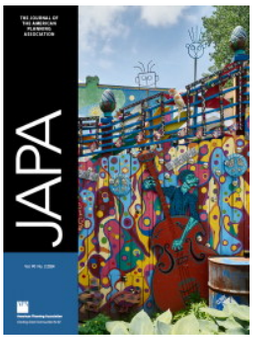

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The State of Sustainable Urban Last-Mile Freight Planning in the United States

Thomas Maxner Giacomo Dalla Chiara Anne Goodchild

ABSTRACT

Problem, research strategy, and findings: The transportation sector is the largest contributor of greenhouse gas emissions in the United States. To articulate how cities may combat rising emissions, municipalities throughout the country have produced climate action and sustainability plans that outline strategies to reduce their carbon footprints from transportation. At the same time, last-mile delivery—also known as *urban freight*—is becoming an increasingly important component of urban transport emissions due to the rise of e-commerce. However, few cities are overtly pursuing policies to reduce emissions from this subsector. In this research we used content analysis to determine the extent to which major cities (based on population and growth) were considering or actively developing sustainable urban freight practices. We developed a simple contextual scale to compare the comprehensiveness of planning trends between cities. This content analysis also identified the strategies those cities are considering. Our findings show that fewer than half (45%) of the studied cities have considered last-mile freight in sustainability planning at all. Of those, only 17 (29%) have articulated an intent to dedicate resources toward achieving that goal.

Takeaway for practice: We found that urban freight planning is still in its infancy in terms of actions taken by municipal agencies. Though some cities have comparatively comprehensive plans dedicated to the industry, most are just now scratching the surface. Those cities lacking dedicated last-mile freight plans can learn from those other cities initiating pilots and collecting data from the industry. We point out also, though, that urban freight planning requires an understanding of the stakeholders, namely, delivery companies, and the first step for many cities is to initiate communication and collaboration with the private sector to better understand the environmental impact of urban freight in their city.

Keywords: last-mile freight, sustainability, transportation policy, urban freight

Last-mile goods delivery, and the externalities associated with it, is on the rise in urban areas (Buldeo Rai et al., 2017; World Economic Forum, 2020). The increase in urban deliveries can be attributed to changes in consumer demand, new or better services offered by companies, and the increase in the urban population. E-commerce has changed the way customers interact with companies by offering platforms outside traditional shopping channels (Wagner et al., 2020). Services including same-day delivery, prepared food delivery applications, and grocery delivery services have resulted in the growth of e-commerce-related urban freight trips (Rotem-Mindali & Weltevreden, 2013) as well as an increase in the number of vehicles competing for limited space on city infrastructure (Chen et al., 2016; Viu-Roig & Alvarez-Palau, 2020). Cities, then, have been increasingly affected by the local air and noise pollution, greenhouse gas (GHG) emissions, congestion, and road safety hazards associated with last-mile delivery vehicle activities. Air and noise pollution have immediate, negative impacts on the health of urban populations, and GHG emissions are contributing to long-term climate change (U.S. Environmental Protection Agency, 2016). Dense, highly populated, and rapidly growing cities can expect to see an increase in goods-related vehicle traffic of up to 30% in the coming decade (World Economic Forum, 2020).

Our research is part of a larger project aimed at identifying ways to reduce emissions from last-mile goods movement and the challenges that exist to implementation of those strategies. Throughout this article we use *urban freight* and *last-mile delivery* or *goods*

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movement interchangeably. This research is centered on the planning aspect of urban freight. Policy problems, in this case emissions from freight, are often referenced in long-range planning documents and solutions are offered. Planning documents can be a useful tool to identify the scale and scope of resources being allocated to a problem. Our research is the first to ask: What is the state of sustainable urban last-mile freight planning in U.S. cities?

In particular, we address the following questions:

- How do U.S. cities define urban freight?
- What strategies are U.S. cities considering to reduce last-mile delivery emissions?
- How often are freight strategies considered in urban planning?
- What is the context in which sustainable last-mile strategies are referenced?

We answered these research questions by performing a scan of the relevant policy documents published by major U.S. cities. We first identified which sustainable last-mile strategies cities were seeking to implement. Then we evaluated the degree to which those strategies were incorporated into city planning documents: Were there tests or pilots ongoing, or was the reference intended to guide policy decisions in the future? Our analysis here provides a general overview of how widespread sustainable urban freight planning is in U.S. cities.

This article is organized as follows: The next section describes the methods used to select U.S. cities to evaluate, extract prescient references from those cities' planning documents, and the evaluation tool developed for our research. Next, we describe findings from the review of the city plans, organized by research subquestions listed above. We show that the definition of urban freight has been inconsistent and that few cities have considered multiple strategies, much less dedicated resources to testing those strategies. Findings are followed by a discussion of the key findings and conclusions. We found that there were model cities pursuing multiple sustainable freight avenues from which other cities less familiar with the industry could gain valuable knowledge.

Background on Sustainable Urban Freight Planning

Historically, U.S. cities have not regulated urban last-mile deliveries the same way they have passenger transportation or even regional and port-related freight. Last-mile goods movement is often an ignored aspect of city planning (Lindholm & Blinge, 2014). The reasons for this are a) the freight industry is disaggregated and heterogenous, with multiple stakeholders and diverse supply chains involved; b) freight transportation is controlled by private companies; c) cities often lack the data, knowledge, and resources to manage urban deliveries; and d) freight transportation has been, and often still is, conflated with heavy vehicles or sectors like rail and maritime (Lindholm & Blinge, 2014; Maxner et al., 2022). Among each goods category there may be two or three large competitors, but there are also numerous smaller players. It is difficult for cities to reach, much less influence, these many companies. This leads to the second reason cities have not regulated urban freight: a lack of understanding among policymakers of how delivery firms operate (Maxner et al., 2022). Most city planners do not know how many trucks and vans are operating in their cities or where they make deliveries. Few cities have staff dedicated to freight planning, and those that do focus mostly on large trucks.

