EFFICIENT URBAN FREIGHT

BEST PRACTICES

Smart City
MISSION TRANSFORM-NATION

सत्यमेव जयते

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.

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Document 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	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.	http://www.caltrans.-ca.gov/
	—	—	—
	Modal shift of port truck traffic	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.acta.org/ https://www.portof-rotterdam.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/plik-i/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.allliancetexas.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/plik-i/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/plik-i/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-off-hour.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.bento-box-berlin.de/city-log-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-Beaugrenelle-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.ieee.org/document/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/Departments/SDOT/TechnologyProgram/ITSStratgicPlan20102020.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/downloads/pdf/execsum.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.indiaenvironmentportal.org.in/-files/file/Urban%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.seattle.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/driving/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/downloads/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.delhi.gov.in/sites/default/-files/All-PDF/Electric%20Policy%202018.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.

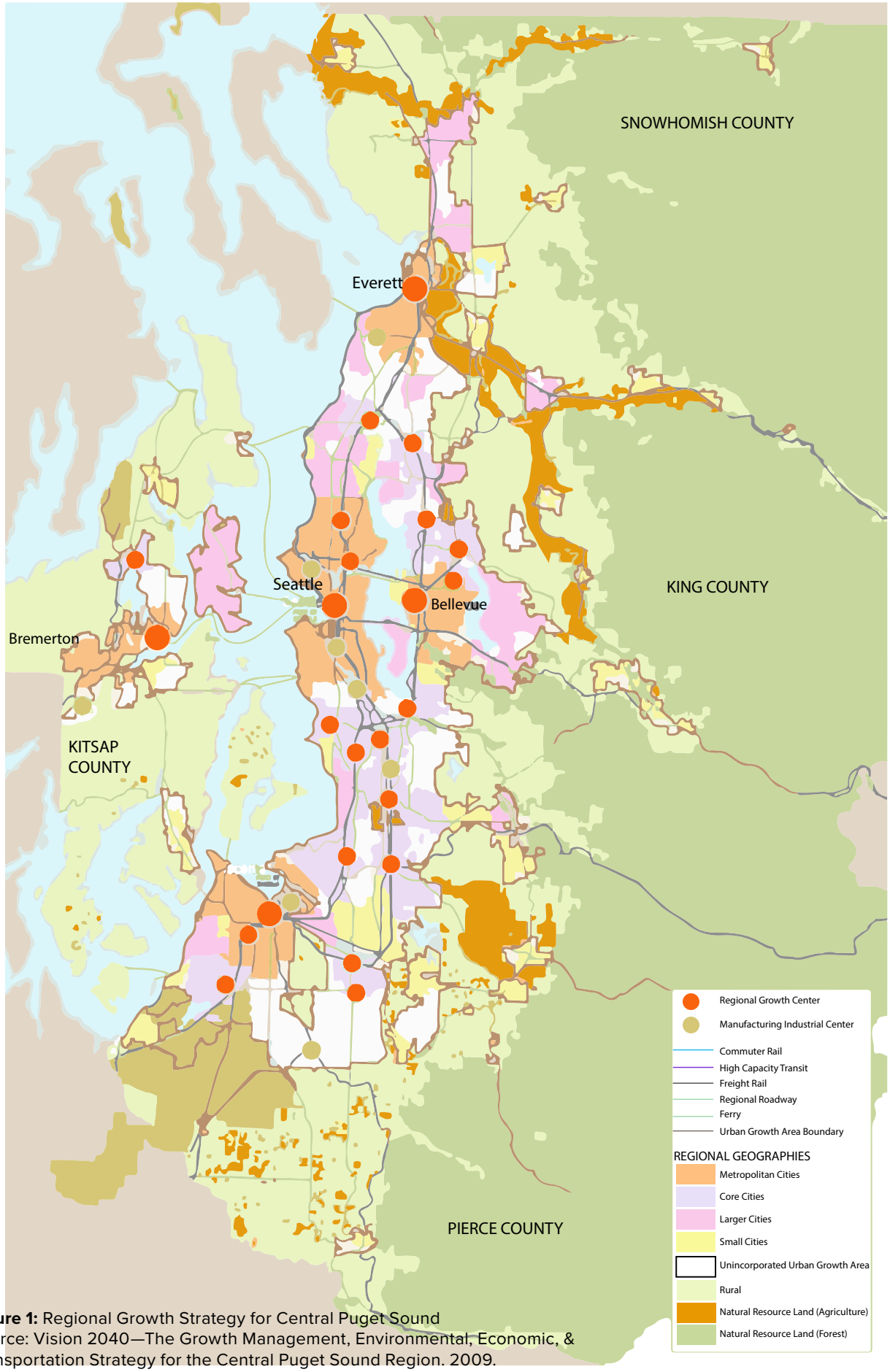


Figure 1: Regional Growth Strategy for Central Puget Sound
Source: Vision 2040—The Growth Management, Environmental, Economic, & Transportation Strategy for the Central Puget Sound Region. 2009.

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]

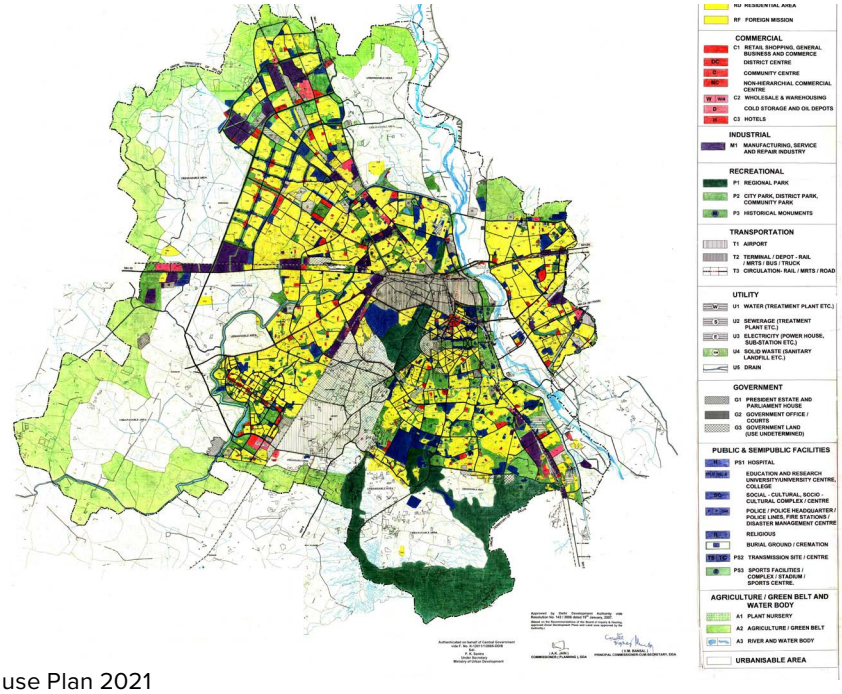


Figure 2: Delhi Landuse Plan 2021
Source: Delhi Development Authority

» 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.

