# NCHRP
## Research Report 1165

National Cooperative Highway Research Program

# Revenue-Related Tools for New Mobility

NATIONAL ACADEMIES Sciences Engineering Medicine

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

# NCHRP RESEARCH REPORT 1165

# Revenue-Related Tools for New Mobility

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## NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

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Many staff from state and local departments of transportation as well as the nongovernmental sector volunteered their time to participate in workshops and inform the development of this research. Their thoughts, experience, and feedback were invaluable to the completion of this work.

# FOREWORD

By Dianne S. Schwager
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*NCHRP Research Report 1165: Revenue-Related Tools for New Mobility* provides a toolkit to help transportation agencies design and evaluate a broad array of revenue-related tools, such as taxes, fees, and subsidies, that may be applied to new mobility. The research included outreach with stakeholders and case studies to understand the challenges posed by new mobility services that are rapidly emerging. This toolkit on revenue strategies for new mobility is both timely and necessary to address the disruptions straining traditional funding mechanisms for transportation. The toolkit should be of particular use to agencies seeking to align funding and policy goals with appropriate revenue-related tools and evaluate their successes and challenges in various contexts.

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Federal, state, and local transportation agencies in the United States employ various strategies to generate funds from traditional automobiles and trucks to help pay for the construction, operations, and maintenance of the transportation system. New mobility options for people and goods have been introduced and deployed globally and throughout the United States. Revenue-related strategies can also influence where and how new mobility options for people and goods are available and who can access them. New mobility options can include bike-sharing, scooter-sharing, car-sharing, ride-hailing, and many package and food delivery services. Additional options, such as connected and automated vehicles and urban air mobility, are also emerging. Many new mobility options have novel business models that do not work well with existing state and local revenue mechanisms and related regulatory practices. Consequently, it has been unclear what revenue-related strategies may be appropriate for new mobility options.

Under NCHRP Project 19-23, "Revenue-Related Strategies for New Mobility Options," ECOnorthwest was asked to develop a toolkit for transportation agencies that addresses how revenue-related strategies support policy objectives and shape the deployment of new mobility options. The toolkit presents an evaluation framework that can help agencies weigh potential revenue options and develop revenue-related strategies for new mobility options that transport people and goods. The toolkit has four main modules:

- **Module 1: Introduction and Framework** establishes an overall understanding of the subject matter and describes the framework for evaluating revenue-related tools for new mobility.
- **Module 2: New Mobility Passenger Services** applies the framework to each new mobility passenger service and for each revenue-related tool.
- **Module 3: New Mobility Goods Delivery** applies the framework to each new mobility goods delivery service and for each revenue-related tool.
- **Module 4: Innovative Case Studies** documents some of the most promising and innovative revenue models that are being tested and refined in cities around the world.

In addition to *NCHRP Research Report 1165*, a new mobility revenue calculator and Appendix A: Revenue Calculator User Guide can be found at nationalacademies.org/publications by searching for *NCHRP Research Report 1165: Revenue-Related Tools for New Mobility*. The calculator can assist with quantitatively estimating revenue size for new mobility revenue options based on assumptions entered by the user, while Appendix A is a user guide for the calculator.

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SUMMARY

# Revenue-Related Tools for New Mobility

Advancements in communication technology, the rise of app-based platforms, and changing consumer behaviors are transforming how people and goods move. New mobility services—micromobility (shared bikes and scooters), car-sharing, ride-hailing, microtransit, and modern goods delivery services—are expanding access to places and goods. These innovations are reshaping urban and rural transportation, creating new mobility opportunities and challenges, and enhancing accessibility.

As more new mobility services enter roadways full of personally owned and commercially owned vehicles, they create challenges for transportation agencies trying to manage the existing transportation system. Current infrastructure, policies, rules, and expectations are tailored for traditional transportation options and can be inadequate for or incompatible with new mobility. In many cities, hundreds—or sometimes thousands—of new vehicles or trips are added to the system before transportation agencies can assess their impact. Transportation agencies need to respond nimbly and adapt quickly to new mobility services as they are introduced within their jurisdictions.

A key challenge for transportation agencies is determining whether to charge taxes or fees on new mobility services. This revenue can fund staff, technology improvements, and right-of-way modifications. Pricing strategies can help manage demand for both the new mobility services themselves and public spaces that the services use, such as curb space. Some new mobility services could merit subsidies because they help achieve community transportation goals. A mix of revenue-related tools may be appropriate depending on local context.

Furthermore, transportation agencies managing new mobility services are often unaware of the range of revenue-related tools available to them. They may wonder what tools other jurisdictions are using to manage new mobility, how such tools measure up against one another, and whether the tradeoffs are relevant to their local situation.

This toolkit presents information about revenue-related tools and a decision-making framework to help transportation agencies evaluate and implement revenue-related tools for new mobility services. The framework brings together new mobility services, transportation policy goals, revenue-related tools, and implementation considerations to help plan a coherent set of pricing policies for new mobility.

## What Is New Mobility?

New mobility refers to innovative transportation services that redefine how people and goods move within the existing transportation system. These services fall into two categories:

- **Passenger services:** Shared bikes, scooters, and cars; ride-hailing (including human drivers and autonomous vehicles), and microtransit (e.g., on-demand shuttles).

- **Goods delivery services:** E-commerce logistics, crowdshipping (app-based food and package delivery), and microfreight (cargo e-bikes and autonomous delivery devices).

New mobility services are defined by three disruptive trends that distinguish them from traditional transportation:

- **On-demand ordering, routing, and shared access:** Enabled by mobile and app-based technologies, users can seamlessly access shared transportation options or request goods delivery on demand. This flexibility increases trip generation, adds complexity to transportation networks, and places new demands on streets, curbs, and public infrastructure.
- **Automation and electrification:** Advances in autonomous vehicles (AVs) and the growing use of electric vehicles (EVs) are anticipated to reduce operating costs and emissions but disrupt traditional revenue streams, such as fuel taxes. AVs and EVs also raise new considerations around infrastructure investment, charging networks, and regulatory oversight.
- **New uses of public infrastructure:** The rise of new mobility services has intensified competition for limited space—sidewalks, curbs, bike lanes, and streets. Jurisdictions are rethinking land use planning, future transportation investments, and curb management to accommodate diverse mobility options.

## Why Is It Important for Transportation Agencies to Manage New Mobility?

Transportation agencies face three major challenges in managing new mobility:

- **Outdated infrastructure and policies:** Most roadways, curb space, and regulations were designed for traditional transportation systems, and they need updates to support new mobility services that are shared and autonomous.
- **Resource constraints:** Agencies operate with limited staff and financial resources to monitor, regulate, and invest in infrastructure that supports new mobility while also maintaining existing services. New revenue from taxes and fees on new mobility can be used to fund transportation infrastructure and system management, either by directly investing in new mobility or by supplementing general transportation funding.
- **Pricing for desired outcomes:** Without proper planning, new mobility services can add congestion, increase vehicle miles traveled, and worsen environmental impacts. Other less desirable outcomes can arise if services are not accessible or affordable. Incentives for using some new mobility services can make sense when they help reduce congestion, emissions and other air pollutants, and health and safety risk compared to traditional mobility options.

## What Are the Goals of Revenue-Related Tools for New Mobility?

Revenue-related tools are essential for transportation agencies to integrate and manage new mobility services while achieving policy goals. These tools address multiple objectives:

- **Cost recovery:** New mobility services use public infrastructure, which requires investments to operate, maintain, and enhance the system. Revenue tools ensure that those who benefit from or impose costs on the system contribute to its management and capital improvements.
- **Promoting public good:** Subsidies or investments in new mobility services may be needed to support the expansion of services that generate a public benefit, such as reducing transportation costs, improving accessibility, or reducing emissions and other air pollutants.

- **Managing negative impacts:** Pricing strategies or regulatory measures can mitigate public harms like congestion, pollution, emissions, and crashes. They can also help ensure that burdens and benefits of new mobility services are fairly distributed.

## Framework for Decision-Making

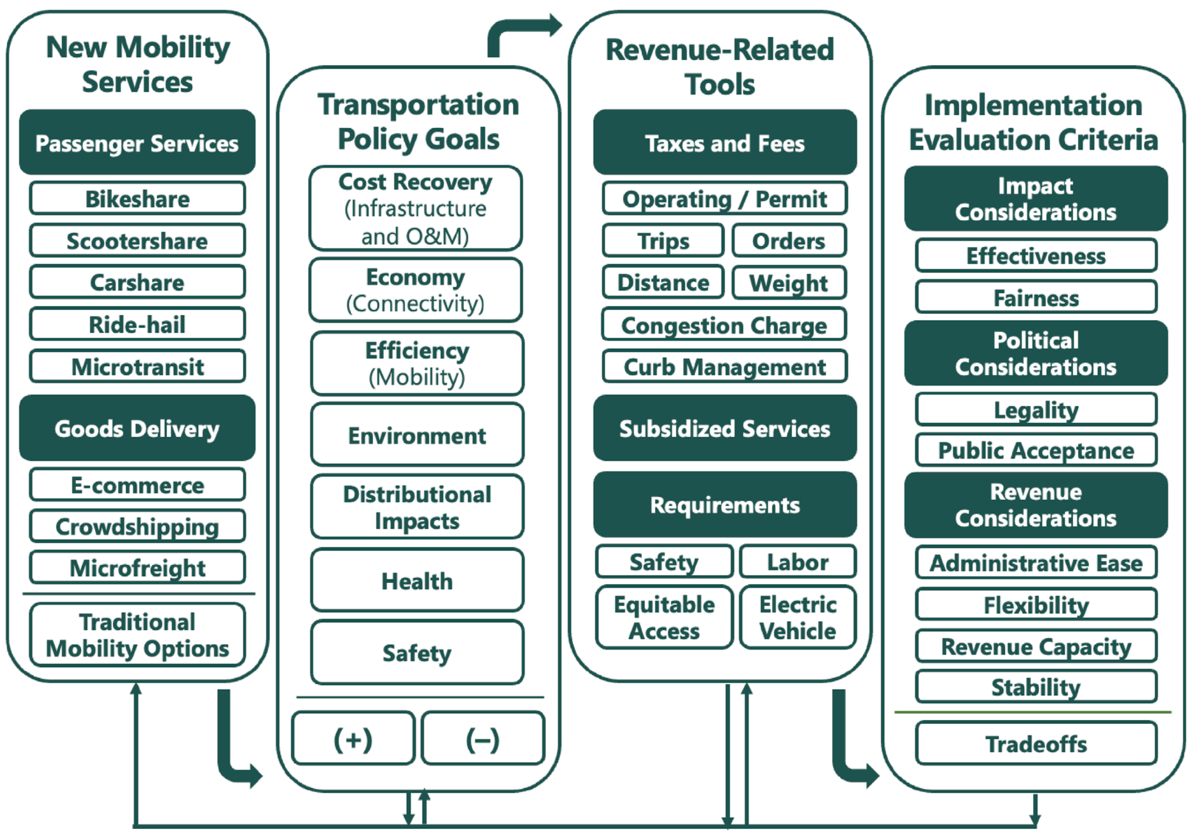
This toolkit introduces a structured framework (Figure 1) to help agencies think through their options for implementing revenue-related tools for new mobility services. The framework is designed to emphasize the importance of

- Analyzing new mobility services and their impacts without isolating them from traditional mobility options, which new mobility services may either complement or replace;
- Aligning transportation policy goals with revenue-related tools so that transportation agencies define clear objectives before choosing revenue strategies; and
- Assessing revenue-related tools for their implementation successes and challenges.

## What Is in the Toolkit?

This toolkit is organized into four practical modules:

- **Module 1: Introduction and Framework** establishes an overall understanding of the subject matter and describes the framework for evaluating revenue-related tools for new mobility, as described in Figure 1.




Note: O&M = operations and maintenance.

*Figure 1. Revenue-related tools framework for new mobility.*

- **Module 2: New Mobility Passenger Services** applies the framework to each new mobility passenger service and for each revenue-related tool. Comparison of the revenue-related tools using the framework resulted in the following generalized takeaways:
  - **Operating and permit fees** and **per vehicle fees** are often charged as part of the agreement that allows new mobility companies to operate within a jurisdiction. These fees are somewhat easier to implement and administer than other tools, but they are unlikely to generate significant revenue and are better suited for recovering transportation agency costs than for influencing transportation decisions. Fees that are assessed one time or annually (e.g., operating and permit fee) are more suitable for cost recovery, while usage-based fees that charge by the trip, distance, or time are more suitable for changing how people use passenger services.
  - **Per trip fees** and **per passenger mile fees** offer a balance between generating revenue and influencing travel behavior. They are scalable based on usage, ensuring that users contribute proportionately to their impact on the transportation system.
  - **Per vehicle mile fees** and **congestion charges** can generate significant revenue, but they are more complex to implement due to political resistance and administrative challenges. Also, they are broader in scope and apply to most vehicle trips, not just new mobility services.
  - **Curb management fee** is a dynamic parking fee that is charged as part of a curb management strategy. Although evidence is limited, pilot programs show it can reduce curb congestion while raising some revenue. Implementing more complex versions of curb management fees can be challenging because they can require sensors and real-time databases to enforce parking rules.
  - **Subsidized services** and **regulatory requirements** can help achieve specific policy goals—such as greater economic development and increased mobility options for people with fewer options. There is likely to be wide political support to address needs of specific populations; however, these tools do not generate revenue, and they require public investment. Subsidies are most common for bikeshare services, followed by scootershare services.
  - Many states have **preempted regulations**, including application of revenue-related tools, for ride-hail and AV services. Thus, it is impossible to produce one set of evaluations that can be applied across the United States. In particular, the legality of certain revenue-related tools will vary by state.
- **Module 3: New Mobility Goods Delivery** applies the framework to each new mobility–goods delivery service and for each revenue-related tool. Comparison of the revenue-related tools using the framework resulted in the following generalized takeaways:
  - **Indirect source rule (ISR)** is designed to reduce air pollution by imposing fees or other requirements on owners of warehouses and distribution centers. Also, the fees can be reinvested in programs that reduce emissions. While there is insufficient evidence to evaluate its effectiveness, ISR could generate revenue while addressing place-based pollution disparities, which would benefit low-income communities near warehouse clusters.
  - **Weight-distance tolls** can generate substantial revenue by charging freight shipments across a state or between different markets. However, so far these tolls have been applied to heavy goods vehicles and are less applicable to the light goods vehicles that dominate urban deliveries. Innovations in weight-distance tolling are likely to focus on shorter trips within regional or local markets.
  - **Congestion charges** are designed to incentivize off-peak deliveries, but they face resistance from carriers who may struggle to adjust their operations. Instead of generating revenue or reducing congestion, the pricing tool can unintentionally consolidate the market, favoring large logistics companies that can absorb costs.

  - **Low- or zero-emission delivery zone** and **curb management fee** require vehicle owners to pay a fee or have a permit to access a place. While there are insufficient examples in the United States, and there are implementation challenges, examples in Europe suggest these tools can be effective at changing how deliveries are made. However, there may be disproportionate impacts on smaller companies.
  - **Delivery fee** can generate substantial revenue and is gaining traction. It is cost-efficient—generating high revenues with limited administration costs—and has seen high levels of political support. While the fee is supposed to account for the carriers' road usage and encourage environmentally sustainable behaviors like using parcel lockers or selecting time-flexible delivery options, the pricing signal may be insufficient to result in changes to delivery behaviors.
- **Module 4: Innovative Case Studies** documents some of the most promising innovative revenue models that are being tested and refined in cities around the world, ranging from car-free districts and smart loading zones to dynamic pricing models and mobility wallets. The case studies feature the following themes:
  - Successful mobility solutions require innovative governance. Strategic public investments and well-structured partnerships can lead to scalable and sustainable shared mobility ecosystems.
  - Fees, taxes, and surcharges that are designed thoughtfully can encourage individuals to adopt cleaner mobility options and advance broader societal goals, such as increased nonautomotive transportation options, improved safety, and sustainability. Moreover, new revenue streams can be used to make it more appealing for private companies to invest in emerging mobility markets, supporting the community's economic development goals.
  - There are ongoing innovations in curb management programs that feature a mix of dynamic pricing models, platform-supported permitting, dedicated loading zones, and zero-emission zones. Integrating data-driven tools and further supporting programs with policy are crucial for managing the rising demand for curb space, deliveries, and shared transportation options.
  - New programs strengthen alignment with local objectives. New revenue models focus on funding innovative mobility solutions that also promote sustainability goals and transportation access for underserved populations, such as those with disabilities and those who live in low-income communities.

In addition, the toolkit is accompanied by a new mobility revenue calculator that transportation agencies can use to think systematically about how much revenue new taxes or fees can generate. The revenue calculator is not intended to be either a starting place or the ultimate solution. Instead, it is designed to be a helpful tool that works within the framework of the research in this toolkit. The calculator and its user guide, Appendix A: Revenue Calculator User Guide, can be found at nationalacademies.org/publications by searching for *NCHRP Research Report 1165: Revenue-Related Tools for New Mobility*.

## What Was the Process for Developing the Toolkit?

To fill a gap in the body of knowledge related to new mobility, NCHRP Project 19-23, "Revenue-Related Strategies for New Mobility Options," was created to help transportation agencies meet their policy goals and shape the deployment of new mobility options through revenue-related strategies (e.g., taxes, fees, and investments/subsidies). While new mobility also penetrates airways and waterways (e.g., unmanned aerial vehicles and uncrewed cargo ships), this toolkit is primarily designed for transportation agency staff at localities—cities and counties, state departments of transportation, and metropolitan planning organizations—that manage surface transportation networks and how they are funded. The decision-making framework in the toolkit can also help legislators and their staff better understand the questions and tradeoffs that must be weighed when pricing, regulating, or supporting new mobility services.

The project team developed this toolkit over a two-year period with guidance from the project panel. The research process included the following activities:

- Conducting a literature review and a policy scan to understand and summarize theories and practices of transportation revenue strategies,
- Evaluating commonalities and key differences among various new mobility services,
- Developing a logical and cohesive framework that can be applied to revenue-related tools for new mobility,
- Researching revenue-related tools and developing criteria to evaluate them,
- Creating a spreadsheet-based revenue calculator tool, and
- Conducting multiple workshops with transportation agency staff, academics, and industry professionals.

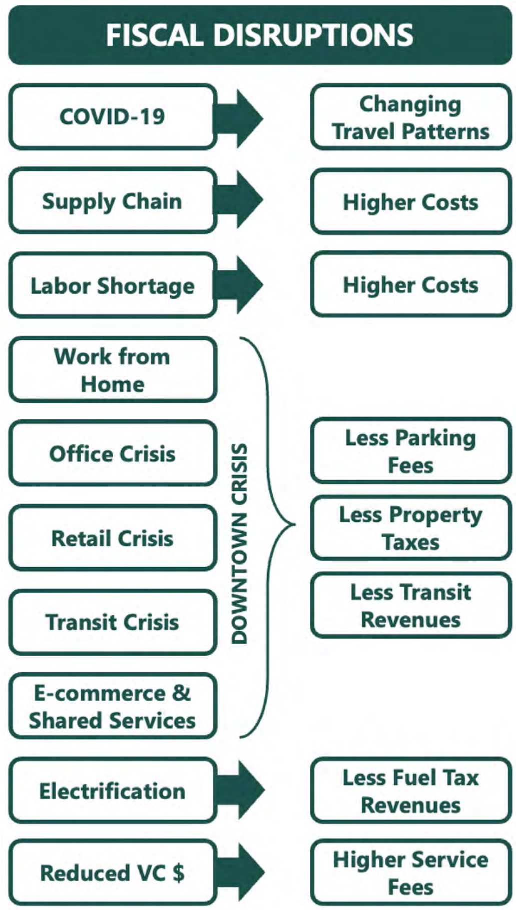
MODULE 1

# Introduction and Framework

## 1.1 Recent Changes to Transportation and Public Sector Revenues

How people and goods move on streets and highways currently is different than it was at the turn of the century, and this change has fiscal implications for how governments fund transportation. The adoption of smartphones and advances in computing have made it possible for new business models that allow people to easily share rides on bikes, scooters, and cars and order goods and meals online. By the end of 2019, many communities had various new mobility passenger services—including bikeshare, scootershare, carshare, ride-hail, and microtransit—and e-commerce had surpassed 12 percent of retail sales (U.S. Department of Commerce 2025). Then, policy responses to manage and recover from the COVID-19 pandemic drastically changed travel behavior. Temporary closures in schools and businesses created long-term changes in how people work, study, and shop. These changes resulted in the following fiscal disruptions, summarized in Figure 2.

- Allocation of street and curb space for curbside dining and recreation (often called "open streets") in response to the COVID-19 pandemic restricted space on streets and curbs for both traditional mobility and new mobility. These streets and curbs are valuable transportation assets with economic benefits and the potential for future revenue streams for the public sector.
- Supply chain issues, a tight labor market, high inflation, and the interest rate response by the Federal Reserve to fight inflation in 2022 and 2023 have increased the costs of goods, services, and labor, including transportation agency costs.
- The resilience of work-from-home culture decreased the value of office and retail property in many central cities and changed travel behavior, leading to less revenue from parking fees, property taxes, and transit fares.
- The COVID-19 pandemic also accelerated e-commerce and urban delivery trends as more people became accustomed to ordering online and receiving goods at their homes. E-commerce sales briefly exceeded 16 percent of retail sales during the pandemic and then continued to stay above 14 percent (U.S. Department of Commerce 2025). E-commerce activities are leading to more congested curbs without incurring any consequences for their negative impacts. Moreover, long-term trends in shared mobility services and automation threaten the traditional models of funding for transportation infrastructure, operations, and maintenance (Lewis and Clark 2021). Shared mobility services and automation could impact tax and fee revenues from vehicle sales, registration of vehicles, licensing of individuals, parking receipts, citation revenues, and more.
- Growing investments in electric vehicle (EV) charging infrastructure (and underlying policy changes regarding the electrification of transportation) are shifting consumer habits and generating new challenges and opportunities related to transportation funding and right-of-way (ROW) uses. Electrification of vehicles and prohibition of new gas-powered cars in




Note: VC = venture capital.

***Figure 2. Disruptions to transportation revenue in the United States, 2020 to 2024.***

several states are expected to speed up the erosion of receipts from fuel taxes, which transportation agencies rely on (Tucker 2022).

- As of 2024, venture capital funds for mobility-related start-ups were facing headwinds, resulting in a greater reliance on service fees for those firms. It remains to be seen if they will be profitable in the future.

Moreover, the rise of new mobility services has increased the demand for better management of transportation systems and curbside spaces. New mobility needs to be integrated into the existing transportation systems, but the transportation systems also need to evolve to better manage curbside spaces, which are frequently used by new mobility. The COVID-19 pandemic accelerated e-commerce growth while simultaneously reducing curb space availability due to restrictions, heightening the need for curbside management. Effective improvements to the management of transportation systems will require new funding sources.

Rising costs for labor, goods, and services, combined with declining revenues from multiple sources, have created significant challenges for transportation funding. Traditional funding tools no longer work like they used to. Moreover, emerging transportation technologies are reshaping revenue streams and investment priorities, making it essential to align budgets with the evolving needs of new mobility.

To address these financial pressures, transportation agencies are exploring new and alternative funding mechanisms. Potential solutions could include new or increased taxes across transportation options, targeted taxes on new mobility, transfers from taxes on nonusers of the transportation system (e.g., grants, impact fees, income taxes), or advertising and sponsorships. Taxes on new mobility is the focus of this toolkit.

Shifting transportation priorities must also navigate a complex political landscape, where pricing strategies for passenger services have gained attention, but pricing for goods delivery remains underexplored. A comprehensive revenue strategy should account for both passenger and goods mobility, recognizing their distinct logistical and supply chain complexities while ensuring they complement each other.

## 1.2 Toolkit Purpose

The purpose of *NCHRP Research Report 1165: Revenue-Related Tools for New Mobility* is to provide a decision-making framework and examples of best practices for taxing or subsidizing new mobility services. The revenue-related tools can help pay for transportation-related expenses or encourage services that provide public benefits. Both passenger travel and goods movement operate in a shared, public environment funded by public transportation agencies. Therefore, government bodies have a responsibility and an opportunity to develop revenue-related strategies that align with public policy goals.

An economic principle that runs through this work is that transportation services are evaluated equivalently, independent of mode, ownership, or any arbitrary distinction. If a service relies on public assets or investments to operate, then it is reasonable to design a revenue strategy that recovers the costs funded by the public sector. If users of a service impose a financial burden on others, then it is reasonable to consider charging them fees for that behavior. Ideally, policy preferences would be reflected through greater taxes or fees on services that impose greater public costs and burdens. At the same time, policies could prioritize growth in segments of transportation services that help achieve transportation policy goals. Finally, with the introduction of new mobility to an existing transportation system, it is important to consider the impacts of new mobility compared to traditional mobility.

**What Is New Mobility?**

New mobility can be defined as innovative transportation services that redefine how people and goods move within the existing transportation system.

Why Is New Mobility Important?

1. Traditional transportation systems may have difficulty adopting new mobility if the system is deficient or incompatible.
2. There are limited public resources to manage the existing system. Shifting focus to support the integration of new mobility requires new resources.
3. Taxes and fees can mitigate negative impacts of new mobility, and subsidies can prolong positive impacts.

**Who Is This Report for?**

This report is primarily designed for transportation agency staff at localities (cities and counties), state departments of transportation (DOTs), and metropolitan planning organizations (MPOs) that manage surface transportation networks and how they are funded.

## 1.3 Traditional and New Mobility Options

The patterns of how people and goods move, what moves them, and why they move are changing. Though the American transportation system traditionally has been built around car ownership, it is starting to evolve to better accommodate other road users, including pedestrians, cyclists, and people who share rides and vehicles. The existing streets and land uses had previously been designed to accommodate delivery services that move products from warehouses to stores, but now they are being redesigned to accommodate a greater frequency and variety of last-mile deliveries.