The importance of addressing emissions from urban freight has grown over time. As noted by Jaller and Pahwa (2023), aspects of e-commerce such as expedited delivery times have led to the environmentally inefficient transport of goods via unconsolidated truckloads and an increase in the number of fossil fuel–burning vehicles on the road to maintain rush delivery services. The share of consumer products purchased online has been increasing and is projected to represent 50% of all retail growth by 2025 (Jaller & Pahwa, 2023; Mashalah et al., 2022). Despite representing only 10% to 12% of transportation emissions in cities including Oakland (CA), Seattle (WA), and New York City (NY), vehicle miles traveled and emissions from the sector have been trending upward (City of Oakland, 2020; City of Seattle, 2020; New York City Department of Transportation [DOT], 2021). This comes as emissions from passenger and transit vehicles trend downward (City of Oakland, 2020; Deliali et al., 2021).

Reducing emissions from urban last-mile deliveries also lends itself to a separate goal shared by planners in many U.S. cities, which is improving transportation equity. Zoning laws and pre-existing land use patterns have contributed to certain population groups being subjected to higher levels of pollution (Deveci et al., 2022; Heisel et al., 2022). Researchers have shown that low-income neighborhoods are subject to higher emissions from urban warehouses and the associated last-mile deliveries than wealthier regions (Fried et al., 2023). Focusing more planning effort on urban goods movement could alleviate some of these impacts in the future.

Urban last-mile deliveries today are reliant on vehicles that make use of city-managed infrastructure (World Economic Forum, 2020). As owners of the physical transportation infrastructure, cities have the ability and tools to act to reduce emissions from urban freight

(Markolf et al., 2020). By leveraging municipal control over curb space access restrictions and by providing resources to private companies including public charging, information, and even state-supported grants, cities can meaningfully reduce emissions from the urban freight sector (C40 Cities, 2023).

Several cities in the United States have been pioneers in deploying and piloting strategies for sustainable last-mile deliveries. Examples include Santa Monica (CA), which piloted Zero Emissions Zones, and New York City, which developed after-hours delivery pilots and cargo bike delivery programs (Conway et al., 2017; Holguín-Veras et al., 2014; Peters, 2021). Though several of these strategies and pilots have been analyzed in the literature (Anderson et al., 2005; Figliozzi et al., 2020; Holguín-Veras et al., 2014), it is not clear how many other cities are prepared to deploy these strategies.

We have established the motivations for city action on last-mile freight emissions, but we must also acknowledge the role of the private sector. Each of the aforementioned pilot programs required private sector commitments, and indeed it is those companies that are ultimately responsible for introducing new technology. Many companies have sustainability plans of their own that affect the last-mile industry (PepsiCo, 2022; UPS, 2021; Volvo Group, 2023). These companies are testing new technology and pursuing strategies with or without collaboration of cities. Indeed, some of these strategies—load sharing, optimization tools, routing, and even mode choice—can be achieved outside the knowledge of cities. However, the focus of our study was to explore the role of cities in urban freight sustainability.

The contributions of our work are methodological and practical. The urban freight transportation body of work has lacked any systematic reviews of city planning documents for urban freight content. By adapting a content analysis approach, we have developed a reproducible technique for analyzing a range of municipal publications. This methodology has been applied to scholarly or scientific work for urban freight research in the past but not in policy-focused literature for public consumption. This work is practical in that it highlights a need: Urban freight is a growing industry that cities do not fully understand. The environmental impacts of the industry are therefore not prioritized and often not considered by policymakers. Through our analysis we can identify those cities that do prioritize urban freight, which can educate policymakers only recently putting focus on last-mile deliveries.

Data Collection and Methods

We used a systematic literature review of long-range city planning documents to determine the state of sustainable last-mile freight planning in major U.S. cities. First, we ranked U.S. metropolitan areas by population metrics, and 37 such areas were selected for further processing. Relevant planning documents were gathered through Policy Commons, followed by a search of city-published websites to overcome omissions from the database search. Only about half of the reviewed documents were available on Policy Commons, making the city-by-city website search necessary. The documents were collected between December 2021 and March 2022. Each document was scanned for references to last-mile delivery goals, action items, and emissions reduction strategies. Using keywords (listed in a subsequent section) associated with last-mile delivery, planning documents were analyzed for their inclusion of sustainable last-mile freight policies. Each program was then evaluated on a scale from anecdotal references to concrete, actionable policymaking.

Selection of Cities (Data)

We used population data from the U.S. Census Bureau to select cities for inclusion in this study (U.S. Census Bureau, 2012; Wilson et al., 2012). Rather than selecting cities by population only, we included population density and growth trends as selection criteria because geographically small but dense cities and rapidly growing cities are experiencing the negative externalities of last-mile freight as much as the largest cities by population alone (World Economic Forum, 2020). Population density and growth are recorded by the U.S. Census Bureau according to metropolitan area. The Los Angeles (CA) metropolitan area, for instance, also includes Long Beach and Santa Ana (U.S. Census Bureau, 2012).