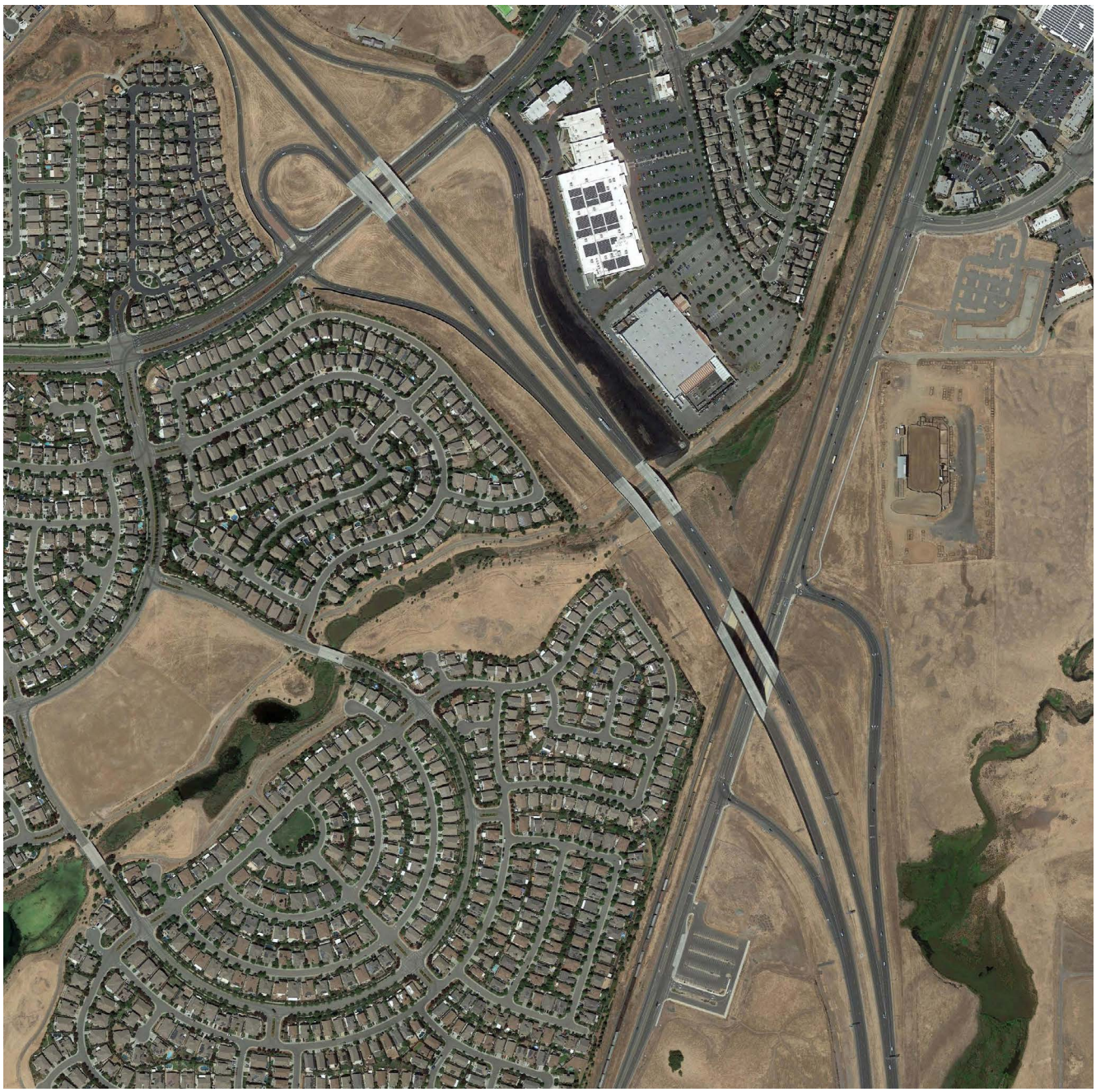


Figure 3: Lincoln Bypass
Source: Google Earth Image - 17/08/2018

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.

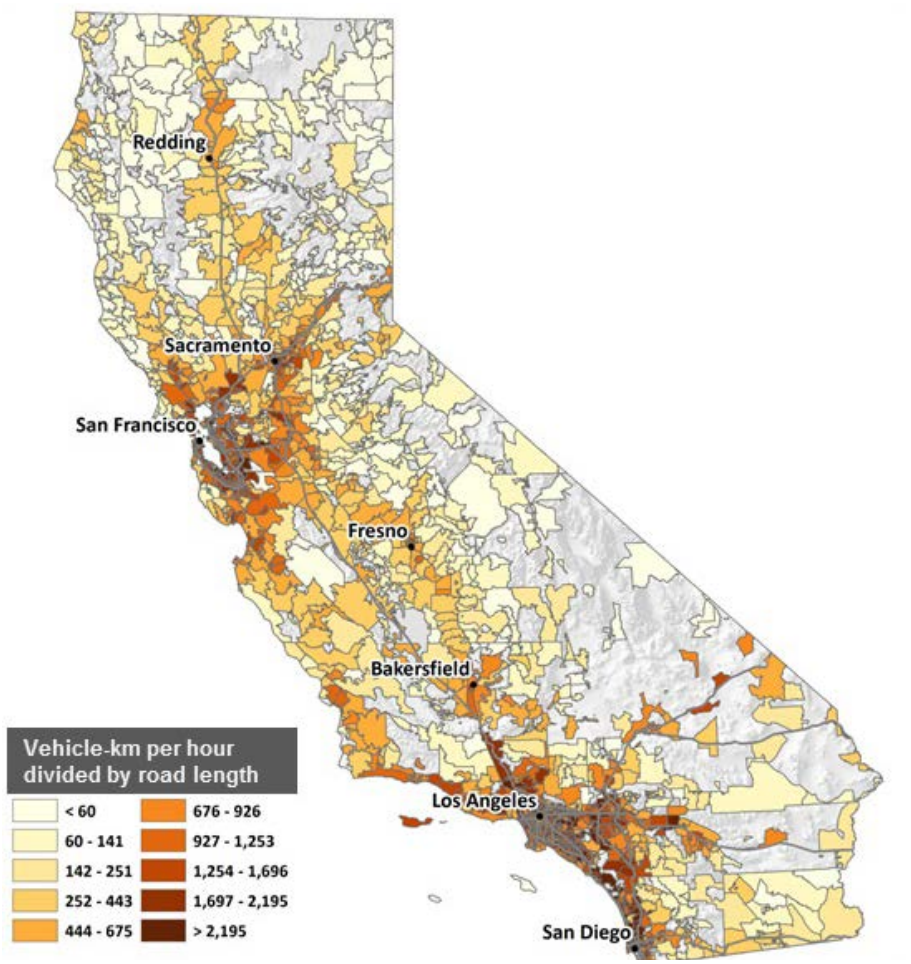
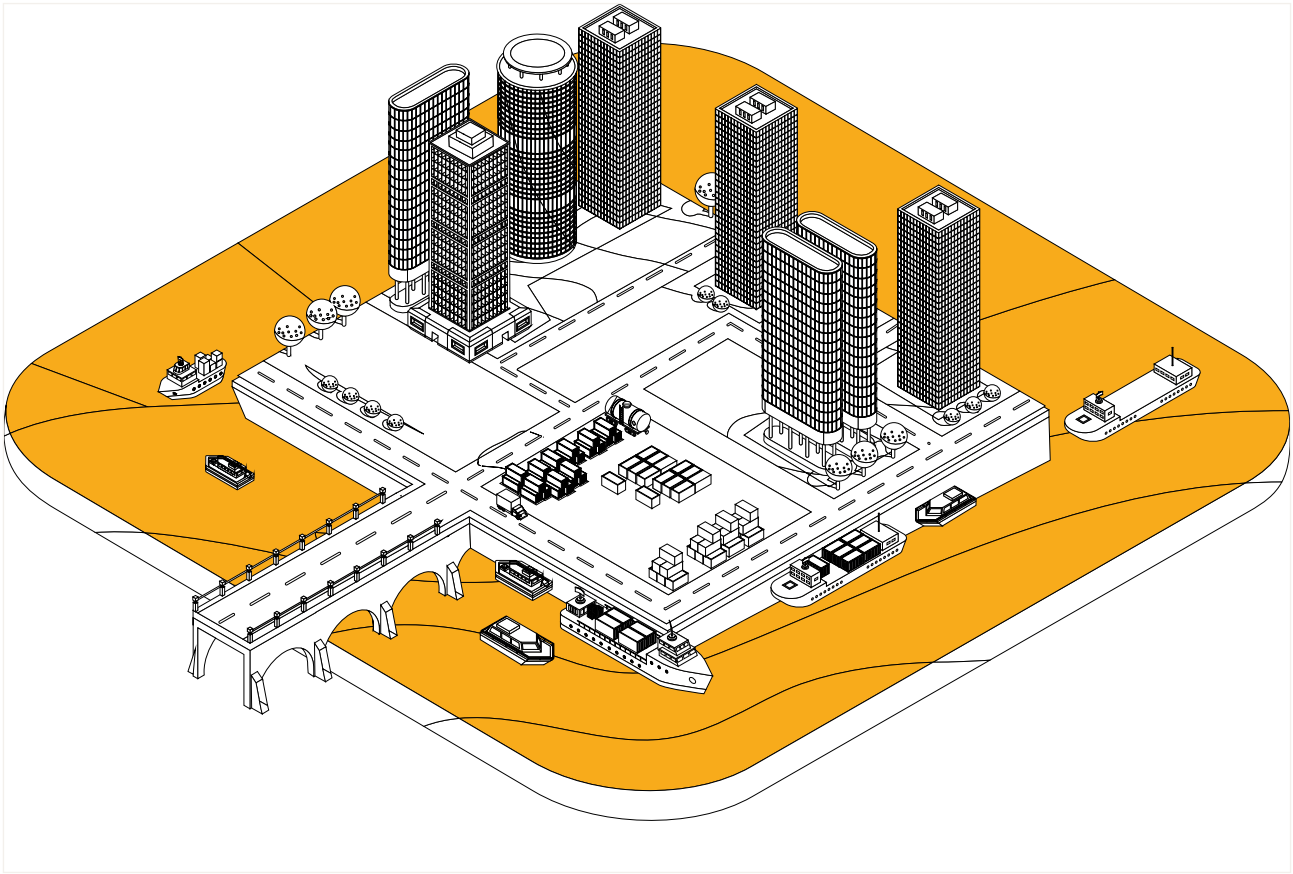