The primary goal of both traditional and new mobility options is to connect people and goods to other people and places. The key difference between the two is that new mobility is more than just a mode of transportation; it is also a form of service. This section first compares the modes and services that move people and goods. Table 1 and Table 2 show both traditional modes and new mobility services included in this toolkit. These distinctions are relevant for understanding how new mobility and other trends disrupt existing revenue streams and create new opportunities for passenger and goods delivery services.

### Passenger Services

There are many ways people travel to and from destinations like home, work, and places of entertainment: their own means (i.e., walking), using mobility technologies they own (i.e., bicycles, mobility aids, motorcycles, scooters, and automobiles), or paying for a ride (i.e., transit and taxis). New mobility adds to the mix a set of new transportation services, all mobility modes not owned by passengers, that enhances flexibility in terms of trip origins, trip destinations, and payment options.

Micromobility and shared mobility services, such as **shared bicycles and scooters**, mopeds, e-cargo bikes, and others, are transportation service models where private companies or

**Table 1. Traditional and new mobility: Passenger modes and services.**

| Traditional Mobility Mode | Traditional Mobility Owner/Operator | New Mobility Service/Mode | New Mobility Owner/Operator |
|---|---|---|---|
| Walking, bicycle, mobility aids | Individual | Pedal bikeshare (docked or dockless) | Owned by companies, public sector, or private-public partnerships<br>Vehicle operated by rider |
| Motorized (motorcycles, e-bikes, scooters, etc.) | Individual | Scootershare | Owned by companies<br>Vehicle operated by rider |
| Private automobile | Individual (including carpool) | Carshare | Owned by companies or individuals<br>Vehicle operated by rider |
| Taxi | Individuals and companies | Ride-hail (with a driver) | Private owners and drivers |
| | | Ride-hail (driverless) | Vehicles owned and operated by companies |
| Transit | Public sector or private companies | Microtransit (with a driver or driverless) | Companies, public sector, or private-public partnerships |

**Table 2. Traditional and new mobility: Goods delivery modes and services.**

| Traditional Mobility Mode | Traditional Mobility Owner/Operator | New Mobility Service/Mode | New Mobility Owner/Operator |
|---|---|---|---|
| Truck or van (package delivery) | Third-party logistics companies | E-commerce delivery service | Online sellers and logistics companies |
| Automobile or other motorized vehicle (food delivery) | Companies | Crowdshipping service | Private drivers |
| | | Microfreight (cargo e-bikes, personal delivery devices) | Companies |

transportation agencies own or maintain bicycles and scooters that are operated individually on a shared, charge-per-trip basis. The bikes and scooters are typically either docked (i.e., picked up and returned to a specific docking area) or dockless (i.e., picked up or dropped off anywhere within a designated are) (Jia, Liu, and Liu 2018). **Bikeshare** is considered one of the oldest micromobility services, with a monetized (coin-operated) model first appearing in 1995 in Copenhagen (Chen, van Lierop, and Ettema 2020). Larger-scale bikeshare systems formed in Europe and the United States in the 2000s (Shaheen, Guzman, and Zhang 2010). Unlike bikeshare, **scootershare** services are relatively new and started as a chargeable, electric option (i.e., e-scooters). The first scootershare system was launched in 2017 by the scootershare company Bird in Santa Monica, CA (Button, Frye, and Reaves 2020).

**Car-sharing** is a transportation service where a single vehicle can be used by multiple persons at different points in time, enabling people to drive without ownership of the vehicle. Carshare is different than ride-hail because customers rent the vehicle and drive it themselves. Similar to e-bikes and e-scooters, carshare can be free-floating, where users can pick up the vehicle and drop it off anywhere within a service zone, or station based, where users pick up and return the vehicle from a specific car-sharing station (such as Zipcar) or address (such as Turo) (Lenz and Fraedrich 2016; Amirnazmiafshar and Diana 2022). The origin of car-sharing can be traced to 1948 in Zurich, Switzerland. It was piloted in the United States in 1983, with a formal program launched in 1994 (Cohen and Shaheen 2018).

**Ride-hail** companies, which emerged in the late 2000s, exclusively use app-based platforms to connect customers with drivers. In this toolkit, "ride-hail companies" refers to transportation network companies, but a broader definition of ride-hail could include taxis and other for-hire services. Uber, the first ride-hail company, launched in 2009, and Lyft launched a few years later in 2012, both in San Francisco, CA (Uber n.d.; Flores and Rayle 2017). For the rest of the 2010s, these ride-hail companies continued to expand internationally. This expansion spurred various public-private partnerships, lawsuits, and additional regulations. Ride-hail services are starting to become available with autonomous vehicles (AVs). Companies like Waymo are currently testing different service models and have launched self-driving vehicle services in Austin, TX; Los Angeles, CA; Phoenix, AZ; and San Francisco, CA.

**Microtransit** vehicles, including shuttles, minibuses, and vans, often replace or offer alternative transportation to full-size diesel buses. These smaller-scale, on-demand services often provide both fixed and flexible routes, stops, and schedules that can enhance accessibility in low-density areas. Whereas microtransit in the United States can be traced to 1914, when individuals in Los Angeles provided bus-like services during a streetcar strike, modern-day microtransit services resemble Kutsuplus, which launched in 2012 in Finland. Via is currently one of the largest operators in the United States.

## Goods Delivery Services

The purpose of delivery services is to connect people with perishable food items and non-perishable packaged items. These services are typically provided via semitrucks for freight and bulk delivery; trucks, vans, and cars for last-mile trips; and cargo bikes. In more recent years, companies like Starship and Kiwibot have been experimenting with the technology for driverless delivery robots, often referred to as personal delivery devices (PDDs), that operate on sidewalks.

**E-commerce delivery**—the process of transporting goods ordered online to a customer—led to major logistical and market transformations, as well as a wide array of **trucks, vans, and cars** delivering packages in residential and commercial neighborhoods in ever-increasing numbers. While traditional mobility has included package delivery on trucks and vans, e-commerce is primarily differentiated by online points-of-sale, scale, and logistical complexity. In the United States, online shares of retail sales have soared by nearly 160 percent in the past decade, growing from about 7 percent in 2015 to about 18 percent by the end of 2024 (U.S. Department of Commerce 2025). Social distancing measures, store closures, and supply shortages induced by the COVID-19 pandemic catalyzed e-commerce sales. The pandemic also expedited physical retail's adoption of click-or-brick "omnichannels" and app-based delivery services (Beckers et al. 2021; Dablanc et al. 2022; Kohli et al. 2020). E-commerce's urban footprint is getting closer to consumers in dense areas to better fulfill time-sensitive last-mile deliveries (Fried and Goodchild 2023). The rapid growth of e-commerce and its usage of roads and land offer new pathways and challenges for efficient and fair pricing, especially in urban areas; however, the pricing implications have yet to be fully researched.

**Crowdshipping** is a new method of package and food delivery enabled by smartphones and online market interfaces that transformed delivery providers' relationships with consumers. Sales made on app-based, on-demand food delivery platforms (e.g., DoorDash, Uber Eats) have grown seven-fold since 2018 (Ahuja et al. 2021). It is not difficult to draw parallels to the mobility-as-a-service (MaaS) model, in which online platforms facilitate the on-demand sharing of passenger transport assets (e.g., scootershare and ride-hail). In the case of "delivery-as-a-service," or crowdshipping, shared delivery assets (Uber Eats, Instacart, Amazon Flex, etc.) can involve a **personal car or bicycle as well as underutilized space on trucks or even buses** (Buldeo Rai et al. 2017; Jaller et al. 2020; Pourrahmani et al. 2020).

**Microfreight** refers to goods delivery services provided by **cargo e-bikes and PDDs**. There are two primary types of autonomous delivery vehicles—ground-based and aerial (Rai, Touami, and Dablanc 2020). However, only ground-based microfreight is discussed in this toolkit. Electric cargo bikes (or cargo e-bikes) present a human-powered logistical approach to microscale household delivery. They can also function as staging areas to organize the goods before last-mile deliveries (Wehrmann 2018). Cargo e-bike adoption has been mostly observed in European countries such as Germany and France (Robichet, Nierat, and Combes 2022). UPS piloted e-cargo bike delivery in the United States (Chiara et al. 2023). PDDs include both sidewalk-operating and road-operating vehicles. Examples include semiautonomous, sidewalk-based Kiwibot, which delivers meals at university campuses across the country. There also are low-speed, road-based vehicles by Nuro, which partners with major retail and food chains to deliver pizza and other goods in cities such as Houston, TX (Kane 2018; Korosec 2020; Lucas 2012).

## How Is New Mobility Different from Traditional Mobility?

Three disruptions differentiate new mobility from traditional forms of transportation. This framework is not only useful for categorizing traditional and new mobility modes and services but also foundational to designing revenue-related tools for new mobility. These disruptions are not unique to the transportation sector, but their applications to transportation modes and services have not yet been studied in an organized and comprehensive way. For each disruption, there are both changes to passenger mobility as well as implications of e-commerce on demand for transportation and land use.

New mobility is different because of

1. On-demand ordering, routing, and shared services;
2. Automation and electrification; and
3. New uses of public infrastructure.

### *Disruption 1: On-Demand Ordering, Routing, and Shared Services*

Advancements in technology related to smartphones and personal computers that enable on-demand ordering and routing have allowed new mobility services to proliferate across the United States and around the world (Howell et al. 2020; Shaheen et al. 2016). Digital devices are regularly used to look up best routes and approximate travel time by different modes. The ability to access a fleet of shared bikes, e-scooters, cars, or vans to either transport people where they want to go or order goods, groceries, or meals for delivery has increased access to destinations and goods at an unprecedented scale.

One of the hallmarks of new mobility is that the vehicle being used is not owned by the user. That is, passenger vehicles—including bikes, scooters, and automobiles as well as trucks, vans, and PDDs—are not owned by the people requesting trips or receiving packages. While the concept of a shared ride itself is not new to transportation, new mobility services often rely on app-based technology to connect **customers** seeking a ride or a delivery of goods or food to a **fleet** of vehicles that can deliver them or the goods wherever they need to go. Unlike traditional mobility, where a person would use their personally owned vehicle to travel to work or go to the store, new mobility allows people to easily "rent" the transportation they need for however long they need it.

E-commerce has ushered in a form of "consumer logistics," in which consumers have more control over when, where, and how they receive products (Wang et al. 2023). In essence, households have become "freight trip generators" (Wang and Zhou 2015). E-commerce and supply chain management platforms have invested in their logistics infrastructure, including warehouses and inventory, to better meet shifting consumer demand (Kern 2021). Last-mile distribution centers are increasing in number, moving closer to consumers, and integrating with existing land uses (Fried and Goodchild 2023). Parcel lockers are adding complexity to land uses for buildings, sidewalks, and public spaces (Buldeo Rai, Verlinde, and Macharis 2021; Ma 2017).

One significant implication of the added economic activity is an increase in congestion and pollution. While new mobility increases people's options to access places and goods, they can also add to vehicle miles traveled (VMT), deadhead miles, and congestion on roads (Anair et al. 2020; Cramer and Krueger 2016; ICF et al. 2021; Henao 2017; Komanduri et al. 2018; Nair et al. 2020; Schaller 2017; Wenzel et al. 2019; Wu and MacKenzie 2021; San Francisco County Transportation Authority 2018).

### *Disruption 2: Automation and Electrification*

AVs are nascent, but they have the potential to shape a new mobility pathway. A study of simulated AV services suggests a large share of trips could be replaced or augmented by AVs (Harb et al. 2022). AV sensors, components, and related software made up about 20 percent of global investment in new mobility start-ups between 2010 and 2018, representing the second largest share of mobility start-up investments, behind app-based ride-hail services (Holland-Letz et al. 2019).

Still, the deployment of AV ride-hail in the United States has been limited so far to a few cities, including San Francisco and Los Angeles, CA; Phoenix, AZ; Las Vegas, NV; and Austin, TX. The rollout of AVs has been delayed by potential safety issues and legal challenges (Wong 2024). Because of the prominence of AVs and the increasing exposure of the industry to the public, as of 2020, 29 states and Washington, DC, had enacted legislation regarding the definition, usage, and liability of AVs (Center for Sustainable Systems 2022). Other states may be considering similar legislation.

AVs are expected to use electrical propulsion; therefore, these vehicles are intricately associated with electrification and the associated challenges of vehicles in general (Alsalman et al. 2021). Advocates of innovations in autonomous, connected, electric, and shared vehicles envision a smart, on-demand mobility system that is safer, cleaner, cheaper, and more accessible. Research into AV technology has approached it from the perspective of electrification and automation, even for goods delivery (Jaller et al. 2020).

Electrification is also a dominant trend in human-operated vehicles. Most of the public's attention is on individually owned EVs. As for new mobility, shared bikes are increasingly offered with electric options, and shared scooters have always been electric (North American Bikeshare & Scootershare Association 2024). California and New York are requiring ride-hail fleet vehicles to be fully electric by 2030 (NACS 2023). Delivery companies are also adopting EVs into their fleets, such as food delivery robots on the University of Pittsburgh, PA, campus, as seen in Figure 3 (Boudette 2023).

As new mobility trends introduce more EVs into the mix of transportation options, a key implication is a reduction in fuel tax revenues, which is a major source of transportation funding.


Source: iStock.com/JHVEPhoto

***Figure 3. Starship personal delivery device carrying food from four campus restaurants, January 11, 2020.***

Nevertheless, issues related to stability in transportation funding have existed long before the introduction of new mobility (Congressional Research Service 2021).

### *Disruption 3: New Uses of Public Infrastructure*

This final disruption, new uses of public infrastructure, is primarily a consequence of the first two disruptions. New mobility ideas, technology, and business models become real services when the wheels touch the ground. Much of the existing public ROW is designed for traditional transportation modes. New mobility is changing how these public spaces are used, increasing the usage of streets, sidewalks, and curbs. Transportation and land use planners are having to rethink how existing infrastructure is used as well as reconsider the design and use of public spaces for new mobility in the future.

New mobility passenger services are increasing the demand for bike lanes, sidewalk space, parking stalls (Figure 4), curb space, and charging facilities, as well as space for vehicles moving on the street. Some city DOTs have responded with a locking requirement for free-floating shared scooters and bikes, new bike lanes, dynamic curb management, and mobility hubs (Rodriguez 2019).

Dynamic curb management is the data-driven understanding, allocation, and operation of the curb across space and time to optimally serve curb uses and users, as determined by community values (Mitman et al. 2022). It is an advanced form of curbside management that uses technology and real-time data to proactively manage curb uses. Dynamic curbside management is typically implemented at the local level, but state DOTs and MPOs play a crucial role in regulating dynamic curbside management, creating funding options, developing guidance, providing technical expertise, and facilitating data management (Mitman et al. 2022).

Mobility hubs are locations where people can access multiple types of transportation in a central location that is typically adjacent to transit stops and stations (Regional Transportation Authority n.d.). These locations capitalize on the concentration of transportation and community assets, which can connect people to destinations through various means while fostering connections through programs and civic activities.

Until the rise of online shopping, most goods were typically delivered to retail stores, which would then sell those goods to consumers. But with e-commerce, goods are increasingly being delivered directly from warehouses to consumers. Consumers are no longer limited to goods on store shelves; they can scroll through a much wider selection of goods online. To accommodate

Source: iStock.com/Simone Hogan

***Figure 4. Dedicated scooter parking in San Diego, CA, to keep scooters off the sidewalk.***

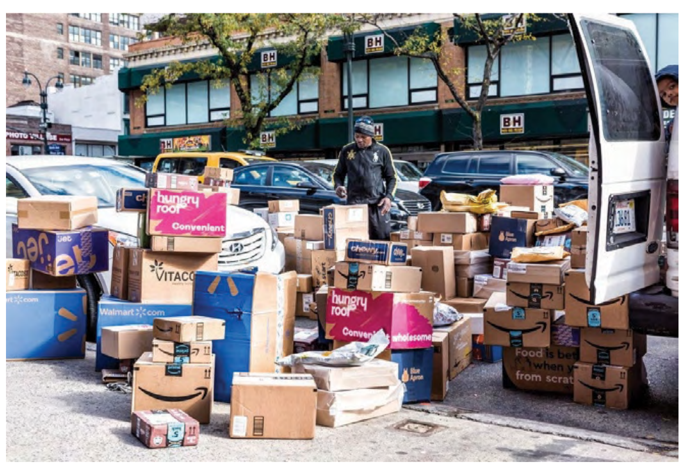
consumer demands, such as same-day delivery and large volumes of package returns, logistics services have become more fragmented, with networks of smaller warehouses on the periphery of urban areas and various drop-off or pickup points. In other words, goods delivery has become decentralized.

Delivery decentralization complicates public space management, specifically at the curb (Marsden, Docherty, and Dowling 2020). The business needs of e-commerce are competing with all forms of mobility for space at the curb and on sidewalks (Figure 5), and impacts are most noticeable in highly urbanized areas, densely populated neighborhoods and cities where a lack of sufficient delivery areas contributes to congestion on roadways (Beckers, Cardenas, and Sanchez-Diaz 2022). Regulatory approaches to contend with increased competition for limited street and curb space have included integrating urban logistics into long-term plans; e-cargo bicycle pilots, implemented with mixed success; and subsidizing "microhubs" to consolidate cargo vans and stage the shipments onto e-cargo bicycles (Aifandopoulou and Xenou 2019; Dalla Chiara et al. 2023; Katsela et al. 2022; Mills 2022; New York City Department of Transportation 2021, 2023; Urban Logistics as an on-Demand Service 2022). Microhubs, also known as urban consolidation centers (UCCs) or delivery transfer points, are small-scale distribution centers that are usually designed to distribute goods via environmentally sustainable modes. Locations for microhubs tend to be central and easily accessible for delivery providers, retailers, and consumers.

## 1.4 Purpose of Revenue-Related Tools for New Mobility

When a transportation agency decides to permit, partner with, tax, or invest in a new mobility service, they must determine the appropriate mix of regulations, pricing, and incentives to ensure that the service achieves the full range of envisioned outcomes. This section presents a logical way to think about imposing fees and taxes for cost recovery, increasing positive outcomes, and limiting negative outcomes as well as how those goals are incorporated into policies, regulations, subsidies, and revenue tools to pay for infrastructure, operations and maintenance (O&M), congestion management, and service administration.

Outcomes are broadly defined to include both direct effects of a policy as well as externalities, which are indirect benefits or costs affecting people who are not involved in an activity. From an economic perspective, externalities are problematic because resources may be misallocated




Source: Shutterstock

***Figure 5. Online sales adding to curb congestion in New York City.***

when people who cause the benefit or the cost do not experience either one themselves. In transportation, externalities are benefits or costs that people who use the transportation system create for other people who may or may not be using the same transportation system.

For example, congestion created by certain types of vehicles or categories of road users and experienced by other vehicles or road users is a negative externality. Damaging the road or otherwise making road conditions less safe for other road users is also a negative externality. In contrast, transportation options that reduce congestion or air pollution have a positive externality.

The public sector has a role in creating, supporting, and managing the transportation system, both generally and for new mobility specifically. And the purpose of the transportation system is to move people and goods. New mobility options have spurred many user benefits around increasing mobility options, supporting new avenues for active transportation, providing on-demand services, improving first-mile/last-mile connections, and more. These benefits, however, have been met with noteworthy concern around the accessibility, affordability, and safety of these mobility options along with the increased congestion, greater total vehicle miles traveled (VMT), greater pollution, and decreased use of transit.

Broadly, revenue-related tools can align with a typical transportation agency's roles regarding fiscal responsibilities and provision of public goods in the following ways:

- **Revenue generation for cost recovery:** New mobility services impose direct costs on public transportation systems, and transportation agencies need to generate revenue to recoup the costs associated with construction, O&M, congestion management, and administration.
- **Investments to promote public good:** Investments and subsidies (in part or whole) may be needed to support expansion of new mobility services that generate a public benefit. Goals of transportation agencies would include creating supply (of a public good) as well as capturing positive externalities. Public support for reducing transportation costs may help urban places become more economically productive through agglomeration and economies of scale.
- **Revenue generation to limit negative outcomes:** New mobility services also impose public costs in the form of congestion, pollution, and safety hazards. Moreover, their disproportionate impacts need to be considered. Government actions may include pricing strategies, but they can also include regulatory (non-revenue-generating) strategies, such as permits and minimum service requirements.

This toolkit is largely based on economic principles and does not consider legal or political motivations for jurisdictions that want to pursue policies for regulating new mobility. In practice, new mobility policies may be determined with little adherence to economic principles and, instead, by the desire to align with the existing regulatory system; power dynamics among political incumbents, institutions, and coalitions; and external political pressure (through lobbying and preemption) (Castellanos, Wright, and Grant-Muller 2024).

The goals of transportation agencies can be summarized as follows:

- **Cost recovery** methods aim to ensure that users pay for the benefit received and there are no free riders. Because transportation agencies incur costs to provide and maintain transportation networks, cost recovery is a valid goal for determining new policies, regulation, programs, taxes, fees, and subsidies. The purpose of cost recovery is primarily to pay for infrastructure and O&M costs associated with new mobility services. The generated revenue can either partially recover costs, with the intent of subsidizing the new mobility services, or exceed the costs, so the revenue can supplement existing streams of transportation revenue.

- **Economies** grow when people and goods are connected. Transportation agencies are responsible for providing some transportation services as well as building, maintaining, and operating a transportation system, which individuals would not be able to do on their own. Transportation investments are critical to economic development in early stages of growth because they create new networks and open new markets, providing access to resources, workers, and businesses. In more urbanized areas, transportation investments can act as a catalyst for economic growth when they help relieve traffic or increase access to jobs, so economic benefits are closely tied to efficiency improvements (Kockelman et al. 2013). Additionally, new transportation system investments directly support new jobs during the construction and operation phases.
- **Efficiency (or mobility)** in the transportation system can be achieved by optimizing the networks to support free-flowing movement, system coordination, and economies of scale while allowing for compatibility across a wide range of transportation modes (Janošková 2014). Transportation agencies can also use pricing to disincentivize actions that congest roadways, sidewalks, or curbs for others.
- **Environmental** effects of new mobility options include the use of lower-carbon modes (e.g., micromobility) and less emissions through lower use of carbon-based fuels, though electricity may still rely on carbon-based fuels upstream in the energy supply chain. The incremental additions of emissions associated with new mobility could be subject to regulation and price-based disincentives. On the other hand, their potential emission levels could be lower than driving a personally owned vehicle. If so, subsidies and other incentives might be justified based on the net reduction in system-wide emissions.
- **Distributional impacts** in transportation affect people who might have access to different parts of the transportation system, experience different costs to access transportation, or benefit disproportionately from increased economic productivity. Improved transportation systems can reduce the cost of connecting people to destinations, but not everyone benefits equally. Moreover, given existing spatial distributions of economic inequality, policymakers may also consider policy goals that attempt to rebalance levels of access. Policies favoring lower-income groups are considered progressive, and the ones that burden lower-income groups are referred to as regressive (Kockelman et al. 2013).
- **Health** outcomes of those who use active transportation options, like shared bicycles, can improve as a result of using the service. In contrast, negative health outcomes include less physical activity for carshare and ride-hail and worsened health conditions due to poor air quality.
- **Safety** improvements—such as slowing down automobile traffic and making walking and biking safer with dedicated bike lanes and pedestrian islands in crosswalks—require investments in and upgrades to the transportation infrastructure. For example, Vision Zero aims to eliminate all traffic fatalities and severe injuries, making the roadways more inviting for people who might otherwise travel less. Vehicle crashes are not just costly for those involved in the crashes; they also affect police and fire service costs, emergency service availability, and friends and families of the victims through emotional suffering.

In summary, transportation planners and engineers (and the leaders they advise) can consider a wide range of community goals related to **cost recovery, economy, efficiency, environment, distributional impacts, health, and safety (Table 3).** These and other goals shape the policies, regulations, subsidies, taxes, and fees created to pay for capital expenditures for infrastructure as well as to fund O&M, demand management (congestion management) for the system, and service administration. While the actual goals that transportation agencies prioritize can be narrower than the sets of goals they initially establish (Castellanos, Wright, and Grant-Muller 2024), this toolkit is designed to help agencies consider a broad set of goals as they strive to increase benefits and limit negative outcomes.

**Table 3. Transportation goals and potential outcomes.**

| Possible Goals | Potential Outcomes |
|---|---|
| Cost recovery (infrastructure and operation & management) | • Users paying for services received<br>• Funding for infrastructure, O&M, congestion management, as well as service administration |
| Economy (connectivity) | • Improved access to jobs, employees, markets, and materials<br>• Support new mobility industry and innovation |
| Efficiency (mobility) | • Increased mode choice<br>• Improved network flow<br>• Less congestion |
| Environment | • Lower operational and embodied emissions, like $CO_2$, $CH_4$, and $N_2O$ |
| Distributional impacts | • Improved affordability<br>• Reduced barriers to access |
| Health | • Promotes active transportation<br>• Improved air quality and reduced air pollution |
| Safety | • Reduced crashes, fatalities, or serious injuries (Vision Zero) |

Note: $CO_2$ = carbon dioxide; $CH_4$ = methane; $N_2O$ = nitrous oxide.

### Transport and the Economy

The demand for transportation is related to the demand for goods, services, and activities that are only accessible via transportation. Transportation agencies aim to lower associated costs through transportation investments or management strategies. Most, though not all, places are already accessible via the existing transportation system, so transportation investments are usually improvements to a base level of accessibility.