Metropolitan areas were ranked by the metropolitan areas' population density, total population, and population growth from 2000 to 2010 (U.S. Census Bureau, 2012; Wilson et al., 2012). Any metropolitan area ranked in the top 25 of two or more of these demographic characteristics was selected for plan review. If a metropolitan area did not rank in the top 25 of two categories but was ranked in the top 15 of a single category, that area was also included in the plan review. A ranking of 1 to 15 was selected for the single category selection criterion to set limits on the document review scope while also focusing on cities that would feel the externalities of urban freight most acutely (World Economic Forum, 2020). The number of metropolitan areas meeting these criteria was 37. Next, every city or urban area within the 37 metropolitan areas was compared with a list of the top 100 most populous cities in the U.S. (U.S. Census Bureau, 2022). If the city or urban area was included in this list, it was selected for plan review. This resulted in 56 individual cities and two counties. The full list of evaluated metropolitan areas

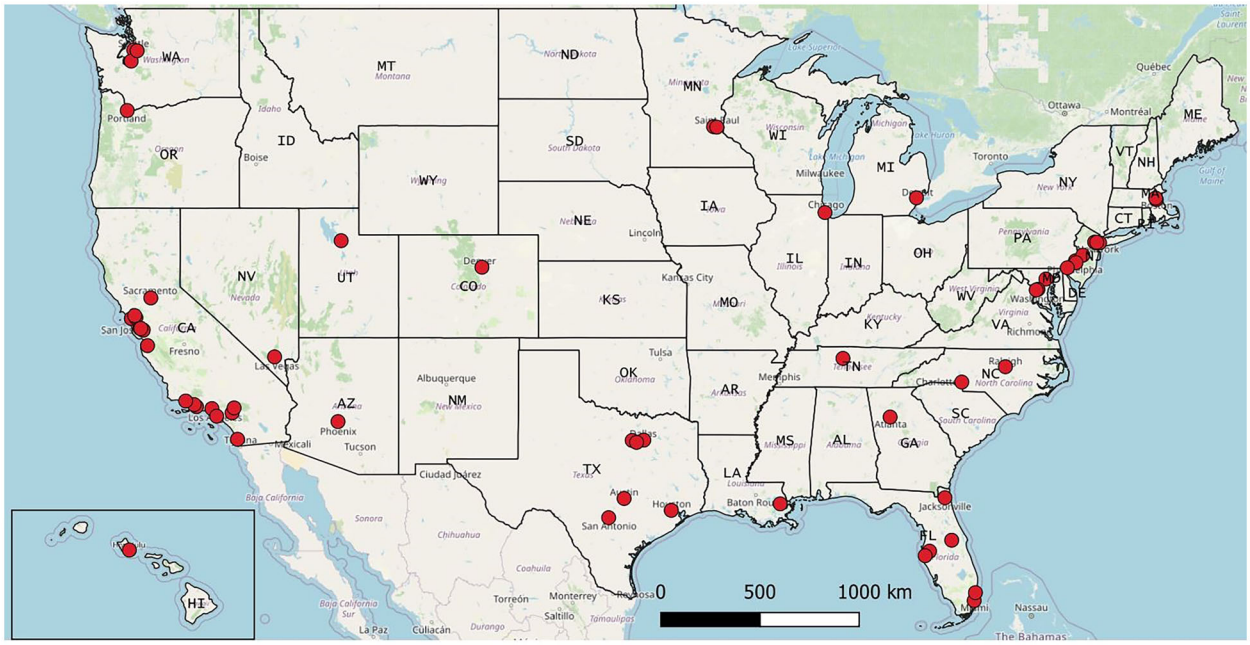

Figure 1. Cities and counties included in planning document scan.

(46), reviewed cities or countries (58), and excluded cities (54) is included in the Technical Appendix.

Figure 1 shows the selected cities and counties. It should be noted that there is a lack of metropolitan areas included from the central part of the country. For instance, St. Louis (MO) ranked 18th in total population but did not rank in the top 25 for the other two variables.

Types of Planning Documents Considered

After a review of agencies and their publications for five test cities, we identified four categories of planning documents to provide the most complete overview of urban freight planning. These were transportation plans, sustainability plans, freight plans, and bicycle plans. Transportation plans can be included in general plans, strategic plans, or comprehensive plans as a specific chapter or as standalone documents. General, strategic, and comprehensive plans are developed at the behest of the mayor or city council and require involvement from nearly every department in the city. Transportation plans are typically produced by a single department (transportation, planning, or public works).

Sustainability plans are typically published as standalone reports, but three of the test cities include chapters in the cities' comprehensive plans dedicated to sustainability. These plans can be alternatively titled *climate action plans*, *sustainability plans*, or *environmental plans*. Although mostly produced by the office of sustainability in a given city, some of the documents reviewed also included significant input from the DOT. Alternatively, they can be produced directly by the office of the mayor or by a city council special delegation.

Few cities have dedicated urban freight plans, but those that do focused on last-mile freight rather than regional freight. These were produced exclusively by departments of transportation. Finally, bicycle plans were reviewed for the sole reason that an emerging strategy to last-mile freight emissions has been using micromobility modes to replace larger vehicles. If a city was considering this strategy within their own jurisdiction, the policy should appear in the bicycle plan.

Planning documents from higher administrative districts were not included with a few notable exceptions. Two cities, Arlington (VA) and San Bernardino (CA), were found to make most transportation policy decisions and produce most planning documents at the county level. In these cases, county plans were analyzed instead of city plans. Local neighborhood improvement plans were largely omitted from this analysis except for Austin (TX) and Seattle. These plans tended to either a) align with the policies outlined in citywide documents or b) provide an analysis of specific transportation projects. Table 1 shows the agencies commonly responsible for each document type.