Figure 4: State of California: Traffic Density by Zip Code
Source: California Environmental Health Tracking Program and the Office of Environmental Health Hazard Assessment

» 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

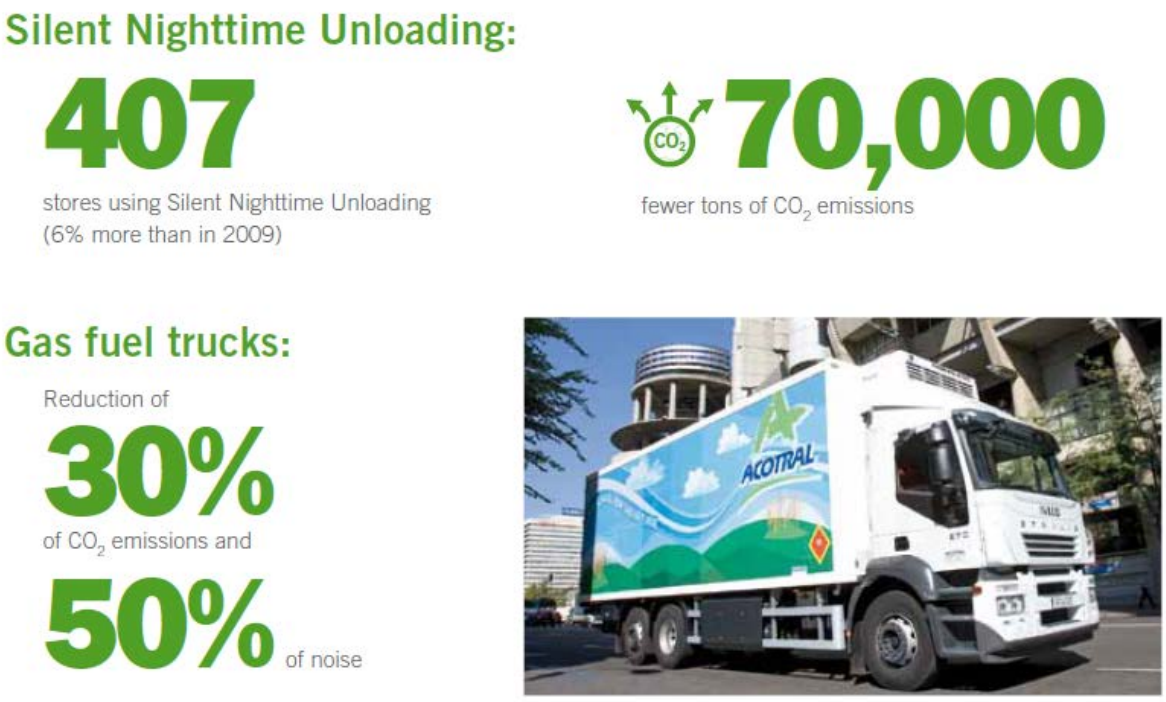


Figure 7: Benefits of night - time deliveries in Barcelona, Spain
Source: Mercadona environmental policy, 2010

» 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.

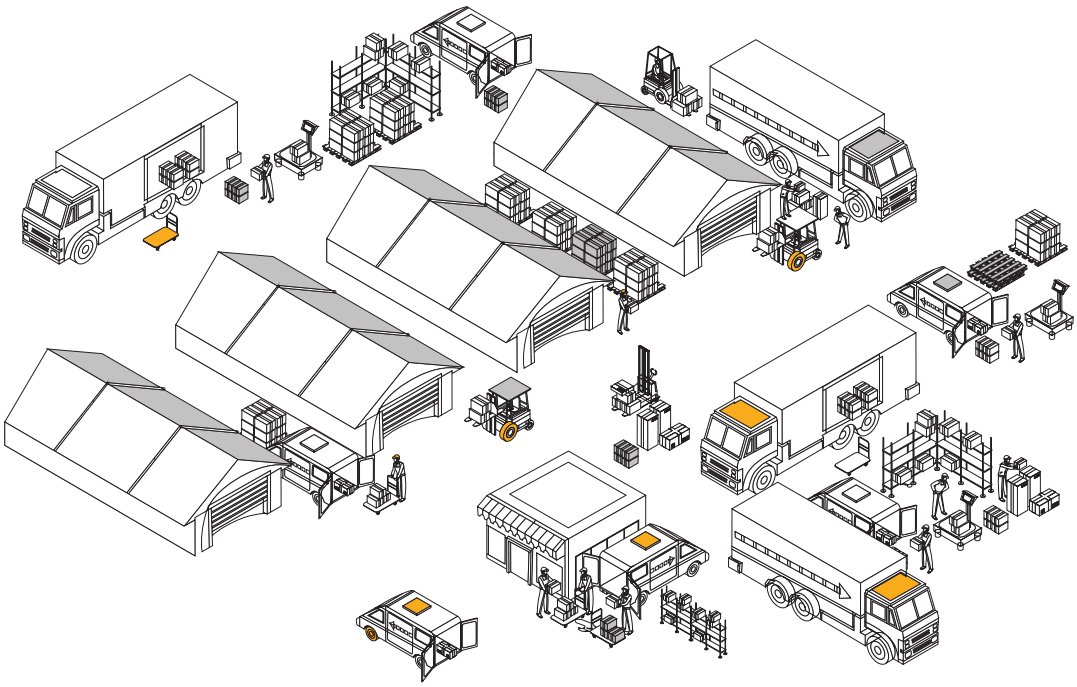
Figure 8: Night- time delivery in Barcelona City
Source: Mercadona Environmental Policy 2010