Transportation systems and services benefit people by reducing travel time and out-of-pocket costs and by improving travel reliability. These benefits help people earn, save, and spend more. They also help companies grow by reducing total labor costs and by improving the connection between jobs and skills. Transport infrastructure also has an impact on urban agglomeration, which positively impacts all workers and increases their productivity (Santos et al. 2010). Extensive economic literature supports the general finding that urban places are more economically productive than rural places (Glaeser 2010).

Transportation is often considered a public good, something that society might not produce enough of if it is left to individuals making decisions on their own. This idea suggests that society will be better off if the government makes transportation investments on behalf of the community. For the most part, federal, state, and local governments either (a) own and operate much of the transportation ROW in the United States or (b) regulate the markets in which private parties own the infrastructure and services.

Public sector management of transportation means that governments face three related challenges. They must determine:

1. Types and quantities of transportation services to provide,
2. Mechanisms for recovering costs related to the provided services, and
3. From whom to recover the costs so that economic injustices are addressed.

## Considerations for Evaluating New Mobility Options and Goals

When evaluating potential policies for new mobility services and their goals, it is important to consider how people and goods would move without new mobility. Establishing the "counterfactual" scenario—a likely alternative—is an effective strategy for evaluating the net impacts that a policy could have.

### *Trip Generation Versus Trip Replacement*

In some instances, new mobility could generate new trips because it satisfies latent (unmet) demand for movement of people or goods. In other words, new mobility may increase total transportation activity, and a policy to address unintended outcomes of new mobility might be warranted.

But it is also possible that new mobility could replace trips that would have occurred anyway via other options. People may choose new mobility over traditional mobility because they believe new mobility is a better option. In this case, there is no additional trip generated because of new mobility, and a policy to address unintended outcomes might require exploring the net impact of the trip replacement.

### *Net Impact of Travel Alternative*

Even with trip replacement, the evaluation of new mobility services can lead to different conclusions depending on which traditional mobility option is being compared to these services. For example, if people who would have driven to a store use a bikeshare service or order a good delivered through a centrally managed delivery system, they might reduce the total VMT. This scenario may warrant policies that support new mobility and encourage people to use new mobility more. In contrast, if people who would have taken a transit service opt to schedule a ride-hail service instead, they would increase the total VMT, potentially leading to a conclusion that supports the need for a policy intervention.

To fully assess the policy implications of new mobility services, it is important to examine which traditional mode of travel a new mobility service is most likely replacing. For example, consider a rider taking a ride-hail service to a workplace: If the rider would have taken public transit instead, the net impacts are additional congestion and pollution (negative externalities) from the trip. Instead, if the likely alternative to taking a ride-hail service is driving a personally owned vehicle, the trip from home to the workplace likely did not create additional congestion—though pollution would depend on the type of vehicle fuel used. Still, the net impact of taking ride-hail could be an increase in congestion because the ride-hail vehicle would spend additional time on the road looking for passengers (i.e., deadhead miles). In this case, a policy goal might be to reduce deadhead miles as well as any resulting pollution.

### *Existing Policies*

In addition to determining a counterfactual scenario, it is also important to consider existing means of addressing unintended outcomes. If there already are pricing mechanisms or regulations to limit negative impacts of traditional modes of transportation, they may be sufficient to limit the same type of impacts from new mobility services. Conversely, if there are no such mechanisms for traditional modes of transportation, adopting a new pricing mechanism or regulations for new mobility alone would unduly burden new mobility without mitigating similar unintended outcomes of traditional mobility. Applying revenue-related tools to address externalities and achieve public goals is more suitable when new mobility creates outcomes that cannot be addressed by pricing mechanisms or regulations that exist for traditional modes of transportation.

## 1.5 Transportation Revenue: Theory and Tools

State governments use a wide variety of taxes and fees to fund their transportation systems, including state fuel taxes, vehicle fees (e.g., registration and title), sales taxes, and tolls. Some states also use congestion charges, rental vehicle fees, property sales and lease revenues, cigarette taxes, state lotteries, interest income, and other nontransportation taxes to fund transportation investments (American Association of State Highway and Transportation Officials 2016). Local and regional governments also rely on property taxes (through the general fund), real estate excise taxes, parking fees, local sales taxes and gas taxes, and development impact fees.

There are two broad classifications of transportation revenue tools: fixed and variable.

1. **Fixed fees and taxes** are usually based on ownership and not related to the frequency or intensity of use. They are intended to generate revenues for transportation agencies, and they are important for cost recovery. Fixed fees and taxes influence affordability and accessibility of the transportation mode (Leontyeva and Mayburov 2016). Examples include vehicle sales taxes, registration fees, and driver's license fees. The transportation economics literature is critical of ownership taxes because they are not explicitly designed to address externalities. Moreover, because they tend to be fixed rates, they generally do not keep up with rising transportation capital and maintenance costs. However, they are easier to implement and face limited political opposition because they tend to be one-time expenses for consumers or businesses (Barter 2005).
2. **Usage-based fees and taxes** are usually determined by intensity of use—calculated based on one's impact on the transportation system—and they are recurring expenses for consumers and businesses. Examples include emission taxes, fuel taxes, pricing based on vehicle miles (or kilometers) traveled, parking fees, and congestion charges. Congestion charges can be further broken down into cordon pricing, area pricing, highway pricing, corridor pricing, and congestion charge zones (Santos et al. 2010). Ideally, usage-based taxes would be based on marginal costs of a specific transport service so that social benefits are maximized and external costs are minimized (Kockelman et al. 2013; Pigou 1920; Vickerman 2023). Examples of external costs include crashes, road damage, environmental damage, congestion, and oil dependence (Santos et al. 2010). Pricing plays an important role in reflecting the true cost of mobility in different modes and attempting to affect individual behaviors of trip generation and mode choice (Vickerman 2023). Transportation agencies can also implement incentive-based policies to address negative externalities.

There is a wide range of fiscal tools used to fund the transportation system and charge users of the transportation system. Many are applicable to both traditional and new mobility, but only a few are unique to new mobility. There are many taxes and fees designed for traditional mobility users that new mobility participants also pay. These include driver's license fees, vehicle registration fees, fuel taxes, parking fees and penalties, and tolls. Evaluating the appropriateness of using these tools to price new mobility outcomes and externalities requires a broader consideration of all forms of mobility.

**Some tools are more applicable to new mobility, and they are the focus of this toolkit.** These tools include operating fees, fees charged per trip or order, fees calculated based on distance or vehicle weight, and pricing incentives to manage congestion on road and curbs. The toolkit also focuses on regulatory tools that could have financial impacts, including subsidies to support the launch and operation of new mobility systems, requirements to provide discounts for specific user categories, minimum wage or other labor-related regulations, and EVs in fleet-based services.

Finally, both traditional and new mobility are funded by tools that do not directly tax the mobility options, such as (nonvehicle) excise taxes, income taxes, property taxes, transportation levies, sponsorships, grants, and general fund allocations. These pricing mechanisms are not unique to new mobility, so they are not evaluated in this toolkit.

## 1.6 Implementation Evaluation Criteria

Transportation agency staff and executives need to compare policy ideas and alternatives to decide the best option within the local context. The context can change over time, and new decisions may need to be made on the same set of policy ideas. Policy evaluation criteria can include measures of effectiveness (whether a policy achieves its goals and outcomes), efficiency (the balance between benefits and costs), and the distribution of benefits and costs. Decision-makers also need to consider whether the policies are administratively and technically feasible as well as whether a policy is legally possible and politically achievable (Kraft and Furlong 2015; Transportation Research Board of the National Academies 2006; Rossell 1993; Salamon 2002).

When evaluating revenue-related tools, transportation agency staff might find it helpful to use evaluation criteria, like those shown in Table 4, to rate and rank each tool. The evaluation criteria are designed to help narrow policy options, but this not a perfect strategy. It is highly likely that many revenue-related tools will rate both positively and negatively for a given criterion. Users of the evaluation criteria are encouraged to clarify via robust debate what the tool is and is not, what goals it is intended to achieve, and whether its applicability depends on time, location, and types of transportation system users.

**Table 4. Example use of implementation evaluation criteria.**

| Evaluation Criterion | Tool 1 | Tool 2 | Tool 3 | Tool 4 | Tool 5 |
|---|---|---|---|---|---|
| **Impact Considerations** | | | | | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | ↑ | ↑ | ↑ | ? | ? |
| **Fairness**<br>Who does it benefit or harm? | ↑ | ↑ | ? | ↑ | ↑ |
| **Political Considerations** | | | | | |
| **Legality**<br>Is it allowed? | ↑ | ↑ | ↑ | ↑ | ↓ |
| **Public acceptance**<br>Could there be organized support or opposition? | ? | ↑ | ? | ↓ | ? |
| **Revenue Considerations** | | | | | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | ↑ | ↓ | ↓ | ↑ | ↓ |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | ↑ | ↑ | ↓ | ↓ | ↓ |
| **Revenue capacity**<br>How much revenue will it generate? | ↓ | ↑ | ? | ↓ | ↓ |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | ↓ | ↓ | ↑ | ↑ | ↓ |
| **Ranking** | 2 | 1 | 3 | 4 | 5 |

Note: Up arrow means the tool is likely to score **well** on the evaluation criterion. Down arrow means the tool is likely to score **poorly** on the evaluation criterion. Both up and down arrows means the scoring depends on the new mobility service or jurisdiction. Question mark means there is uncertainty due to lack of information. Rankings are numbered in ascending order from best to worst.

The remainder of this section further describes the implementation evaluation criteria and provides examples of questions that can be answered to evaluate a tool.

## Impact Considerations

### *Effectiveness*

A tool would ideally achieve the intended goals—changes in new mobility user behavior, business decisions of new mobility service providers, fiscal conditions, or environmental impacts. Goals should be identified before a tool is adopted, and there should be clear metrics to help monitor and analyze the achievement of those goals.

Questions to determine effectiveness could include:

- What are the intended outcomes?
- Is there a nexus (or a connection) between the costs, benefits, and outcomes?
- What are reliable measures of benefits or costs?
- Are there improvements in quantitative or qualitative measures of benefits or costs?
- How widely is the policy having an impact?

### *Fairness*

A simple definition of fairness in public finance is that users pay for benefits they receive or costs they impose unless they are in groups recognized in policies or programs (e.g., low income, older adults, people with disabilities). Fairness can be a judgment (normative) call, and it is prudent to consult local experts when possible. Fairness could apply to individuals or groups of people, including businesses and special interests.

Questions to determine fairness could include:

- Do those who receive the same benefit pay the same costs?
- Are there different pricing structures to account for differences in incomes or other user characteristics?
- Is there a logical link between how the fee is imposed and how the revenues are expended?

## Political Considerations

### *Legality*

If the tool is currently prohibited by state statutes or local ordinances, then there is a very large administrative and political hurdle to overcome up front. All the benefits of a revenue-related tool are negligible if the tool is not legal or cannot be legally enabled within a desired timeframe. Even for tools that are legally allowed, the likelihood of legal challenges adds to the cost of implementing them.

Questions to determine legality could include:

- Is the tool legal in the jurisdiction of interest?
- Are essential aspects of the tool legal?
- If not legal locally, is the tool legally enabled in the state (and implemented elsewhere) such that localities could adopt or implement it?
- Have there been attempts to thwart the tool with legal challenges?

### *Public Acceptance*

The adoption of funding tools requires enactment by elected officials, and the usage of a tool may require voter approval. Thus, public opinion and perception of the funding mechanism matters for implementation. Public acceptance is a judgment (normative) call, and it is prudent to consult local experts when possible.

Questions to determine public acceptance could include:

- Does a majority of the public support this tool, as evidenced by prior implementations, surveys, or local knowledge?
- Is the tool something the public frequently hears or talks about?
- Is the impact concentrated among a group of people or a geography, or is it disbursed across a large segment of the public?
- Is the ultimate expenditure, which necessitated the implementation of the tool, a popular use of funds?
- Is the public aware of the benefits funded or supported by the tool?

## Revenue Considerations

### *Administrative Ease*

The usefulness of a revenue-related tool is impacted by how easy it is to collect the revenue. Existing regulatory and technological systems to assess and collect taxes and fees will make it easier to generate revenue. The information technology that makes new mobility unique can be leveraged to enable dynamic pricing based on tracked services. Existing resources such as staff capacity, a robust database of new mobility users, and institutional knowledge about fee collection would also help. Coordination across agencies or jurisdictions will take more time and be difficult to implement.

Questions to determine administrative ease could include:

- Is there an established mechanism or process in place to collect revenue?
- If the tool will require a new mechanism to collect the revenue, how easy would it be to create the mechanism and collect the revenue?
- Would new staffing resources be required to implement this tool?
- Does the tool involve multiple decision-makers to implement?
- What kind of enforcement mechanisms are necessary to ensure compliance?

### *Flexibility*

The use of the generated revenue depends on the guardrails initially set up by transportation agencies and legislative bodies. Some revenues are deposited into the general fund, allowing transportation agencies to fund various programs. On the other hand, some revenues are dedicated to specific purposes, limiting new funding to specific programs.

Questions to determine flexibility could include:

- Does the enabling legislation or statute restrict or define specific programs, expenditure categories, or budgetary accounts?
- Does the tool's geographic boundary determine where the revenue can be spent?

### *Revenue Capacity*

The relative size of the potential revenue generated by a revenue-related tool is important for considering whether to adopt the tool. Though quantitatively estimating the size could be challenging based on the available data, this toolkit includes a revenue calculator to assist with this step. The calculator and its user guide, Appendix A, can be found at nationalacademies.org/publications by searching for *NCHRP Research Report 1165: Revenue-Related Tools for New Mobility.*

Questions to determine revenue capacity could include:

- Are there legal, political, or administrative limitations that impede revenue generation?
- How much revenue (or benefit) can the tool generate? (If appropriate, utilize the revenue calculator.)
- Does the tool have a high potential for revenue growth over time?

### *Stability*

Some revenue-related tools can establish an ongoing and predictable stream of revenue, assisting transportation agencies with long-term planning efforts. The variability in revenue can depend on the tool design, maturity of the new mobility service, and broader economic factors.

Questions to determine stability could include:

- Are the new mobility services used intermittently or regularly?
- Is the tool durable, or is it easy to remove?
- Is the tool term-limited, or does it last decades or indefinitely?
- Is the tool likely to experience major volatility or seasonality?
- Is the tool resilient to economic cycles?

**Establishing Government Charges and Fees**

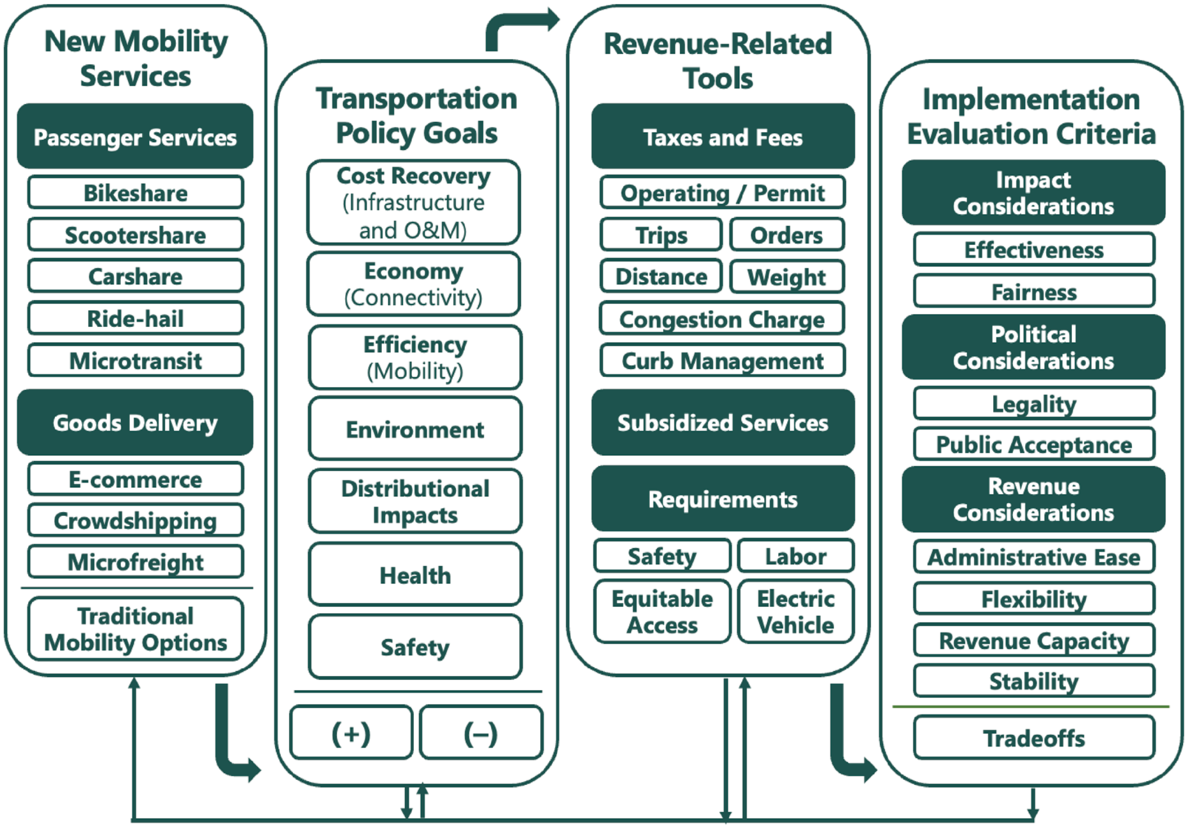
An additional resource on best practices for implementing fees is a short guide by the Government Finance Officers Association. This resource on fees in general lists a few key questions that state and local governments can ask themselves as they determine appropriate fees. While this resource is not further discussed in this toolkit, it may be relevant for determining fees for new mobility.

## 1.7 Putting It All Together: Framework Application Steps

Module 1 of this toolkit defines new mobility, discusses long-term trends that make new mobility a particular concern for transportation agencies, and introduces conceptual tools to help transportation agencies think through how to integrate new mobility into their existing transportation systems. Implementation evaluation criteria for these conceptual tools can help agencies evaluate new mobility policies for goal alignment as well as implementation feasibility. These concepts are organized into the revenue-related tools framework for new mobility (Figure 6).

The framework is intended to guide transportation agency staff at various stages of adopting new mobility policies. It emphasizes the need to establish clear goals that have logical and coherent alignment with the revenue-related tools implemented to regulate—either through pricing incentives or requirements—new mobility options. It is also designed to work with various new mobility options in both passenger mobility and goods movement.

A key consideration in implementing revenue-related tools is the connection between (a) the impact people and companies have on the transportation system through new mobility and (b) the pricing mechanisms and regulations related to that impact. The framework does not include using revenue-related tools solely for generating revenue. Finally, the framework includes an evaluation step to determine the suitability of selected revenue-related tools.




Note: This image also appears as Figure 1 in the Summary.

***Figure 6. Revenue-related tools framework for new mobility.***

While the framework emphasizes logic and coherence, transportation agency staff may find it difficult to apply the framework in the suggested sequence. Moreover, evolving policy considerations could mean that framework steps must be repeated using new information. It is not critical to follow the same steps with each evaluation cycle. Rather, the framework organizes categories of concepts that would be important for policy evaluation. Regardless of where someone starts in the framework, what is important is that they have considered the alignment between the goals and the tools.

MODULE 2

# New Mobility Passenger Services

## 2.1 Introduction

There is a wide range of inconsistent regulations and operations for new mobility services across local jurisdictions. Some lack a clear nexus to policy objectives (Kim and Puentes 2018; Lowe, Ashton, and Kasal 2021). Some governments have adopted policies reactively to regulate new mobility services after they had been introduced and in response to communities that experienced the unintended effects of their deployment (Griswold 2015). However, even with careful consideration and proactive planning, there now exists a complex mix of state and local policies.

Regulations with a clear and logical purpose are essential for mitigating the impacts of new mobility while facilitating the expansion of innovative mobility options. Some experts say a lack of comprehensive regulations for new mobility has resulted in various unaddressed problems, including increased road congestion, air pollution, and conflicts over the use of public spaces such as curbs and sidewalks (SAE International, Shared and Digital Mobility Committee 2021). For some companies, a clearly regulated environment provides the predictability they need to plan their revenues effectively (Squires 2022). Without a proactive approach to regulation, companies are left to make business decisions in a policy vacuum (Reynolds 2019).

Therefore, to clarify their purpose, transportation agencies can establish clear goals and objectives before instituting new regulations, fees, or subsidies for new mobility. They could also evaluate whether their policies are designed to achieve such goals and objectives. The success of these goals and objectives often affects the decision-making processes of transportation system users, including people who use a new mobility service and companies that provide the service.

Module 2 is designed to be an illustrative application of the revenue-related tools framework, introduced in Module 1, to passenger services. It is organized into the following sections:

- **Background and Context.** This section briefly introduces passenger services and their growing importance.
- **Passenger Service Stakeholders.** This section summarizes key participants involved in passenger services.
- **Goal Alignment of Passenger Services.** This section assesses whether new mobility options help achieve transportation policy goals.
- **Revenue-Related Tools.** This section discusses specific revenue-related tools, narrative summaries of examples, their alignment with transportation policy goals, and assessments using the implementation evaluation criteria.
- **Key Takeaways.** This section synthesizes the findings about revenue-related tools and discusses policy implications.

The discussion of revenue-related tools starts with what is often the first requirement for deploying services in a city or state: an operating agreement or a permit. Operating and permit fees may be paired with additional fees charged per vehicle, trip, or passenger mile. As vehicles become more efficient and pay less in fuel taxes, states are exploring the possibility of imposing a per vehicle mile fee. This module explores two revenue-related tools that are designed to manage the space in which vehicles operate: congestion charges and curb management fees. Finally, this module discusses subsidized services and regulatory requirements, two revenue-related tools that do not result in revenue for transportation agencies but can still be used to promote public goals. This toolkit covers the following revenue-related tools that are relevant to passenger services:

1. **Operating and permit fee:** a periodic (usually annual) fee to operate a new mobility passenger service within a jurisdiction.
2. **Per vehicle fee:** a fee charged for new mobility passenger service vehicles.
3. **Per trip fee:** a fixed charge for each trip that a passenger takes.
4. **Per passenger mile fee:** a fee charged for each distance traveled while a passenger is using a new mobility passenger service. There is no charge if the vehicle is moving without any passengers.
5. **Per vehicle mile fee:** a fee charged to passenger service vehicles for distance traveled. This fee can also be called mileage-based user fee (MBUF), VMT fee, or road usage charge (RUC).
6. **Congestion charge:** a fee specific to an area, lane, or corridor to reduce vehicle congestion.
7. **Curb management fee:** a fee for the use of curb spaces.
8. **Subsidized services:** passenger services that are financially supported by public investment.
9. **Regulatory requirements:** policies that impact the use of new mobility passenger services and, therefore, revenues from or subsidies for the passenger services.

## 2.2 Background and Context

The five new mobility passenger services introduced in Module 1—bikeshare, scootershare, carshare, ride-hail, and microtransit—are the focus of the rest of this module and will be collectively addressed as **passenger services.** These passenger services are different than traditional transportation modes (i.e., personally owned vehicles) primarily as a result of technological advancements that allow for on-demand ordering, routing, and shared services. App-based connections between potential customers and fleet transportation options have made the traditional relationship between the driver and the road more complex.

Though past transportation planning practices might have been oriented toward designing and funding transportation networks that primarily support car-centric lifestyles, many planners are now in the process of building and funding a new transportation system. A novel approach is needed to build a new system that better serves not only those who drive their own vehicles but also those who walk, bike, ride, and share vehicles. A key task in this process is determining who contributes financially to the transportation system. Users of new mobility passenger services may be less subject to fuel taxes, existing transportation user fees, and taxes that go into general funds to create and maintain roads, curbsides, and sidewalks. If there is an incremental negative impact on the transportation system, it may not be adequately captured with existing fees and taxes. If, instead, the impact is more positive than that of traditional transportation options, transportation agencies could also consider ways of supporting the growth of passenger service options through subsidies.

Fiscal challenges remain—and may even have worsened—as ridership for new mobility passenger services and transit recovers from the impacts of the COVID-19 pandemic. In 2024, bikeshare and scootershare ridership surpassed pre-pandemic levels, and transit ridership reached 79 percent of pre-pandemic levels (APTA 2024; North American Bikeshare & Scootershare Association 2024; Shared-Use Mobility Center 2025). Local and regional governments and transit agencies survived the pandemic with the help of federal funding, but this temporary assistance is either running out or has already run out.

Another important context for revenue-related tools applied to passenger services is that fuel tax revenues are declining (Transportation Research Board of the National Academies 2006). Improvements in fuel efficiency and vehicle electrification are eroding federal, state, and local fuel tax revenues, which are major sources of transportation funding. Transportation agencies seeking to recoup declining fuel tax revenues may be interested in exploring revenue-generating potential from passenger services. However, some argue that certain passenger services are suitable as complementary services to public transit, suggesting that they may warrant subsidies instead of being taxed to recoup declining revenues.

## 2.3 Passenger Service Stakeholders

Before further exploring revenue-related tools for passenger services, it is important to understand the different stakeholders who can affect and respond to the revenue-related tools.

Passenger service stakeholders covered in this section:

- Advocates,
- Companies (passenger service organizations),
- Customers, and
- Government agencies.

### Advocates

Advocates are primarily concerned with questions about those who participate in new mobility passenger services (i.e., customers or workers) and those who are affected by them. Advocates can be individuals, nonprofit organizations, elected officials, academics, and others who want to ensure that passenger services consider and address a variety of outcomes. They play an important role in expressing the public's goals or concerns regarding different services.

