.acta.org/ https://www.portofrotterdam.com/en

Truck loading capacity	Selective relaxation of weight limits	Barcelona, Spain worked with grocery store chains to allow night-time deliveries by 40 ton trucks, which replaced 7 daytime trips by medium trucks.	http://www.sugarlogistics.eu/pliki/handbook.pdf
Net load factor	Reverse logistics	London Construction Consolidation Center serves as a consolidation point for inbound deliveries of construction materials to building sites and as a reverse logistics channel for waste materials, which increases operational efficiency and reduces empty running.	http://www.ndslogistik.se/files/reports/1425975813_9.pdf
	—	—	—
	Density in logistics development and logistics parks	Paris regional master plan has sites selected for development of dense industrial and logistics use and areas targeted for deployment of multimodal freight transport infrastructure.	https://www.iledefrance.fr/environnement-territoires/construire-l-ile-de-france-de-2030
		AllianceTexas in Dallas/Fort Worth demonstrates how logistics parks can create logistics density which enables efficient trucking in metropolitan areas and low-cost intermodal transport of goods nationally.	https://www.alliancetexas.com
	—	—	—
	Urban consolidation centers and collaborative warehousing and distribution	Freiburg, Germany has government subsidized warehouses near the urban core that serve as consolidation points for inbound shipments.	
		KANE, a North American third party logistics services provider, has a program collaborative warehousing and distribution program, which consolidates goods from various suppliers to retail stores and builds full truckload shipments, rather than using partially loaded trucks or expensive LTL services.	https://www.kaneisable.com/
Delivery productivity	Parking and unloading infrastructure	Barcelona, Spain has building codes for commercial establishments to mandate the provision of off-street loading and unloading space for urban deliveries.	http://www.sugarlogistics.eu/pliki/handbook.pdf
		Barcelona has multi-use lanes dedicated to passenger or bus traffic during peak commuting hours and freight loading and unloading during non-peak hours.	http://www.sugarlogistics.eu/pliki/handbook.pdf
	—	—	—
	Night-time deliveries	New York City has adopted night-time delivery scheme that incentivizes receivers to accept night delivery from carriers.	http://www.nyc.gov/html/dot/downloads/pdf/ssi10-offhour.pdf
	—	—	—
	Parcel delivery terminals for reduced discretization of delivery points	Berlin, Germany, has bento boxes, where trucks swap boxes in off-peak hours and electric bikes make final deliveries during the day.	https://www.bentobox-berlin.de/citylog-projekt/
		In Turin, Italy, package recipients pick up the packages directly from the parcel delivery terminal.	http://www.transport-research.info/sites/default/files/project/documents/20130813_150820_65836_CITYLOG_D0.4_Final_report_Public_version.pdf
		In India, Smartbox operates automated parcel delivery terminals.	https://smartbox.in/

Logistics sprawl	Urban logistics spaces and logistics hotels	Paris has dedicated urban spaces, usually former underground parking garages between 100 and 250 square meters, as well as large spaces (~45,000 square meters) to logistics users to use as a link in urban supply chains.	http://www.best-fact.net/wp-content/-uploads/2016/01/CL-1_135_QuickInfo-Bea-ugrenelle-16Dec2015.pdf
Routing efficiency	ITS for real-time route optimization	Detroit, U.S.A., uses Intelligent Transportation Systems (ITS) for visibility around real-time congestion and route optimization.	https://ieeexplore.ie-ee.org/docu-ment/1438386
		Seattle's 10-year plan for ITS deployment prioritizes high-volume arterials roads, designates freight routes and routes with capacity to handle emergency diversions.	https://www.seattle.-gov/Documents/De-partments/SDOT/Tec-hnologyProgram/ITSStratgicPlan2010 2020.pdf
	—	—	—
	Truck routes	New York City has adopted night-time delivery scheme that incentivizes receivers to accept night delivery from carriers.	http://www.nyc.gov-/html/dot/down-loads/pdf/exec-sum.pdf
Truck-related casualties	Hierarchical road networks	In India, four broad categories exist in road hierarchies- arterials, sub-arterials, collectors and local/access roads.	http://www.indiaenvi-ronmentportal.org.in/-files/file/Ur-ban%20Road%20Code%20of%20Practice.pdf
	—	—	—
	Identifying truck collision hotspots	As part of the Vision Zero plan for Seattle, which seeks to end fatalities and serious injuries on urban streets by 2030, all truck-related accidents in the city were mapped and 'hotspots' were identified where truck incidents were clustered.	https://www.seat-tle.gov/visionzero
Truck emissions	Low-emission zones	In Greater London, LEZs cover a 600 square mile area and the entry is conditional on whether the vehicle is in compliance with predetermined levels of the Euro truck standard system.	https://tfl.gov.uk/-modes/driv-ing/low-emission-zone
	—	—	—
	Relaxation of access restrictions for zero-emission vehicles	In Shenzhen, China, most of the urban roads are open to electric urban delivery trucks 24 hours a day while daytime entry bans and road restrictions still apply to diesel trucks.	http://www.nyc.gov-/html/dot/down-loads/pdf/execsum.pdf
		Delhi's draft EV policy outlines a set of 'e-Carrier incentives' for the first 5000 electric three wheeler goods carriers to be registered in the state, which includes exemption from road tax, registration fees and one-time parking fee as well as permission for plying and idle parking of light goods vehicles.	http://transport.del-hi.gov.in/sites/default/-files/All-PD-F/Electric%20Policy%2002018.pdf

2.0 Freight intensity of GDP

2.1 Industrial planning

» Description	Urban policymakers are often faced with a desire to maintain industrial facilities in a metropolitan area due to the large quantity of high quality jobs that such facilities create. But they also have an awareness of significant external costs, including heavy truck traffic, which such facilities generate. In order to maintain the benefits of industry without suffering excessively from the external costs that it may generate, long-term land-use planning at a metropolitan level is needed.

» Case study	In order to maintain industrial vitality without negatively impacting both outdoor recreation activities and knowledge-based economic activities, the Seattle metro region created a long-term metropolitan land-use plan called Vision 2040. A key element of Vision 2040 plan was to designate regional manufacturing and industrial centers (MICs, green dots on map) on lands planned specifically for industrial and manufacturing uses and protected from the land designated as natural resource land.

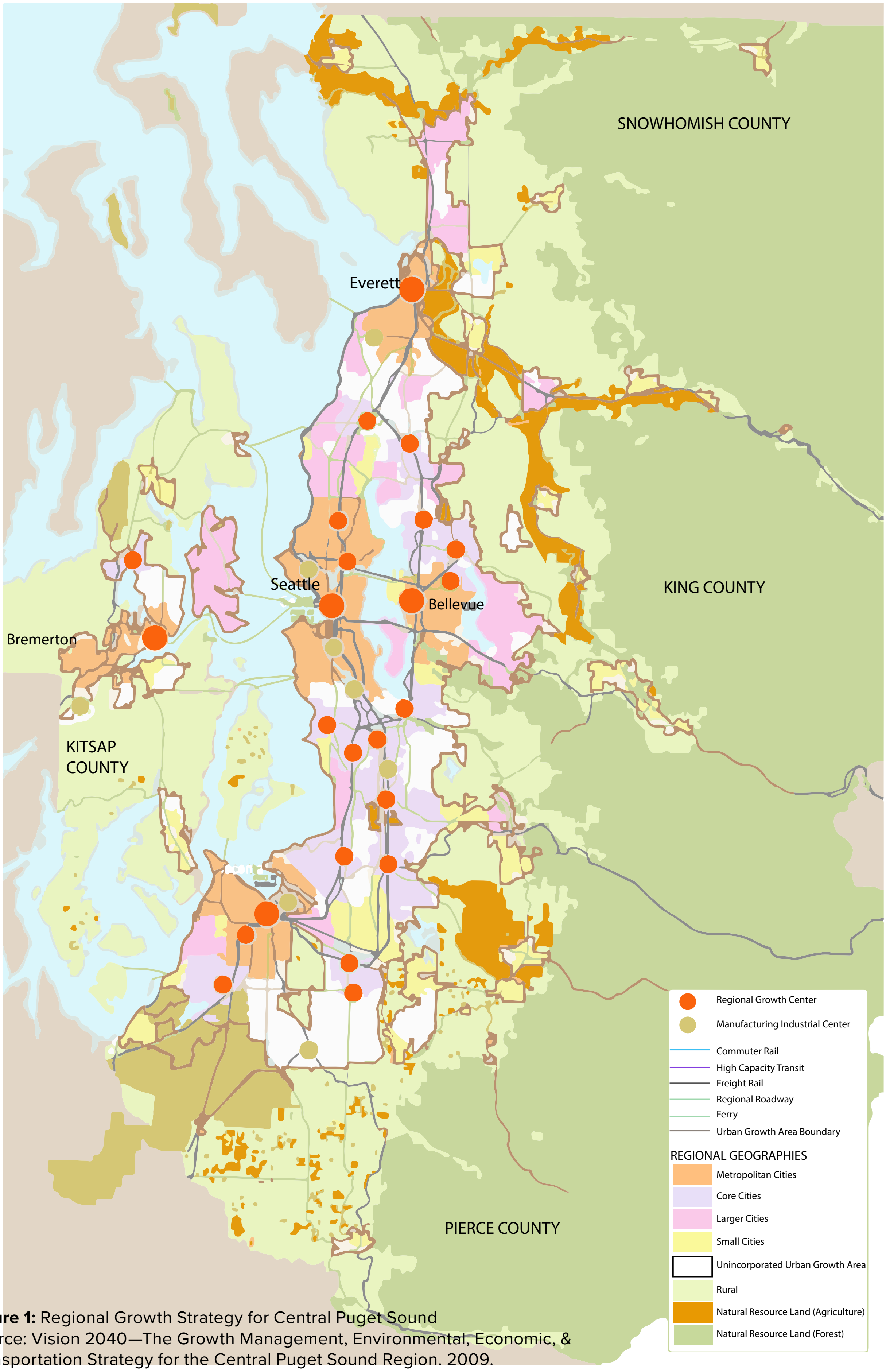


Figure 1: Regional Growth Strategy for Central Puget Sound
Source: Vision 2040—The Growth Management, Environmental, Economic, & Transportation Strategy for the Central Puget Sound Region. 2009.