» 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. «

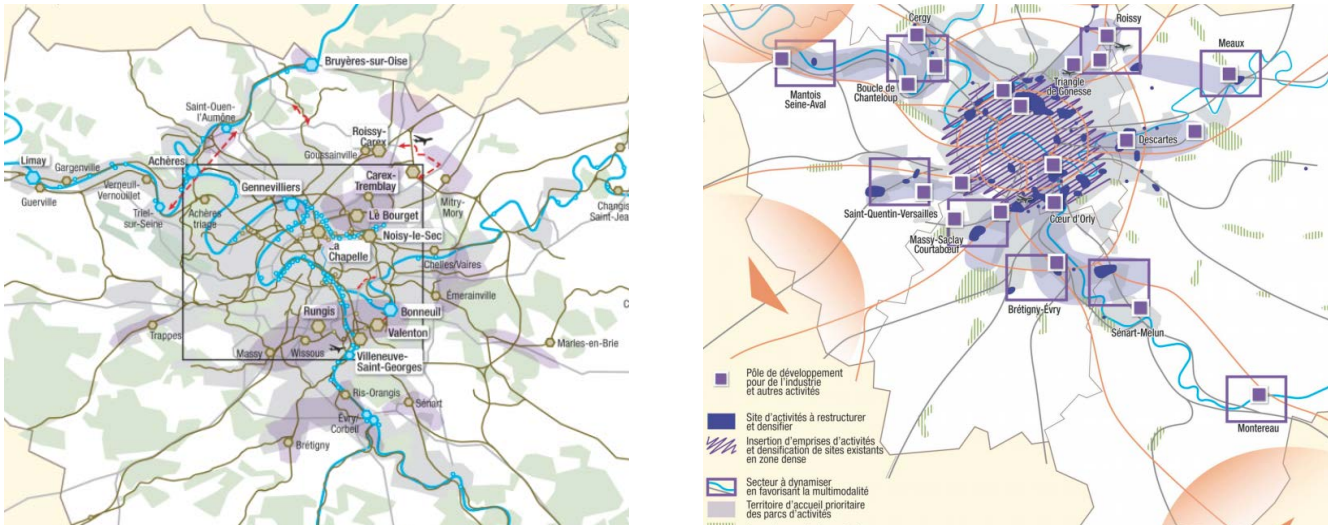


Figure 9: Paris industrial Master Plan
Source: Conseil régional d'Île-de-France. Île-de-France 2030 Defis, Projet Spatial Regional et Objectifs., 2013.

» 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

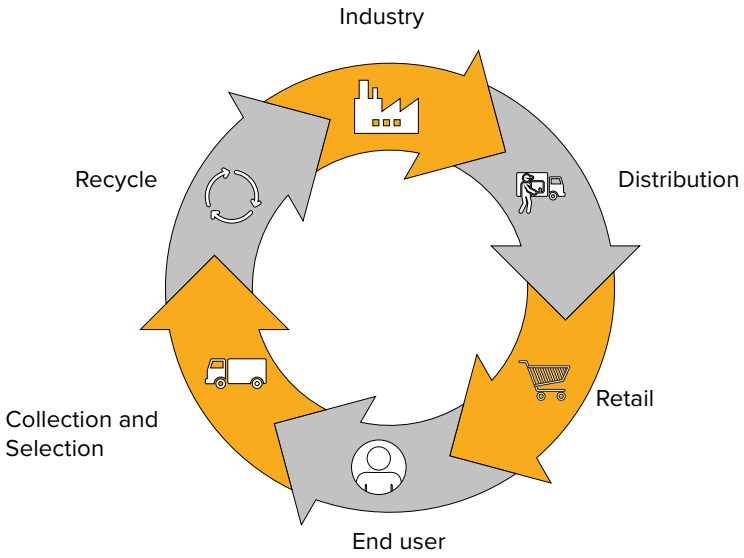
transportation. As shown by its occupancy, Alliance Texas is a good example of how logistics parks can create the logistics density, which enables efficient trucking in metropolitan areas and low-cost intermodal transport of goods nationally.

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. «

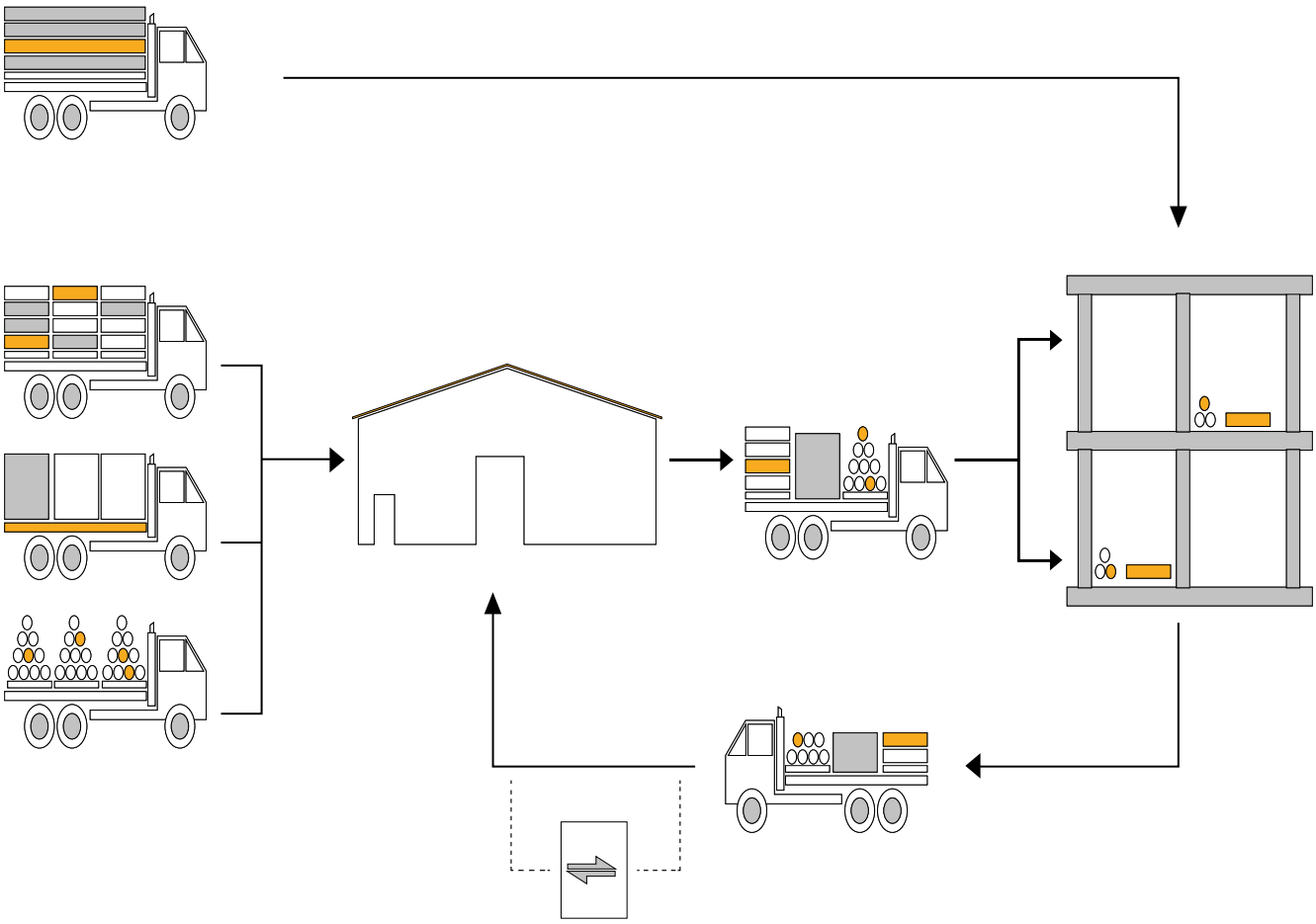
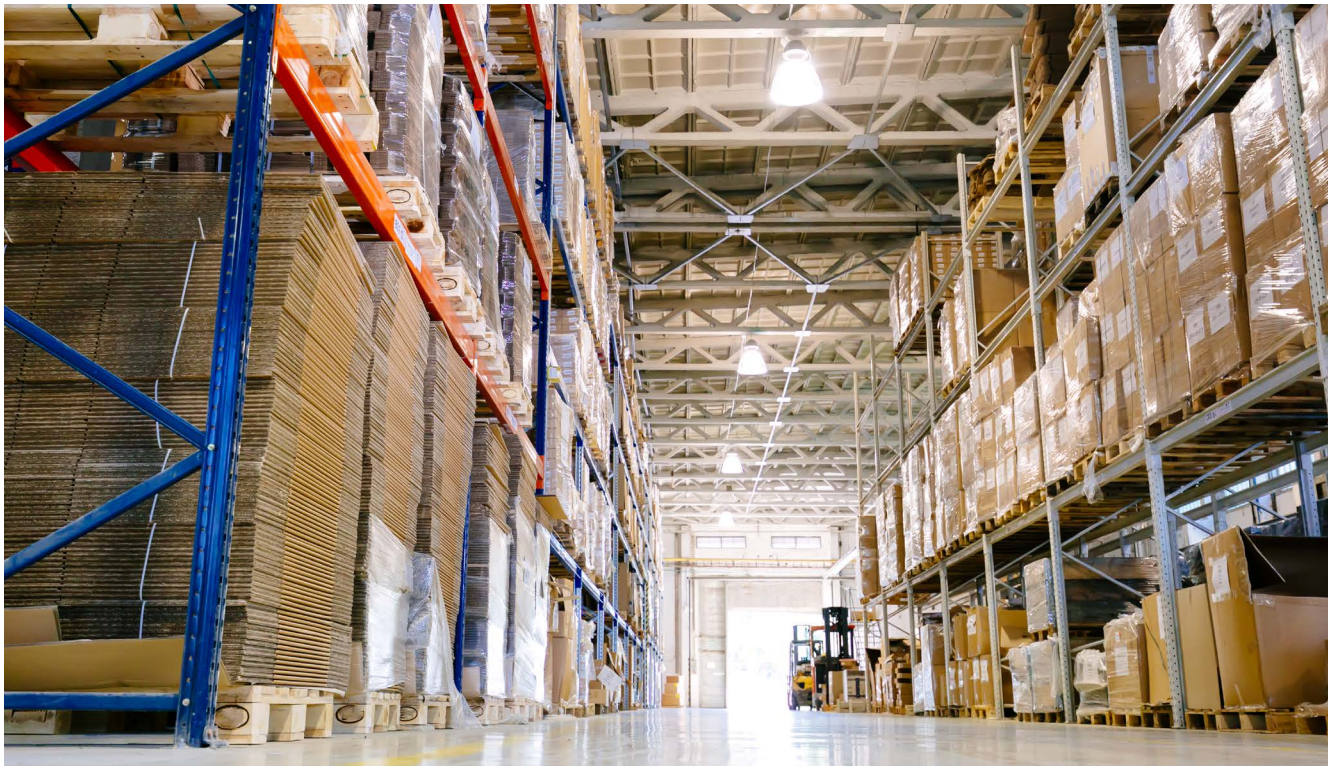