Analysis of Planning Documents

From the 58 cities analyzed, 241 unique documents were scanned for keywords. A review of the related literature led us to select 24 keywords: *last-mile, freight, delivery, goods, truck, van, e-commerce, urban, logistics, carrier, courier, package, cargo, parking, curb, curb management, off-peak, electric [vehicle], charger or charging,*

Table 1. Types of planning documents by agency responsible for their development.

	Types of plans				
Agency name	**Transportation plans**	**Sustainability plans**	**Urban freight plans**	**Bike plans**	**Total**
Department of transportation or traffic	16	1	4	23	44
Planning department	18	5	1	10	34
Office sustainability or environment	1	21	0	2	24
Department of public works	5	1	0	9	15
City council special committee or commission	3	3	0	6	12
Mayor's office special committee or commission	3	7	0	0	10
County offices	0	1	0	2	3
City manager office	1	2	0	0	3
Multidepartment coalition (planning, transportation, sustainability, and/or others	0	3	0	0	3
Mayor's office	1	1	0	0	2
Metropolitan planning organization	0	0	0	2	2
Department of parks and recreation	0	0	0	1	1

alternative fuel, loading, consolidation, cargo bike, and *electric bike*.

If one or more of the keywords were included in a document, that section and the overall goals of the plan or plan section were read in detail. If the reference did not contain context related to reducing GHG emissions or sustainability in general, it was not included in the database. The reference, policy, or strategy was logged in a city plan database and evaluated according to contextual tiers created for this study. The tiers represent whether a) a city can measure progress toward a goal and b) the reference-suggested implementation was practical or imminent. These categories speak to the maturity of sustainable urban freight planning, although without a clear measure of change in the temporal scale it was not possible to evaluate maturity such as performed by Kiba-Janiak (2017). The tiers were developed after an initial review of approximately 10 cities:

- Tier I: Anecdotal references
- Tier II: Planning or policy guidelines
- Tier III: Action plans or actionable program
- Tier IV: Specific goals or targets

Tier I documents did not commit the city to further action. The document might acknowledge that a certain strategy exists or that the strategy is being pursued in other cities but did not signal that the city intends to pursue it further. An example of an anecdotal reference to cargo bikes comes from the St. Petersburg (FL) Integrated Sustainability Action Plan (City of St. Petersburg, 2019). In the plan, the Office of Sustainability noted that emissions can be reduced in the parcel delivery industry using cargo bikes instead of vans. It did not suggest expanding cargo bike use was a priority for the city or that the city would in any way support cargo bikes directly.

Tier II documents did not have the concrete steps outlined in actionable program. For instance, Charlotte (NC) committed itself to "reduce emission resulting from … excessive vehicle idling" in the 2045 Metropolitan Transportation Plan (Charlotte Regional Transportation Planning Organization, 2018). The city did not, however, outline what actions would be taken to reduce vehicle idling. Policymakers have not committed themselves to an action in particular but should evaluate a range of policies to reduce idling in some way.

Tier III documents communicated a series of actions that the agency would take toward achieving some goal. To signal to logistics companies that the market must shift to electric trucks, a city might perform a study to determine curbs designated for electric or zero-emission vehicles only. Another example is a pilot program. The City of Minneapolis (MN), for instance, included this action in its 2020 Transportation Action Plan: "Pilot a shared locker system that can accommodate multiple e-commerce deliveries and is available to the public" (City of Minneapolis, 2020).

Tier IV documents not only contained strategies that cities are adopting but were also state-measurable goals to track their deployment progress. For instance, San Jose (CA) set a goal for 60% of local delivery vehicles to be electric by 2030 and 100% by 2040 (City of San Jose, 2018).

There are certain limitations to this methodological approach. First is the geographic extent of our analysis. Heavily favored were cities in populous states: California, Texas, Florida, etc., but missing were cities from the Midwest and small states. Second, we reviewed only the most recent planning documents. In that respect, the results cannot offer an understanding of progress and therefore maturity (Kiba-Janiak, 2017). It is possible that some cities have mentioned the same strategies every 5 years without allocating resources. That being said, most of the technology referenced has been developed within the time frame of most plans' publication to today.

Findings

How Do Cities Define Urban Freight?

Before we can understand the approaches cities take toward reducing emissions from urban freight, we must define urban freight in the planning context. Urban freight includes the delivery and pickup networks to move and store freight on its way from origins to destinations in urban areas as well as the infrastructure on which those service networks operate (Bektaş et al., 2017). In the selected planning documents, there was not a single definition that U.S. cities used to define what urban freight is, and it did not always align with this technical definition.

There are freight activities that take place within the urban environment that would not be considered urban freight. These include drayage to and from ports and regional goods movement on highways passing through or around cities. More than half the studied cities (34 of 58) either included one or both activities in their definition of urban freight along with last-mile deliveries or referenced only regional-type goods movement as freight. Of the remaining 24 cities, 19 referenced last-mile activities directly. The other five cities did not define urban freight or last mile directly, although they mentioned these terms in their plans.

What Strategies Are U.S. Cities Considering to Reduce Last-Mile Delivery Emissions?

The state of sustainable urban freight planning depends on the actions, if any, cities are taking. These actions are referred to as *strategies*. We identified 15 strategies for reducing last-mile delivery emissions by reviewing city planning documents. Table 2 is adapted from Maxner et al. (2022) and groups strategies into four main categories. It is important to note that this list comprises only those strategies explicitly named in city planning documents. It does not include many other strategies companies are exploring such as shipment consolidation and alternative fuels like hydrogen or biofuels.