Advocates for passenger services have stressed the importance of government agencies working with operators to ensure that public goals are achieved. Examples of public goals are safe services for older adults, people with disabilities, women, and transgender people; service availability in and across communities; and reduction in emissions like $CO_2$, $CH_4$, and $N_2O$ and other sources of pollution (Rodrigue 2024). Labor organizations also advocate for safety and wages for those who provide operations and maintenance services for bikeshare or scootershare companies, as well as gig workers who drive for ride-hail and microtransit services (Cohen et al. 2016). For ride-hail services, many groups have advocated for improved local labor conditions, like minimum pay or employee classifications for drivers, but they have generally found little success in many jurisdictions (McKane and Hess 2023).

Success stories for community organizing have entailed promoting increased mobility options and expanding accessibility. For example, in recent years, the Multicultural Center for Mobility in Los Angeles, CA, has succeeded in promoting the city's coverage of bike facilities in lower-income areas and culturally competent safety and cycling information for bikeshare users (National Association of City Transportation Officials 2016).

Advocacy for public goals is intertwined with the revenue-related tools available to transportation agencies. Successful advocacy can result in policies that require funding to directly subsidize passenger services, such as a publicly funded bikeshare system. In addition, policies like energy or labor regulations can indirectly influence the potential for revenue generation by increasing the cost of business for passenger service operators. If increased operating costs are passed onto passenger service users, thus reducing demand for the service, transportation agencies are less likely to generate revenue by imposing taxes or fees on passenger services.

**Taxes** are typically paid by the public and used to fund services and amenities that have broad benefits. Governments usually have greater flexibility in using tax revenues because they are allocated to general funds, though there are often restrictions. This means those who pay and those who benefit are not necessarily linked. However, taxes are also a public mechanism for redistributing wealth and funding public benefits that a private market would not deliver on its own.

**Fees** are typically paid by people who directly benefit from specific services, and sometimes they are also used to fund the same types of services. While policy designs could dilute the link between user and benefit, fees are more like payments for publicly provided services than taxes are. Fees can be more easily adjusted for inflation or other cost increases. Flat or fixed fees, which economists call **regressive,** could be more burdensome for people with less income or other resources.

**Revenue-related tools for passenger services resemble fees more often than taxes.** Users who directly benefit from or impact the transportation system are charged accordingly. The revenue generated from the fees can sometimes be dedicated to funding specific services.

## Companies (Passenger Service Organizations)

Companies that provide passenger services care about taxes and fees for multiple reasons. For example, taxes and fees are **direct costs** of operating a business, and they impact the bottom line. In exchange for the taxes and fees they pay, companies generally expect to receive related benefits, which can include well-maintained infrastructure and public spaces in which to operate.

Companies also look for taxes and fees that create a consistent and predictable operating environment. Companies prefer to know in advance how many vehicles they can deploy, what regulations and requirements will be applied, and how much will be charged in taxes and fees. An agency's early and frequent involvement in determining taxes, fees, and other regulations surrounding them could yield stronger relationships that companies can rely on when they need a collaborative partner to resolve an issue.

Taxes and fees are also **indirect costs** to companies because they can impact demand for the services that companies provide. When taxes and fees are directly placed on customers each time they use a passenger service, the taxes and fees become part of the total cost that people pay (and see) for passenger services. Because people tend to respond to total prices (and not necessarily to individual taxes and fees), companies have to consider taxes and fees when determining their price offerings.

There are a significant number of organizations and companies that provide passenger services in communities across the country. Many new companies and business models have formed to provide passenger services, and many existing companies are exploring mobility innovation through partnerships and by furthering their own investments. This section briefly describes examples of companies that operate passenger services.

- **Bikeshare:** New York City's Citi Bike operates the largest bikeshare fleet in the United States. Private companies like Lyft own and operate fleets that span across different metropolitan areas in the United States (Bureau of Transportation Statistics 2023). They generally work directly with local governments to negotiate service agreements. Bikeshare companies (including Citi Bike and others) often have corporate sponsors who contribute to the system in exchange for branding and marketing.
  - There are a number of nonprofit organizations that also provide bikeshare services. For example, Cascadia Mobility owns and operates bikeshare services in many smaller communities in Oregon, with its largest bikeshare network in Eugene through a partnership with PeaceHealth hospital system, University of Oregon, and Lane Transit District (PeaceHealth 2020).
- **Scootershare:** Scootershare systems started as a chargeable, electric option for micromobility (i.e., e-scooters) in 2017. The first system to launch was by the scootershare company Bird in Santa Monica, CA (Button, Frye, and Reaves 2020). According to the Bureau of Transportation Statistics, as of 2023, 252 e-scooter systems serve 156 cities (Bureau of Transportation Statistics 2023). Major companies that operate scootershare systems in multiple cities across the United States include Bird, Lime, Lyft, and Spin, as well as several smaller companies. Some companies operate both scootershare and bikeshare services within the same location. The number of scootershare (or combined scootershare and bikeshare) operators in a city tends to scale with size, with smaller cities (fewer than 200,000 residents) typically having only one operator, two operators in medium cities (200,000–500,000 residents), and three or more in cities with a population of 500,000 or more (North American Bikeshare & Scootershare Association 2023).
- **Carshare:** Private companies provide almost all carshare services. The carshare business is volatile; many companies have gone out of business after fewer than 10 years of operation. Models for car sharing include both peer-to-peer services (like Turo), where individuals rent their own car to other users, and business-to-consumer services (like Zipcar), where a company owns a fleet of vehicles dispersed throughout an area and rents the vehicles to consumers outside of a traditional car rental center (Golalikhani et al. 2021). Other business-to-consumer services, such as Sharenow and Drivenow, offer free-floating car sharing where users can pick up and drop off in different locations. Although these providers have largely pulled out of U.S. markets, they are still prevalent in other countries. Carshare services can be station-based, meaning customers need to go to designated spots to pick up and drop off vehicles, or free-floating, where customers can pick up and drop off vehicles at any location within a designated service area.
  - A few nonprofits have mission-based carshare models to reduce environmental impacts while increasing mobility within a neighborhood or for specific populations, like low-income residents, people with disabilities, or older adults. For example, Colorado Carshare (Boulder and Denver) and Ithaca Carshare (New York) are committed to reducing the environmental impacts of individual car ownership (Colorado Carshare, n.d.; Ithaca Carshare, n.d.).
- **Ride-hail:** Ride-hail companies, which exclusively use app-based platforms to connect customers with drivers, emerged in the late 2000s. Uber, the first ride-hail company, launched in 2009, and Lyft launched a few years later in 2012, both in San Francisco, CA. Ride-hail services are starting to become available with AVs through companies like Zoox and Waymo.
- **Microtransit:** Both the public and private sectors play a role in microtransit services. These services are often led by public transit agencies but rely on software developed by private companies. Operating staff can be public or private sector employees. In a few markets, private companies like Via directly operate microtransit. (See Figure 7 for an example of a microtransit vehicle.) In many cases, public agencies provide vehicles and staff.

Companies provide passenger services so they can make a profit. Taxes and fees, along with regulatory requirements, competition, general market demand, and other factors, determine


Source: Mass Transit

***Figure 7. Groove On-Demand, Via's microtransit service, in Memphis, Tennessee.***

whether a company can profit and stay in business. By themselves, government taxes and fees may not be the deciding factor in whether a company will operate or be able to stay in business in all communities. However, the possibility of taxes and fees halting new mobility operations is a serious concern for transportation agencies.

## Customers

When transportation agencies are considering revenue-related tools for passenger services, it is important for them to understand how people using the passenger services make their travel decisions. Passenger service users are important stakeholders because they pay the taxes and fees, which are embedded in the prices they see when using passenger services. Customers will change their use of passenger services depending on perceived safety, comfort, enjoyment, convenience, and price of the service.

The sensitivity of users' responses to changes in price is called the **elasticity** of the price, and it impacts the effectiveness of pricing as a management tool. Figure 8 shows how various factors could change users' transportation decisions. They might use different services or vehicles, travel at

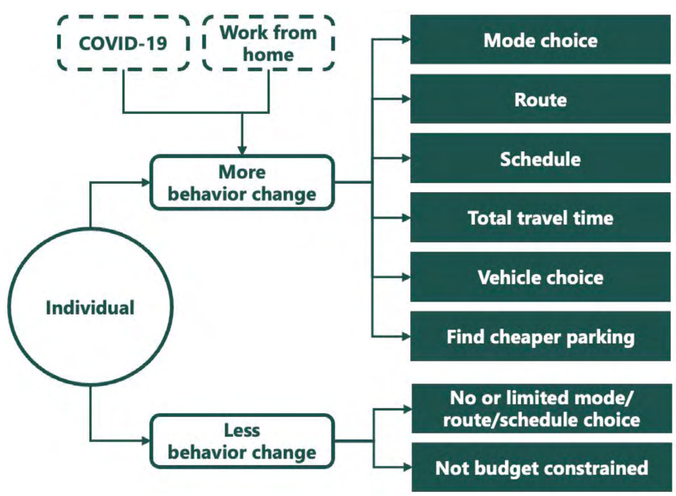



***Figure 8. Pricing and travel behavior for passenger services.***

different times of the day, or make other changes depending on the price of the services (i.e., elastic). But some people may not change their travel decision if (a) they do not have flexibility around the vehicle they use, the time of day that they travel, or the route they travel on, or (b) they are affluent enough to pay a higher price for their preferred transportation option (i.e., inelastic).

The importance of price sensitivity depends on a transportation agency's goals. If the goals of revenue-related tools are to function as pricing signals to consumers and to influence travel decisions, the tools will work better when people are at least somewhat sensitive to prices and will respond accordingly. If, instead, the goal is to raise revenue, transportation agencies need to consider whether high taxes and fees could reduce the number of users or how frequently they use passenger services.

## Government Agencies

Local, regional, state, and national government agencies are directly responsible for ensuring that people and goods can move freely. To do so, they need the resources to build and maintain transportation infrastructure as well as to plan for and manage the transportation system. From this perspective, taxes and fees on passenger services can be a critical component of revenues that fund transportation infrastructure and support new mobility.

Government agencies have a role in ensuring that passenger services are deployed to improve transportation options while mitigating costs to society. They often use pricing to manage demand in transportation and other sectors. Agencies can also use subsidies to incentivize passenger services that increase access to mobility or reduce pollutants such as $CO_2$, $CH_4$, and $N_2O$ emissions. On the other hand, increasing taxes and fees can lower demand in congested areas or reduce other negative outcomes.

In addition to pricing strategies to manage passenger services, the role of government agencies includes the following:

**Contracting and subsidizing:** Government agencies regularly contract for a variety of mobility services. For example, cities can work with nonprofit organizations or private companies to provide bikeshare services (e.g., bicycles, maintenance, bicycle stations, and program management).

Agencies can take different approaches to these partnerships, such as contracts, incentives, or subsidies. Some cities have completely subsidized bikeshare services to offer users free trips, such as EcoBici in Buenos Aires, Argentina, and EnCicla in Medellín, Colombia (Moro 2019). Larger cities in the United States typically subsidize some amount while still requiring user fees. However, some smaller jurisdictions have also piloted fully subsidized programs that are free to users. For example, Aspen, Colorado, began allowing up to 30-minute rides for free in 2013 (National League of Cities 2022). Some agencies also help negotiate sponsorships, grants, or other forms of funding to further support bikeshare services. Like taxes and fees, subsidies are also considered a revenue-related tool.

Government agencies and cities may contract for microtransit services that offer flexible access to transportation networks. Contracted microtransit services were piloted with funds from the Mobility On Demand Sandbox grant program from the FTA. Via, one of the largest microtransit companies, participated in the FTA program to provide first-mile/last-mile microtransit services in Los Angeles, CA (partnering with Los Angeles County Metropolitan Transportation Authority), and in Seattle, WA (partnering with King County Metro and Sound Transit) (Gustave et al. 2018).

**Owning and operating:** Though less common, government agencies can own and operate passenger services. In 2024, the City of Austin, TX, agreed to own the physical infrastructure of their bikeshare system while the Capital Metropolitan Transportation Authority (CapMetro) operates and maintains the system. This new approach allows for a greater service expansion using funding provided by FHWA through the Transportation Alternative Set-Aside program (Capital Metropolitan Transportation Authority 2024).

**Regulating and charging:** Government agencies also play an important role in regulating passenger services, imposing fines and fees, and implementing a range of revenue-related tools, like those presented in this toolkit. In some cases, government agencies require operators of passenger services to pay for the license to deploy their systems. This is most often the case for services like scootershare that can have unpredictable impacts on traffic flow and road safety (Cloud, Heß, and Kasinger 2023; Kazemzadeh, Haghani, and Sprei 2023).

## 2.4 Goal Alignment of Passenger Services

The purpose of revenue-related tools for new mobility passenger services is to increase the benefits of passenger services while limiting their unintended consequences. Depending on the circumstances, passenger services can support transportation policy goals or work against them. Pricing can be an effective tool to help transportation agencies mitigate the impacts of passenger services while also achieving their transportation goals.

### Cost Recovery for Infrastructure and Operations and Maintenance

Because passenger services impose additional costs on transportation agencies to operate and manage the transportation system and fund infrastructure, there is a rationale for extracting revenue from these services to pay for their share of the transportation system. Taxes and fees explicitly designed for passenger services would be appropriate for covering some or all of the incremental costs related to operations, maintenance, and infrastructure of the transportation system.

Transportation agencies could charge to recover costs related to managing scootershare, carshare, and ride-hail services. These services are often provided by private companies, with transportation agencies incurring the resulting costs. However, state preemption for ride-hail may limit the ability of a local government to regulate and extract fees.

In contrast, it is less common for transportation agencies to impose additional fees on bikeshare and microtransit because these services are often paired with public transit—bikeshare is often a public-private partnership, and microtransit is often a contracted service for a transportation agency. Since there are public benefits of bikeshare (e.g., improved health, more efficient use of the roadway) and microtransit (e.g., first-mile/last-mile connectivity), and because transportation agencies often want to make these services more affordable, it is rare to find examples of transportation agencies extracting full cost recovery for these services.

The uses of revenues from passenger services can be varied. The fees can be calibrated to pay for the incremental costs of managing passenger services and providing associated infrastructure. The uses could include staffing to develop and revise regulations, process permits, collect and analyze data, enforce requirements, or respond to complaints. Transportation agencies may need to buy new equipment, software, or licenses specific to data management. Some transportation agencies hire companies to collect data about shared services and provide reports that analyze the data. Sustainable revenue is needed to pay for these varying costs of passenger services.

### Economy (Connectivity)

Passenger services that increase access—connecting more people to more destinations—support economic growth. All forms of passenger services are presumed to increase access by offering different transportation options. Although services like ride-hail may be costly, they can increase access in many time-sensitive circumstances (e.g., job applicants who need to go to an interview, older adults or people with disabilities who need to go to a medical appointment, parents who are picking up a child from a daycare facility or a school).

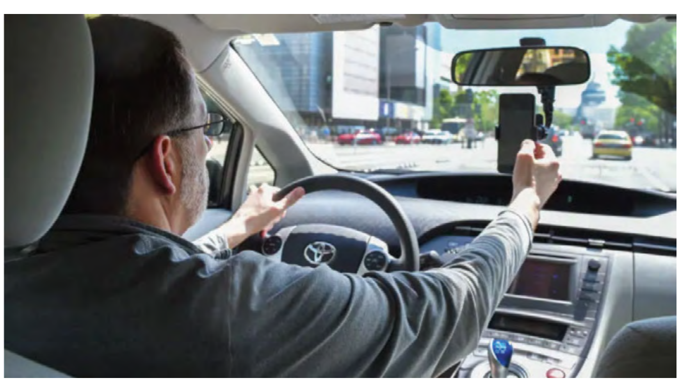
Depending on how the taxes or fees are set up, they can either help or hinder the economic benefits of transportation. Taxes and fees can be beneficial if they generate adequate resources for the transportation agencies that manage the transportation system. However, it may be counter-productive if the charges are set so high that they reduce access—and economic connections—or if they are set too low to sufficiently mitigate congestion and other negative externalities. When assessing whether a policy helps the economy, the main question one should ask is whether the policy reduces the cost of access for road users. If the policy reduces costs, then more connections between people and destinations can happen, leading to increased economic growth.

## Efficiency (Mobility)

Transportation agencies work to ensure that vehicles can move efficiently across the transportation system with as little congestion as possible. If passenger services reduce vehicles on roads, on average they would improve road system efficiency and mitigate congestion. While this might be possible for some passenger services—bikeshare, scootershare, carshare, and microtransit programs—ride-hail programs could potentially worsen road system efficiency because they add deadhead miles, which are miles driven to pick up a new passenger (Figure 9). AV ride-hail could make congestion even worse (Circella et al., n.d.; Harb et al. 2022). Therefore, taxes and fees for ride-hail and reduced fees or subsidies for other passenger services are likely to support goals related to road use efficiency. In addition, subsidies and policies can increase access and mobility for low-income travelers, older adults, children, and other populations.

### *Deadhead Miles*

One of the most significant unintended consequences of ride-hail is the potential for increased VMT and congestion (Anair et al. 2020; Barnes, Guo, and Borgo 2020; Cramer and Krueger 2016; ICF et al. 2021; Komanduri et al. 2018; Nair et al. 2020; San Francisco County Transportation Authority 2018; Schaller 2017; Wenzel et al. 2019; Wu and MacKenzie 2021). For example, ride-hail companies were the biggest contributor to traffic congestion in San Francisco, CA, between 2010 and 2016, increasing hours of delay by 62 percent compared



Source: Jonathan Newton/Getty Images

***Figure 9. Ride-hail driver looking for new passengers.***

to 22 percent in a counterfactual scenario for 2016 without ride-hailing (Erhardt et al. 2019). Others also found that ride-hail trips often occur between highly accessible neighborhoods that could be accessed by other modes (Anair et al. 2020; Bradley et al. 2022; Gehrke, Felix, and Reardon 2019; Marquet 2020). AVs are anticipated to exacerbate this trend and potentially add even more VMT to the system.

### *Trip Generation Versus Replacement*

Taxes and fees on passenger services can influence travel behavior by either curbing the additional trips that these services generate or discouraging their use in favor of public transit, ultimately shaping the broader transportation ecosystem.

If the passenger services will generate new trips that would otherwise not have occurred, taxes and fees could reduce the number of new trips. For example, some bikeshare programs are intended to generate new trips, often by designing programs with the launch of a new bus rapid transit line or by collocating stations at transit stops. Bikeshare services can provide first-mile and last-mile connections to and from public transit stations (Rogers 2024). Ride-hail could also generate new trips for some people due to a lack of parking and intoxication (Clewlow and Mishra 2017). However, taxes and fees could disincentivize their use.

In contrast, ride-hail, AVs, and free-floating car-sharing systems can replace transit trips (Ampudia-Renuncio et al. 2020; Baumgarte et al. 2021; Becker, Ciari, and Axhausen 2017; Papu Carrone et al. 2020; Pakusch, Stevens, and Bossauer 2018). In these cases, pricing tools can make the passenger services less compelling and thus incentivize transit use.

## Environment

Bikeshare and scootershare services emit much lower emissions per mile traveled than a typical personally owned vehicle or ride-hail service. Bikeshare and scootershare services are often powered by electricity, which has lower emissions than fossil fuels. Carshare can reduce emissions like $CO_2$, $CH_4$, and $N_2O$ by reducing car ownership, total VMT, and fuel consumption (Cohen, Shaheen, and McKenzie 2008; Fleury et al. 2017). In addition to bikeshare, scootershare, and carshare, EVs can support goals to reduce direct emissions (Figure 10). On the other hand, ride-hail services can lead to higher VMT and emissions due to deadhead miles. Therefore, taxes and fees for ride-hail services (both with driver and driverless) and subsidies for other passenger services can support goals related to the environment.

Source: Kara/stock.adobe.com

***Figure 10. Charging EV and a bicycle lane.***

### Distributional Impacts

Passenger services can add transportation options across demographic and income categories and geographic areas. For example, bikeshare and scootershare can provide additional transportation options for commuters—though a study did show a preference for docked bikes during peak commute hours because they were more reliably available than dockless bikes (Reck et al. 2021). Carshare and ride-hail services increase access for those who do not own vehicles (Cohen and Shaheen 2018). Older adults (at least 54 years old) and people with physical disabilities who frequent health care facilities are more likely to use microtransit (Wang et al. 2015; Miah et al. 2020).

Therefore, subsidies and policies that increase mobility, in particular for people with fewer mobility options or less income, may support goals related to distributional impacts. The City of Portland (2019), for example, charges a $0.50 fee per ride-hail trip to partially fund the availability of wheelchair-accessible vehicles (WAVs).

However, if access to and use of passenger services is limited, passenger services would not provide significant benefits. Given that the typical users of passenger services tend to be male, more educated, more resourced, urban, white, and younger, taxes and fees for passenger services could support goals related to distributional impacts by increasing access beyond typical users.

### Health

Pedal bikes are aligned with goals around health because they require significant physical exertion. Other forms of passenger services that reduce air pollution and improve air quality, such as electric scooters and EVs, could also be aligned with health-centric goals. Governments that prioritize better health outcomes could subsidize (not tax) pedal bikeshare programs and other passenger service options that improve air quality. For example, Bike Share Pittsburgh, Inc. launched its bikeshare program, Healthy Ride, to promote a healthier lifestyle. The program is funded by FHWA, Highmark (a health insurance provider), and Allegheny Health Network (a regional health care provider) (American Hospital Association 2016). Alternatively, to achieve a similar effect, governments could tax (not subsidize) passenger service options that worsen air quality.

### Safety

Passenger services that reduce vehicles on roads are likely to support safety goals. Similar to the efficiency goal, this is likely but not always true for bikeshare, scootershare, carshare, and microtransit programs. However, ride-hail programs are less likely to align with safety goals because they can add deadhead miles and replace potentially safer transportation options. Therefore, taxes and fees for ride-hail and subsidies for other passenger services are likely to support goals related to safety.

However, there are safety concerns for bikeshare and scootershare. The main safety issue is their potential to inflict injuries and impede pedestrian access to sidewalks. A review of e-bike and scooter pilot programs found many safety issues, including a lack of helmet use, sidewalk use impeding pedestrian safety, and inappropriate parking (DuPuis, Griess, and Klein 2019). Pedestrian safety issues have a disproportionate impact on older adults and people with disabilities, who already face barriers with basic sidewalk access (Ruvolo 2020). As tripping hazards, shared bikes and scooters also impede access for older adults and those who rely on mobility aids or wheelchairs (Fraade-Blanar et al. 2021). Protecting pedestrians was one of the key goals for Paris's policies regulating the use of shared mopeds, bicycles, and scooters (Castellanos, Wright, and Grant-Muller 2024). That said, studies show improper scooter parking happens less often than people perceive (Klein, Brown, and Thigpen 2023).

## 2.5 Revenue-Related Tools

This section discusses specific revenue-related tools, narrative summaries of examples, each tool's alignment with transportation policy goals, and assessments using the implementation evaluation criteria. This toolkit covers the following revenue-related tools that are relevant to passenger services:

1. **Operating and permit fee:** a periodic (usually annual) fee to operate a new mobility passenger service within a jurisdiction.
2. **Per vehicle fee:** a fee charged for each new mobility passenger service vehicle.
3. **Per trip fee:** a fixed charge for each trip that a passenger takes.
4. **Per passenger mile fee:** a fee charged for each distance traveled while a passenger is using a new mobility passenger service. There is no charge if the vehicle is moving without any passengers.
5. **Per vehicle mile fee:** a fee charged to passenger service vehicles for distance traveled. This fee can also be called MBUF, VMT fee, or RUC.
6. **Congestion charge:** a fee specific to an area, lane, or corridor to reduce vehicle congestion.
7. **Curb management fee:** a fee for the use of curb spaces.
8. **Subsidized services:** passenger services that are financially supported by public investment.
9. **Regulatory requirements:** policies that impact the use of new mobility passenger services and, therefore, revenues from or subsidies for the passenger services.

The operating and permit fee is one of the most common types of fees charged by a transportation agency for passenger services. The operating permit can also be a mechanism for implementing other fees. Many transportation agencies commonly include terms that refer to charging per vehicle, per trip, a per passenger mile, and other fees within the agreement establishing the operating permit. A per vehicle mile fee is different from a per passenger mile fee because it is assumed that the fees will be charged to all vehicles—personally owned and shared services alike. Ultimately, transportation agencies need to determine whether shared services or vehicles will be charged differently than personally owned vehicles. Congestion charges and curb management fees are designed to influence travel decisions and fund investments that can alleviate congestion. The final two tools—subsidized services and regulatory requirements—are two different approaches to achieving public goods, either by paying directly (subsidized services) or requiring companies to provide public goods through regulation.

This toolkit provides examples of evaluating these tools using the revenue-related tools framework for new mobility (Figure 6), described in Module 1. Transportation policy goals are introduced in Section 1.4 and further described in Section 2.4. Implementation evaluation criteria are described in Section 1.6.

### Operating and Permit Fee

#### *Fee Description*

Cities can better manage the transportation system and influence their outcomes and externalities when they know what vehicles and services are operating in their system. A permit system for passenger service operations allows cities to collect information about passenger service providers and shape the services by creating requirements, such as how many vehicles can be deployed and when they can operate. Local and state governments can help passenger service providers by establishing standard operating procedures and coherent regulations, limiting the total number of providers or vehicles, consistently enforcing regulations, and managing congestion and cluttered vehicles at pickup and drop-off locations. Collection and analysis of information can also help indicate where new infrastructure may be needed (additional bike lanes, parking areas, etc.) and facilitate coordination around construction, street closures, special events, and more. These public services come at a price, and operating and permit fees for businesses can help pay for management of services in the public realm while benefiting service providers.

An operating permit can also be part of a broader service contract that establishes the operating structure and contractual relationship between a transportation agency and a passenger service entity. Terminology used for this can include an operating permit, a permit, a business license, a service contract, a concession agreement, or a memorandum of understanding. While there may be differences among the various operating structures, they are all critical for establishing an operating and permit fee as well as other fees.