Figure 11: Construction Consolidation Center
Source: Greger Lundesjo, The Logistics Business - Working together for a world without waste

» 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.

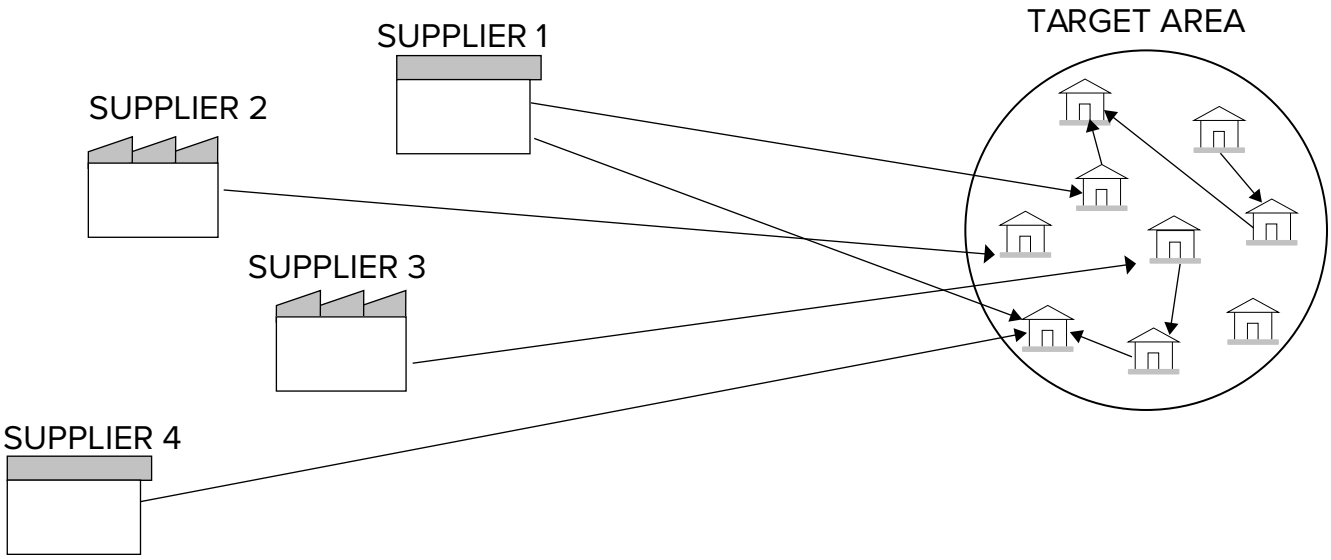


Figure 12a: Deliveries in absence of the consolidation center
Source: Columbia University, Going the Last Mile

» 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.