MICs are outside of dense commercial and residential areas and have access to transportation facilities and services such as major highways, freight and commuter rail lines and ports. This allows the metro area to maintain the jobs and incomes provided by industrial employers. It also keeps the freight that those installations generate off urban roads and on infrastructure that is capable of handling high volumes of heave truck traffic.[1]

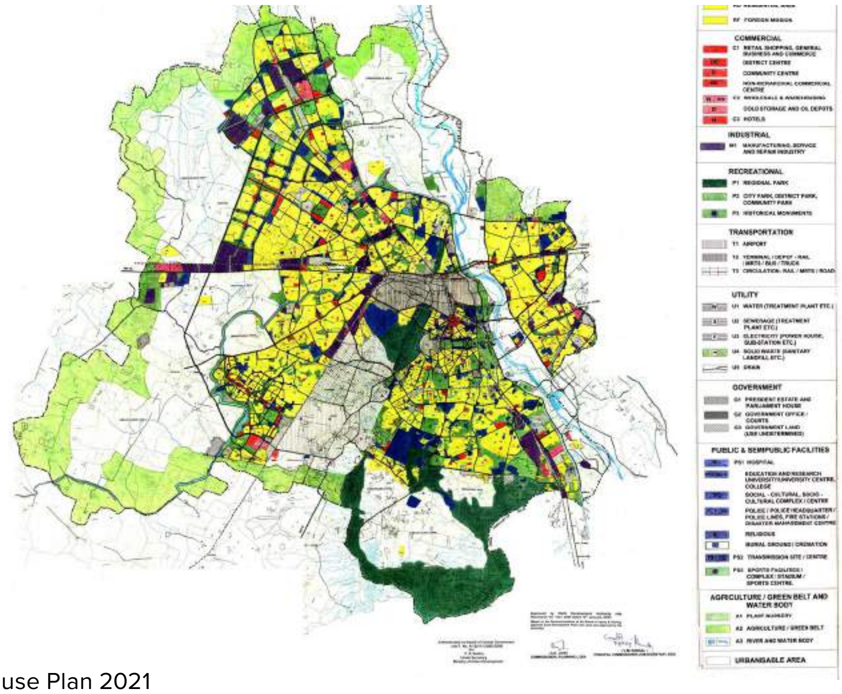


Figure 2: Delhi Landuse Plan 2021
Source: Delhi Development Authority

» Case study

In India, the Delhi Development Authority (DDA) has developed the Delhi Master Plan, Vision 2021 with the goal of making “Delhi a global metropolis and a world class city”.[2] This plan focuses on 16 different sectors, including land-use policy, transportation, industrial areas, urban design and physical infrastructure. The plan divides the urban region and periphery into residential, commercial and industrial zones, as well as government land, etc. The zoning restrictions ensure that industrial areas are not near residential areas in order to manage traffic in the city and reduce negative health impacts due to industrial pollution.

3.0 Through-freight share of total freight tons

3.1 Bypasses and ring roads

» Description	Ring roads and bypasses are a common demand management tool used in cities globally. Their application in urban logistics is to route heavy trucks around the city and also provide efficient access to the urban core for the final-mile delivery, which minimizes travel needed on lower capacity streets.

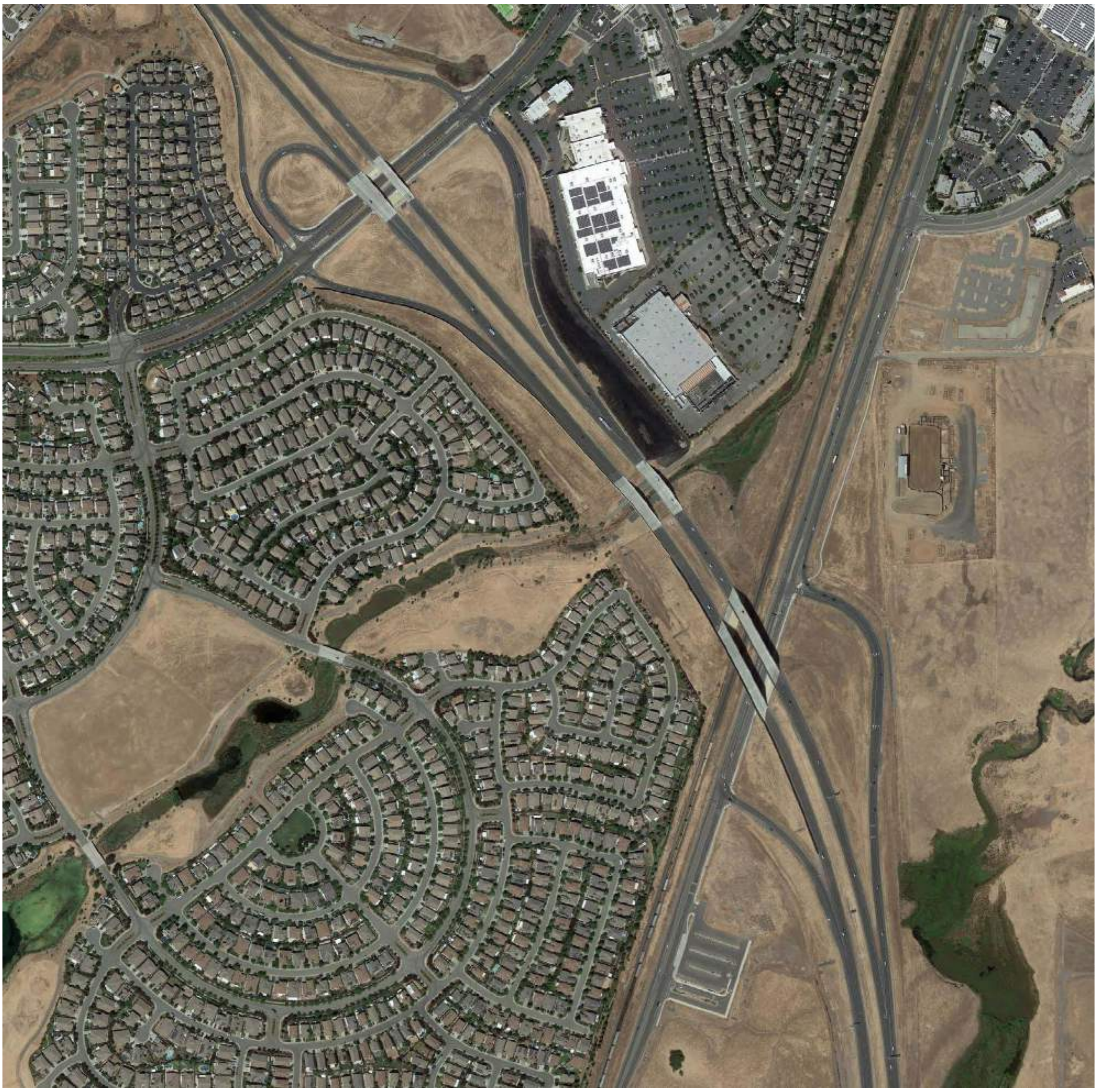


Figure 3: Lincoln Bypass
Source: Google Earth Image - 17/08/2018

Bypasses are also desirable for logistics efficiency outside of the urban sphere. The increased travel time that trucks incur while waiting to be allowed into the city both increases their costs and increases order lead times. Creating infrastructure to route those trucks around the city, can reduce long-haul trucking costs and product lead times.

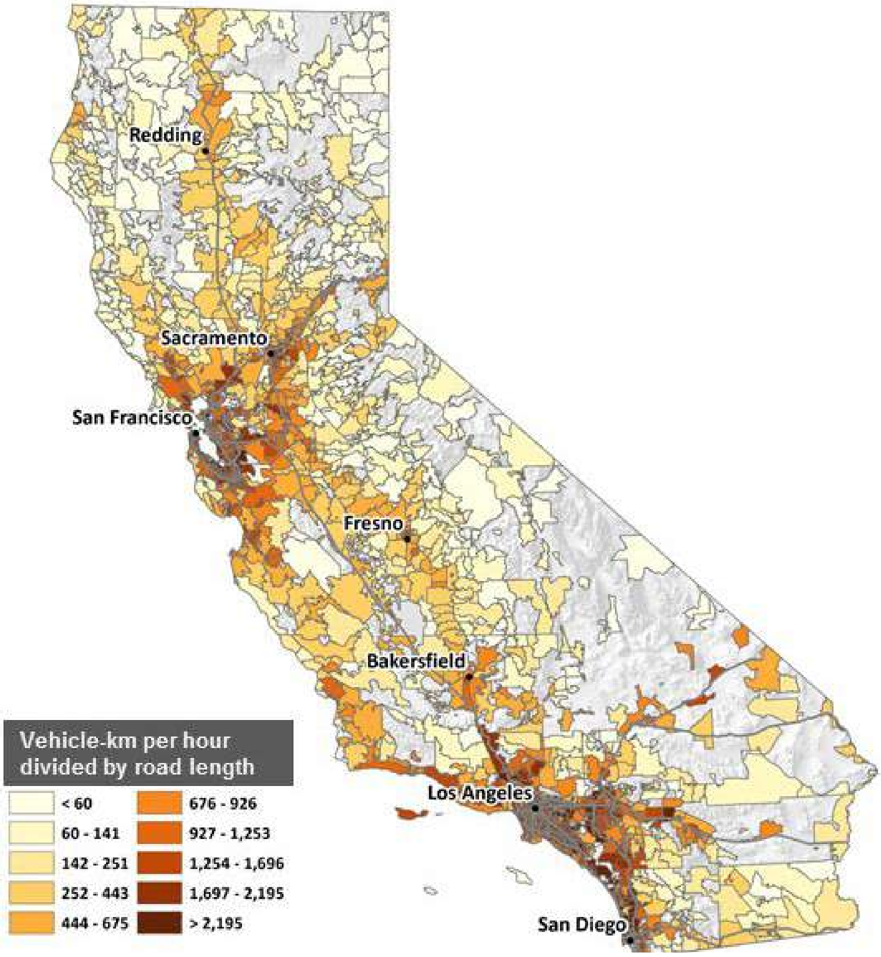


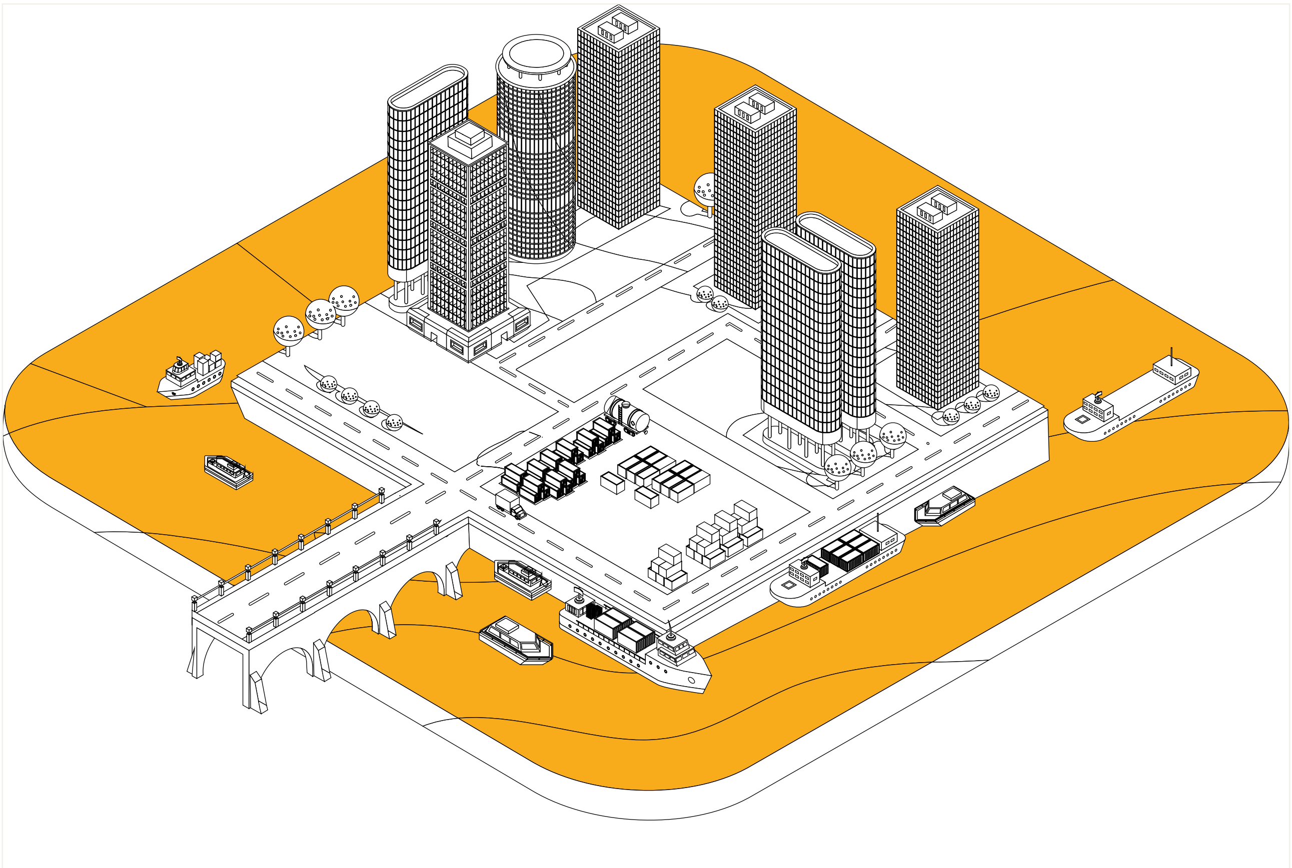
Figure 4: State of California: Traffic Density by Zip Code
Source: California Environmental Health Tracking Program and the Office of Environmental Health Hazard Assessment