#### *Use Across New Passenger Services*

Operating and permit fee systems can vary across passenger services. Bikeshare systems are often publicly owned and operated or public-private partnerships, commonly created through a public procurement process. On the other hand, scootershare and carshare services are primarily operated by private companies, and they often operate under permit agreements, service contracts, or concession agreements with local authorities. Regulations for ride-hail services are less common at the local level due to state regulations. Many states preempt local governments from imposing regulations or taxes on ride-hail companies or severely curtailing them, limiting the ability of local authorities to intervene in their operations. Finally, the structure of microtransit operators can resemble bikeshare systems (public or public-private partnerships) or scootershare and carshare systems (private companies operating under permit agreements).

Operating and permit fees are fixed charges that are paid periodically (usually annually). They can be either flat fees or tiered-rate fees. These fees are commonly charged when a company fills out a required permit. Some cities charge an additional fee (e.g., per vehicle or per trip). For example, the City of San Francisco has a Powered Scooter Share Program permit fee of $39,322 and an annual renewal fee of $5,512 (San Francisco Municipal Transportation Agency 2021). The City of Portland (2023) charges a $500 application fee on top of the pilot permit fee for the scooter program. The passenger service operator may need to pay the cost of printing permits and vehicle identification stickers, if required. Table 5 shows examples across passenger services.

#### *Policy Goals Assessment*

Operating and permit fees are likely suitable for (partial) cost recovery. The operating and permit system creates a relationship between the private operator and the transportation agency to improve coordination and transportation system efficiency. However, operating and permit fees are unlikely to be suitable for achieving other policy goals. Table 6 shows potential policy goals that can be achieved through operating and permit fees.

#### *Evaluation of Policy Implementation*

Table 7 shows the evaluation criteria for operating and permit fees.

### Per Vehicle Fee

#### *Fee Description*

A per vehicle fee refers to a fee charged for a vehicle to operate within a jurisdiction. Traditionally, per vehicle fees have mostly been associated with purchasing or licensing fees for vehicles. In 1901, New York became the first U.S. state to require that all vehicles be registered. Vehicle registration did not become a requirement for all states until 1921. At this time, vehicle registration taxes and license fees, which came about alongside these registration requirements, became

**Table 5. Operating and permit fee examples.**

| Passenger Service | Example |
|---|---|
| **Bikeshare** | Seattle created the first permit program in the country for regulated and structured dockless bikeshare services (Shared-Use Mobility Center 2019). The permit fee structure is composed of permit issuance, a renewal fee, a permit review fee, and a yearly administrative fee. The cost for permit issuance was most recently updated to $416 in 2024, or $316 for permit renewal as specified in the street use permit fee; the permit review fee was $350 per hour of review as specified in the street use permit fee schedule or as subsequently amended. The annual administrative fee varies based on the number of vendors granted permits—in 2024, it was $50 per permitted bicycle (Seattle Department of Transportation 2024). |
| **Scootershare** | The City of San Francisco has a Powered Scooter Share Program permit fee of $39,322, an annual renewal fee of $5,512, and a per scooter fee of $100 (San Francisco Municipal Transportation Agency 2021). The City of Portland (2023) charges a $500 application fee and $20 per vehicle, per quarter fee as the pilot permit fee for the scooter program. |
| **Carshare** | The Carshare Program in New York City is open to both round-trip and one-way carshare services. Eligible carshare organizations must pay an annual site permit fee of $475 for new and existing sites. |
| **Ride-hail** | Oregon is one of the only states that does not preempt local regulations of ride-hail. In Portland, both ride-hail companies and individual drivers for those companies are required to obtain a permit from the Portland Bureau of Transportation (PBOT). The same permit is required for all for-hire vehicles, including taxis, limos, and other services. For individual drivers to obtain permits, there is a combination of requirements related to the vehicle, driver, safety, and documentation. Record checks and reviews include a fee of $50 per driver, $975 for new ride-hail companies, and $680 for renewing companies (Portland Bureau of Transportation, n.d.). |
| **Microtransit** | Public transit agencies and private companies both offer microtransit services. The private microtransit company Via is one of the largest in the United States, and it operates in a number of communities. A survey of microtransit pilots across the United States found “contracts for service are more common than permits” (Steckler et al. 2020). Still, the San Francisco Municipal Transportation Agency board has a Private Transit Vehicle permit program, which includes application requirements, permit conditions, fines, and fees. The Private Transit Vehicle permit program applies to companies that operate such types of services entirely within San Francisco city limits. For example, Chariot, a microtransit commuter shuttle service owned by the Ford Motor Company, was permitted for their services in 2017, but it was no longer operating as of early 2024. |

**Table 6. Policy goal assessment for operating and permit fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | Fee charges through an operating and permit system can help recover some costs. Agencies can charge fees to service providers in return for granting them permission to operate within their jurisdictions. Cost recovery is likely to be the most important policy goal for operating and permit fees. (This is also true for per vehicle fees.) |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | An operating and permit system can improve efficiency by creating a formal relationship between the private operator and the transportation agency. Transportation agencies can require vehicles to be located or available in all (or many) neighborhoods, enhancing accessibility. In addition, transportation agencies can work with operators at specific locations or times of high demand (i.e., during large events) to coordinate pickup and drop-off locations and allow space for queuing. However, a flat operating or permit fee is not an appropriate tool for pricing trips for services when or where they are most in demand; rather, usage-based fees are better for pricing trips. |
| **Economy, environment, distributional impacts, health, and safety** | While operating and permit fees can be used for operations, maintenance, and infrastructure related to passenger services, it is difficult to scale or tailor them in a way that directly influences the decision-making processes of companies or customers. While operating and permit fees can advance goals related to the economy, environment, distributional impacts, health, and safety, other revenue-related tools that are usage based will likely be better at pricing for these goals. |

**Table 7. Evaluation of policy implementation for operating and permit fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness** Does it achieve the intended outcomes? | The fees have a clear link to the costs of the permitting service that is provided, so they help achieve some cost recovery. The operating and permit system also helps establish relationships between companies and transportation agencies for future coordination on passenger service availability and expansion. |
| **Fairness** Who does it benefit or harm? | Operating and permit fees that are set up to fund the minimum cost of managing services are directly proportional to their impact on the transportation system and could be considered fair. Portions of the fee that can be scaled to the number of vehicles also allow for greater charges to companies that have a more significant impact on the transportation system. |
| **Political Considerations** | |
| **Legality** Is it allowed? | Operating and permit fees for bikeshare and scootershare services are legal in all states. Ride-hail and autonomous vehicle companies have aggressively worked to preempt local regulations and, in some instances, pricing of their services. At least 31 states have preemption laws, while others curtail regulations at some level (Lehe et al. 2024). |
| **Public acceptance** Could there be organized support or opposition? | Operating and permit fees may be acceptable if the general public or elected representatives view passenger services as extracting or using public resources. They may be easily compared to other permit fees that cities usually collect. Since the companies pay the fees, the existence of the fees will be less apparent to the users of passenger services. |
| **Revenue Considerations** | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | Many local and state governments have experience developing and implementing operating and permit fees and the associated regulations for other uses. |
| **Flexibility** Can the revenue be spent in multiple ways? | The use of revenue depends on how the transportation agency sets up the fee. Fees sometimes go into specific budgetary accounts to fund specific programs. |
| **Revenue capacity** How much revenue will it generate? | Operating and permit fees generate a relatively small amount since a fee is usually charged when companies negotiate the terms of providing their service within a jurisdiction. |
| **Stability** Is the revenue stream resilient to economic cycles? | A portion of the fees will be stable because companies are charged and contracts are renewed on a regular basis. However, fees related to the number of vehicles could change over time as the service provider calibrates the number of vehicles to deploy to meet the demand. |

a major source of revenue for highways (U.S. DOT 1975). However, vehicle registration and per vehicle fees are different in that registration is attached to specific vehicles and allows them to be driven legally, while a per vehicle fee is not attached to a specific vehicle but the fleet as a whole. As passenger services such as bikeshare and scootershare start to gain popularity, the relevance of per vehicle fees for these services is also increasing.

### *Use Across New Passenger Services*

Among passenger services, per vehicle fees are typically charged for bikeshare, scootershare, and carshare programs. State preemptions limit per vehicle fees for ride-hail in many states. The funding mechanisms for these passenger services operate similar to that of the permit system, and per vehicle fees can be part of an agreement establishing an operating and permit fee. For example, the City of San Francisco has a per scooter fee of $100 to ensure that there are enough bike racks for both bikes and scooters (Chiu 2021). The City of Portland charges a $20 per vehicle, per quarter fee for the Shared Electric Scooters program (City of Portland 2023). Many car-sharing entities are similarly required to pay per vehicle permit fees at the beginning of the year or annually from when they begin offering service. For example, for the City of Seattle, permit holders are required to pay $300 for each free-floating vehicle (Seattle Department of

Transportation, n.d.-a). Minneapolis charges a $680 annual free-floating permit for each vehicle for operating companies (Cieminski 2016).

### *Policy Goals Assessment*

Like operating and permit fees, per vehicle fees are likely suitable for partial cost recovery. In addition to creating a relationship between the private operator and the transportation agency to allow for coordination and improved transportation system efficiency, per vehicle fees also allow for more accurate accounting of the vehicles for better management. However, per vehicle fees are unlikely to be suitable for achieving other policy goals.

Table 8 shows potential policy goals that can be achieved through per vehicle fees.

### *Evaluation of Policy Implementation*

Table 9 shows the evaluation criteria for per vehicle fees.

## Per Trip Fee

### *Fee Description*

A per trip fee is a relatively simple pricing tool—it is a standard fee paid to the transportation agency for each passenger trip. This type of fee is typically paid to the city or county. It is separate from the fare charged by the passenger service provider for the ride, which is often based on distance or time in use. Trip fees are often used in part because they are easy for service providers to implement. Furthermore, their simplicity makes it relatively straightforward for companies and government agencies to forecast revenues. A trip fee is slightly better than an operating or permit fee at achieving goals that reflect how much the transportation system is used. However, trip fees are less proportional than per mile fees, which better correspond to the total demand or impact on the transportation system.

### *Use Across New Passenger Services*

Public sector entities that operate bikeshare or scootershare services sometimes charge a fee for each trip, usually in the form of a fee to unlock or access the mobility device. Carshare services

**Table 8. Policy goal assessment for per vehicle fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Per vehicle fees most closely align with the vehicle's impact on infrastructure and parking. Therefore, these fees are better suited for recovering costs that scale with the number of vehicles in a fleet. For example, per vehicle fees can help compensate for swapping automobile parking spots with scooter parking or for the purchase and installation of bike racks that can also be used to lock scooters. For carshare, the fees can replace parking fees that otherwise would be collected from other vehicles. Cost recovery is likely to be the most important policy goal for per vehicle fees. (This is also true for operating and permit fees, as described in the previous section.) |
| **Environment** Does it help reduce emissions? | While per vehicle fees do not account for environmental costs that scale with the number of trips a vehicle takes (e.g., emissions from fuel consumption), they can be a suitable tool for addressing environmental costs that are associated with the manufacturing of the vehicle (e.g., emissions from the production of materials used to make the vehicle). |
| **Economy, efficiency, distributional impacts, health, and safety** | Per vehicle fees generally have relatively fewer impacts on economy, efficiency, distributional impacts, health, and safety, though improved public-private coordination can increase system efficiency in terms of mobility. |

**Table 9. Evaluation of policy implementation for per vehicle fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | Per vehicle fees have a clear link to the goal of cost recovery. Additionally, the tool creates a relationship between the private operator and the transportation agency, which improves coordination and transportation system efficiency as well as creates a more accurate accounting of the vehicles for better management. |
| **Fairness**<br>Who does it benefit or harm? | Per vehicle fees encourage better management of the transportation system through a more accurate inventory of vehicles, which helps to ensure that there are enough bike racks, scooter racks, and other infrastructure for users. As a result, users could have an enhanced experience, and more users are likely to benefit given the shared and affordable nature of these mobility options. |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | Per vehicle fees generally fall within the realm of operating and permit fees for bikeshare, scootershare, and carshare; therefore, they are legal in all states. However, fees for ride-hail are preempted in many states. |
| **Public Acceptance**<br>Could there be organized support or opposition? | The concept of per vehicle fees is relatively common, as vehicle owners pay on a per vehicle basis for registration on a regular basis and are familiar with the fee mechanism. However, per vehicle fees are less common than operating and permit fees in public transportation spaces, which may imply less public acceptance associated with the per vehicle fees in comparison with operating and permit fees. That said, these fees are less likely to be transparent to the public, thus, there may be less resistance to them. |
| **Revenue Considerations** | |
| **Administrative Ease**<br>Does it require new knowledge, staffing, or systems? | Local and state governments generally have experience with developing and implementing per vehicle fees (i.e., vehicle registration fees) and the associated regulations for other uses. |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | The use of revenue depends on how the transportation agency sets up the fee. Fees sometimes go into specific budgetary accounts to fund particular programs. |
| **Revenue Capacity**<br>How much revenue will it generate? | Per vehicle fees generate a relatively small amount since the fee is usually charged when companies negotiate the terms of providing their service within a jurisdiction. |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | Given that the fee is per vehicle, if the number of vehicles fluctuates based on demand, the number of vehicles could change over time and affect the stability of the revenue stream. |

may also be charged a fee, though the fee could vary by type of vehicle. In Portland, OR, carshare companies pay $1 for each trip that starts or ends in the city limits (City of Portland, n.d.). For Seattle, WA, the per trip fee is $0.50 per trip for internal combustion vehicles and $0.25 per trip for EVs (City of Seattle, n.d.). There are also cities that only charge a single permit fee and per vehicle fee, such as New York City (New York City Department of Transportation, n.d.).

Ride-hail services like Lyft and Uber are also subject to various fees and taxes in some cities and states, such as a $2.75 per trip fee in New York City, and the revenue is used to fund public transportation (via the Metropolitan Transportation Authority). The licensing and regulation fee for ride-hail drivers in Seattle is paid through a “per trip fee” of $0.23 (King County) and $0.08 (City of Seattle) collected by the ride-hail service. Each ride-hail service also pays a $0.10 per trip fee for the Wheelchair Accessible Services Fund. As of April 2020, five states (California, Connecticut, Georgia, Massachusetts, and New Jersey) and five cities, as well as multiple counties in Maryland, also charge a flat fee for ride-hail services (Brown 2022). One of the least expensive charges is a $0.10 per trip fee in California, followed by per trip fees in Massachusetts ($0.20) and Connecticut ($0.25). Comparatively, Portland issued a $0.50 per trip fee in 2015, and New York issued a $2.75 per trip fee in 2019 (Kim and Puentes 2018).

Although a per trip fee is rare for microtransit services, some cities have experimented with it. For example, San Francisco's Commuter Shuttle Pilot Program had a per trip fee of $3.67 (San Francisco Municipal Transportation Agency 2017). The pilot program is not currently running.

### *Policy Goals Assessment*

The dimensions of evaluation for policy objectives include cost recovery, economy, efficiency, environment, distributional impacts, health, and safety. Table 10 shows the relevant policy goals that per trip fees could help to achieve.

### *Evaluation of Policy Implementation*

Table 11 shows the evaluation criteria for per trip fees.

## Per Passenger Mile Fee

### *Fee Description*

Some government agencies charge a fee that is based on each passenger mile (or a fraction of a mile) traveled during a passenger service trip. The per passenger mile fee is different from per vehicle mile fees charged to vehicles (see description in the following section). Similar fees may charge a percentage of the total fare paid for a passenger trip, which also functionally scales the amount charged proportionately to distance traveled.

**Table 10. Policy goals assessment for per trip fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Per trip fees are one way to scale the fees paid to the impact on the transportation system. Systems with a large number of trips will require planning, tracking, and analysis, and there could potentially be a larger number of complaints or other issues that must be addressed. Charging a per trip fee could roughly correspond to the level of effort necessary to manage the service in the public ROW. While per trip fees generate revenue and help offset agency costs, cost recovery may not be the only or the most important policy goal. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Per trips fees would marginally increase the cost of access, though it is uncertain whether they would be large enough to result in different outcomes. |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | Per trip fees can be calibrated to improve overall efficiency of the service. Higher fees can reduce the number of trips and reduce congestion. |
| **Environment** Does it help reduce emissions? | Per trip fees are better at achieving environmental goals than operating and permit fees or per vehicle fees. The impact on the environment is proportional to the number of trips taken, so fees that scale with the number of trips can help mitigate negative impacts on the environment. Also, such fees can be adjusted based on the type of vehicle (internal combustion engine or electric). A lower per trip fee for EVs can encourage more trips to be taken by such vehicles, resulting in less air pollution. However, per trip fees do not scale as well as mileage-based fees, so they are not as good at pricing for emissions in longer trips. |
| **Distributional impacts** Does it help make the transportation system more fair? | Similar to calibrating per trip fees to achieve environmental goals, providing access to services can be incentivized by reducing per trip fees in geographic locations that improve access for special populations. |
| **Health, safety** | Though research is limited, bikeshare could have greater health and safety benefits if riders would otherwise have taken motorized vehicles that move at more dangerous speeds. In this context, per trip fees would likely work against health and safety goals. Still, safety risks could increase for scootershare, ride-hail, microtransit, and carshare if their increased use leads to a greater chance of road collisions. In this case, per trip fees would be effective at improving road safety at the margins. |

**Table 11. Evaluation of policy implementation for per trip fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness** Does it achieve the intended outcomes? | Per trip fees have a clear link to the goal of cost recovery based on usage. Additionally, the tool creates a relationship between the private operator and the transportation agency to allow for coordination and improved transportation system efficiency, as well as more accurate accounting of the vehicle volume for better management. Lastly, per trip fees scale well with external costs associated with health, safety, and the environment. |
| **Fairness** Who does it benefit or harm? | Per trip fees encourage better management of the transportation system by capturing traffic volumes better than per vehicle or flat operating fees. As a result, users could have an enhanced experience, and more users are likely to benefit given the shared and affordable nature of these mobility options. However, trip fees are less proportional than a per mile fee, which better corresponds to the total demand or impact on the transportation system. |
| **Political Considerations** | |
| **Legality** Is it allowed? | Per trip fees generally fall within the realm of operating and permit fees for bikeshare, scootershare, and carshare services, therefore they are legal in all states. However, per trip fees for ride-hail services may be limited in some states. |
| **Public acceptance** Could there be organized support or opposition? | Per trip fees are common, especially for ride-hail services in cities; such fees are easy for passengers to understand and for providers to implement. This simplicity makes it relatively straightforward for companies and government agencies to forecast revenues. |
| **Revenue Considerations** | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | Local and state governments generally have experience developing and implementing per trip fees and the associated regulations for other uses. |
| **Flexibility** Can the revenue be spent in multiple ways? | The use of revenue depends on how the transportation agency sets up the fee. Fees sometimes go into specific budgetary accounts to fund particular programs. |
| **Revenue capacity** How much revenue will it generate? | Revenue capacity would correspond with the demand for trips for each mobility option. |
| **Stability** Is the revenue stream resilient to economic cycles? | Given that the fee is per trip and the number of trips fluctuates based on demand, the number of vehicles and trips could change over time and affect the stability of the revenue stream. For bikeshare and scootershare, weather may also impact the number of trips taken, as well as seasonality (i.e., more trips in warmer months, fewer in colder months). Other less predictable events can also impact the number of trips, such as the COVID-19 pandemic; presence of wildfire smoke; heat waves; or major protests, labor strikes, or other large, disruptive events. |

Like per passenger mile fees, **percent-based fees** are closely related to distance traveled for ride-hail trips. They are based on the total fare paid by passengers for mobility services, which usually includes a calculation for time and distance as well as any flat rate or surcharge fees applied by the operator. Some states, including Alabama, California, Hawaii, Nevada, New York, Rhode Island, South Carolina, South Dakota, and Wyoming, charge fees to ride-hail companies that are calculated based on a percentage of total passenger fare (Kim and Puentes 2018). The percentage of passenger trip fees for ride-hail range from less than 1 percent of total trip fare to over 8 percent. South Carolina and Alabama both have a 1 percent fee on total fare, issued in 2017 (Brown 2022; Kim and Puentes 2018). Fees in Wyoming and South Dakota are 4 and 4.5 percent of total fare, respectively, which go to the general fund and local governments for each state. The State of Rhode Island and New York City so far have the highest percent-based fees, at 7 percent and 8.88 percent of total fare, respectively, both of which funnel revenue into general funds for the state (Kim and Puentes 2018).

### *Use Across New Mobility Modes*

Government fees for passenger services per passenger mile aim to capture revenue based on the distance traveled for services. Most passenger services have a formula for calculating the cost of a ride that is derived using the distance or time that passengers travel (also typically influenced by other factors, like time of day or demand volumes). This is the cost that a user pays to the service provider. The amount charged by government agencies per passenger mile ranges widely between jurisdictions and modes. Per passenger mile fees for ride-hail can be implemented locally by cities or at a regional or state scale, if allowed by state law (Fuller and Brown 2021).

The data tracked by service providers can be a convenient mechanism for jurisdictions to implement a per passenger mile (or percent of passenger trip) fee since companies have this information available about distance, time, and fares for individual trips. Many jurisdictions have required companies to share this information with them.

> Mobility Data Specification (MDS) services are an important way that government agencies (typically cities) and companies work together to communicate information about new mobility services. These digital tools allow cities to track use patterns, monitor mobility programs, implement new initiatives, and create clear communication channels between public and private partners (Open Mobility Foundation 2023). MDS can help cities implement revenue tools like per trip fees and per passenger mile fees by streamlining communication while also ensuring third-party validation and privacy for users. For microtransit, transactional data specification is beginning to enable a network of transportation providers to view and transfer information about requested trips among users of services like nonemergency medical transportation and paratransit (Benedict et al. 2024).

### *Policy Goals Assessment*

Fees charged per passenger mile can help jurisdictions rightsize the amount charged for passenger services. Whereas flat, per passenger trip fees apply standard rates to all trips (or all trips of a certain type), per passenger mile fees are scaled to the net impact of individual trips. Table 12 shows the relevant policy goals that per passenger mile fees could help to achieve.

### *Evaluation of Policy Implementation*

Table 13 shows the evaluation criteria for per passenger mile fees.

## Per Vehicle Mile Fee

### *Fee Description*

MBUFs, VMT fees, and RUCs (referred to as per vehicle mile fees in the rest of this section) are all structured based on the distance driven by a vehicle on a defined network of roadways.

Per vehicle fees are not widely used in the United States. Current pilot projects across the country are being carried out by state DOTs, but no jurisdiction in the United States has yet implemented a per vehicle mile fee that explicitly accounts for services like ride-hail and car-share. As of this writing, the federal government has included funding for a national pilot project for per vehicle mile fees. It is anticipated that per vehicle mile fees will be created at the state or

**Table 12. Policy goals assessment for per passenger mile fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Collecting revenue based on travel distance will generate revenue and help with offsetting the cost of operating and maintaining new mobility services. However, when transportation agencies operate the services or partner to provide them, they may charge a low rate or not charge a fee at all in order to make the services more available and attractive to potential users (Andersen 2016). Therefore, mileage-based fees are not the best tool if cost recovery is the most important policy goal. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Per passenger mile fees implemented by jurisdictions are likely to be passed through from companies to users and increase the cost of ride-hail trips (Tarduno 2024). Therefore, such fees tend to increase the cost of accessing a place by this mode. This negative impact may be greater with per passenger mile fees than per trip fees because the former are scaled to the trip distance rather than a flat charge. |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | Per passenger mile fees can disincentivize users by increasing the cost of using a service. Depending on the mode, this can increase overall efficiency by reducing the volume of users contributing to congestion. However, ride-hail service charges per passenger mile (rather than per vehicle mile) do not fully account for deadhead miles traveled between trips, thus underestimating the full impact of the service on congestion in the transportation system (Yanocha and Mason 2019). |
| **Environment** Does it help reduce emissions? | Per passenger mile fees as well as those charged as a percentage of total trip cost create proportionate pricing based on the distance traveled. By charging for each mile driven, these fees help account for environmental impacts associated with greater VMT for ride-hail and carshare trips. |
| **Distributional impacts** Does it help make the transportation system more fair? | In some cases, charging based on the distance a passenger travels can disproportionately impact users in certain geographic areas that have less access to transportation. However, jurisdictions can apply policies that encourage services to operate in areas that have had below-average access to transportation (Yanocha and Mason 2019). |
| **Health, safety** | Like environmental impacts, per passenger mile fees can more accurately reflect the proportionate impacts on public health and safety associated with VMT from individual trips than flat, per passenger trip fees. |

national level, and revenue will be used primarily by state DOTs or the federal government to fund state and federal transportation infrastructure, operations, and maintenance. These funds may be distributed (a) from the federal government to the state or local governments or (b) from the state to local governments, depending on how formulas, grant programs, or other mechanisms are set up. It remains to be seen if and how federal or state per vehicle mile fee programs will integrate with local efforts regarding similar fees. This section considers how per vehicle mile fee programs at the federal or state level might be coordinated with shared passenger services at the state or local level. If this is not possible for any state or local governments, they may want to default to passenger mile fees instead (see previous section).

Approximately 14 states have piloted or enacted per vehicle mile fees, while others have participated in state and regional research. However, only four states assess these fees on an ongoing basis: Oregon and Virginia do so on a volunteer basis, while Utah and Hawaii assess these fees for EVs (Shrode 2023). These fees are distinct from per passenger mile fees (described in the previous section) because they are related to the vehicle itself and may be better for capturing deadhead miles (i.e., the distance driven by ride-hail vehicles between trips, without a passenger). These fees also differ from tolls, which typically only apply to a specific route or segment of a route.