The vehicle technology category includes two connected strategies: public charging (16 cities) and vehicle electrification (15 cities). Cities that included either strategy generally wanted to incentivize the use of electric vehicles (Maxner et al., 2022). It is assumed by the cities that referenced autonomous vehicles that these vehicles are electric and that emissions reductions would occur from fuel switching. Zero-emissions refrigeration, mentioned only by New York City, also involved fuel switching.

Of the land use strategies, curb space management was cited most. As it relates to freight this typically means providing adequate curb space for trucks. Theoretically, providing adequate space for parking would reduce the time drivers need to search for parking and related emissions. Nine cities referenced *microhubs* or *freight hubs*, which are facilities within a city where goods can be dispatched on smaller, low-emission vehicles.

The most referenced alternative delivery method was cargo bikes. These vehicles would replace fossil fuel trucks or vans on delivery routes but could also be paired with strategies including microhubs. Parcel lockers can reduce emissions by reducing the number of stops a vehicle must make because they shift multiple destinations to a centralized location.

Off-peak deliveries were the most cited enforcement strategy. Off-peak delivery programs have been demonstrated to reduce emissions from freight in New York City (Holguín-Veras et al., 2014). Anti-idling regulations are longstanding laws in many cities, and the references typically referred to dedicating more resources to enforcing anti-idling laws more strictly. Low- or zero-emission zones and vehicle size limits would restrict the type of vehicle entering an area of a city. In practice this could incentivize electrification or downsizing to more efficient fossil fuel vehicles.

Table 2. Sustainable last-mile freight strategies and count of cities that reference each strategy.

Category	Strategy	No. cities that mention strategy
Vehicle technology	Public charging	16
	Vehicle electrification	15
	Autonomous vehicles (cars, vans, drones, robots, etc.)	4
	Zero emission refrigeration	1
Land use	Curb space management	17
	Microhubs or freight hubs	9
Alternative delivery methods	Cargo bikes	17
	Parcel lockers	9
	Transit for freight	1
Enforcement	Off-peak deliveries	17
	Anti-idling regulations	9
	Low- or zero-emission zones	7
	Vehicle size limits	5
Other levers		2

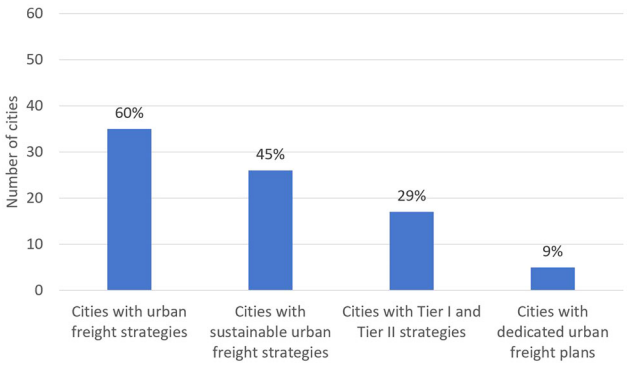

Figure 2. Number of cities and level at which they addressed emissions from urban freight.

Other levers includes creating a recognition program for clean vehicles and exploring the efficacy of freight-only lanes.

How Often Are Sustainable Freight Strategies Considered in Urban Planning?

Figure 2 depicts how often, in terms of the share of cities, sustainable urban freight planning exists. Most cities (36 of 58, 60%) included policies aimed at last-mile freight activities in some manner. This included any sustainability-related policies but also those aimed at increasing roadway efficiency, reducing congestion, and improving safety for those vehicles. Fewer cities addressed emissions from last-mile freight separate from other forms of transportation. Only 26 cities (45%) referred at least once to strategies aimed at reducing carbon emissions from last-mile goods movement. Reducing emissions from last-mile freight was not a universal concern across departments. In 17 of those 26 cities a last-mile freight policy was mentioned in only one planning document. Eleven cities mentioned only a single strategy, in either their sustainability plans or long-range transportation plans but not both. This suggests that the departments responsible for producing those reports were not prioritizing the same policy issues. Of the cities that mentioned two emission reduction strategies, the same lack of consistency existed. Six cities—Dallas (TX), Philadelphia (PA), Arlington (VA), Nashville (TN), Baltimore (MD), and Houston (TX)—included two emission reduction strategies, and in all cases the policies were included in reports produced by one department. Only Arlington mentioned these two strategies in separate documents.

What Is the Context in Which Sustainable Last-Mile Strategies Are Referenced?

We categorized each strategy reference into four tiers to better understand how close cities were to implementation or whether that was a stated goal. The tiered ranking approach (Table 3) can signal whether a city was allocating significant or even any resources to the problem.

Sustainable urban freight strategies were referenced a total of 160 times across 125 individual documents. Most (54%) of these references are Tier II planning guidelines, followed by Tier III (27%), Tier I (15%), and Tier IV (<4%). This finding suggests that a) only a small share of cities was prepared to take specific action to address emissions from urban freight and b) U.S. cities had not yet allocated resources to many strategies referenced in planning documents.

More than a third of Tier I anecdotal references involved cargo bikes, many of which suggested cargo bikes could replace fossil fuel vehicles. They did not indicate that a city planned to support this strategy, only that it existed. Other anecdotal references acted as an information sharing tool. For example, Tampa's (FL) Office of Sustainability included a link to a website displaying publicly available chargers.