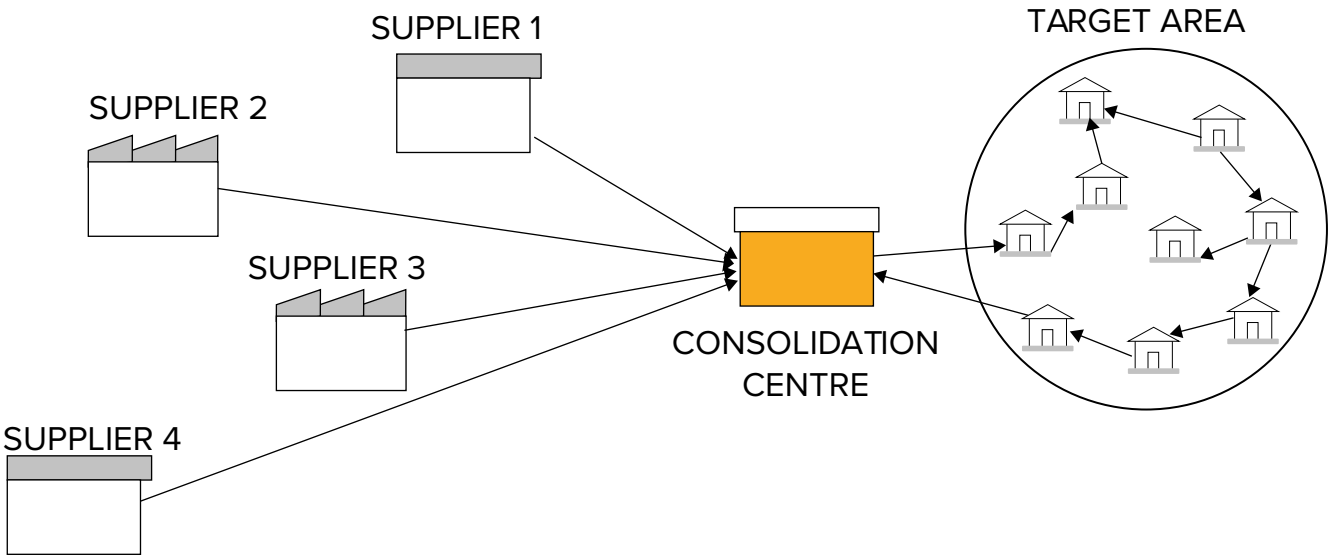


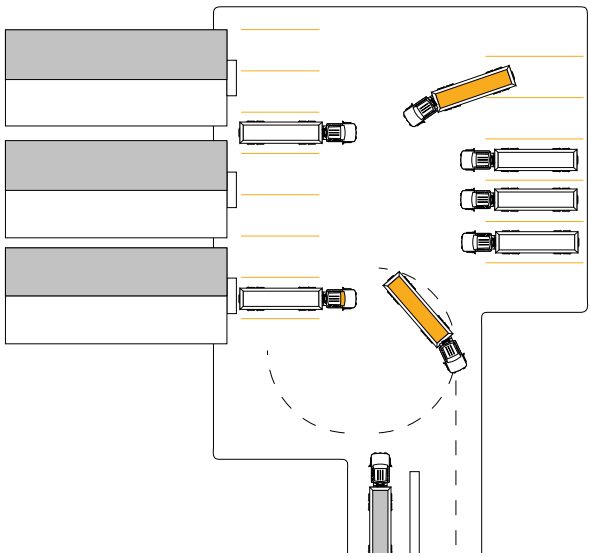
Figure 12b: Deliveries in presence of the consolidation center
Source: Columbia University, Going the Last Mile

» 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.

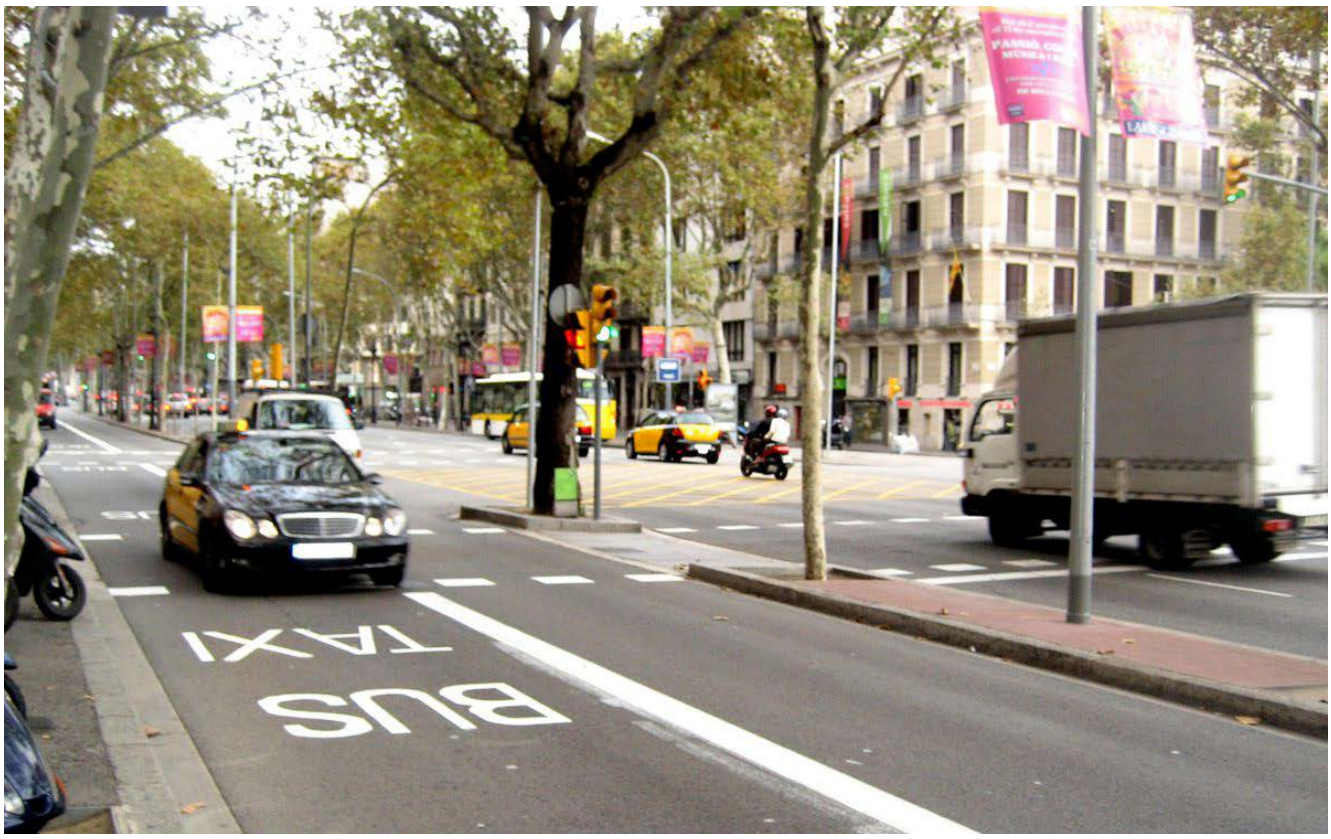


Figure 13: Multi-use lanes in Barcelona
Source: Complete Streets. 2030 Palette.

» 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

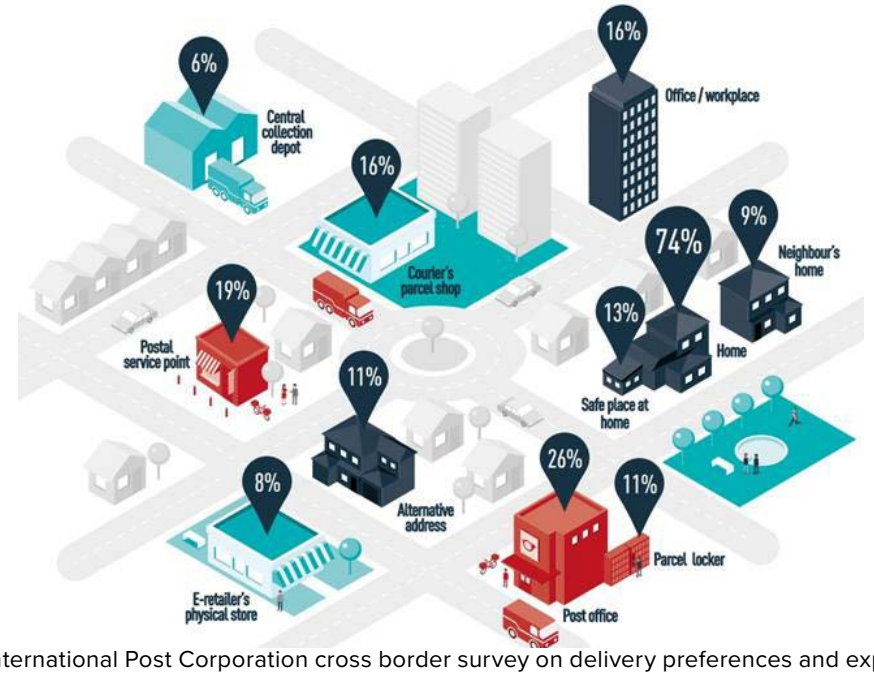


Figure 15: 2017 International Post Corporation cross border survey on delivery preferences and experiences of over 28,892 frequent cross-border online shoppers across 31 countries
Source: International Post Corporation