Compared to traditional fuel-based charges or tolling, per vehicle mile fees link transportation fees closely to actual roadway usage throughout the system. Per vehicle mile fees can also be implemented in different ways for different types of users; sometimes they are flat charges, which are the same for all users of the transportation system, or variable, based on factors such as class of vehicles, driver characteristics, or travel patterns (California Transportation Commission 2024).

Mileage-based user fee (MBUF), vehicle miles traveled (VMT) fee, and road usage charge (RUC) are all terms used to describe fees that government agencies collect based on VMT. Given the relatively new nature of this type of fee, there is not yet one standard term for it, but all terms for this fee describe the funding mechanism that is typically used by state DOTs to charge road users. This report refers to these programs broadly as per vehicle mile fees, but local program names may vary between jurisdictions.

**Table 13. Evaluation of policy implementation for per passenger mile fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | Per passenger mile fees are effective for helping jurisdictions charge for passenger services proportionate to the length of individual trips. These fees can help jurisdictions achieve policy goals for cost recovery, efficiency, environment, health, and safety, particularly when applied to ride-hail and carshare services. |
| **Fairness**<br>Who does it benefit or harm? | Per passenger mile fees are typically applied to all trips at an even rate, regardless of the trip type. Such fees are more fair in jurisdictions like San Francisco, Chicago, New York City, and New Jersey where the fee is lower for shared ride-hail trips (Fuller and Brown 2021). |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | Per passenger mile fees have been implemented at both the city and state level for multiple modes. They require adoption by the corresponding government body and may vary based on local legislative context, but they are generally allowed (if not preempted by the state). |
| **Public acceptance**<br>Could there be organized support or opposition? | Companies who operate passenger services are the most likely to oppose per passenger mile fees. Because per passenger fees are often directly passed on to the customer, it is very apparent how much the fee increases the total cost of the trip. Given this transparency, opposition may be more effective and make implementation of this policy more difficult. |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | Data about individual trips, including distance, time, and total cost, are already collected by most passenger services, which can relieve the administrative burden of collecting this data. Mobility Data Specification services provided by companies such as Ride Report, Populus, and others can help cities implement per passenger mile fees by providing data and addressing issues around privacy and accuracy (Open Mobility Foundation 2023). |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | The flexibility of passenger mile revenue depends on local context. Jurisdictions that are currently implementing per passenger mile fees for ride-hail services spend the revenue in different ways. In some cases, revenues go into the local transportation agency budget or a local general fund; in other cases, revenues are used for specific initiatives related to transit or mobility goals (Welle, Petzhold, and Minella Pasqual 2018). For micromobility services, revenues are most often directly connected to specific funds, but they also may be routed to local general funds (MacArthur, Fang, and Thigpen 2024). |
| **Revenue capacity**<br>How much revenue will it generate? | The volume of revenue generated from per passenger mile fees depends on the structure of the fee, which can be calibrated to specific targets. Jurisdictions often consider a balance of charging enough to cover costs associated with a service (e.g., administrative fees for agency staff) and ensuring financial feasibility for services to continue operating (MacArthur, Fang, and Thigpen 2024). |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | While distance-based taxes are theoretically possible with all passenger services, in practice, ride-hail is the most relevant service. Bikeshare and scootershare trips are generally low mileage, microtransit usually requires a fixed fare, and carshare is usually a time-based service. Although literature is limited, ride-hail services have relatively inelastic demand, and they are likely to continue generating revenue despite economic cycles (Tarduno 2024). |

### *Use Across New Passenger Services*

Per vehicle mile fees are a relatively new type of transportation revenue–related tool for jurisdictions in the United States. In 2015, Oregon launched the nation's first RUC program, called OReGo, which is a voluntary program that collects two cents per mile from cars and light commercial vehicles (Oregon Department of Transportation, n.d.). Drivers may opt into the program in exchange for a fuel tax credit. Funds collected through the program go to the state's highway fund (Oregon Department of Transportation, n.d.). Utah also has a program for VMT-based fuel taxes, which is a voluntary option for EVs (Utah Department of Transportation, n.d.). Participants may pay a flat fee for alternative fuels during their annual vehicle registration or enroll in the RUC program to pay per mile, up to the additional flat fee amount (Utah Department of Transportation, n.d.). Neither Utah nor Oregon charges different rates for ride-hail and carshare services.

Additional states (including California, Colorado, Delaware, Missouri, and Washington) are piloting similar per vehicle mile fee programs with distributed funds from the $15 million FHWA Surface Transportation System Funding Alternatives (STSFA) grants (FHWA 2017). Fees are generally collected from within existing processes, then used to pay for costs related to the state's transportation infrastructure. However, state preemption may restrict the ability of local governments to charge per vehicle mile fees in some jurisdictions. Some per vehicle mile fees are applicable across all vehicles in a particular transportation network while also having specific implications for new mobility modes.

In states that adopt a per vehicle mile fee, government agencies will need to carefully consider if they want to add an additional passenger mile fee for new mobility services. Funds from any statewide program's per vehicle mile fee will be distributed to local governments based on agreed-upon formulas. For states like Oregon and Utah that are implementing per mile fees across all vehicles, ride-hail and carshare services are captured as part of the overall fee as long as they volunteered to participate (in Oregon) or they have an EV and opted into the program (in Utah). These services are either charged under a flat rate (the same as other users in a transportation network) or charged at the rate designated for ride-hail or carshare services. No participants in the federal pilot program for STSFA have implemented charges specific to ride-hail services, but they have used the fleet of carshare programs to easily track potential data-gathering mechanisms (e.g., Minnesota Department of Transportation or MnDOT). When vehicles within ride-hail or carshare programs travel within those networks, the per vehicle mile fees incurred may be absorbed by the operator or passed on to users. This may incentivize drivers to reduce deadhead miles between trips in order to reduce per vehicle mile fees.

For example, MnDOT received a federal grant from the STSFA program to pilot a mileage-based fee program in partnership with two shared mobility providers, HOURCAR and Zipcar (Minnesota Department of Transportation 2022). This program was able to accurately collect and transmit data for assessing mileage-based fees within systems already in place, and it "confirmed that levying fees on fleet services may lower DBF [distance-based fees'] administrative costs by reducing the total number of collection points and accounts to be administered and audited." (Minnesota Department of Transportation 2020).

### *Policy Goals Assessment*

Table 14 shows the relevant policy goals that per vehicle mile fees could help achieve.

### *Evaluation of Policy Implementation*

Table 15 shows the evaluation criteria for per vehicle mile fees.

**Table 14. Policy goals assessment for per vehicle mile fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | Fees based on miles per vehicle have the potential to provide a growing share of revenues for state DOTs. In particular, their ability to capture the emerging number of EVs (and EV miles) on the road can help replace the funds that EVs are not paying via the fuels tax. EVs still impose costs on the transportation system, such as road damage, so per vehicle mile fees can help recover some of these costs. Proponents see this as a way to increase transportation revenues as vehicle mile fees increase, while fuel utilization decreases due to increased vehicle efficiency and alternative fuels (Kim and Puentes 2018). If jurisdictions apply specific rates to new mobility modes, such as ride-hail and carshare vehicles, it could help fund cost recovery. |
| **Economy (connectivity)**<br>Does it lower the cost of accessing a place? | Per vehicle mile fees increase the cost of accessing a place by vehicle, and they could likely be passed through from ride-hail or carshare companies to users, as with other types of government fees for passenger services (Tarduno 2024). On one hand, this can increase the overall cost for people to access economic centers, which conflicts with economic development goals. On the other hand, increased funding can pay for better management of the transportation system and can increase efficiency and access to jobs, shopping, education, homes, recreation, and other destinations. |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | Fees based on vehicle miles driven generally tend to reduce usage and increase efficiency because of the added cost of traveling longer distances. For ride-hail and car-sharing programs, if these fees from government agencies are passed on from companies to users, they could serve as disincentives. Ride-hail programs, in particular, can worsen road system efficiency because they add deadhead miles and generate more trips, which per vehicle mile fees capture better than per passenger mile fees (Anair et al. 2020; Cramer and Krueger 2016; ICF et al. 2021; Henao 2017; Komanduri et al. 2018; Nair et al. 2020; Schaller 2017; Wenzel et al. 2019; Wu and MacKenzie 2021; San Francisco County Transportation Authority 2018). Reducing use through these fees may have benefits for efficiency throughout transportation networks. |
| **Environment**<br>Does it help reduce emissions? | Mileage-based fees will typically decrease demand for car-based activities; in the case of ride-hail and carshare services, this can reduce VMT if users are incentivized to use low-carbon modes. However, reducing the use of private vehicles overall more closely aligns with policy goals for the environment since EVs also create emissions during manufacturing and disposal (U.S. DOE, n.d.). Full vehicle lifecycle costs could amount to 60 grams of carbon dioxide equivalent emissions ($CO_2e$) per mile for EVs (U.S. DOT, n.d.). Fees charged per vehicle mile can more accurately reflect the impact on emissions from deadhead miles for services like ride-hail, which are not reflected in per passenger mile fees. |
| **Distributional impacts**<br>Does it help make the transportation system more fair? | Flat-rate vehicle mile fees charge all users of the transportation system the same amount, at all times of day, and in all areas, regardless of congestion conditions, vehicle efficiency, or driver characteristics. By charging equally for every mile driven regardless of fuel type, congestion conditions, or location, flat-rate fees do not incentivize more efficient trips. Without means-based discounts, flat-rate fees—like fuel taxes—are inherently regressive; they cost those with lower incomes proportionately more than those with higher incomes.<br>Variable mileage-based fees can be more fine-tuned to help achieve or address specific goals. Variable fees, especially those that are means based, can reduce charges for low-income drivers. The extent and distribution of benefits depend on the program's design around these variables. |
| **Health, safety** | Per vehicle mile fees can more accurately reflect VMT associated with ride-hail and car-sharing services. Increased VMT can have negative impacts for both health and safety, including air pollution and higher incidence of crashes (Currey et al. 2015). |

**Table 15. Evaluation of policy implementation for per vehicle mile fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | Charging per vehicle mile fees for car-based passenger services is effective for policy goals around cost recovery, efficiency, environment, health, and safety. Even if jurisdictions only create rates for new mobility modes, like ride-hail and carshare vehicles, it could still help to fund cost recovery for transportation systems. RUCs, VMT fees, MBUFs, and similar tools could allow jurisdictions to more accurately reflect total VMT for ride-hail and carshare services, including deadhead miles between trips. Collecting revenue that is proportionate to VMT can also help jurisdictions capture revenue from EVs as they become a larger share of the overall system. |
| **Fairness**<br>Who does it benefit or harm? | Many pilot programs currently charging per vehicle mile fees are voluntary for drivers to opt into. If a fee were applied to all drivers in a system, it could either be a flat rate that applies equally to all vehicles or varied based on set criteria (e.g., driver characteristics or vehicle efficiency). Variable charges can help to alleviate disproportionate impacts on some users (e.g., low-income users). |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | Legal restrictions on per vehicle mile fees vary based on local context. States have a range of requirements about implementing taxes or tolls, which will likely be applicable considerations as more jurisdictions consider per vehicle mile fees (including rates calibrated for new mobility services), such as privacy, how revenues may be used, enforcement, and other potential conflicts (Fernandez et al. 2023). |
| **Public acceptance**<br>Could there be organized support or opposition? | New fees that apply to all road users (or a targeted rate for ride-hail and carshare services) are likely to face some opposition. Best practices include sharing background information and context publicly (Fernandez et al. 2023). |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | RUCs, VMT fees, MBUFs, and other per vehicle mile tools have yet to be rolled out on a wide basis, and it will take some effort for states (and possibly the federal government) to build up systems and capacity to implement them. Most pilot programs have been integrated within existing structures in state departments of motor vehicles or partnered with ride-hail or carshare companies to track potential data-gathering mechanisms. |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | Some states and the federal government have restrictions on how revenues from per vehicle mile fees may be used. States vary on requirements for how revenues collected from taxes must be allocated; revenues from per vehicle mile fees will likely follow rules similar to those that govern how fuel taxes can be spent (Tax Policy Center 2022). Given that revenues will likely be collected by states, there may be some questions related to distribution of funds to local jurisdictions and whether those funds will correspond with the actual miles driven in each jurisdiction. |
| **Revenue capacity**<br>How much revenue will it generate? | Forecasting that is regularly completed by state DOTs for VMT and fuel consumption can help to estimate how much revenue will be collected for the overall system (Fernandez et al. 2023); however, estimating the specific amount from new mobility services may require additional modeling that has not yet been created. Still, applicability across a wide range of road users likely means a large potential for revenue generation. |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | Per vehicle mile fees will likely help make transportation agency budgets more resilient to economic cycles and to the shift from gas fuel to EVs. |

## Congestion Charge

### *Fee Description*

Congestion charges are fees that are targeted within a specific geographic area to moderate congestion. They can apply to vehicles entering a specific geography (cordon pricing) or vehicles using specific lanes (highway pricing, also referred to as express lane pricing or high-occupancy toll lanes) (Southern California Association of Governments 2022). This toolkit focuses mainly on cordon pricing, though tolls are also mentioned.

Congestion charges can be flat or variable depending on their intended purpose. If used primarily to raise revenue for investment in space-efficient transportation (e.g., pedestrian, bicycle, and transit facilities), flat rates or tolls may be sufficient, as well as easier to administer. However, variable rates that respond to daily or hourly changes in demand are more suitable for managing demand (FHWA 2008). Dynamic congestion charges can allow for variations in location, time, and vehicle type and respond to peak hours for specific areas (Litman 2011). They may also distinguish between characteristics of vehicles or other factors, such as the number of passengers or type of vehicle.

Gothenburg, Sweden; London, United Kingdom; Milan, Italy; Oslo, Norway; Singapore; and Stockholm, Sweden, have all implemented cordon pricing with varying policies and effectiveness. The congestion charge in Singapore is the most fine-tuned pricing system to date, with its differentiation pricing and the uniqueness of its political system and geographic location (Santos et al. 2010). None of these cities exempt ride-hail vehicles from the congestion charges. London used to exempt both taxis and ride-hail vehicles, but now only taxis are exempt (San Francisco County Transportation Authority 2020).

### *Use Across New Passenger Services*

Carshare, ride-hail (with driver and driverless), and microtransit services can all be charged congestion fees. This tool is typically not applicable for passenger services like bikeshare and scootershare since they do not contribute in the same way to overall congestion.

In 2020, the City of Chicago implemented a congestion charge that applies only to ride-hail vehicles. The goals of the Downtown Zone Surcharge are to reduce congestion, improve environmental quality, and generate revenue to support public transportation systems. The city implemented a tiered structure that varies the fee by geography, time of day, vehicle type, and trip type (i.e., single or shared). The Downtown Zone Surcharge applies to any ride-hail trip that starts or ends within the designated area during weekday peak times (between 6 a.m. and 10 p.m.). There is an additional surcharge of up to $7.75 for vehicles that start or end in special zones like airports or Navy Pier. A discounted rate of $0.55 applies to trips in WAVs, regardless of geography or time of day (City of Chicago 2024).

New York City has a surcharge for taxis and ride-hail vehicles. As of 2019, the New York State Congestion Surcharge is assessed on trips in for-hire vehicles that start, end, or pass through the congestion zone, which stretches south from 96th Street. The surcharge is $2.50 for non-shared trips in taxis, $2.75 for non-shared trips in other for-hire vehicles, and $0.75 for shared trips. There is no surcharge for WAVs (New York City, n.d.).

New York City is the first city in the United States to implement a cordon (area-based) congestion charge for all vehicles. The toll applies in the congestion relief zone, which stretches south from 60th Street. This toll is in addition to the congestion surcharge applied to ride-hail vehicles (Martinez and Holliday Smith 2025; New York City 311, n.d.). While the governor had temporarily delayed the launch of the program in 2024, it has been generating revenue since January 2025. The fee structure varies based on vehicle type, time of day, and other factors, including distinguishing between taxis, ride-hail, and other passenger vehicles. Passenger and small commercial vehicles pay a daily fee of $9 during peak periods for entering the congestion relief zone (or $2.25 for overnight trips). The fee is scaled to $1.50 per trip for ride-hail services and $0.75 per trip for taxis licensed with the NYC Taxi & Limousine Commission (Metropolitan Transportation Authority, n.d.). The fees are higher for customers not using an electronic toll payment system called E-ZPass. As of this writing, the fees are set to increase in 2028 and 2031 (Metropolitan Transportation Authority 2025).

### *Policy Goals Assessment*

Congestion charges directly address policy goals for efficiency because they are inherently designed to manage the use of the ROW and use pricing to mitigate the incremental impact of congestion. This revenue tool also has clear connections to policy goals of cost recovery, distributional impacts, and other objectives detailed in Table 16. These implications can vary by type of congestion charge model.

### *Evaluation of Policy Implementation*

Table 17 shows the evaluation criteria for congestion charges.

## Curb Management Fee and Other Fees for Zone Access

### *Fee Description*

Curb management fees are often charged as a component of a broader curb management strategy. Curb space is in high demand due in part to the rise of ride-hailing, micromobility, urban delivery, and new technologies. New mobility competes for space with traditional uses

**Table 16. Policy goals assessment for congestion charges.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | Congestion charges can be designed to generate revenues that match the costs of managing the congestion charge system. However, the purpose of congestion charges often extends far beyond cost recovery. |
| **Economy (connectivity)**<br>Does it lower the cost of accessing a place? | Although reduced congestion can save time for a segment of road users, congestion charges impose costs on travel. People who benefit from reduced congestion pay for the benefit through the congestion charge. Other road users may opt for other means of travel to avoid the congestion charge, even if it means a longer commute time. |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | By design, congestion fees are targeted at specific areas with higher congestion. Variable congestion charges are more effective at changing demand than flat rates because they can target peak hours (FHWA 2008). These fees can have unintended impacts on congestion; for instance, congestion charges applied to only one part of a system can divert traffic to surrounding areas (U.S. DOT 2009). That said, congestion charge funds are often used to invest in nonautomotive modes (walking, biking, and transit), which may improve mobility overall. |
| **Environment**<br>Does it help reduce emissions? | Congestion charges that result in reduced VMT can positively benefit the environment by reducing air pollution. Communities benefit from reduced fuel consumption and associated emissions (FHWA 2022). |
| **Distributional impacts**<br>Does it help make the transportation system more fair? | Congestion charges can affect lower-income individuals more negatively, though careful policy design can ensure all drivers are affected similarly (Kockelman et al. 2013). Congestion charges can also reduce the impact on those who live near high-traffic areas (FHWA 2008). Funds can be invested in pedestrian, bicycle, and transit services that are more likely to be used by people with lower incomes. |
| **Health, safety** | Congestion fees can disincentivize the use of cars, particularly in areas with higher volumes of traffic. These fees may be passed on to users of ride-hail and carshare services, reducing the total VMT. By decreasing congestion and reducing VMT, congestion charges can help to reduce negative health outcomes and traffic-related accidents and deaths (Currey et al. 2015). |

**Table 17. Evaluation of policy implementation for congestion charges.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | The primary purpose of congestion charges is to mitigate congestion. Because the charges are designed for specific areas or corridors with high traffic volumes, they effectively reduce congestion through a pricing mechanism. Congestion charges that vary by time of day are even more effective. They also help lower emissions by reducing VMT. Surcharges for ride-hail, like those in Chicago and New York City, are charged per trip and easy to show on customer receipts. Therefore, this pricing strategy is likely to be effective at influencing ride-hail consumption, depending on the fee rate. |
| **Fairness**<br>Who does it benefit or harm? | A key concern about congestion charges is the possibility of disproportionate impacts on lower-income individuals and other populations that are more vulnerable. Because congestion charges are usually flat fees charged for each (daily) use of a public ROW, they are a regressive form of taxation (i.e., the charges take a greater percentage of income from lower-income individuals).<br>Furthermore, to the extent that lower-income populations depend more on ride-hail services, surcharges could have disproportionate impacts. People with higher incomes may pay the congestion charges, remain on the road, and benefit from lower congestion, while people with lower incomes choose other options (FHWA 2008). Still, some evidence suggests congestion charges are more likely to be paid by people with higher incomes because they tend to drive into congested areas, whereas people with lower incomes are more likely to ride public transit in the first place (Serna 2019).<br>On the other hand, the revenue generated from congestion charges could be used to disproportionately benefit people with lower incomes (Eby, Roskowski, and Puentes 2020). |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | Cordon pricing is rare. Singapore, London, and Stockholm have had cordon pricing for many years. New York City launched the first cordon pricing in the United States in January 2025. Chicago and New York have area-based surcharges for ride-hail and taxis. |
| **Public acceptance**<br>Could there be organized support or opposition? | The general public usually does not favor adopting new congestion charges or other surcharges for ride-hail because they have a direct and visible cost to road users. Ride-hail users can also see the congestion charges reflected in their receipts. Broad awareness of congestion charges and a long-standing assumption that roads should be “free” to use pose political challenges for adopting new congestion charges, especially in places that do not have them yet. However, support for congestion charges could increase after people experience the benefits of mitigated congestion (Schuitema, Steg, and Foward 2010). |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | Congestion charges are difficult and expensive to administer. They require investments in capital infrastructure to monitor and transmit data about vehicles that enter designated areas or lanes. However, surcharges on ride-hail are much easier to administer because they can be added onto each trip charge. |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | Flexibility depends on how the transportation agency sets up the fee. Revenues from congestion charges can go into specific budgetary accounts to fund particular programs. |
| **Revenue capacity**<br>How much revenue will it generate? | Large amounts of revenue can be raised because congestion charges are charged for each (often daily) use, and many road users are subject to them. Moreover, the potential for revenue generation is high because the prices are usually set at an amount that is high enough to deter some road users from entering the congestion charge area or lane. However, revenues from ride-hail surcharges may be smaller than for other modes because ride-hail is generally a smaller subset of trips in congestion charge zones. |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | Congestion charges are a relatively stable source of revenue. Revenue is generated daily, and road usage may not vary much with economic cycles. |

of the curb, such as bike corrals, bus bulbs, space for local businesses, public displays of art, and others. To manage different types and levels of curb demands, jurisdictions can develop a curb management strategy. Depending on policy priorities, a curb management fee may apply only to new mobility services or more broadly to other transportation options.

Curb management includes consideration for pedestrians, micromobility, parking, and business access. FHWA has identified the following steps for municipalities to manage the curb (Intelligent Transportation Systems Joint Office 2023):

- Inventory existing conditions,
- Identify land use and activity considerations to develop modal prioritization,
- Establish performance measures,
- Identify appropriate treatment alternatives,
- Assess and present alternatives for public feedback, and
- Refine and implement treatments.

"Curbside management is a hyper-local challenge. Any strategies for managing curb space are going to be most effective when they are made on essentially a block-by-block basis and based solidly on information or data pertaining to the needs of the area and current curb usage."—Leona Agouridis, Executive Director, Golden Triangle Business Improvement District (Civic Well 2018)

### *Use Across New Passenger Services*

Many curb management pilot programs focus on parking pricing strategies, with less focus on new mobility management. For example, the demand-based Penn Quarter/Chinatown Parking Pricing Pilot, which applied to on-street parking in Washington, DC, aimed to improve parking utilization and turnover. Parking prices varied by day of the week, time of day, block, and side of the street. Results of the pilot program show increasing usage of low-demand blocks and decreasing search time for parking (Kittelson & Associates, Inc. 2019). The City of Bellevue, WA, issues permits for reserving curbside spaces for temporary loading and unloading of goods for delivery (discussed in Module 3) and for passenger service considerations, like pickup and drop-off zones (City of Bellevue 2023).

There are limited examples of curb management fees specifically for managing new mobility. But future policies for new mobility need to consider the implications of curb management fees because bikeshare, scootershare, and ride-hail services all occupy curbside space and can influence the effectiveness of curb management strategies.

### *Policy Goals Assessment*

Curb management has the potential to recover costs, improve distributional outcomes, and increase efficiency, environment, health, and safety outcomes. Table 18 summarizes an assessment of curb management fees across policy goals.

### *Evaluation of Policy Implementation*

Table 19 shows the evaluation criteria for curb management.

## Subsidized (Publicly Funded) Services

### *Description*

Public investments and subsidies are sometimes used to support the expansion of passenger services that generate a public good and meet goals within a transportation system. In addition to tools outlined in the previous sections that collect revenue from new mobility services, government agencies may also choose to reduce taxes or fees or provide public funding for some passenger services. Generally, jurisdictions may consider allocating funds toward a service when it has a public benefit that would not otherwise be offered by a private or nonprofit provider. This may mean providing subsidies either across an entire system or toward a targeted component that extends specific benefits.