» Case study

For example, in California, CalTrans, identified a need to bypass a severe truck bottleneck in their interstate system. Time savings and operational cost reductions for trucks were estimated to provide an over 8% return on the investment in the bypass. Additionally, four other key benefits were observed but not included in the ROI calculations:

1) Congestion relief and safety enhancement by segregating slow-moving truck traffic,
2) Improved goods movement in the San Francisco Bay Area and California Central Valleys,
3) Reduced use conflicts
4) Chokepoint resolution and improved reliability of goods movement[4]

3.2 Modal shift for port truck traffic



» Description

For port cities, especially those with container ports, trucks hauling cargo from the port to national highway networks can be a major driver of trip generation. Because neither the port and nor the city can be relocated, the only viable situation in these circumstances is to create an infrastructure to facilitate a switch to alternative modes, typically either water or rail.

Figure 5: Alameda Corridor
Source: Alameda Corridor Transportation Authority (retrieved from JOC.com)

» Case study

The ports of LA and Long Beach handle approximately 20% of shipping containers entering the US. Those trade flows create enormous amounts of through-freight in the city of Los Angeles, leading to severe congestion issues and very high rates of air pollution along the corridor, where those trucks ply. Prior to 2002, the only rail lines serving the port were four low-speed, at-grade branch lines, with approximately 200-level crossings in LA, limiting rail capacity and creating enormous congestion problems as urban traffic had to stop to allow slow freight trains to pass. To resolve those problems, a high capacity below-grade rail line, known as the Alameda Corridor, was created to replace the four aging branch lines. The line has the capacity for 150 trains daily, up from 32 on the old lines and each train eliminates 250 to 280 truck trips daily good for a maximum of 12 million truck trips eliminated per year.

Figure 6: Port of Rotterdam
Source: Port of Rotterdam Authority

» Case study

When geography is favourable, similar opportunities can exist to eliminate truck trips by shifting containerized freight from trucks onto inland waterways. For example, the port of Rotterdam is the largest container port in Europe, handling approximately 8.2 million containers per year. However, because of an extensive network of inland container ports, nearly 40% of those containers make their onward journeys to the destinations in Rotterdam's hinterland by river, greatly reducing truck traffic in the Netherland's second largest city.

4.0 Truck loading capacity

4.1 Selective relaxation of weight limits

Figure 7: Benefits of night - time deliveries in Barcelona, Spain
Source: Mercadona environmental policy, 2010

» Description

Inventory restocks for many urban stores are commonly carried out using light-duty vehicles due to urban entry regulations. These regulations are in place to reduce congestion, air pollution and other external costs. However, they also create unnecessary trips. Allowing heavy trucks to enter the city while carefully minimizing external costs that they create, can reduce overall truck travel and logistics costs.

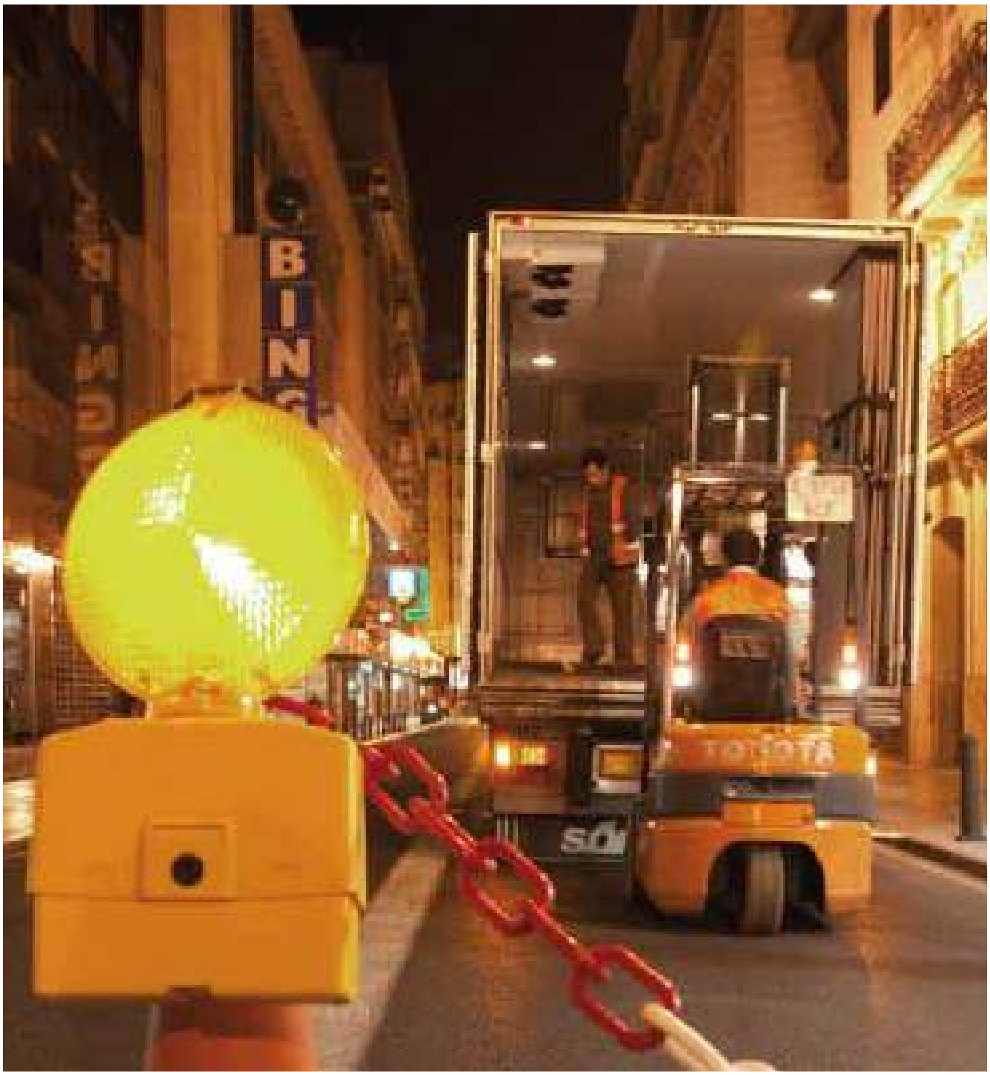


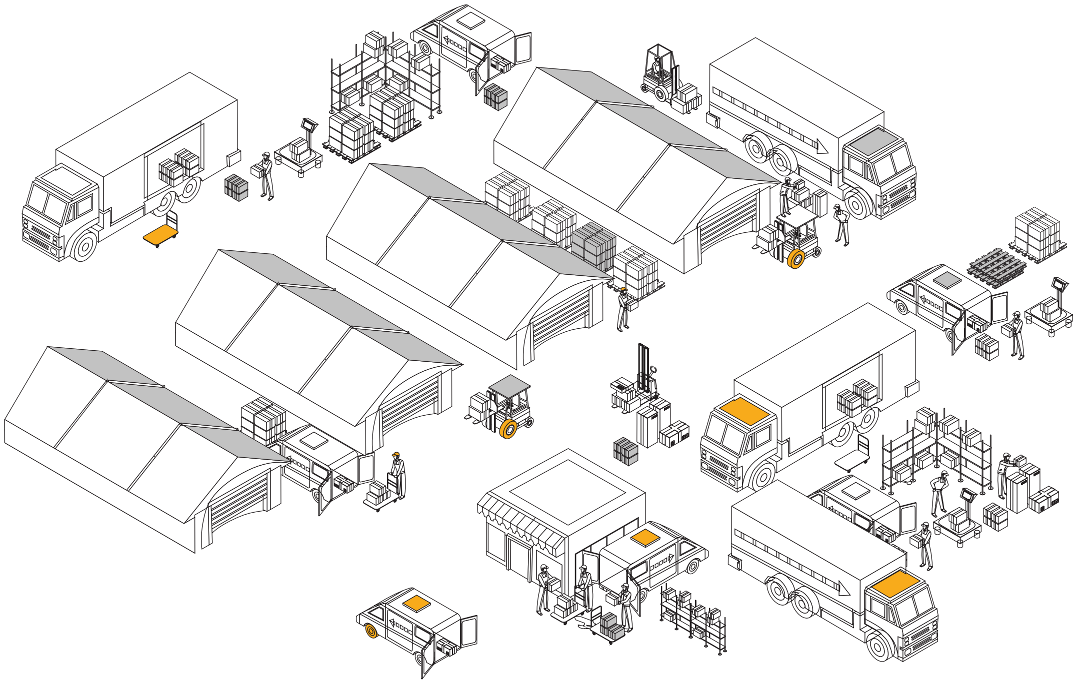
Figure 8: Night- time delivery in Barcelona City
Source: Mercadona Environmental Policy 2010

» Case study

Barcelona, Spain worked with several major grocery store chains to allow night-time deliveries by 40 ton trucks, especially modified to reduce noise pollution displacing daytime deliveries by smaller trucks and vans. The strategy reduced delivery costs, enabling a one and a half to three years payback period for the modified heavy truck and replaced seven daytime trips by medium trucks with a single night-time truck removing logistics vehicles from the road during peak congestion times. Noise levels were monitored during a pilot phase and were found to not be significantly different from ambient levels, protecting quality of life for residents near the markets served by the trucks.[5]

5.0 Net load factor

5.1 Density in logistics development and logistics parks



Logistics Park

» Description

While profit motives lead commercial operators to optimize the way they load and drive their vehicles, they can only do so within the overall geography of the freight system. Policymakers can support that commercial search for efficiency by optimizing the geography of the freight system itself. In a metropolitan area, density of freight generating facilities influences both empty running rates and load factors. Dutch research showed that co-located logistics firms in high-density areas are significantly more likely to use transport capacity of competitor firms and provide their own transport capacity to competitor firms than those in more dispersed locations.[6]

Furthermore, logistics firms that typically had less than truckload (LTL) shipments were more likely to co-locate in high-density areas than those with large TL loads, supporting the idea that logistics firms seek cost effective means to consolidate shipments. Logistics parks can achieve very high levels of logistics density by aggregating industrial and logistics activities into a single facility. This agglomeration can not only enhance load factors but can also enable multimodal transport, which requires large regular volumes of freight to be cost-effective.