Within Tier II references, curb space management, public charging, off-peak deliveries, and vehicle electrification were referred to across the highest numbers of planning documents, coinciding with overall mentions. The context of these references, however, were vague in terms of actual examples. They include "work with partners to identify funding to advance alternative fuel technologies" (City of Seattle, 2016, p. 88). These references lacked the allocation of personnel or funding and did not describe how support of these programs could be achieved.

Concrete actions (Tier III) technically committed city departments to fulfilling those actions, though timelines were not always outlined in the planning documents. Again, electrification, public charging, and off-peak deliveries were referenced more than other strategies. However, microhubs, parcel lockers, cargo bikes, and anti-idling regulations were only referenced in two fewer documents. These strategy references could specifically detail pilot programs: "in December 2019, New York City announced a six-month cargo bicycle pilot concentrated in Manhattan's central business district" (New York City DOT, 2021). Minneapolis likewise was moving toward a parcel locker pilot located at high-traffic transit stations (City of Minneapolis, 2020).

Finally, Tier IV strategies were the smallest share of strategy references. Only vehicle electrification, public charging, and off-peak deliveries were evaluated at this level of planning. The main difference between Tier III and IV was that measurable outcomes were defined in Tier IV. For example, Los Angeles's Green New Deal established a plan to "deploy 50-100 zero emission trucks in a clean truck program" (City of Los Angeles, 2019). Another example was San Jose's plan to convert 100% of last-mile deliveries to electric vehicles by 2040 (City of San Jose, 2018). Although the plan did not indicate how this goal would be tracked, it did set a timeline and a measurable outcome.

In addition to the contextual ranking of strategies, we evaluated the state of urban freight planning through the age of planning documents. Figure 3 shows how often plans have been updated in the last two decades. Although most of these plans were published in the last 5 years, there were still a substantial number published before the rise of e-commerce, reflecting the fact that the definition of urban freight has changed over time and is inconsistent across cities. Almost 53% of all plans describing sustainable urban freight have been published in the last 6 years, most (50 of 81) of which were published in the last 3 years. These plans were most likely to include Tier III and IV strategies or attempt to quantify the impacts of urban freight.

Table 3. Strategy references by tiered categories.

		No. documents to include strategy			
Strategy	**No. cities that mention strategy**	**Tier I[a]**	**Tier II[b]**	**Tier III[c]**	**Tier IV[d]**
Off-peak deliveries	17	3	11	6	1
Cargo bikes	17	9	9	6	0
Curb space management	17	1	15	3	0
Public charging	16	2	13	5	1
Vehicle electrification	15	2	10	6	4
Microhubs	9	2	6	4	0
Parcel lockers	9	1	6	4	0
Anti-idling regulations	9	0	5	4	0
Low-emission zones	7	1	3	3	0
Vehicle size limits	5	1	4	0	0
Autonomous vehicles	4	2	3	0	0
Transit for freight	1	0	1	0	0
Zero emission refrigeration	1	0	0	1	0
Other levers	2	0	1	1	0

Notes: a. Tier I: Anecdotal references. b. Tier II: Planning or policy guidelines. c. Tier III: Action plans or actionable program. d. Tier IV: Specific goals or targets.

Discussion

Review of Results

Through this analysis we have determined that 60% of major U.S. cities have published details related to sustainable urban freight strategies in their long-range planning documents. Long-range plans are intended to be visionary documents, but they are representative of policy trends. Within the 60% of cities that discuss urban freight, there was a wide range in both the number of strategies considered and the progress cities have made in introducing those strategies. Most cities were in the early stages of planning. These cities mentioned one to five strategies but did not establish concrete plans to test new technology or assign resources to the topic. These cities' plans have been published in the last 5 years. Most of these strategies were mentioned by a single agency in the document or documents that agency is responsible for developing.

A second group of cities (9 of 35) discussed multiple emission reduction strategies but progressed far enough in their planning to establish at least one pilot program or other concrete action in the immediate future. These cities had similar, clear definitions of urban freight without overlap with regional goods movement or port operations. These plans indicated a willingness or intention to dedicate resources to freight projects. In this group, we also began to see consistency in the strategies referenced by different agencies in their long-range plans.

The final group of cities (8 of 35) showed the most progress in sustainable urban freight planning. Not only did these cities consider seven or more emission reduction strategies, but they outlined plans for multiple pilot programs or concrete actions. In addition, five of these eight cities had dedicated urban freight plans. These cities were also beginning to set measurable goals or outcomes for their urban freight programs.

The Role of Private Firms

Cities want to foster an environment in which the private sector can test different technologies and decide upon the best path forward for their business (Maxner et al., 2022). This is reflected in the *carrot versus stick* (Piatkowski et al., 2019) approach conveyed in the text of planning documents. With the notable exception of anti-idling regulations, the strategies referenced by cities came in the form of carrots. Rather than enforcing parking bans for delivery vehicles, cities sought to provide curb space more aligned with their needs (New York City DOT, 2021). Cities also sought to provide real estate (freight hubs), programmatic support (cargo bike regulations), or charging infrastructure. Ultimately companies will finance decarbonization of the urban freight industry, but cities can help facilitate the creation of low-emission technologies by supporting or participating in pilot programs. However, communication with the private sector is key. Without an understanding of last-mile operations, cities run the risk of focusing public funds on strategies companies may not pursue. It is critical that some cities, including Austin and Chicago, have already included in their plans the creation of industry groups to gain this understanding from companies (City of Austin, 2019; City of Chicago, 2016).