**Table 18. Policy goals assessment for curb management of passenger services.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Curb management could play a role in partial cost recovery in transportation systems. Curb management programs could also generate revenue through usage fees and fines. If a jurisdiction implements both a curb management fee and a per vehicle mile fee, there could be countervailing effects: The per vehicle mile fee could incentivize ride-hail service vehicles to park and reduce deadhead miles, but curb management fees could counteract this incentive. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Curb management policies can reduce congestion and save time for people who are not using the curb, though the policies would impose direct costs on users of the curb. |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | Multiple curb management pilot programs have increased efficiency by reducing parking and loading times for passenger services, with streamlined pickup and drop-off zones and better allocation of resources (Intelligent Transportation Systems Joint Office 2023). |
| **Environment, distributional impacts, health, and safety** | Pilot programs showed a decrease in double parking and illegal U-turns as well as an increase in better curb use, which improved distributional, health, and safety outcomes. Additionally, a study in San Francisco, CA, showed a reduction in emissions as a result of curb management practices (Intelligent Transportation Systems Joint Office 2023). |

**Table 19. Evaluation of policy implementation for curb management of passenger services.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness** Does it achieve the intended outcomes? | Although there is limited evidence, curb management policies are designed to improve transportation network efficiency (connectivity, mobility, and accessibility). Time-based and location-specific (i.e., block-by-block) pricing models can limit demand for curb space in times and places that are the most congested. |
| **Fairness** Who does it benefit or harm? | Curb management fees are directly related to people's impact on the transportation system, which could be considered fair; those who use more curb space and contribute more to curbside congestion would pay more. However, there are important considerations related to distributional impacts. For instance, curb management fees would have disproportionate impacts to the extent that curbside users have lower incomes. |
| **Political Considerations** | |
| **Legality** Is it allowed? | Curb management fees are usually controlled at a local level. |
| **Public acceptance** Could there be organized support or opposition? | Congestion charges are targeted at a limited number of people who use curb space, while the benefits could be broadly attributed to all who are impacted by congested curb space. However, the concentrated costs of curb management could also result in organized opposition against it. |
| **Revenue Considerations** | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | Curb management fees may be new to many cities and may require new staff to implement and enforce them. While there are some resemblances to parking fees, curb management fees could be more complex. Still, Curb Data Specification services (discussed in detail in Module 3) can assist with implementation. |
| **Flexibility** Can the revenue be spent in multiple ways? | The use of generated revenue depends on how the transportation agency sets up the fee. Fees sometimes go into specific budgetary accounts to fund particular programs. |
| **Revenue capacity** How much revenue will it generate? | The size of the potential revenue generation will depend on how each curb management program is designed. The revenue capacity may be small if the program is limited to a small geographic area, such as a downtown core area or certain times of day. |
| **Stability** Is the revenue stream resilient to economic cycles? | The revenue stream's stability depends on how the curb management program is designed. |

Public subsidies already exist for many different functions in traditional transportation funding. For example, users typically pay 75 to 80 percent of costs for highways, largely through federal fuel tax (14 percent), state fuel tax (19 percent), tolls (9 percent), and other fees and taxes on vehicles (35 percent) (Federal Transit Administration, n.d.; Transportation Research Board of the National Academies 2006). This means 20 to 25 percent of costs for highways is subsidized through general fund dollars, including property taxes collected by local and state governments. In contrast, transit users typically pay for 20 to 25 percent of transit costs, largely through fares, and 75 to 80 percent of costs are subsidized through public funding (Federal Transit Administration, n.d.; Transportation Research Board of the National Academies 2006).

### *Use Across New Passenger Services*

In new mobility passenger services, the extent of subsidies provided by governments likely depends on how different modes fit into the overall transportation system. Public funding for services, most commonly bikeshare and microtransit, may be ongoing or it may be implemented early on in a new mobility service program, until the program is able to operate without a government contribution to incentivize it to grow.

Modes with greater negative externalities (like congestion or safety risk) or greater public benefits (like improved health or environmental outcomes) are important considerations for governments when they are deciding whether to subsidize. For passenger services, car-based services like ride-hail and carshare are less likely to receive subsidies as jurisdictions try to reduce road congestion and vehicle-based emissions. In some cases, subsidies may be considered when these services are providing a targeted benefit, like connecting users to public transit routes, extending services to hours that are unavailable with existing transit lines, or providing vehicles that can be easily accessed with a wheelchair or other mobility devices.

The most common type of subsidized new mobility service is bikeshare. The positive impacts of bikeshare are greater than those of car-based services, like ride-hail and carshare, and are comparable to the impacts of public transit (Moro 2019). In Washington, DC, the District Department of Transportation (DDOT) partners with surrounding jurisdictions on its Capital Bikeshare program throughout the metro area to both charge fees and subsidize service. Capital Bikeshare uses a time-based model to collect user fees that includes both a flat rate charge of $1 in addition to $0.05 per minute, while day passes or annual memberships provide unlimited 45-minute rides with an additional fee past that amount (District Department of Transportation, n.d.). Fees collected for DC's publicly supported bikeshare go toward cost recovery for operation of the system itself rather than the general fund or other broad transportation funds (Arlington County Commuter Services 2022). In recent years, cost recovery from fees charged to users has ranged from 30 to 39 percent, with the remainder of expenses for the system subsidized by other government funds (Arlington County Commuter Services 2022).

To increase access to travel options, many transportation agencies have also created or required service providers to provide direct waivers, discounts, or other fee structures for qualifying passengers (including older adults, youths, people with disabilities, and lower-income passengers). Through waived costs or reduced prices, these subsidies ensure those with greater barriers to public and private travel have access to a wide range of travel options. To ensure even greater access to travel, many public transit agencies have instituted lower-income programs to provide fare coverage for older adults, youths, people with disabilities, and lower-income residents (TriMet, n.d.).

For example, the District of Columbia incentivizes passenger service companies to provide services for lower-income riders. DDOT can waive up to 100 percent of the per vehicle fees if at least 10 percent of miles traveled are by low-income riders. The fee waiver is decided using a predetermined sliding scale (Moller 2023).

The City of Denver decided to forgo all operating and permitting fees for micromobility companies and, instead, started requiring them to make certain investments and develop a program to improve distributional outcomes. Bikeshare and scootershare providers must pay for designated parking areas and distribute discounted fare passes to residents enrolled in programs like Medicaid and the Supplemental Nutritional Assistance Program (SNAP). In this sense, the City of Denver is indirectly subsidizing micromobility transportation services (MacArthur, Fang, and Thigpen 2024).

Using prepaid fares to cover the use of new passenger services for certain passengers could help provide further access to travel for certain communities (Brown 2022). As new passenger services have surfaced, so has the study and evaluation of their accessibility (Creger, Espino, and Sanchez 2018; Brown 2022; Steckler et al. 2020). McNeil et al. (2019) surveyed bikeshare operators and found that larger cities tend to have more programs focused on distributional impacts than smaller ones. Between 71 and 79 percent of bikeshare systems with over 150 bikes were working to improve distributional outcomes. Through new mobility pilot formations, public sponsorships, and regulatory policies, cities and transportation agencies have instituted accessibility, affordability, and sustainability requirements. Key to affordability has been ensuring various waivers and discounts for qualifying new mobility users (Creger, Espino, and Sanchez 2018; Steckler et al. 2020).

Many jurisdictions also provide reduced fees for micromobility services, either directly through partnerships with bikeshare or scootershare companies that include public funding or by providing funds to users to cover the cost of rides. The City of Seattle's department of transportation works with the companies Bird and Lime to provide both bikeshare and scootershare options, such as the Regional Reduced Fare Permit, at a lower rate for riders who qualify for other programs based on income, as well as access to free helmets (Seattle Department of Transportation, n.d.-b). In an evaluation of mobility program requirements, researchers found a range of options to improve distributional outcomes for micromobility, including geographic requirements for coverage, reduced rates, adaptive vehicles, alternatives to smartphone use, cash payment options, language accessibility, and targeted outreach and marketing to underserved communities (Brown, Howell, and Creger 2022).

The public sector can also partner with private companies to provide car-sharing services in lower-income communities. For example, the City of Los Angeles partnered with Blue Solutions to deploy 100 shareable electric cars and 200 charging stations throughout the city. The program receives funding from the state's cap and trade program (Holub-Moorman 2024). Other cities have also directed car-sharing companies to provide discounted pricing to low-income households. As with bikeshare and scootershare operators, the City of Portland requires carshare operators to provide a discounted pricing plan to low-income individuals (City of Portland, n.d.).

### *Policy Goals Assessment*

Subsidizing new mobility passenger services could directly help jurisdictions achieve policy goals. In particular, subsidies for new mobility services are applicable for decisions around the expenditure of public funds. Funds for subsidies may come from different sources and vary by different restrictions across jurisdictions. In general, subsidies for new mobility systems or users help to meet goals around distributional impacts as well as health, safety, environment, and others.

Table 20 summarizes policy goals for subsidized rides.

### *Evaluation of Policy Implementation*

Table 21 shows the evaluation criteria for subsidized services.

**Table 20. Policy goals assessment for subsidized services.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | The purpose of subsidized services is not to generate revenue. Subsidizing access to passenger services typically uses revenue generated from other sources to provide support that addresses barriers for system users. This tool negatively impacts cost recovery if it often draws directly from revenues collected from the service. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Subsidized services can increase access to a greater area for more users who might otherwise have a difficult time commuting. Some cities have used subsidized services for economic development. The City of Baltimore used a six-month pilot program with Lyft to provide subsidized first-mile/last-mile rides for residents living in food deserts, including up to eight rides per month at a discounted rate of $2.50 per ride (Stacy et al. 2020). Miami-Dade County initiated multiple programs to address first-mile/last-mile connectivity to transit, including their "Go Nightly" ride-hail program designed to transport people that work swing shifts between midnight and 5 a.m. to and from transit lines to increase access to job opportunities (Miami-Dade County 2022). |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | Subsidizing passenger services does not necessarily advance efficiency goals, but it can help address disparities for riders. While promoting accessibility for a wider range of people, subsidies for these services likely increase the number of users and trips. Connecting residents in underserved geographic areas with job centers and amenities is challenging and can result in longer rides (Stacy et al. 2020). |
| **Distributional impacts** Does it help make the transportation system more fair? | Achieving goals related to improving distributional outcomes is the central purpose of subsidizing passenger services and creating greater access. Studies have found that most ride-hail, e-bike, and e-scooter users have disproportionately higher incomes (Brown et al. 2022; Brown 2022; Steckler et al. 2020). Research has also shown that the majority (71 to 79 percent) of larger cities implement programs related to distributional impacts (McNeil et al. 2019). The largest share of these programs targets low-income residents (56 percent), while about one-third target areas with fewer transportation options (McNeil et al. 2019). Overall, high service costs, fluctuations in fee prices, and technology-reliant new mobility services (i.e., dependent on smartphones) can pose greater barriers for lower-income residents (Brown et al. 2022; Steckler et al. 2021, 2020). While subsidies may not be able to address all barriers that people may face to access new mobilities, they can help reduce disproportionate challenges associated with the cost of these services. |
| **Environment, health, and safety** | Jurisdictions may also choose to subsidize services that improve public health and environmental outcomes by reducing overall VMT or transitioning vehicles from gas to electric fuels. A growing number of programs offer support, such as grants, tax credits, or rebates, for individual households to purchase EVs (U.S. DOT 2023). Some jurisdictions are beginning to extend programs like these to other types of new mobility passenger services. California's Air Resources Board has worked in partnership with several local transportation agencies for fleet electrification of carshare and microtransit services in Sacramento, Los Angeles, the San Joaquin Valley, and Santa Cruz that serve low-income communities and Tribal communities (California Air Resources Board, n.d.). |

## Regulatory Requirements

### *Description*

Government agencies can directly subsidize services to achieve public benefits, as described in the previous section, or they can require companies to behave in certain ways with regulatory requirements. Regulations can be considered as part of the revenue tools for new mobility services because they typically involve companies providing specific services or addressing needs for specific populations without the public paying for those programs. Although they do not charge a direct cost to mobility service providers, regulations have financial implications for both private companies and transportation agencies. For companies who offer passenger services, new requirements typically add costs for expenses like labor, licensing, equipment, administering new programs, or other new features in a system. However, regulations can also alleviate

**Table 21. Evaluation of policy implementation for subsidized services.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | Subsidized services are most often effective at achieving policy goals around improving distributional outcomes and economic development as determined by specific programs. They can also be targeted to address health, safety, and environmental concerns. The calibration of subsidized service programs varies widely, but the programs can come with tradeoffs for goals around cost recovery and efficiency. |
| **Fairness**<br>Who does it benefit or harm? | Providing subsidies for passenger services can benefit community members who face disproportionate challenges to mobility. Public funding is often targeted to address needs for specific populations, such as low-income residents or people with disabilities, to access services. Subsidies improve health, safety, and the environment by encouraging the use of options like carpooling and reducing pollution, which can also have benefits for all residents by improving quality of life. |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | Subsidies are generally allowed and follow local processes and requirements for implementation. |
| **Public acceptance**<br>Could there be organized support or opposition? | Subsidies for new mobility services may have the potential to generate strong public support; jurisdictions may work with advocacy or community-based groups to align programs with specific community needs and implement them successfully. |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | Subsidy programs can require a high level of administrative capacity, depending on the level of direct community involvement, program tracking and monitoring, and compliance with agency budgets required. |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | Jurisdictions generally have flexibility to spend public funds for a variety of different initiatives, depending on political viability, dollars available, and local needs. |
| **Revenue capacity, stability** | These considerations are generally not applicable since subsidies do not generate revenue. However, if the funding source for a subsidy is volatile or unpredictable, this can reduce its users' confidence that the subsidy will be available when needed. |

spending among transportation agencies by removing the need to provide certain programs or respond to negative externalities.

### *Use Across New Passenger Services*

Regulatory requirements that benefit the public are often implemented within existing systems for corresponding transportation services or through minimum service requirements that come with fines or penalties. Local regulations around bikeshare and scootershare track closely with existing safety laws around personal bicycles and scooters. For ride-hail and carshare programs, regulatory policies often come into play for operating permit or license processes. Many jurisdictions have a history of regulating traditional passenger services, like licensing requirements for taxis and for-hire vehicles, which provides a model for regulating car-based services; these tend to be stronger regulations in larger cities in the United States, with more considerations for service requirements (Transportation Research Board 2016).

Transportation agencies can use regulations to exact public goods from private companies, with the most common being safety regulations, fair access initiatives, labor requirements, and EV incentives. Programs for safety and fair access can apply to all services, including micromobility and microtransit programs, but considerations for labor laws and EVs are applicable only to ride-hail and carshare services.

In a survey of micromobility services across the United States, one study found that 62 percent of programs have some requirements related to fair access, with the most common being procedural requirements to address underserved communities (such as smartphone alternatives, cash payments, and language services) as well as other considerations, such as public data reporting (Creger, Espino, and Sanchez 2018).

**Safety Requirements**

Addressing safety concerns through regulatory requirements is relevant across new mobility passenger service modes. In many jurisdictions that have bikeshare and scootershare services, there is often an emphasis on speed limits, safety equipment, lighting, and where bikes or scooters may be ridden; some cities have additional requirements around parking, locking, no-ride zones, and age restrictions, especially for dockless systems (Apollo Scooters 2024). Bikeshare requirements typically track with existing safety requirements for bicycles where they are applicable. At least 30 states as well as individual cities apply safety regulations explicitly for scootershare; these policies have been adapting since these services emerged in recent years (Apollo Scooters 2024). Companies that are trying to comply with these safety requirements can create financial incentives or penalties that influence travel decisions.

Safety concerns for ride-hail and carshare services are different from those around micromobility modes, often focusing on interactions between drivers and passengers. Relevant requirements in some jurisdictions include driver background checks, fingerprinting, and vehicle signs that aim to ensure a greater level of vetting for drivers (Teale 2019). Like labor requirements, these regulations can add costs for ride-hail companies and create tradeoffs for other policy goals.

**Fair Access Requirements**

Regulations can be effective at increasing access in various ways, from explicitly creating policies around anti-discrimination to programs that increase access for communities that have had below-average access. The anti-discrimination ordinance in Seattle, WA, prohibits service providers from refusing to provide services to certain groups or to increase access for disabled customers (San Francisco County Transportation Authority 2017).

Local requirements for mobility programs can include a range of options to advance distributional outcomes related to micromobility, including geographic requirements for coverage, reduced rates, adaptive vehicles, alternatives to smartphone use, cash payment options, language accessibility, and targeted outreach and marketing to certain communities (Brown, Howell, and Creger 2022). The City of Los Angeles includes a local requirement for scootershare providers to create a low-income customer plan with no deposit, affordable cash payment options, and unlimited trips under 30 minutes (Los Angeles Department of Transportation 2020). To increase access to travel options, many transportation agencies have also implemented requirements for companies to provide discounts or alternative fee structures for qualifying passengers based on income or other factors (such as older adults, youths, and people with disabilities).

**Labor Requirements**

Regulation of ride-hail services has been a controversial topic for many state and local governments since the rise of major companies like Lyft and Uber highlighted the need for regulation regarding minimum wage and other topics. In some cases, these rules may resemble requirements for for-hire taxi services. However, some states have laws that preempt local jurisdictions from imposing these types of regulations on ride-hail services (Washington State Joint Transportation Committee 2019).

Many jurisdictions, including state and local governments, across the United States have passed or proposed laws on driver wages and working conditions for ride-hail companies. These requirements often direct companies to classify workers as employees rather than contractors, which can subsequently trigger other local labor laws, such as minimum wage standards and employee benefits like sick time, overtime pay, and others, as applicable (Shetty et al. 2022). These requirements can change many cost considerations for ride-hail companies and the way they operate within a local market. Labor-related regulations can increase the costs to operate a ride-hail service and lead to higher service fees or less service coverage. Research on the impacts of these laws is still relatively new, but initial findings show that a minimum wage law could reduce pooling and increase traffic congestion (Shetty et al. 2022).

**EV Requirements**

Requirements for ride-hail and carshare fleets can help address goals for reducing emissions associated with these services. A few jurisdictions in the United States have implemented fleet electrification requirements, including a state legislation in California and local requirements in New York City. California's Senate Bill 1014 (2018) directs a state board to establish emissions targets for ride-hail companies, requires adoption of EVs by 2030, and requires the companies to develop implementation plans to meet the state's emissions goals. New York City's Taxi and Limousine Commission began the Green Rides Initiative in 2024, setting incremental targets for ride-share companies to increase their share of zero-emissions vehicles (ZEVs) or WAVs. The benchmarks are 5 percent in 2024, 15 percent in 2025, 25 percent in 2026, 40 percent in 2027, and then rising to 100 percent by 2030 (City of New York 2023). These policies aim to meet existing targets within relevant climate plans and strategies. These changes have important implications for ride-hail drivers and the availability of ride-hail services. In response, state agencies can ponder future subsidies for ride-hail companies, drivers, or EVs.

### *Policy Goals Assessment*

Table 22 shows the relevant policy goals that regulations help achieve.

### *Evaluation of Policy Implementation*

Table 23 shows the evaluation criteria for regulations.

## 2.6 Key Takeaways

Transportation agencies can move toward achieving their policy goals with carefully designed revenue-related tools. Pricing strategies can generate revenue to pay for services (i.e., cost recovery for infrastructure and O&M) and influence travel decisions in ways that improve transportation system efficiency, reduce emissions, or promote other goals related to distributional impacts, health, and safety. This module identifies, describes, and evaluates seven such tools. It also explores subsidies and regulations that can be effective at achieving policy goals without generating revenue.

The discussion of each revenue-related tool includes assessing the tool along a set of evaluation criteria identified in Module 1. Table 24 and Table 25 summarize the assessments of the tools. The evaluations are discussed in detail in each tool's section in this module. The evaluations and the rankings presented in the tables are meant to be examples. The appropriate evaluations and rankings for each jurisdiction will be highly context dependent, so transportation agencies are encouraged to conduct their own evaluations of the revenue-related tools.

Assessments of the revenue-related tools for passenger services led to generalized takeaways.

## Table 22. Policy goals assessment for regulations.

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Regulatory requirements do not generate revenue for jurisdictions, and these rules are not likely to directly help meet goals for cost recovery. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Regulations often increase a company's administrative costs by either intentionally lowering the cost of accessing services for users or indirectly adding costs that are passed through to riders. Regulations that are designed to increase access for more community members can enable greater economic opportunities for those who lack adequate transportation options. |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | Different types of regulations may have benefits for efficiency or tradeoffs with other policy goals. Regulations that can increase costs for users of ride-hail services (such as minimum wage regulations) may help manage demand for these services. This reduced usage can increase overall system efficiency. However, some regulations can have the opposite effect (e.g., increasing service areas) by creating longer trips in exchange for increasing accessibility for underserved users. |
| **Environment** Does it help reduce emissions? | Some regulatory requirements may be directly related to reducing emissions, such as California's and New York City's requirements for ride-hail fleets to transition to EVs by a set date. Other types of regulations that generate more trips may have tradeoffs for environmental benefits while helping to advance goals for service coverage. |
| **Distributional impacts** Does it help make the transportation system more fair? | Many regulations for passenger services around accessibility, labor laws, geographic coverage, scaled pricing, and other requirements can help jurisdictions advance the goal of making a more fair transportation system. |
| **Health, safety** | Some regulations are also directly related to health and safety outcomes for ride-hail, carshare, and micromobility modes, including regulations around driver licensing and safety features in scootershare or bikeshare equipment. |

## Table 23. Evaluation of policy implementation for regulations.

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness** Does it achieve the intended outcomes? | Regulations can be effective at addressing a range of intended outcomes, depending on the type and configuration of requirements. Although regulations do not generate revenue, and therefore have little connection with cost recovery, they can be used to achieve a range of other objectives across the economy, efficiency, distributional impacts, environment, health, and safety. |
| **Fairness** Who does it benefit or harm? | Regulatory requirements for passenger services like ride-hailing, carshare, and micromobility modes aim to ensure distribution of public benefits, but they can also increase operating costs and create barriers to entry for new companies. |
| **Political Considerations** | |
| **Legality** Is it allowed? | The legality of regulations varies widely between types of requirements and local context. |
| **Public acceptance** Could there be organized support or opposition? | Regulations often face strong opposition from companies that operate passenger services, particularly those that increase costs related to administration, wages, or pricing. |
| **Revenue Considerations** | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | Implementing regulatory requirements typically requires capacity from transportation agencies and other government partners. Depending on the specific configuration, requirements may involve review of permits or applications, tracking data, or compliance documentation. |
| **Flexibility**, **revenue capacity**, **and stability** | These considerations are generally not applicable since regulatory requirements do not generate revenue. |

**Table 24. Evaluations summary of revenue-related tools, Part 1.**

| Evaluation Criterion | Operating and Permit Fee | Per Vehicle Fee | Per Trip Fee | Per Passenger Mile Fee | Per Vehicle Mile Fee |
|---|---|---|---|---|---|
| **Impact Considerations** | | | | | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | ↑ | ↑ | ↑ | ↑ | ↑ |
| **Fairness**<br>Who does it benefit or harm? | ↑ | ↑ | ↓ | ↑ | ↑ |
| **Political Considerations** | | | | | |
| **Legality**<br>Is it allowed? | ↑/↓ | ↑/↓ | ↑ | ↑ | ↑/↓ |
| **Public acceptance**<br>Could there be organized support or opposition? | ↑ | ? | ↑ | ? | ↓ |
| **Revenue Considerations** | | | | | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | ↑ | ↑ | ↑ | ↑ | ↓ |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | ↑/↓ | ↑/↓ | ↑/↓ | ↑/↓ | ↑/↓ |
| **Revenue capacity**<br>How much revenue will it generate? | ↓ | ↓ | ? | ↑/↓ | ↑ |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | ↑ | ↓ | ↓ | ↑ | ↑ |
| **Ranking** | | | | | |
| With **greater** emphasis given to revenue considerations | 4 | 5 | 6 | 3 | 2 |
| With **less** emphasis given to revenue considerations | 2 | 4 | 5 | 3 | 6 |

Note: Up arrow means the tool is likely to score **well** on the evaluation criterion. Down arrow means the tool is likely to score **poorly** on the evaluation criterion. Both up and down arrows means the scoring depends on the new mobility service or jurisdiction. Question mark means there is uncertainty due to a lack of information. Rankings are numbered in ascending order from best to worst.

## Revenue-Related Tools

- **Operating and permit fee** and **per vehicle fee:** These revenue-related tools are unlikely to generate much revenue. But it is relatively easier to administer and garner political support for them, provided that they are not preempted by state law.
- **Per trip fee** and **per passenger mile fee:** These revenue-related tools strike a balance across multiple evaluation criteria. They can generate some revenue without facing too many barriers. The more trips and passenger miles that are traveled on shared services, and the bigger the impact on the transportation system, the more these passengers pay for their impact.
- **Congestion charge** and **per vehicle mile fee:** These revenue-related tools are likely to generate a substantial amount of revenue because they are broadly applicable to most vehicle trips, not just to new mobility. However, there are important administrative and political challenges involved. Therefore, more organized effort at the state level to improve the broader transportation system might be more reasonable than a set of policies specifically for new mobility.

**Table 25. Evaluations summary of revenue-related tools, Part 2.**

| Evaluation Criterion | Congestion Charge | Curb Management Fee | Subsidized Services | Regulatory Requirements |
|---|---|---|---|---|
| **Impact Considerations** | | | | |
| **Effectiveness** Does it achieve the intended outcomes? | ↑ | ? | ↑ | ↑ |
| **Fairness** Who does it benefit or harm? | ↓ | ↑ | ↑ | ↑/↓ |
| **Political Considerations** | | | | |
| **Legality** Is it allowed? | ↓ | ↑ | ↑ | ↑/↓ |
| **Public acceptance** Could there be organized support or opposition? | ↓ | ? | ↑ | ↓ |
| **Revenue Considerations** | | | | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | ↓ | ↓ | ↓ | ↓ |
| **Flexibility** Can the revenue be spent in multiple ways? | ↑/↓ | ? | ↑ | N/A |
| **Revenue capacity** How much revenue will it generate? | ↑ | ? | N/A | N/A |
| **Stability** Is the revenue stream resilient to economic cycles? | ↑ | ? | N/A | N/A |
| **Ranking** | | | | |
| With **greater** emphasis given to revenue considerations | 1 | 7 | N/A | N/A |
| With **less** emphasis given to revenue considerations | 9 | 7 | 1 | 8 |

Notes: Up arrow means the tool is likely to score **well** on the evaluation criterion. Down arrow means the tool is likely to score **poorly** on the evaluation criterion. Both up and down arrows means the scoring depends on the new mobility service or jurisdiction. Question mark means there is uncertainty due to a lack of information. Rankings are numbered in ascending order from best to worst.