» Freight or logistics parks can achieve very high levels of logistics density by aggregating industrial and logistics activities into a single facility. «

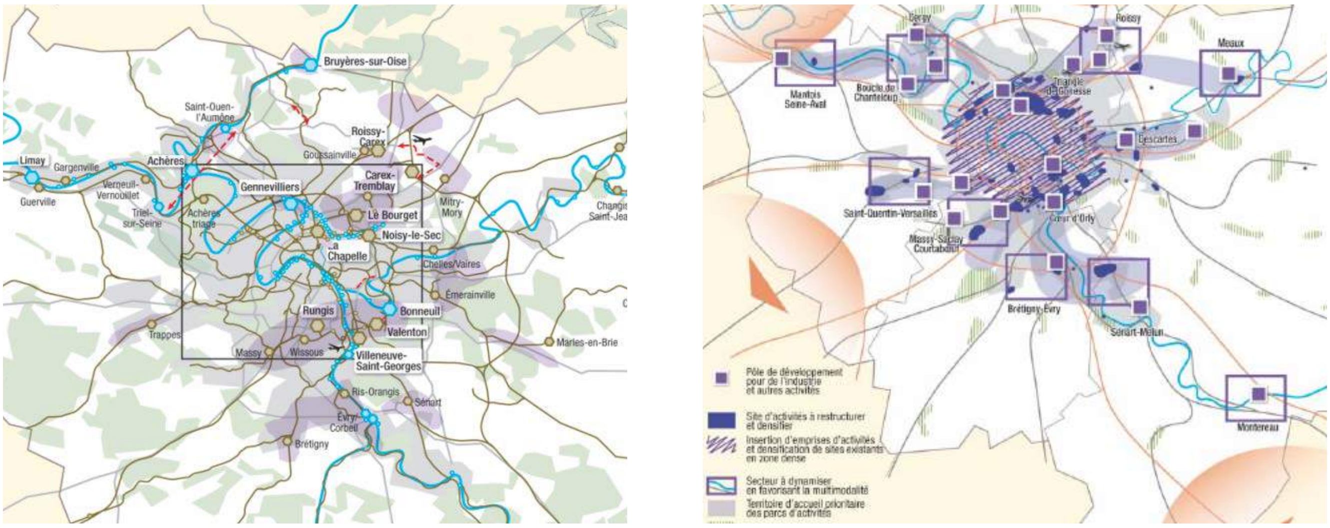


Figure 9: Paris industrial Master Plan
Source: Conseil régional d'Île-de-France. Île-de-France 2030 Defis, Projet Spatial Regional et Objectifs., 2013.

» Case study

While high-density logistics and industrial developments bring in many benefits, including transportation efficiency, the density is quite difficult to achieve. The main reason is that the economic activity of a large city typically extends well beyond the boundaries of the city into neighbouring towns and cities. For example, the greater Paris region covers over 1,300 municipalities. To achieve efficient planning for logistics in very large metro areas, policymakers from various municipal governments in the metro area as well as state-level policymakers must design frameworks and organizations to coordinate policy making. The Paris regional master plan attempted to do that. In that master plan, certain sites were selected for development of dense industrial (solid purple squares) and logistics use (purple shading) in areas targeted for deployment of multimodal freight transport infrastructure (purple rectangles). The aim to achieve high density in regional logistics and industrial development, along with efforts to ensure effective integration with multimodal infrastructure, has the potential to significantly enhance metropolitan logistics efficiency.[7]

SECTOR- WISE DISTRIBUTION OF TENANTS		SECTOR- WISE DISTRIBUTION OF TENANTS	
SECTOR	NO OF TENANTS	SECTOR	NO OF TENANTS
Distribution	26	Support	8
Retail	19	Manufacturing & distribution	4
Manufacturing	10	Transportation	4
Office	10	Sales	3

Table 2: Sector-wise distribution of tenants in AllianceTexas[8]

» Case study

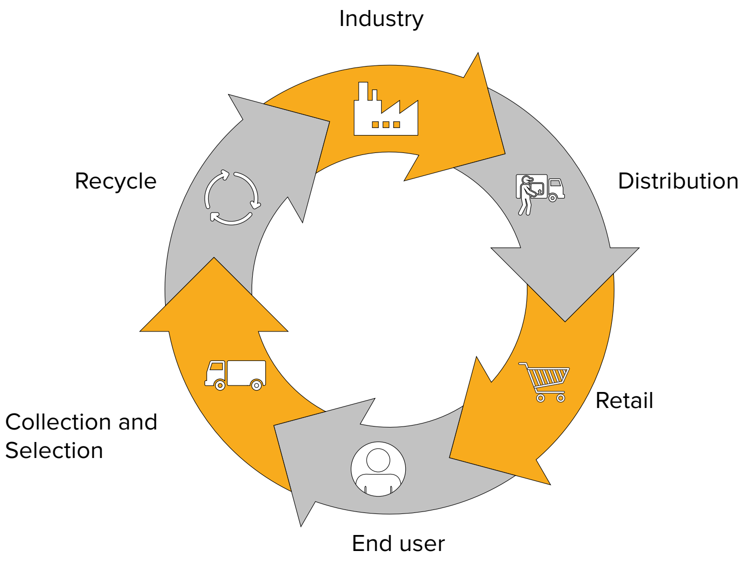
Alliance Texas is master-planned multi-modal logistics park in the Dallas/Fort Worth metro area. It was built as a public-private partnership that has grown to cover 26,000 acres and is now a critical hub in the United States' multimodal transportation network, integrating air, rail and highway transportation. As shown by its occupancy, Alliance Texas is a good example of how logistics parks can create the logistics density, which enables efficient trucking in metropolitan areas and low-cost intermodal transport of goods nationally.

Figure 10: Logistics infrastructure | Source: Construction week India

» Case study

In 2017, the Government of India approved an investment of INR 2 lakh crore to build 34 multimodal logistics parks across the country.[9] The largest logistics parks are likely to be located in Nagpur, Vijayawada, Bengaluru, Surat, Hyderabad, Chennai and Guwahati.[10] These logistics parks will be built as public-private partnerships and will also act as freight aggregators and distribution hubs for long-haul freight to and from major metropolitan areas. Many metro cities in India are also considering the expansion of existing truck terminals to reduce congestion in urban centers. For example, Wadala Truck Terminal currently being developed in Mumbai, is expected to reduce congestion in South Mumbai. The terminal is spread over 115 hectares and will have the capacity to hold 3000 trucks.[11] It will also have facilities like loading-unloading bays, parking infrastructure, transport offices and dormitories.

5.2 Reverse logistics



» Description

In urban delivery, integrating outbound freight such as product packaging or customer returns into inbound supply chains increases the operational efficiency that transporters can achieve and reduces empty running; this integration is known as reverse logistics.

Reverse logistics avoids generation of extra truck trips to serve freight demand going from the city back to distribution centers, warehouses and waste disposal facilities in the suburbs. Reverse logistics are already common in e-commerce, where products are estimated to be returned 30% of the time and are routinely integrated into home delivery activities.[13] However, outside of e-commerce and parcel delivery, reverse logistics is currently not a widely adopted practice.

» Integrating outbound freight such as product packaging or customer returns into inbound supply chains increases the operational efficiency that transporters can achieve and reduces empty running. «

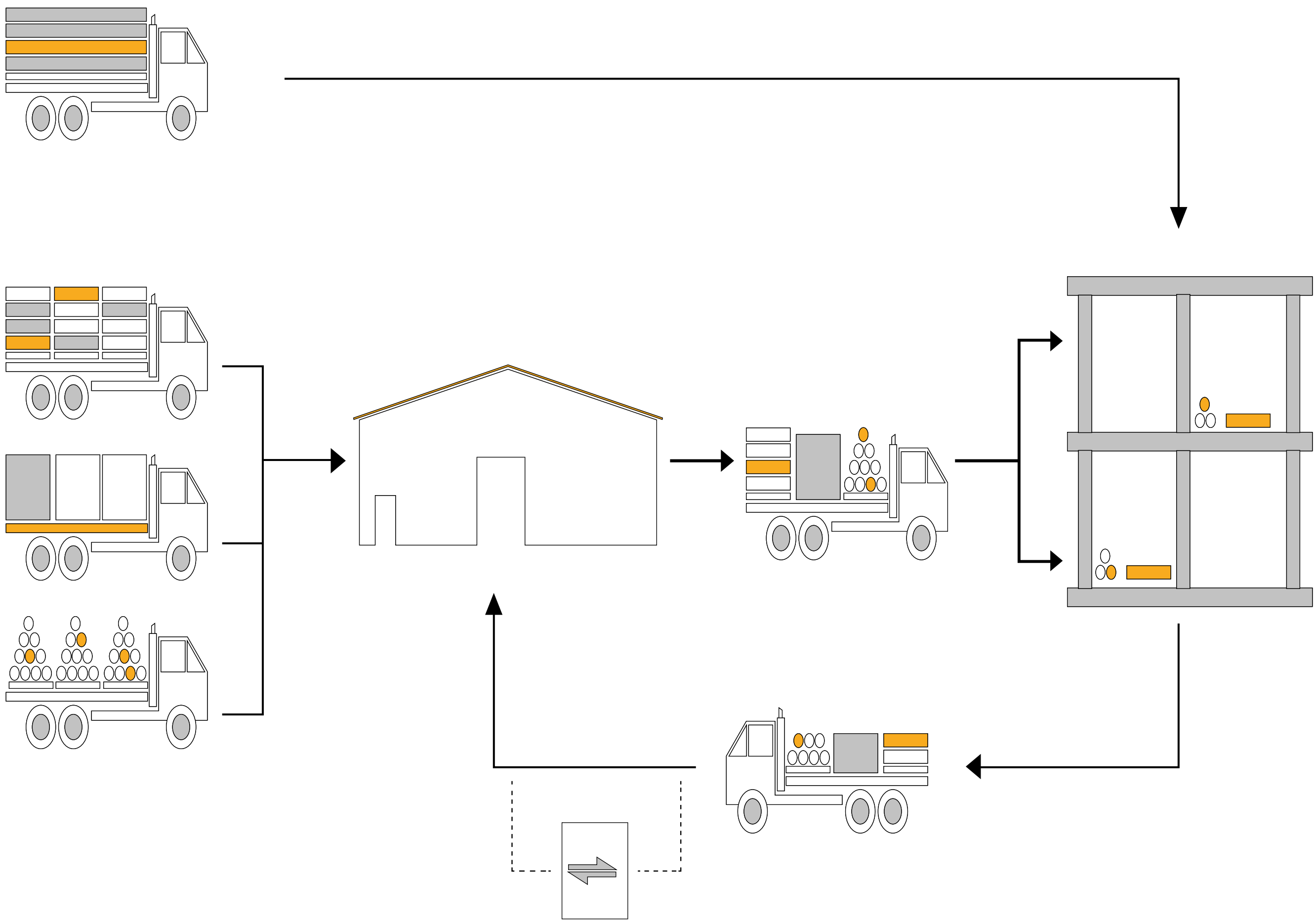
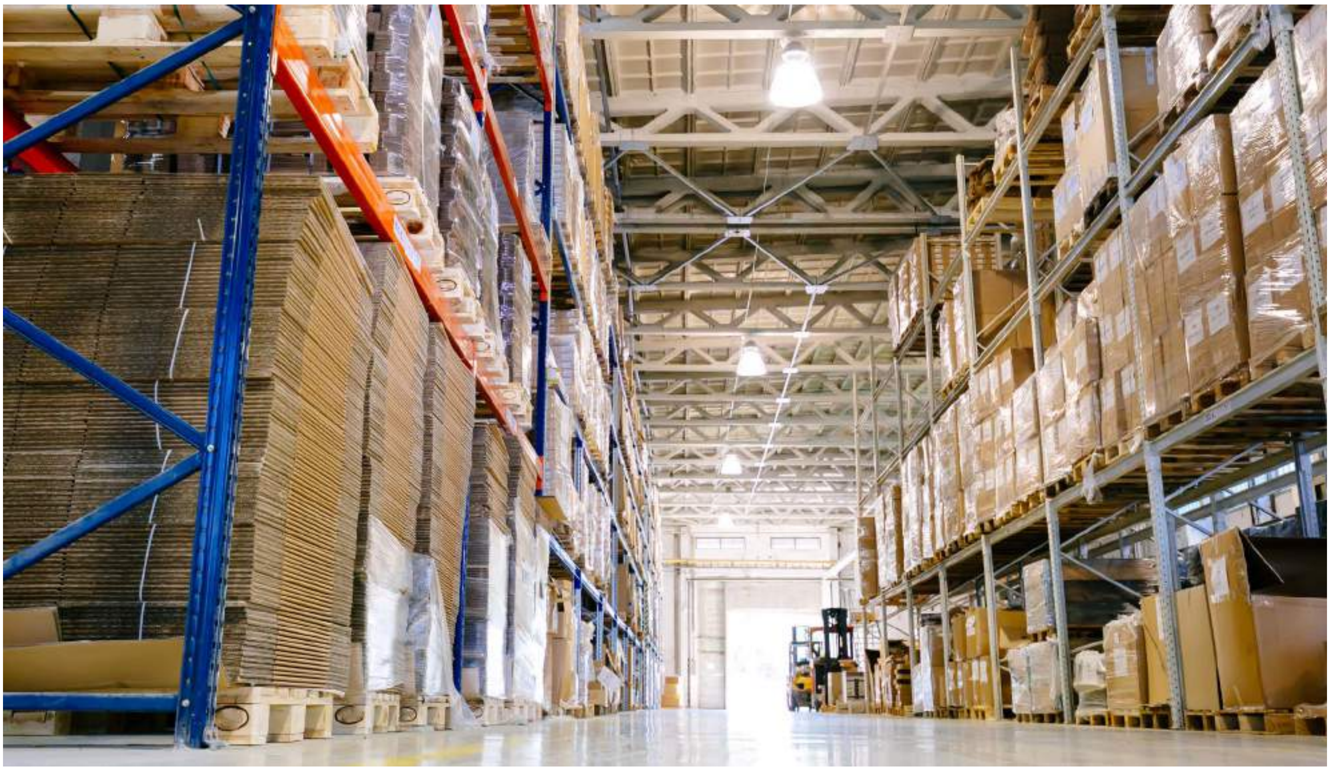