Most Comprehensive Sustainable Urban Freight Planning

The comprehensiveness of a particular city's sustainable urban freight planning can be defined by the number of

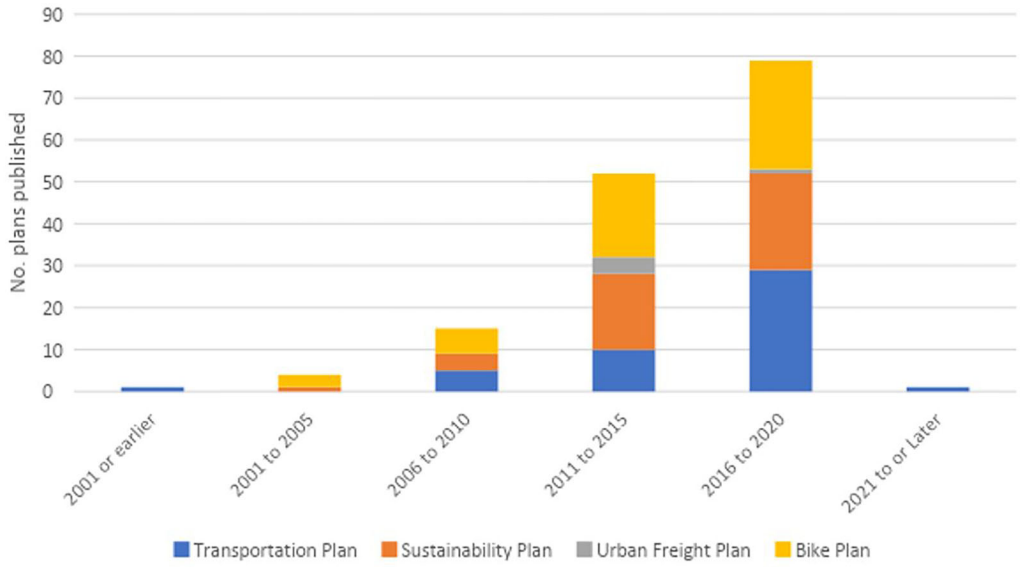

Figure 3. Number of the most recent freight-related long-range planning documents published by U.S. cities.

Table 4. Cities with comprehensive sustainable urban freight planning.

City	Total strategies	Tier III strategies	Tier IV strategies	List of strategies being pursued[a]
Austin, TX	10	1	0	Vehicle electrification, public charging, curb management, cargo bikes, off-peak deliveries, microhubs, parcel lockers, anti-idling regulations, **low-emission zones**, autonomous vehicles
Los Angeles, CA	7	4	1	**Vehicle electrification**, **public charging**, curb management, **cargo bikes**, off-peak deliveries, anti-idling regulations, **low-emission zones**
Minneapolis, MN	8	4	0	**Public charging**, cargo bikes, **off-peak deliveries**, **microhubs**, **parcel lockers**, anti-idling regulations, vehicle size limits, low-emission zones
New York City, NY	12	7	3	**Vehicle electrification**, **public charging**, curb management, **cargo bikes**, **off-peak deliveries**, **microhubs**, **parcel lockers**, vehicle size limits, **low-emission zones**, autonomous vehicles, **zero-emission refrigeration**, other levers
Portland, OR	8	1	0	Vehicle electrification, public charging, curb management, cargo bikes, **off-peak deliveries**, microhubs, parcel lockers, low emission zones
Seattle, WA	9	5	0	**Vehicle electrification, public charging, cargo bikes, off-peak deliveries, microhubs,** parcel lockers, anti-idling regulations, vehicle size limits, autonomous vehicles
Washington, DC	7	3	0	Public charging, curb management, **cargo bikes**, off-peak deliveries, **microhubs**, parcel lockers, anti-idling regulations

Note: a. Tier III (action plan or actionable program) and Tier IV (specific goals or targets) strategies shown in bold.

strategies referenced and how close those strategies were to implementation. Considering both of those factors, we found that seven cities had substantially comprehensive plans to reduce emissions from urban freight: Austin, Los Angeles, Minneapolis, New York City, Portland (OR), Seattle, and Washington (DC; Table 4). Each of these cities discussed at least seven strategies within their long-range planning documents, typically covering several of these strategies across multiple documents or by multiple departments. The cities also had the most Tier III– and Tier IV–type strategies, accounting for almost 60% of these types of strategies across all 58 municipalities.

In some ways cities with the most comprehensive plans were like the overall sample of U.S. cities. Each city

included off-peak deliveries, cargo bikes, and public charging for delivery vehicles in their planning documents, all three of which were among the most-cited strategies overall. The agency responsible for reducing carbon emissions from freight was not consistent. New York City, Austin, Seattle, and DC made it clear the DOTs were responsible. Those DOTs have published all the material relating to urban freight planning and oversaw administering pilot programs. We might assume the DOTs in Portland, Los Angeles, and Minneapolis were also responsible for administering similar projects, but we still saw strategies discussed in climate action plans that are not mentioned in DOT documents.

Juxtaposing two cities against one another, we found evidence of the novelty of urban freight initiatives. Portland and Austin both highlighted a substantial number of strategies without committing to specific pilot programs. Austin clearly stated in that city's 2019 strategic mobility plan that urban freight was being considered as a separate group of road users for the first time. The plan relied heavily on strategies either implemented or contemplated by other cities. Opposite of this example is Portland, one of only five cities with a dedicated urban freight plan. Though this document was released in 2021, many of the strategies it described were also published in the 2015 climate action plan and the 2012 sustainable freight strategy. Portland has had long experience discussing the topic of sustainability with its freight community and has recently begun piloting much of the relatively new and untested technology in its city (Griggs, 2022).