» 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

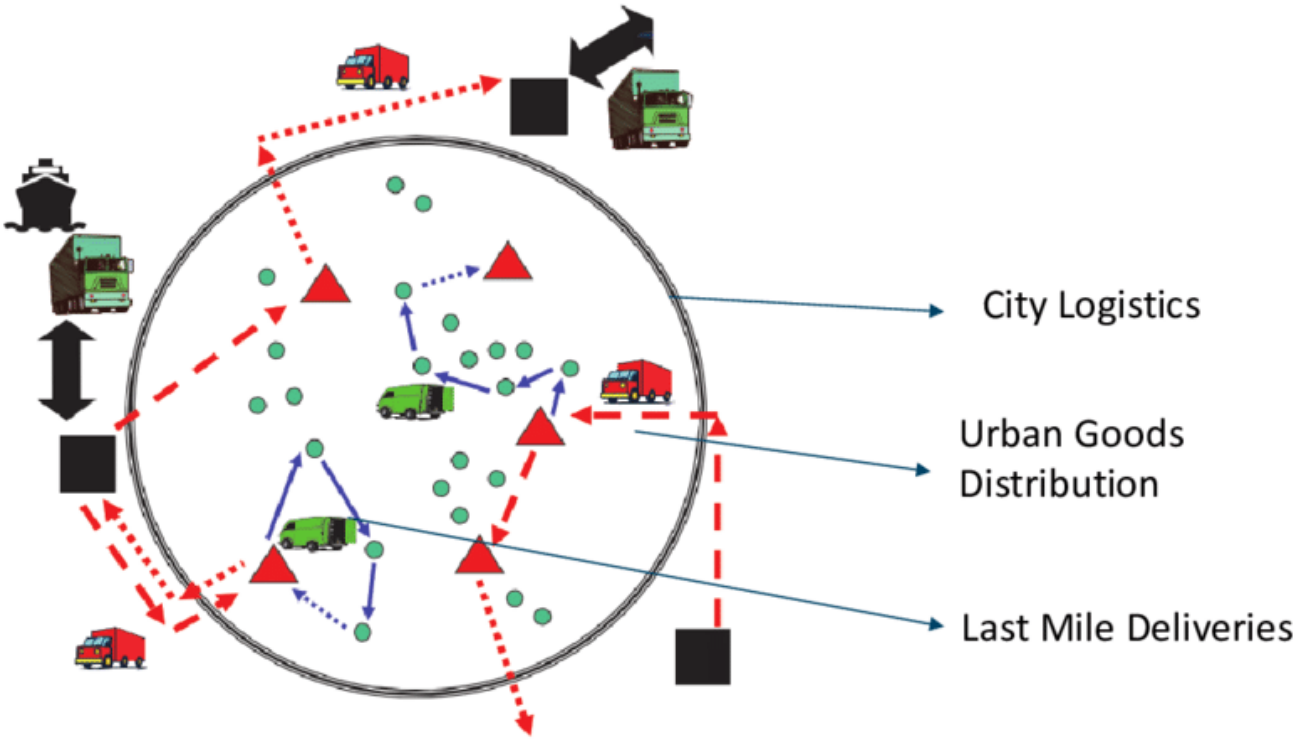


Figure 18: Urban Logistics' Geographical Scope adpted from Crainic et al. 2012, pg 49
Source: Cardenas, Ivan, et al. "City logistics, urban goods distribution and last mile delivery and collection." Competition and Regulation in Network Industries 18.1-2 (2017): 22-43.

» 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.

» Case study

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

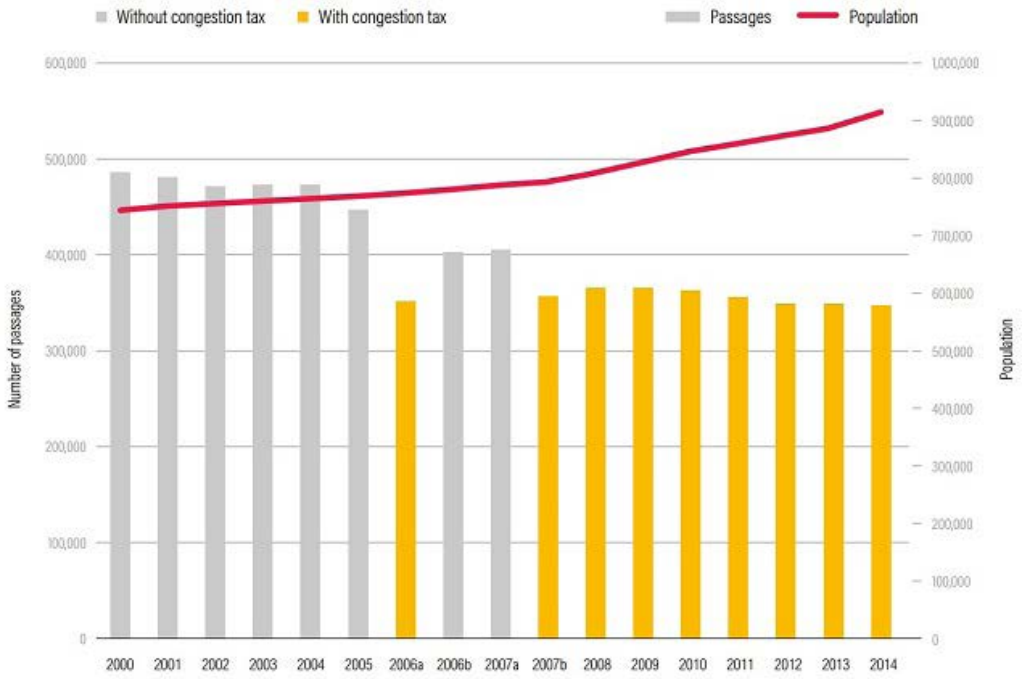

Figure 21: Traffic volume in Stockholm declined and has remained below pre-congestion-charge averages even as population increases. 2006b and 2007a mark the time between the end of the trial period (July 2006) and beginning of the official implementation of charging scheme (August 2007)
Source: World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

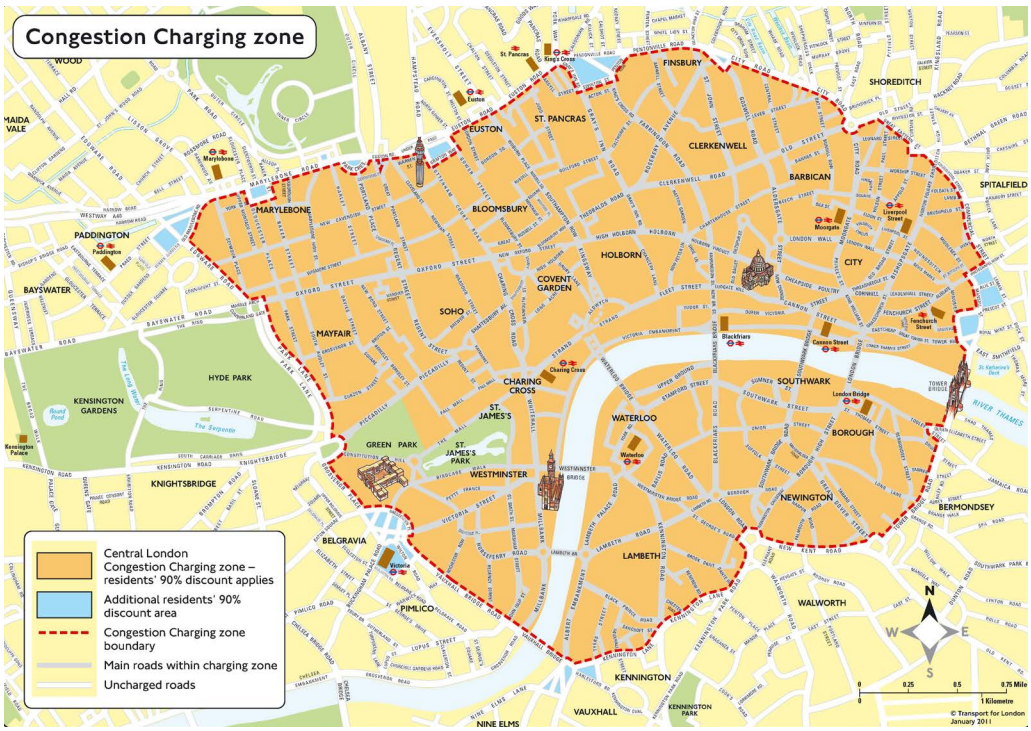

Figure 22: Congestion charge zone in London
Source: Transport for London

» 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.