Figure 11: Construction Consolidation Center
Source: Greger Lundesjo, The Logistics Business - Working together for a world without waste

» Case study

A limited public role in reverse logistics has been attempted in some European cities, especially in tandem with consolidated urban delivery schemes. The most notable example is the London Construction Consolidation Center, which served both as a consolidation point for inbound deliveries of construction materials to building sites in the city center and as a reverse logistics channel for waste materials such as used pallets, packaging and broken supplies.[15]

5.3 Urban consolidation centers and collaborative warehousing and distribution



» Description

In situations where small load size is the cause of poor loading, combining loads together to more effectively use the carrying capacity of trucks is a potential path to improve net load factor. A common approach to spurring consolidation in those types of urban deliveries has been to build urban consolidation centers (UCC)—government subsidized warehouses in or near the urban core that serve as consolidation points for inbound shipments. Rather than hauling freight to its final destination, trucks drop off their loads at the consolidation centers, where smaller loads are combined to maximize both routing efficiency for final delivery and delivery vehicle load factors. Those optimized loads are picked up by specialized urban delivery trucks (often low or zero emissions) and delivered to their final destination.
A similar concept, collaborative warehousing and

distribution, also exists in the private sector with no government support or involvement. Collaborative warehousing and distribution is a business model in which different retail goods manufacturers that supply the same retail stores contract with a third-party logistics company (3pl) for both warehousing and transportation services.

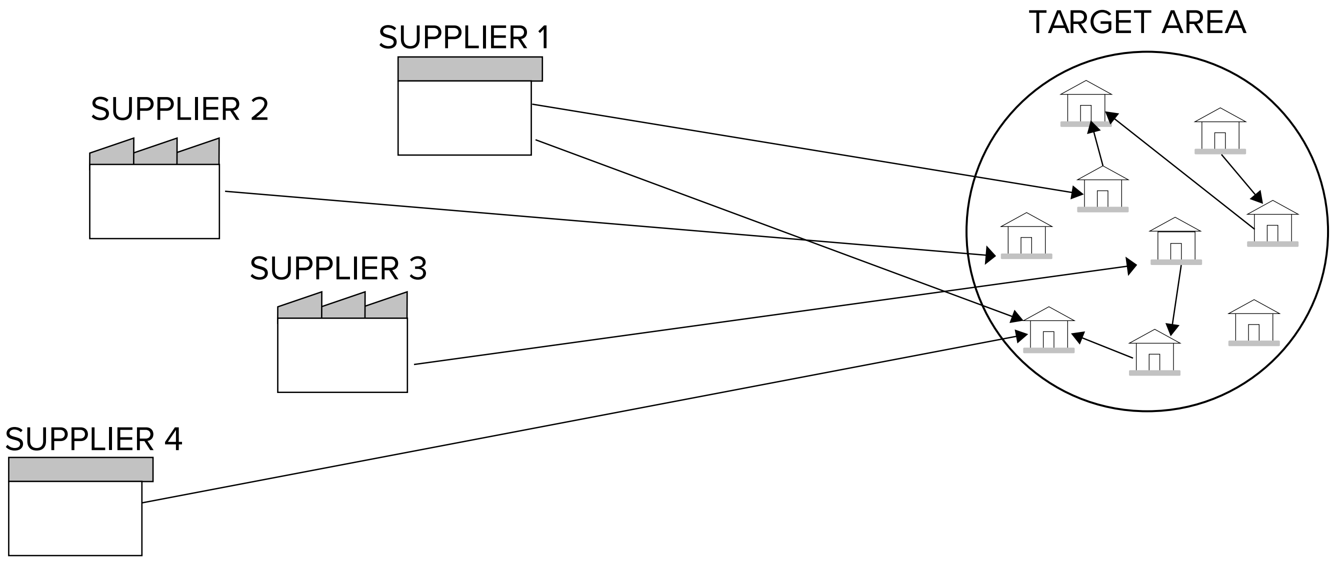


Figure 12a: Deliveries in absence of the consolidation center
Source: Columbia University, Going the Last Mile

» Case study

Many European cities have experimented with UCCs and the efficiency gains seen there were often impressive. For example, in Freiburg, Germany, weight-based load factors increased from 45% to 70% due to the use of UCCs and the number of truck trips to the city center fell by 33%. Similarly, in Kassel, Germany, weight-based load factors increased from 25% to 60% while volumetric load factors increased from 40% to 80%.[18] This led to a 60% reduction in vehicle travel within the city center.[19] Other city experiments yielded similar results. In theory, cost efficiencies gained by sharing the costs of final-mile delivery could offset or even exceed, the cost of operations of the UCCs. In practice, however, this has not been the case. Consolidation by UCCs, with some notable exceptions, has not been successful due to the extra cost, time, complexity and in some cases, redundancy that it adds to the system. As a result, most UCCs in Europe closed after an initial subsidization period expired. The UCCs that have been successful typically serve historic urban cores with strong access restrictions for trucks.

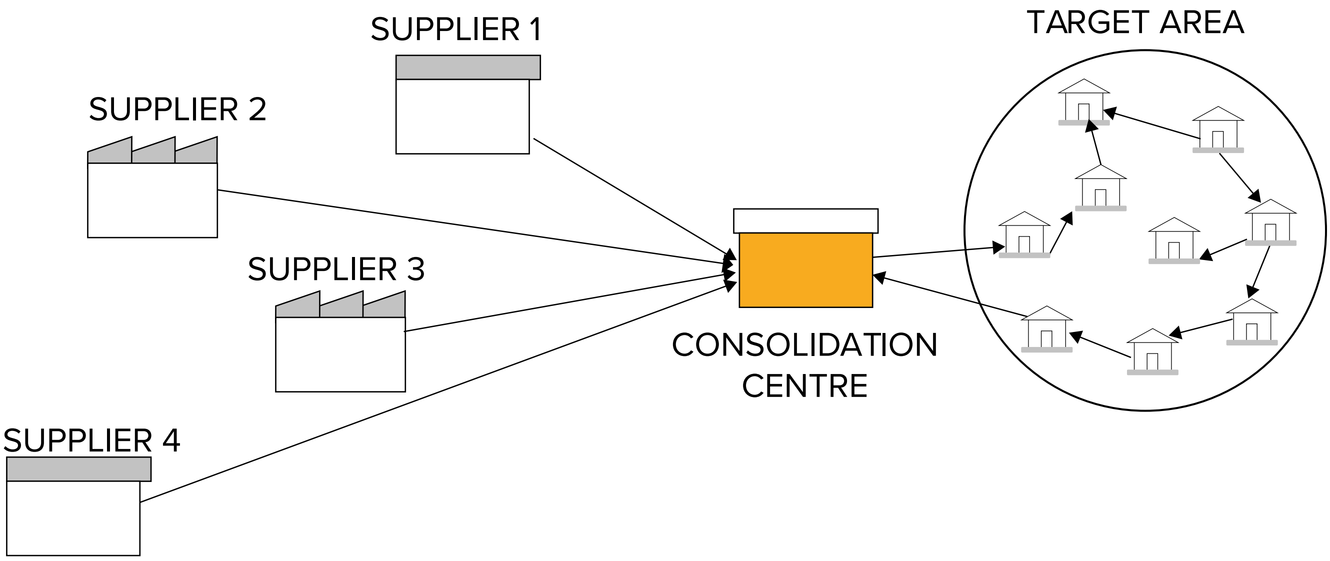


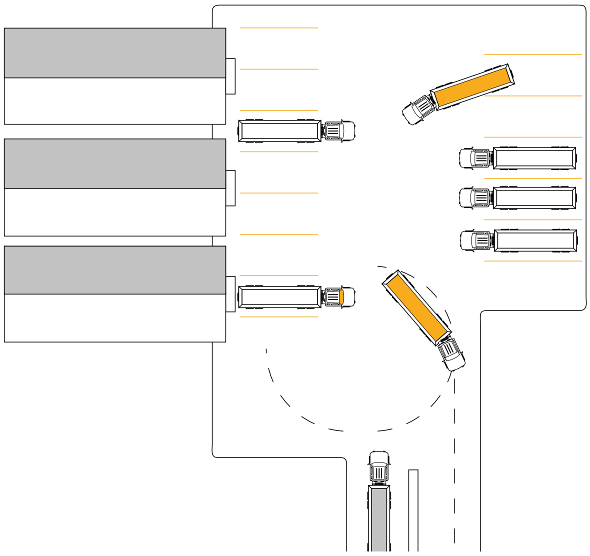
Figure 12b: Deliveries in presence of the consolidation center
Source: Columbia University, Going the Last Mile

» Case study

Collaborative warehousing and distribution operations, the private sector cousins of UCCs, have been documented to reduce transportation costs by 25–30% and warehousing costs by 15%. For example, KANE, a North American third-party logistics services provider, manages distribution for Sun-Maid Growers of California through their freight consolidation services. KANE's freight consolidation program includes delivery of grocery items such as candy, pet food, condiments etc. Based on the location and arrival date requests of the products, KANE consolidates goods from various retailers and builds a full truckload shipment. Sun-Maid only pays for the portion corresponding to the weight of their products. This has reduced Sun-Maid's freight transportation cost by 62%.[20]

6.0 Delivery productivity

6.1 Parking and unloading infrastructure



» Description	Provision of sufficient freight parking is often an overlooked aspect of urban planning. A failure to provide parking creates significant inefficiencies in urban transportation, both for trucks as they drive in circles looking for available parking and for the transport network as a whole as trucks that are unable to find parking often end up stopping in lanes that are meant for either vehicular or pedestrian traffic. Furthermore, because those parking spaces are not intended for freight use, they don't support the use of simple tools such as hand carts or wheeled crates that ease the process of making the delivery, resulting in longer delivery times and decreased productivity.