Other cities have also begun implementing the strategies outlined in their planning documents, especially those determined to be Tier II and IV strategies. Low-emission delivery zones were launched by the Los Angeles DOT in 2022, covering both the low-emission zone and vehicle electrification strategies. Seattle has participated in a microhub including two other strategies: cargo bike and parcel lockers. Minneapolis has installed parcel lockers at transit stations.

New York City stood out even from the list of comprehensive urban freight plans. New York had both a dedicated urban freight plan (New York City DOT, 2021) and a chapter of its overall transportation plan (New York City DOT, 2016) dedicated to freight within the city. Each of these plans outlined the most complete list of freight strategies of any cities. In some cases, New York was the only city to discuss a strategy: zero-emission refrigeration, creating a recognition program for companies with low- or zero-emission vehicles, and advocating for state-level regulations and grant programs for electric freight vehicles. Delivering New York described existing programs than could contribute to GHG emission reductions from freight: The Clean Truck Program has been run since 2012. New York City DOT has implemented policies to promote cargo bikes by designating parking areas or *corrals* for these vehicles, as well as conducting market research on a curb management strategy that could promote the adoption of alternative fuel vehicles.

Challenges to Sustainable Urban Freight Planning

Despite the inclusion of urban freight initiatives in long-range plans, elected officials and municipal departments are not necessarily obligated to follow through on these plans. Part of the difficulty in implementing strategies includes the lack of resources, understanding of the industry, and data upon which measurable goals can be based (Maxner et al., 2022). A review of the city plans revealed other areas that could inhibit strategy implementation. Foremost was the lack of measurable goals. Few cities discussed emissions targets in terms of tons of CO_2 emitted by the sector. Only New York City and Seattle estimated the number of trucks making last-mile deliveries, which is required for an accurate emissions inventory. With few exceptions, the outcomes of even pilot programs were unclear. Did these cities seek to determine whether strategies were feasible or scalable from pilot size to citywide, or were they trying to reduce a certain number of vehicle trips? Without defining these outcomes, it is difficult to determine whether a program was a success. We cannot claim those cities have made progress because there was not baseline or measurable metrics.

Cross-departmental collaboration may be lacking. In most cities the DOT had control over physical infrastructure and could command most transportation-related budget line items. However, there were instances of cross-departmental collaboration, such as the Economic Development Corporation (EDC) in New York with their parking initiative. Offices of sustainability were the second-most cited department. In practice, these agencies could be responsible for administering grants while DOTs could focus on day-to-day activities. Problems might occur when an agency without physical control over resources includes initiatives that are not reflected in the responsible agency's own planning documents. For instance, Los Angeles's Green New Deal detailed plans to support cargo bikes, yet it was not mentioned in the DOT's Great Streets plan. In practice, the Los Angeles DOT has been giving access to curb space for cargo bikes, and this disparity might be reflective of the years in which these plans were developed. But cohesive planning would allow for better prioritization and align different departments.

Conclusions

Urban freight planning is an area that receives little direct attention from city departments, as evidenced by the dearth of freight plans compared with mode-specific plans like bicycle and pedestrian plans (Table 1). This finding alone does not provide an accurate picture of the state of urban freight planning in the United States. By reviewing a series of long-range transportation and sustainability plans, we have shown that reducing emissions from last-mile deliveries is becoming a priority for many cities. Almost half of the sampled cities included emission reduction strategies in these plans, and 29% had clear plans to pilot or fully implement these strategies in the future.

From the standpoint of planning practitioners, we recommend taking a more concerted effort to plan for urban freight. Planners can learn and develop their own last-mile initiatives based on the actions of cities like Seattle and New York. But even those cities with comprehensive plans can contribute to knowledge sharing. By defining measurable goals in their plans and publishing follow-on and progress reports, cities entering the field of urban freight planning can better determine which strategies to pursue and how to engage with private-sector stakeholders. Moreover, city planners can act collectively to influence the freight industry by adopting a standard definition of urban freight so their policies can be better targeted. We have also highlighted a need for cross-departmental collaboration to ensure consistent planning and subsequent administration of policy changes. Finally, we point out that many relevant planning documents were published before the rise of e-commerce. With the impacts of this industry now being measured and published, it is important that planners take urban freight into account in all forthcoming long-range plans.

Our research is the first to perform analysis on city long-range planning documents in the United States and to attempt to analyze what the state of urban freight planning is in those cities. Our novel contributions include a content analysis approach to a systematic literature review of city planning documents and highlighting the general lack of attention paid to urban freight policymaking. The first is important because it can be reproduced and applied to any number of research topics, whether related to sustainability, transportation, or some other municipal policy area. The second contribution serves to identify a need. Urban freight emissions are growing, largely due to swelling urban populations and the growth of e-commerce. Cities must take action now to curb the climate impacts of the industry within their jurisdictions.

This work can serve as a foundation for future urban freight planning research. As noted previously, we did not assess progress toward implementing strategies. The work can be expanded to include previous iterations of each plan as well as press releases and academic work detailing the results of any pilots. It would also be useful to develop a best practices guideline or policy analysis to determine the best way to develop urban freight strategies in a meaningful and sustained way.

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DATA AVAILABILITY STATEMENT

The database of planning documents and urban freight references is available at https://doi.org/10.7910/DVN/023TWR. U.S. Census Bureau data used during city selection are available at https://www2.census.gov/programs-surveys/popest/datasets/.

SUPPLEMENTAL MATERIAL

Supplemental data for this article can be accessed online at https://doi.org/10.1080/01944363.2024.2324096.

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