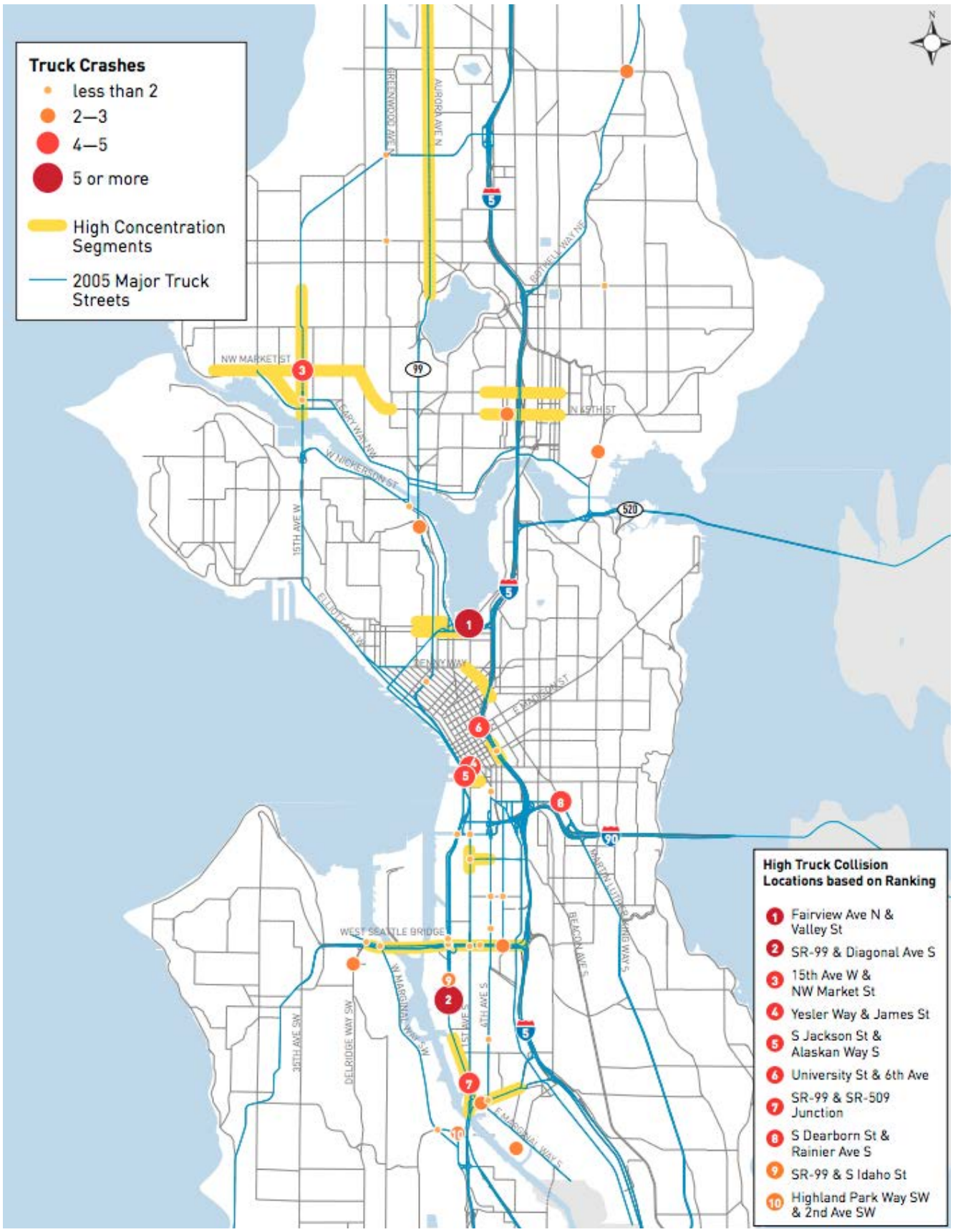

Figure 23: Truck collision hotspots in Seattle
Source: Seattle Department of Transportation. City of Seattle Freight Master Plan. Sept. 2016

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

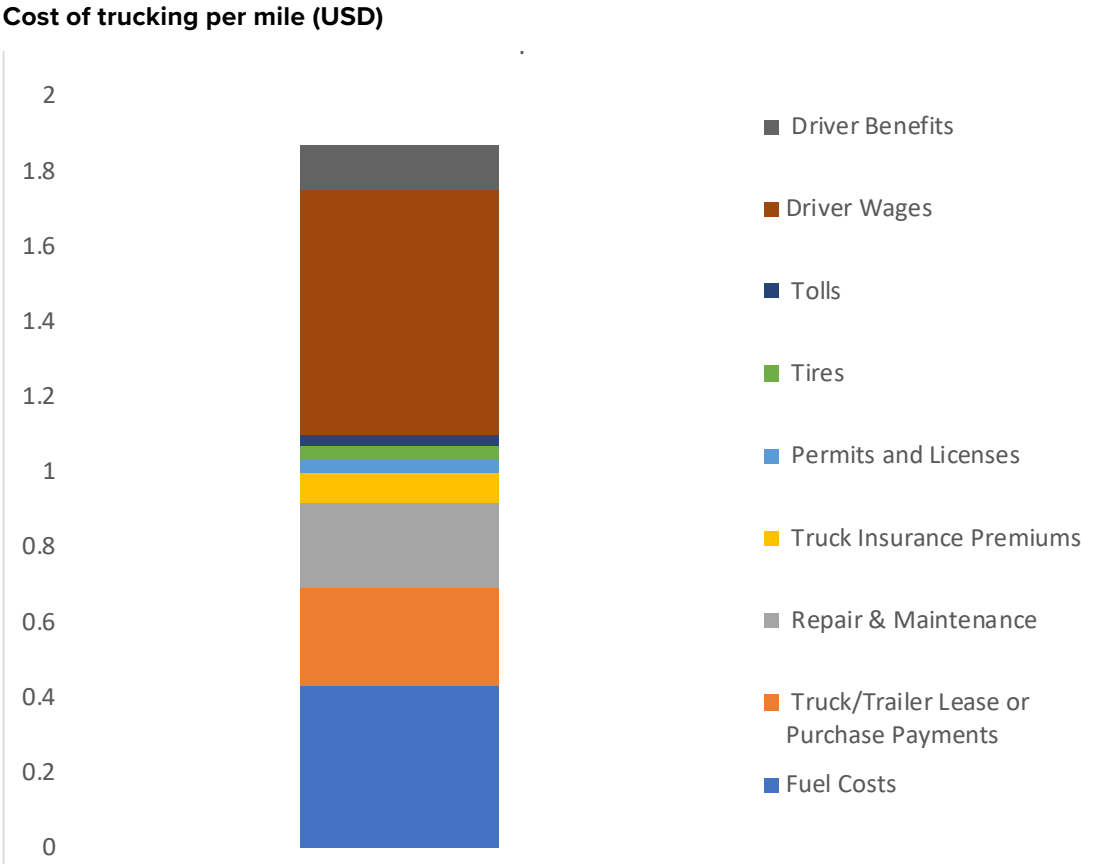

Figure 27: An Analysis of the Operational Costs of Trucking: 2018
Source: American Trucking Research Institute

» 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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