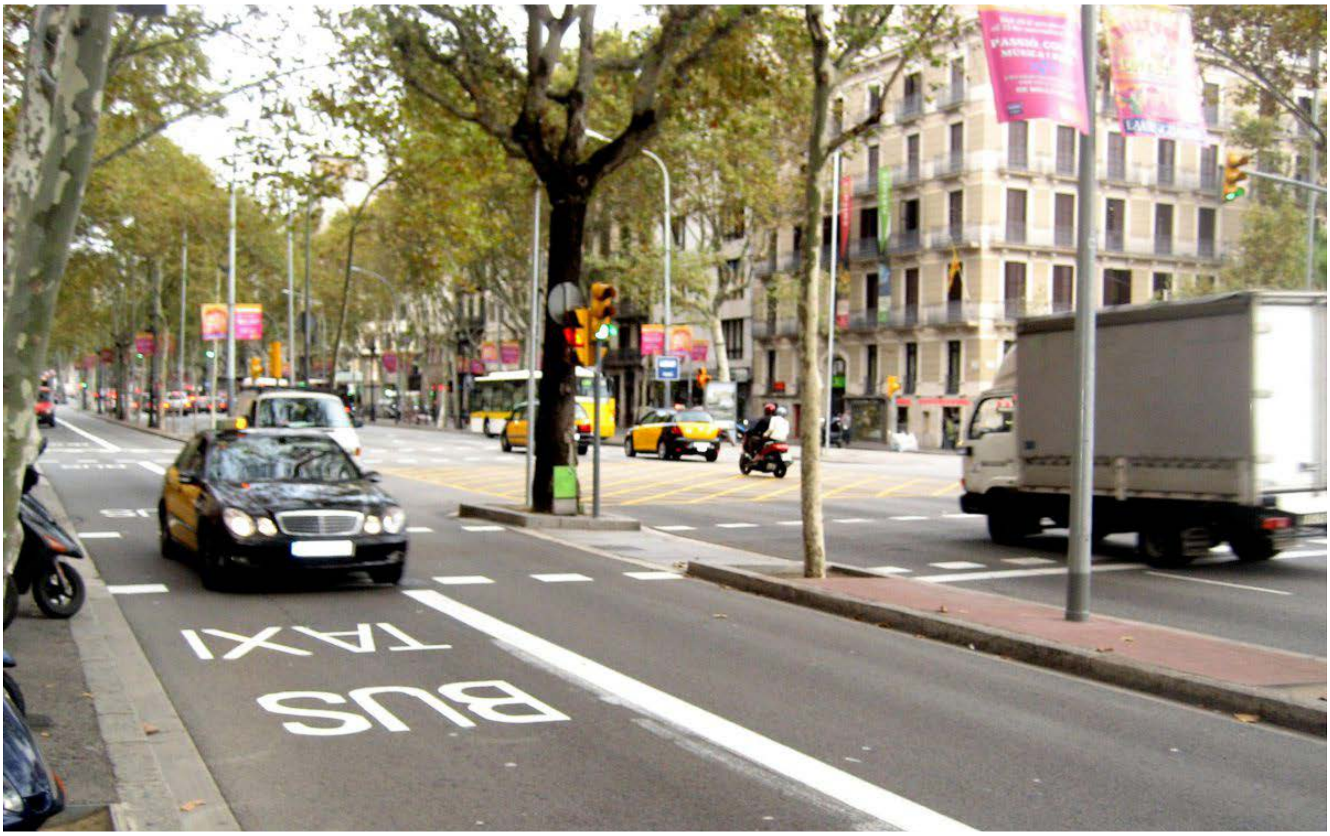


Figure 13: Multi-use lanes in Barcelona
Source: Complete Streets. 2030 Palette.

» Case study

There are a variety of ways to enhance the availability of parking for delivery vehicles. Barcelona, Spain, has adopted multiple approaches to improve the availability of freight unloading spaces on key freight corridors in the city. One approach has been to modify building codes for commercial establishments to mandate the provision of off-street loading and unloading space for urban deliveries. Another approach adopted by Barcelona was to create multi-use lanes whose functions change at different times of the day. Those lanes, on major streets in Barcelona's tourist and shopping districts, are reserved for passenger or bus traffic during peak commuting hours. However, during the workday, when traffic levels are lower, these lanes are used for freight loading and unloading. At night, they serve as parking spaces for residents' cars. The result of this approach has been a 12%–15% reduction in travel times for trucks and improved traffic fluidity on roads with multi-use lanes.[21]

6.2 Voluntary night-time deliveries

» Description	Mandated night-time deliveries, which are common in many cities, are an approach to shift truck traffic to the night. However, they often come with unexpected consequences. For example, in Beijing where strict entry bans exist for goods vehicles during the day, loads are often broken up and put into passenger cars or vans to circumvent the regulations. This actually increases delivery vehicle traffic and associated congestion. To avoid that, some cities have experimented with providing logistics players with inducements to voluntarily adopt night-time deliveries.

» Case study	A widely cited example of best practice in night-time delivery comes from New York City (NYC). In the NYC night-time delivery scheme, the New York Department of Transportation engaged with suppliers and receivers of goods to design a system that would incentivize receivers to accept night delivery from carriers. Key inducements for receivers included financial incentives and delivery systems that provided goods' security with minimal or no need for off-hours staffing. **» Night-time deliveries can reduce the effect of congestion on trucks and also the congestion caused by trucks by shifting activity to the night, when traffic levels are at their lowest. «**

Figure 14: Night-time deliveries in New York
Source: New York City. Strategic Plan for Freight Movement.

The congestion benefits were substantial; median travel speeds of trucks doing night-time deliveries were between 50% and 130% higher than during the day. Furthermore, median dwell times for delivery trucks were approximately half of what they typically were during the day likely due to easy parking availability near the delivery point and empty sidewalks on which goods could be moved between the truck and the establishment. The net effect of this increased speed was to shorten the time needed to accomplish a typical delivery tour by three hours.[24]

6.3 Parcel delivery terminals

Figure 15: 2017 International Post Corporation cross border survey on delivery preferences and experiences of over 28,892 frequent cross-border online shoppers across 31 countries
Source: International Post Corporation

» Description	In certain market segments, another option to improve delivery productivity is to reduce the number of stops a vehicle must make. This strategy is particularly important in parcel delivery, where final-mile costs are estimated to be as high as 50% of total transport costs, largely because there are so many delivery points and serving them effectively is very difficult.

» Case study	Parcel delivery terminals can reduce delivery points. TNT piloted these terminals in various European cities under differing business models. In Berlin, Germany, the terminal was a consolidation point where trucks would swap boxes in off-peak hours and electric bikes would make final deliveries during the day. In Turin, Italy, recipients would pick up the packages directly from the boxes. In both cases, shorter delivery times and decreased traffic congestion impacts were observed.[25]

Figure 16: DHL Automated parcel collection point in Gronau, Germany

Figure 17: Illustration of the Smartbox concept
Source: Smartbox

» Case study

One of the leading examples of similar services in India is Smartbox. Smartbox is an automated parcel delivery terminal available 24x7.[26] Customers can register their Smartbox for parcel deliveries. As soon as their parcel is delivered, customers get a one-time password that can be used to unlock their delivery box while collecting packages. Smartbox also offers a card swipe on delivery service for cash on delivery orders. Currently, Smartbox operates in Delhi, Mumbai, Bangalore and Hyderabad.

7.0 Logistics sprawl

7.1 Urban logistics spaces and logistics hotels

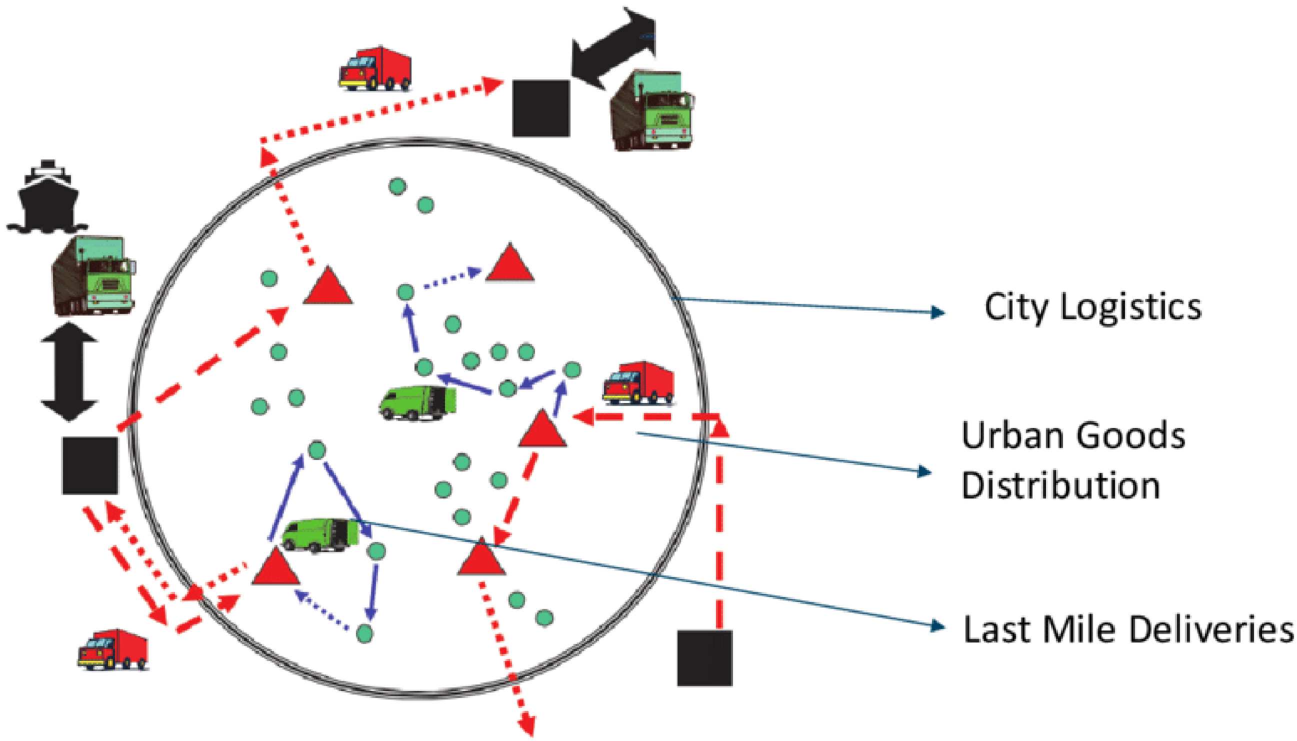


Figure 18: Urban Logistics' Geographical Scope adpted from Crainic et al. 2012, pg 49
Source: Cardenas, Ivan, et al. "City logistics, urban goods distribution and last mile delivery and collection." Competition and Regulation in Network Industries 18.1-2 (2017): 22-43.

» Description	An urban logistics space is an area that logistics firms can use to temporarily store and cross dock goods destined for urban delivery. By doing this within the urban core, rather than in distant suburbs, final-mile delivery can be made substantially more efficient and vehicle selection can be more flexible. Urban zoning and land-use practices can identify and reserve land with high potential for critical urban logistics uses to serve as urban logistics spaces.

Figure 19: Sogaris logistics hotel plan
Source: Sogaris Urban Logistics Commitment

» Case study

In response to the widespread failure of urban consolidation centers, Paris took the approach of facilitating, rather than mandating urban consolidation. To do so Paris made urban space, usually former underground parking garages between 100 and 250 square meters, available to logistics users to use as a link in urban supply chains. These spaces are typically used by a single delivery company to bundle deliveries within its own supply chain. Chronopost, a French parcel delivery company, which is the main tenant of one such facility, expects VKT reductions of 50% and GHG emissions reductions of 80% from deliveries dispatched from that establishment.[27]

» A concept that Paris has promoted that is similar to urban logistics spaces, but larger in scale, is the "urban logistics hotel". «

8.0 Routing efficiency

8.1 ITS for real-time route optimization

» Description	Description: Like many other elements of efficiency in urban logistics, efficiency in vehicle routing is fundamentally a private sector activity and profit motive is a powerful driver of uptake. However, the government can play a role in enabling its uptake in ways that promote public good. The provision of intelligent transportation systems (ITS) is such an example.

» The increased use of ITS may reduce the impact of unpredictable congestion on urban freight by enabling trucks to change their routing to bypass congested areas. «

One of the key functions of ITS is to optimize routes in real time in response to congestion. Globally, non-recurring congestion by roadwork, traffic incidents, poor weather, etc, cause 60% of congestion.[28] The increased use of intelligent transportation systems (ITS) may serve a role in reducing the impact of unpredictable congestion on urban freight by enabling trucks to change their routing to bypass congested areas.

The benefits of this real-time route optimization through ITS can be significant. For example, in the Detroit area, it is estimated that routing trucks in response to real-time congestion data can provide an extra 45% reduction in driving times by merely using the historical congestion data.[29] The strong potential of ITS to mitigate the impact of urban congestion on freight transportation, combined with the relatively high cost of congestion to commercial vehicles, has led policymakers to prioritize ITS deployment in key freight corridors. For example, the city of Seattle, in its 10-year plan for ITS deployment, has prioritized three types of roads: high-volume arterials, designated freight routes and routes with capacity to handle emergency diversions.[30]

» The strong potential of ITS to mitigate the impact of urban congestion on freight transportation has led policymakers to prioritize ITS deployment in key freight corridors. «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8.2 Truck routes

» Description	Truck routes are an important tool in urban freight management because they can concentrate truck travel in high-volume corridors in which truck traffic is not in conflict with other uses. However, if not designed with care, designated truck routes can unnecessarily add route circuity or restrict access to key freight generation points. In those cases, freight efficiency is compromised due to inefficient routing, increasing the enforcement burden on cities as trucks attempt to circumvent the system.

» Case study	New York City is one of the few cities in the US with a comprehensive truck routing system, which has been in place for several decades. In 2007, the city carried out an extensive study to evaluate whether the routing system was meeting the demands of the logistics industry and effectively minimizing the negative externalities that truck activity imposed on urban residents. The study showed that with only 5% of New York City roads open to truck traffic, reasonable access to the city for freight purposes was maintained. Over the years since the initial truck routes were planned, some land use and zoning policies had changed and truck routes were going through formerly industrial areas that had been re-purposed to commercial and residential uses. A key conclusion was the necessity to periodically review the effectiveness of truck routing schemes in the context of changing land uses.[33]

Figure 20: New York City truck routes
Source:New York City Department of Transportation. New York City Truck Route Management and Community Impact Reduction Study. Mar. 2007

9.0 Time travel index on truck lanes

9.1 Congestion pricing

Figure 21: Traffic volume in Stockholm declined and has remained below pre-congestion-charge averages even as population increases. 2006b and 2007a mark the time between the end of the trial period (July 2006) and beginning of the official implementation of charging scheme (August 2007)
Source: World Resource Institute

» Description

Trucks and other delivery vehicles are commonly perceived to be the cause of congestion and their use is regulated accordingly. However, delivery vehicles also suffer from congestion and logistics efficiency is severely compromised by delays that poor traffic creates. In order to optimally allocate scarce road capacity, market-based congestion management strategies are often a superior solution to approaches like truck bans.

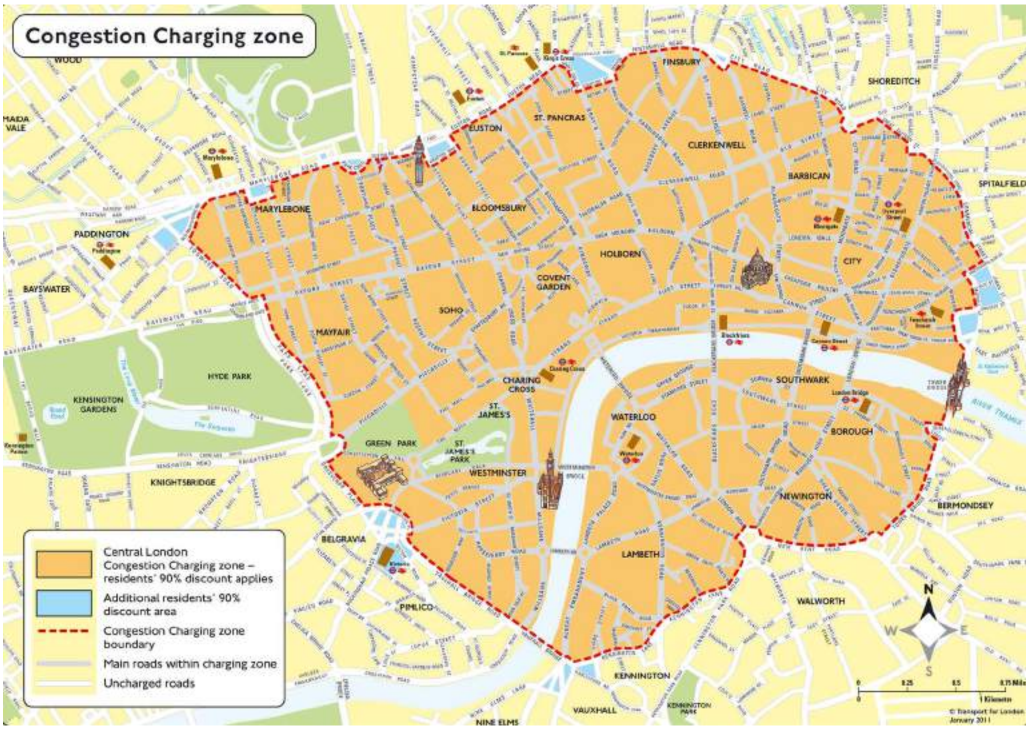

Figure 22: Congestion charge zone in London
Source: Transport for London

» Case study

While congestion pricing has been implemented in many places, its effects on freight transport are well documented in London. In 2003, London implemented a charge for entry into the city centre that has increased over the years and in 2018, is approximately GBP 11.5.[34] The coverage of the congestion zone is only the central downtown area as shown above. The result of the congestion charge was a 20% drop in traffic in the congestion zone after the charge was implemented, with traffic levels stabilizing after the initial fall. While the overall traffic declined, commercial vehicle travel volume remained relatively constant, rising as a share of total traffic from 17% to 20% as congestion pricing was implemented and charges were increased.

Congestion pricing improved speed and reliability of travel in the City of London, including in areas not covered by the charge. This improvement in speed and reliability directly benefited operators of commercial vehicles. Furthermore congestion pricing, combined with changes to signal timing and better infrastructure for non-motorized transit, reduced accidents both within and outside of the charge zone.

10.0 Truck-related casualties

10.1 Hierarchical road networks

» Description

As discussed earlier, the use of truck routes to segregate heavy trucks from vulnerable traffic can reduce use conflicts, including fatalities of pedestrians, cyclists and occupants of passenger vehicles. A precursor to establishing truck routes, however, is the creation of hierarchical road networks. Four broad categories exist in road hierarchies:

01 arterials
02 sub-arterials
03 collectors
04 local/access roads

A well-designed hierarchical road network will enable most driving to occur on arterial roads with feeders and local roads for final delivery. Roads higher up in the hierarchy should not be used by vulnerable groups and should be engineered for high-speed driving by heavier vehicles. Hierarchical urban road networks, when combined with concepts like ring roads and truck routes, can help keep freight traffic segregated from other vulnerable road users while still preserving the ability for freight to move within the city in a cost-effective way.

10.2 Identifying truck collision hotspots

» Description	Traffic collisions, including those involving trucks, are often not entirely random occurrences. They tend to group in certain areas where infrastructure is inappropriate or use conflicts exist. Identifying collision hotspots enables policymakers to understand and resolve the root causes of excess collisions.

» Case study	The city of Seattle created a plan called Vision Zero, which seeks to end fatalities and serious injuries on urban streets by 2030. As part of that plan, it mapped all truck-related accidents in the city and identified 'hotspots' where truck incidents clustered. That data was used to determine whether infrastructure insufficiencies were to blame for truck fatalities and if improvements to specific areas in the road network could mitigate fatalities. At the time of the report publication, Seattle had already invested in improvements to infrastructure at the top two hotspots to improve road safety.[36] In India, the Ministry of Road Transport and Highways is getting road safety audits conducted on several national highways and identifying collision hotspots.

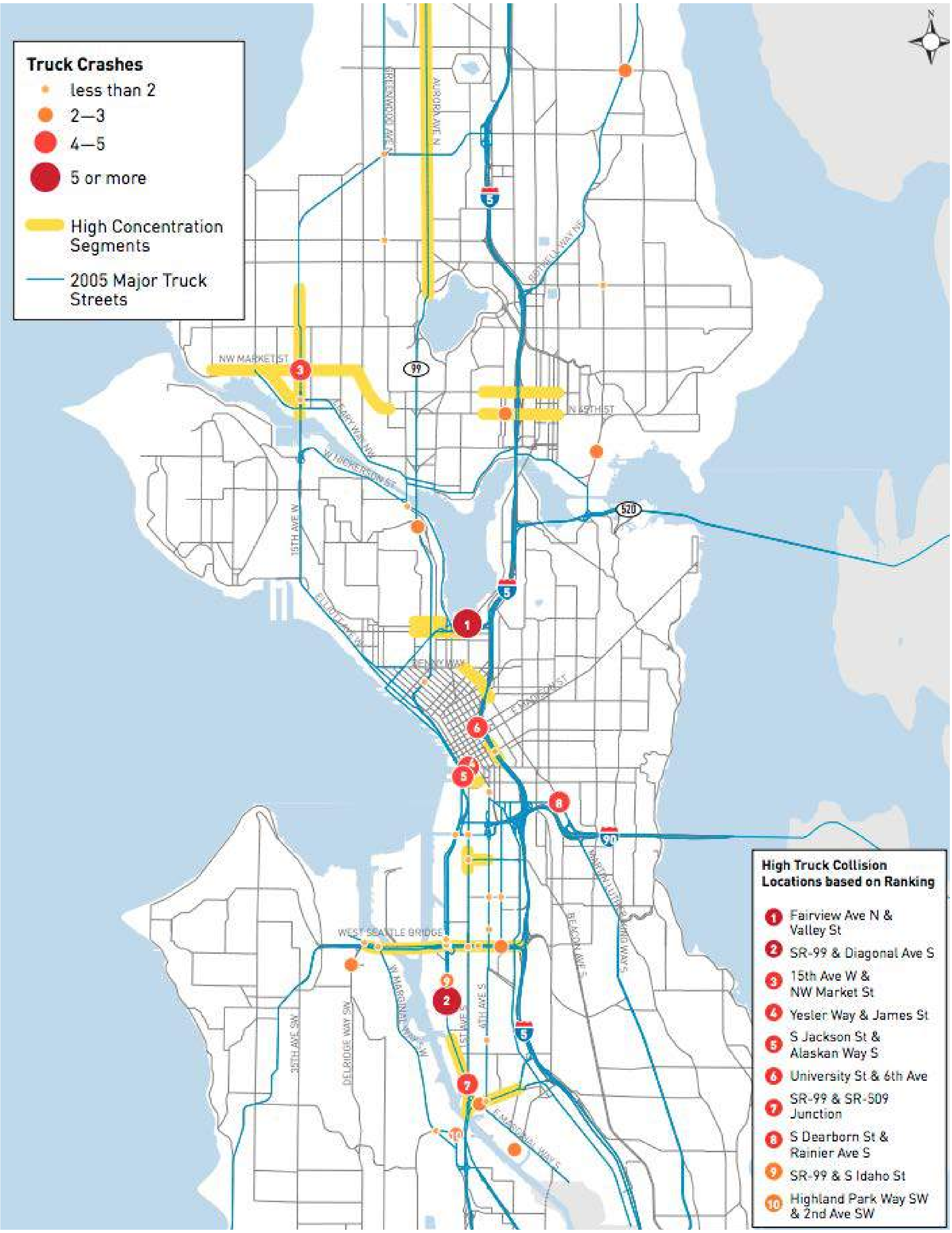

Figure 23: Truck collision hotspots in Seattle
Source: Seattle Department of Transportation. City of Seattle Freight Master Plan. Sept. 2016

11.0 Truck emissions

11.1 Low-emission zones

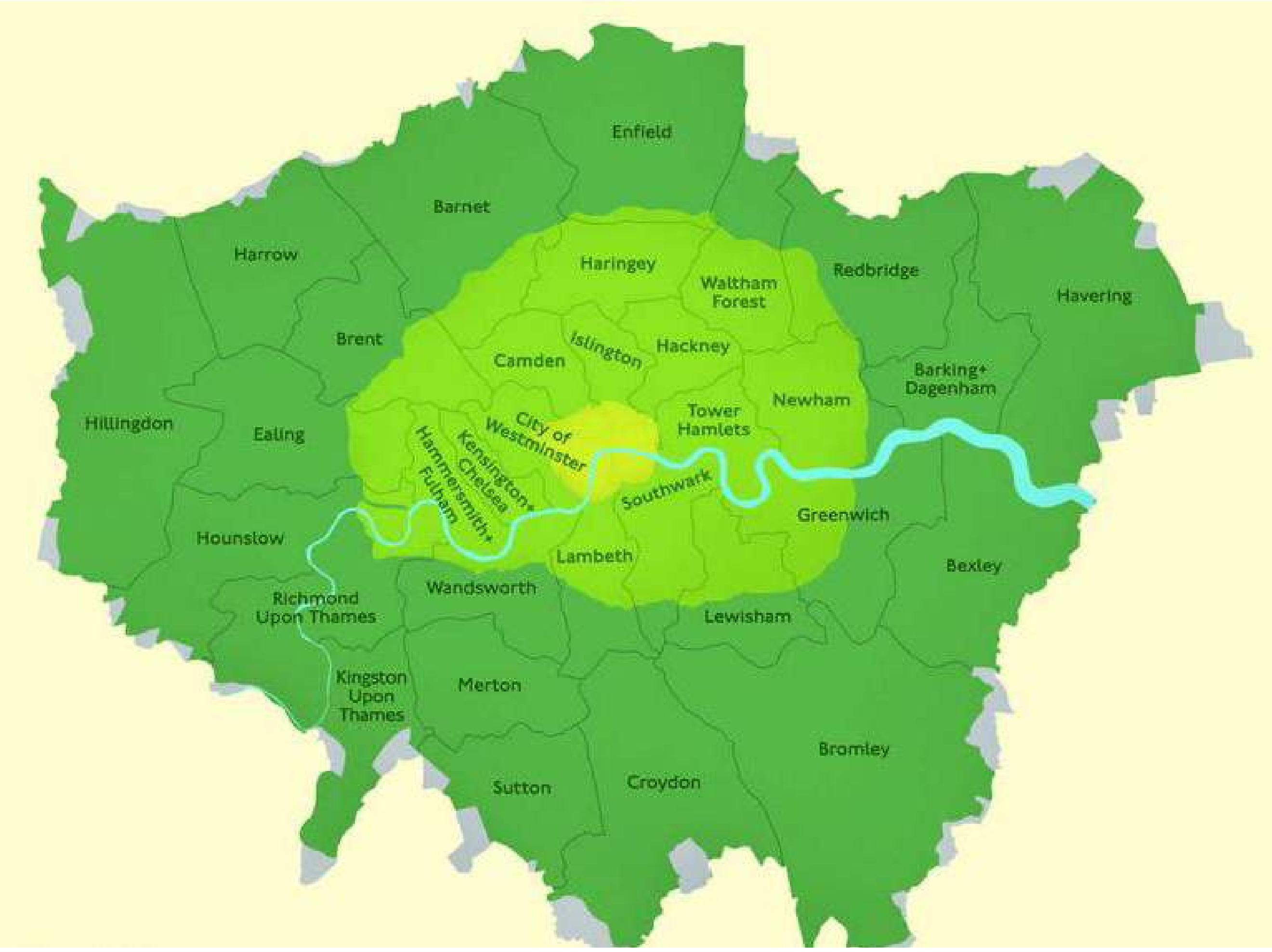

Figure 24: Low emission zone in London
Source: Urban access regulations

» Description	Low-emission zones (LEZs) are areas of the city in which only trucks meeting strict pollutant emissions limitations are allowed to operate.

» Case study

LEZs are most commonly seen in Europe, where entrance into restricted areas is typically tied to compliance with predetermined levels of the Euro truck standard system. There are over 40 active LEZs in Europe. London's LEZ is a particularly well-documented example. The London LEZ was established in 2008 and covers a 600 square-mile area in Greater London.

Between 2008 and 2014, emissions standards were tightened according to a published schedule that increased the share of the vehicle population covered and the stringency of the requirements.

Complying with LEZ mandates can add considerable upfront cost to logistics vehicles. For example, going from the Euro III standard to the Euro IV standard, as was required in later phases of the London LEZ, costs approximately $4,100. Going all the way to Euro VI would cost approximately $7,000.[37] The increased cost of compliance favors switching to zero emissions fuels, particularly electricity, as they become available.

11.2 Relaxation of access restrictions for zero-emissions vehicles

Figure 26: Chanhje electric delivery truck from China
Source: Green Car Reports

» Description	A significant drawback of blanket truck restrictions such as mandatory night deliveries, are the operational burdens that they create. Exempting electric or other zero -emissions delivery vehicles from those restrictions allows logistics operators more flexibility in their routing options and in the case of permitted day entries, creates a longer window in which to generate revenue as well as the opportunity to offer a premium service (delivery during business hours) that competitors in ICE trucks cannot offer.

» Case study	Relaxation of access restriction is one major prong in Shenzhen's effort to promote electric trucks. Most of the urban roads in Shenzhen are open to electric urban delivery vehicles 24 hours a day while daytime entry bans and road restrictions still apply to diesel vehicles. The right to increased urban road access has significantly influenced the decision of logistics companies to purchase and use electric trucks.

12.0 Unit costs

Cost of trucking per mile (USD)

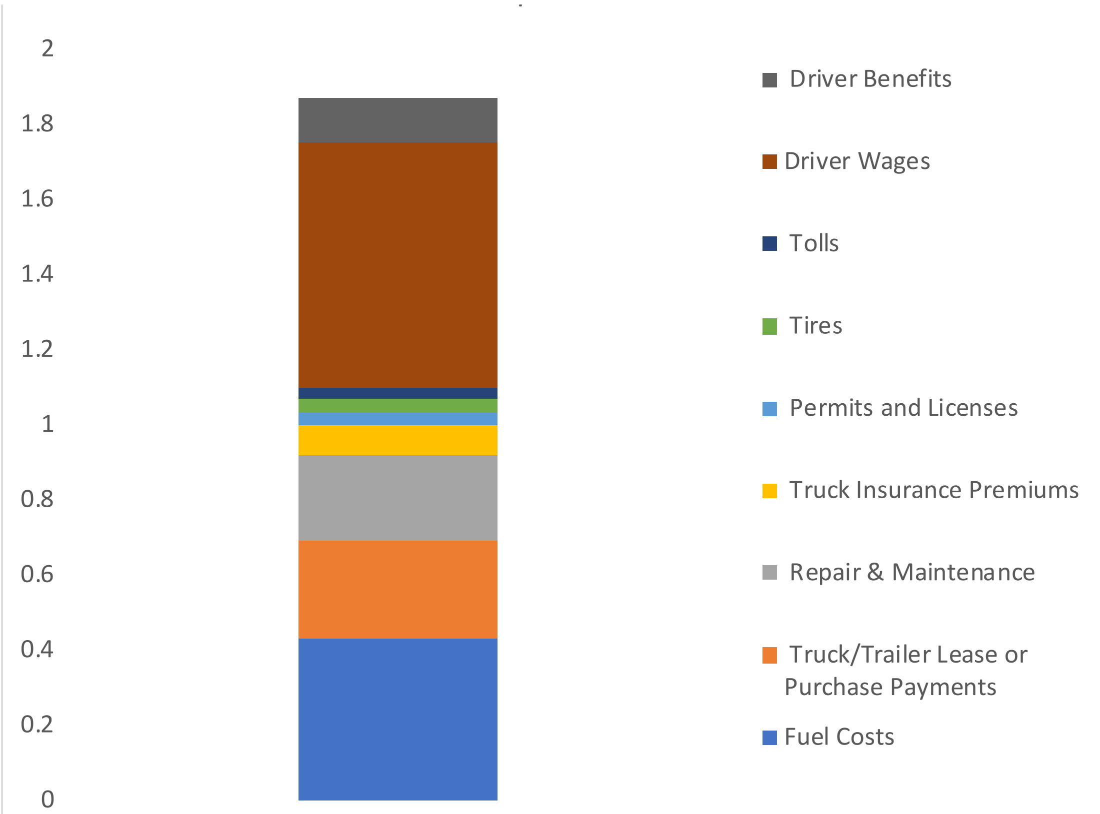

Figure 27: An Analysis of the Operational Costs of Trucking: 2018
Source: American Trucking Research Institute

» Description

Unit costs are not something that policymakers would seek to influence per se. However, all of the metrics discussed above directly contribute to unit costs and one key objective of urban logistics policy is to enable operators to reduce unit costs without externalizing them onto urban residents. As such, tracking unit costs for different types of delivery as well as their composition and trajectory, can help policymakers understand at a glance, whether their overall portfolio policy is meeting its goals and what additional measures could enhance logistics efficiency in the city.


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