- **Curb management fee:** This revenue-related tool is often part of a broader curb management strategy, so an evaluation of the strategy might be more appropriate. When focusing on the fee alone, limited evidence from pilot programs suggests the fee can reduce curb congestion while raising some revenue. However, future evaluations of this tool will depend on how it is implemented, as there remains a lot to be explored about this tool. Implementing more complex versions of curb management fees can be challenging because they can require sensors and real-time databases to enforce parking rules.
- **Subsidized services:** Public investments in passenger services are likely to score well in the evaluation criteria. Transportation agencies can design policies to address specific policy goals—typically related to distributional impacts or economic development—and benefit community members who face disproportionate challenges to mobility. There is likely to be widespread political support to address needs of specific populations, such as low-income residents or people with disabilities. More broadly, public transportation is a subsidized service, so it may be reasonable to subsidize passenger services to the extent that they resemble elements of existing public transportation systems. The most obvious tradeoff is that subsidized services do not generate revenue.

While any service can be subsidized, bikeshare is the most commonly subsidized service, often justified by the low-carbon, health, and first-mile/last-mile benefits, as well as efficient use of the ROW. While scootershare services share many of these traits, they are not commonly subsidized, possibly because private companies are the primary advocates for service.

## Evaluation Criteria

- **Effectiveness:** All tools are generally good at accomplishing one or more transportation policy goals. Fees that are assessed one time or annually (e.g., operating and permit fees) are more suitable for cost recovery, at least in part. Meanwhile, usage-based fees that charge by the trip, distance, or time are more suitable for changing how people use passenger services.
- **Flexibility:** Use of revenue will be highly variable. Local funding needs and decisions by elected officials will decide how public funds can be used. Revenues can go into the general fund and be used for multiple purposes, or they can be dedicated to specific, predefined purposes.
- **Preemption:** Many states have preempted regulations, including those that apply revenue-related tools, for ride-hail and AV services. So, it is impossible to produce one set of evaluations across the United States. In particular, the legality of the revenue-related tools will vary by state. That said, this toolkit demonstrates how preemption might make it more difficult, or in some instances impossible, for a local jurisdiction to achieve its goals. For example, San Francisco described its struggles with AV services in its letter to the California Public Utility Commission urging it not to allow wider deployment of AV services in June 2023 (Tumlin, Chang, and Hillis 2023).

MODULE 3

# New Mobility Goods Delivery

## 3.1 Introduction

Tax revenue from goods delivery providers contributes to the construction and maintenance of transportation infrastructure. Revenue-related strategies have primarily targeted heavy goods vehicles (HGVs), such as tractor trailers and box trucks, and their interregional travel, encompassing close to 80 percent of freight volume transported in the United States (Conway and Walton 2009; Organisation for Economic Co-operation and Development 2022). Taxes that target HGVs—primarily diesel taxes and sales and registration fees excised at both federal and state levels—contributed roughly 40 percent of the revenue allocated to the federal Highway Trust Fund in 2021, even though HGVs accounted for less than 10 percent of the total distance traveled on the road (Tax Policy Center 2024).

Taxes on goods delivery primarily price for usage and wear and tear on highways. Their goal has been to recover costs that goods delivery providers impose on transportation infrastructure (FHWA 1997; Parry 2008). While these taxes may also help reduce emissions like $CO_2$, $CH_4$, and $N_2O$, they have not been designed specifically to do so.

The goods delivery landscape is changing due to the growth of e-commerce. In the United States, the online share of retail sales has soared by nearly 160 percent in the past decade, growing from about 7 percent in 2015 to about 18 percent by the end of 2024 (U.S. Department of Commerce 2025). Social distancing measures, store closures, and supply shortages induced by the COVID-19 pandemic catalyzed e-commerce sales among populations of both frequent and infrequent (e.g., older adult) online shoppers. The pandemic also accelerated physical retail's adoption of click-or-brick "omnichannels" and app-based delivery services (Beckers et al. 2021). In 2022, a third of Americans said they shop online on a weekly basis (Faverio and Anderson 2022). Increasingly, goods are reaching their final destination through a complex network of logistics services.

The growth of e-commerce has influenced how delivery providers use transportation infrastructure. Home delivery spurred the adoption of light goods vehicles (LGVs)—such as cargo vans, cargo bikes, passenger vehicles, and delivery robots—and increased pickup and drop-off frequencies at the curb. The result is a heightened competition for limited street space in dense urban neighborhoods. In London, traffic volumes from LGVs increased by roughly 60 percent between 1993 and 2023, despite decreasing traffic volumes from passenger vehicles and HGVs in the same period (UK Department for Transport 2023).

Taxing goods delivery is becoming outdated. HGVs will continue to use transportation infrastructure, and taxes on those vehicles will remain important for transportation funding. But taxes that work for pricing shipments via HGVs are not working well for pricing shipments via LGVs. Commercial LGVs fall outside the purview of traditional HGV pricing strategies that transportation agencies have in place. LGVs rarely entail commercial licensing and reporting requirements, making fee collection and rate setting administratively and technologically more difficult (U.S. Congressional Budget Office 2019). LGVs are roaming residential streets, taking up more curb spaces, and reaching far more destinations than HGVs.

Therefore, transportation agencies are seeking new ways to tax goods delivery services. Their goals are to make sure that goods delivery services are fairly contributing to construction and maintenance of the transportation infrastructure they use, to improve conditions for emerging delivery operations, and to mitigate their adverse impacts. Adverse impacts are likely to be more acute in space-constrained urban environments. Moreover, different tools may be more appropriate for advancing transportation-related sustainability, distributional impacts, health, and safety goals depending on the goods delivery service and geographic scope.

New ways of delivering goods are still emerging, but this toolkit focuses on road-based, urban deliveries and their implications for transportation agency funding. It also examines how e-commerce affects consumer and carrier behaviors, which presents complexities that are often unaccounted for in traditional revenue strategies.

Module 3 is designed to be an illustrative application of the framework, introduced in Module 1, to goods delivery. It is organized into the following sections:

- **Background and Context.** This section briefly introduces goods delivery and its growing importance.
- **Goods Delivery Stakeholders.** This section summarizes key participants involved in goods delivery.
- **Goal Alignment of Goods Delivery.** This section assesses whether new mobility options help achieve transportation policy goals.
- **Revenue-Related Tools.** This section discusses specific revenue-related tools, narrative summaries of examples, their alignment with transportation policy goals, and assessments using the implementation evaluation criteria.
- **Key Takeaways.** This section synthesizes the findings about revenue-related tools and discusses policy implications.

The organization of the tools reflects their geographic relationship, from interurban freight to urban delivery. This toolkit covers the following revenue-related tools that are relevant to goods delivery:

1. **Indirect source rule (facility access fee):** a fee related to pollution charged for accessing major logistical gateways and nodes, like ports and distribution centers.
2. **Weight-distance toll:** a road usage charge for interurban freight transport.
3. **Congestion charge:** a fee based on the time that a delivery vehicle spends within a designated urban area.
4. **Low- or zero-emissions delivery zone:** a fee based on emissions while a delivery vehicle is within a designated urban area.
5. **Curb management fee:** a fee for using curb space for loading or unloading in a last-mile delivery environment (also includes fixed access fees to operate a vehicle within city boundaries).
6. **Delivery fee:** a fixed fee that applies directly to the delivery provider or end consumer.

## 3.2 Background and Context

As introduced in Module 1, the purpose of new mobility–goods delivery services (referred to as goods delivery throughout the rest of this toolkit) is to connect people to perishable food items and to nonperishable packaged items. While these services have traditionally relied on HGVs delivering bulk goods to stores and consumers driving to stores, the growth of e-commerce has changed the landscape of last-mile deliveries to include home deliveries, crowdshipping, and microfreight.

An important context for goods delivery is that transport taxes have fallen below the cost of transportation infrastructure. The real value of diesel tax has been falling since the 1990s due to increasing fuel efficiencies and stagnating tax rates (Glaeser, Gorback, and Poterba 2023; Gomez and Vassallo 2014). In the long term, as more vehicles become electrified, government agencies will likely face financial shortfalls, and they will need to find ways to cover the gap between less fuel tax revenue and rising infrastructure costs. According to one study, public revenues generated from diesel taxes are projected to fall by nearly 50 percent by 2040 (Dumortier, Zhang, and Marron 2017).

Furthermore, the growth of goods delivery can impose costs beyond just infrastructure maintenance. Goods vehicles emit disproportionate amounts of $CO_2$, $CH_4$, and $N_2O$ emissions and air pollution with adverse health effects, and they are increasingly a source of congestion and road crashes. Within the European Union, diesel vehicles are estimated to pay only about 40 percent of their total costs to society (Santos 2017). One study in the United Kingdom estimates that HGV taxes would have to increase by 50 percent to fully cover their externalities (Piecyk and McKinnon 2007). Meanwhile, time-based taxes (e.g., European Union's Eurovignette) and fixed fees (e.g., vehicle sales taxes, commercial licensing fees, container fees, and overweight fees) are less likely to cover externalities due to their weak linkage to actual road use (Austin 2018; Perera and Thompson 2020). Thus, conventional revenue strategies do not align well with externalities from goods delivery (Forkenbrock 2005; Rietveld and van Woudenberg 2005).

An **externality** is an indirect benefit or cost of an activity that affects people who are not involved in the activity. From an economic perspective, externalities are problematic because resources can be misallocated when people whose actions cause the benefit or cost do not experience it themselves.

Consequently, companies and—indirectly—consumers underpay relative to the socio-environmental costs of freight transport. While fuel taxes and fixed fees for freight carriers will likely remain fundamental in transport financing, it is clear that revenue-related strategies will have to adapt to recover infrastructure costs related to goods delivery and advance transportation goals related to sustainability and distributional impacts.

## 3.3 Goods Delivery Stakeholders

Although digital platforms and MaaS models are commonly studied from the passenger perspective, they also have major implications for government agencies, primarily municipalities, that regulate last-mile delivery environments, carriers or delivery service providers, and consumers of delivered goods. This section explores responses of goods delivery stakeholders to e-commerce.

Goods delivery stakeholders covered in this section:

- Carriers,
- Consumers, and
- Government agencies.

## Carriers

When pricing passenger services with taxes and fees, customers usually bear the costs directly. In contrast, pricing for goods delivery can affect economic decisions made by many agents across a supply chain that is often global (Giron-Valderrama and Goodchild 2020). How goods delivery providers react to pricing will vary across supply chains and be influenced by other actors within and beyond the logistics sector. Figure 11 highlights possible reactions of carriers to revenue-related tools imposed on them.

On one hand, carriers might change their operations in response to a new e-commerce activity or revenue-related tool:

- Logistics system designs consider the trade-offs between transportation costs and inventory costs. They can influence the location and consolidation of warehouses (McKinnon 2009), which have moved closer to urban markets in response to same- or next-day delivery preferences.
- Carriers can also respond by utilizing vehicle capacities more effectively or using "backhauls" to reduce return trips with empty loads. In the United Kingdom, for example, trucks spend roughly a third of their trips driving empty (Volvo Research and Educational Foundations 2016).
- Additional costs can also affect mode choice. Although research suggests there are minimal shifts from trucks to rails (Gomez and Vassallo 2020), carriers are experimenting with micro-freight options such as cargo bicycles and autonomous PDDs. Microfreight may offer promising modal alternatives for some deliveries in dense urban neighborhoods (Oliveira et al. 2017).
- Other responses can include reshaping routes, adjusting delivery timetables, and adopting low-emissions vehicles (LEVs) or ZEVs. Among these operational shifts, off-hour delivery (OHD) and ZEV incentives and mandates have received the most attention from researchers and officials, and they will be discussed further in this module.

On the other hand, it is also possible that carriers may not change their operating behavior in response to pricing. Past experience with fines suggests carriers will absorb pricing costs into their bottom line, pass it on to their customers by raising rates, or cut payroll expenses (e.g., by outsourcing to contractors) (Quak and van Duin 2010). Companies like FedEx and UPS pay tens of millions of dollars per year in parking fines as a "cost of doing business" in New York City (Baker 2019). The stop-and-go traffic and competition for curb space can lead to delivery drivers cruising for parking or illegally double parking (Giron-Valderrama and Goodchild 2020; Jaller et al. 2021). Although these behaviors incur fines and waste time, carriers typically prioritize consumer demands for quick, reliable deliveries during business hours. One concrete example is New York City's efforts to shift delivery to off-peak hours. This module regularly refers to the market conditions discussed in the section on New York City's OHD programs.

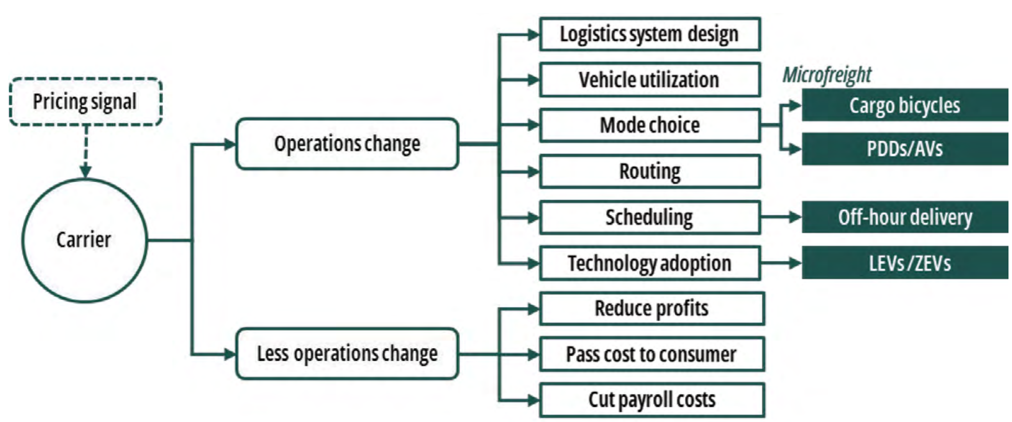



***Figure 11. Carrier responses to pricing signal.***

**Carriers Don't Like Driving in Congestion, So Why Do They Do It?
NYC's Off-Hour Delivery Experience**


Source: New York City Department of Transportation

In 2001, the Port Authority of New York and New Jersey started charging higher tolls for truckers using port facilities during peak hours to reduce port congestion. The benefits were clear: Implementing OHD programs in New York City cut delivery costs by a third and cut emissions by two-thirds (Holguín-Veras et al. 2018). Yet, only 15 percent of carriers changed their scheduling in response to the new rates (Holguín-Veras, Cetin, and Xia 2006). When surveyed about why they did not alter their scheduling, over 75 percent of carrier respondents replied that, due to customer demands, "they did not have a choice."

How carriers respond to revenue-related tools depends on several factors. The logistics sector is a highly competitive marketplace where carriers—often small businesses and contractors—work tirelessly to protect their customer base. Profit margins can range from just 1 to 5 percent, leaving little room for service changes. Modifying the delivery schedule for one location can affect service on the entire route, raise rates for all customers, and risk losing customers. Carriers that possess greater market power—such as larger companies or companies that transport commodities with specialized handling—are better equipped to absorb costs or charge more for deliveries when transportation costs increase (Zhang, Campbell, and Ehmke 2019).

If carriers can pass on costs to the receiver, they are less likely to change operating behaviors (Wang, Kim, and Zhang 2023). Offering incentives for restaurants to receive goods during off hours was a crucial factor for carrier retention in NYC's recent OHD program (Holguín-Veras, Leal, and Seruya 2017). The program awarded participating businesses $2,000 and promoted them publicly on a "Trusted Vendor" registry. As of 2024, New York City Department of Transportation allocated $6 million in grants to incentivize businesses to adopt OHD.

*(continued on next page)*

**Carriers Don't Like Driving in Congestion, So Why Do They Do It? NYC's Off-Hour Delivery Experience *(Continued)***

**Key Takeaways**

- Receivers have outsized market power, allowing them to dictate carrier behaviors.
- Goods delivery pricing usually targets the agent with the weakest market power: the carrier.
- Charges intended to achieve policy goals outside cost recovery have unintended effects.
- Even small incentives can have a big impact in driving behavior change.

## Consumers

In the past, consumers had little interaction with the logistics of their goods before they arrived on the store shelf. Nowadays, online shoppers can choose the delivery method and location: at home or work, curbside pickup, collection and delivery point/parcel lockers, or delivery via crowdshipping app (Wang et al. 2023). Increasingly, consumers are choosing to receive their package at a nearby store or an automated parcel locker rather than at their doorstep (Buldeo Rai, Verlinde, and Macharis 2021). They can also choose the timing of their delivery.

E-commerce consumers are also influencing "reverse" or "return" logistics. Consumers can easily return their goods, and they can even purchase multiple sizes and colors of the same item with the intent of returning those they do not want. According to one marketing firm, consumers return at least 30 percent of items purchased online, compared to just 8.9 percent of items purchased in a store (Saleh, n.d.). E-commerce companies and logistics service providers must find ways to satisfy this demand for return shipments.

In other words, online shoppers are actively participating in logistics choices. Whether online shopping is more environmentally sustainable than traveling to a store depends on urban form, last-mile operations, basket size (i.e., number of items per order), delivery timing and location, return options, and whether the consumer is replacing a shopping trip they would otherwise be making in their car (Jaller and Pahwa 2020; Wygonik and Goodchild 2018). However, the link between online and in-person shopping is complex. Consumers do not necessarily substitute in-person shopping trips with online shopping nor vice versa.

Revenue-related tools have conventionally targeted the carrier or delivery service provider, despite the end consumer—be they an online shopper or business—having a powerful say in how they wish to receive deliveries. Thus, when evaluating revenue-related strategies, it is important to consider how receivers and consumers react to pricing signals.

## Government Agencies

Urban freight systems span multiple geographies and political jurisdictions. Goods can travel across different countries, states, cities, and neighborhoods, each with potentially different political entities and regulations. Carriers adopt various strategies to reduce costs based on the regulatory and operational conditions that exist within each of these geographic scales. Thus, government agencies may want to consider whether their policies are congruent or in conflict with the policies of other jurisdictions and how carriers and consumers might respond to them.

Local jurisdictions play an important role because the visible impacts of goods delivery services are highly localized. E-commerce's influence on urban freight systems is most noticeable in the last-mile delivery environment, often creating conflict with other travel modes in densely populated neighborhoods (Beckers, Cardenas, and Sanchez-Diaz 2022; Marsden, Docherty, and Dowling 2020). If loading zones are not adequately allocated or designed, delivery vehicles may obstruct bicycle lanes, transit corridors, or pedestrian sidewalks, or they may double park in vehicle lanes (Wehrmann 2018). For example, according to a recent study in Seattle, WA, commercial vehicles spend 28 percent of their delivery trip looking for parking (Dalla Chiara and Goodchild 2020).

Cities in Europe have made efforts to integrate urban logistics into their Sustainable Urban Mobility Plans (SUMPs), which outline a city's regulatory approach to reaching long-term environmental and social goals. As of 2022, 62 out of 107 sampled European cities (58 percent) mentioned urban logistics in their SUMPs, while 14 cities (13 percent) have a separate Sustainable Urban Logistics Plan (Aifandopoulou and Xenou 2019; Urban Logistics as an on-Demand Service 2022). For instance, the *Green City Masterplan* of Bremen, Germany, integrates online shared economy platforms, "cargohitching," containerized cargo bikes, and multimodal passenger services with intelligent parcel lockers. The City of Bremen also invested in cargo distribution centers to function as staging depots for last-mile deliveries on e-bikes (Wehrmann 2018).

The approach of North American cities to integrated urban freight management has been more fragmented. Interviews with transportation authorities in nine U.S. and Canadian cities revealed that only four of them had a freight planner on staff (Maxner, Dalla Chiara, and Goodchild 2022). Many of these cities' policy approaches have been pilot programs. For example, New York City launched its e-cargo bicycle pilot with UPS, Amazon, and DHL in 2019. As of 2022, New York cargo bikes have made more than 130,000 trips. In 2023, the city authorized new regulations to increase the permissible width of e-cargo bicycles, allowing bikes to carry more deliveries and enhancing their economic feasibility (New York City Department of Transportation 2023). Despite innovative efforts from U.S. cities to support efficient and sustainable goods mobility, more is needed to ensure that revenue-related strategies align with relevant policy goals and publicly invest in opportunities.

## 3.4 Goal Alignment of Goods Delivery

Revenue-related tools seek to maximize economic, social, and environmental benefits while avoiding inefficiencies and other undesirable effects on businesses, workers, and communities. However, as discussed in the previous section, carriers and consumers can respond to pricing in varied and unexpected ways. Whether goods delivery and its stakeholders' response to pricing can support transportation goals depends on several factors.

### Cost Recovery for Infrastructure and O&M

Because goods delivery services impose additional costs on transportation agencies to operate and manage the transportation system and fund infrastructure, there is a rationale for extracting revenue from these services to pay for their share of the transportation system. Taxes and fees explicitly designed for goods delivery services would be appropriate for covering some or all of the incremental costs related to the operations, maintenance, and infrastructure of the transportation system.

Despite representing a small fraction of the total traffic volume, revenue generated from carriers contributes a large portion to the O&M of infrastructure (Tax Policy Center 2024). In some cases, carriers argue the charges they face are disproportionate relative to the costs incurred by private vehicles. For instance, Oregon is one of the few U.S. states that implements a miles-based road usage charge for HGVs. As of this writing, the most recent state-funded Highway Cost Allocation study estimates that the most common truck configuration, a semitruck with a gross vehicle weight (GVW) between 78,000 and 80,000 pounds, overpays in fees by 72.2 percent relative to its incurred infrastructure costs. At the same time, lighter passenger vehicles underpay by 12.2 percent, based on assumptions in the analysis (ECONorthwest 2023).

LGVs and even some medium goods vehicles (MGVs), such as single-unit box trucks, are typically exempt from many fixed fees and tolls that apply to heavier vehicle configurations. The increased uptake of these lighter vehicles by e-commerce retailers and logistics providers means that goods delivery is generally not priced when entering urban areas. Moreover, since LGVs and MGVs are electrifying at a faster rate than HGVs, their contribution to fuel tax revenues is expected to diminish more rapidly (International Energy Agency 2023). Therefore, new revenue-related tools should ensure that LGVs and MGVs are contributing to the costs of operating and maintaining transportation infrastructure as well as balancing charges with HGVs to ensure they are shared across all road users.

## Economy (Connectivity)

The growth of e-commerce has arguably increased people's connection and access to goods. Online platforms allow a greater variety of goods to be available for browsing and shopping, and e-commerce distribution networks can reach more customers than brick-and-mortar stores. E-commerce helps small businesses expand from brick-and-mortar stores serving a single neighborhood to online businesses with a wider reach (Figure 12).

The benefits of e-commerce and the prices consumers pay for enhanced convenience can change based on the tax or fee structure. Uneven taxation or evasion could reduce competition across an industry. For example, Amazon purchases dropped by 9.4 percent when states introduced a sales tax on online orders made in-state (Baugh, Ben-David, and Park 2014). Since the tax only applied to Amazon initially, it benefited its competitors; for example, Newegg saw a 13 percent increase in sales.

Still, taxes and fees may only have a small effect on consumer prices. For example, tolls in Germany and Spain impact consumer prices by less than 1 percent, although this may be because small carriers and for-hire drivers are unable to invoice the added costs to their customers (Doll

Source: insta_photos/stock.adobe.com

***Figure 12. Small-business employee preparing a delivery parcel.***

et al. 2017). Domestically, the U.S. Congressional Budget Office estimated that the consumer price impact of a proposed VMT tax for commercial trucks would be just 0.06 percent of the income for low-income households and 0.02 percent for high-income households (U.S. Congressional Budget Office 2019).

## Efficiency (Mobility)

Transportation agencies are concerned with the cost of congestion and increasing competition for public space resulting from residential and commercial delivery traffic. One study in New York City suggests that traffic related to e-commerce can cost residents about $400 million per year in congestion delays (Komanoff 2021). Given these high costs, parcel lockers and a mode shift to "right-sized" vehicles (i.e., microfreight) have emerged as prominent areas for public investment.

### *Parcel Lockers*

Carriers prefer to deliver to parcel lockers (Figure 13) when circulating door-to-door in urban congestion is inefficient and expensive (Cárdenas et al. 2017). Lockers also eliminate failed deliveries and theft, which reduces the need for carriers to redeliver packages. One controlled experiment in a downtown Seattle, WA, apartment building found the installation of a parcel locker reduced dwell time at the curb by 50 percent (Ranjbari et al. 2023). Another study found that parcel lockers reduce the last-mile costs of delivery by up to 11 percent (Peppel and Spinler 2022).

### *Microfreight*

While microfreight modes, such as electric cargo bikes (Figure 14), can reduce conventional commercial vehicle traffic, there are many obstacles to increasing the scale of their impact. First, they are less cost-effective outside of regions with high commercial and residential density (Robichet, Nierat, and Combes 2022; Tipagornwong and Figliozzi 2014). A lack of adequate bicycle infrastructure also causes couriers to use public infrastructure in unintended ways. In a

Source: Joni/stock.adobe.com

***Figure 13. Parcel lockers at an apartment.***

Source: David Fuentes/stock.adobe.com

***Figure 14. Cargo bike on a city street.***

Seattle pilot, an e-cargo tricycle courier spent 37 percent of the time operating on the sidewalk (Dalla Chiara et al. 2022). When a bicycle lane was present, the courier only used it half the time due to difficulties in accessing the curb. Moreover, microfreight services typically require a "microhub" or urban consolidation centers to consolidate and stage shipments. These facilities have high potential to reduce VMT by improving load consolidation and shortening the distance travelled by cargo bikes. However, they may occupy real estate in high-demand neighborhoods, require start-up subsidies from local governments, and entail extensive collaboration between and within public and private sectors (Katsela et al. 2022).

## Environment

Freight emissions constitute 40 percent of the transportation sector's share of global $CO_2$, $CH_4$, and $N_2O$ emissions, and they are expected to triple by 2050 (SLOCAT 2021). According to one estimate, half of road-based freight emissions occur during the last mile (Higgs 2022). As such, revenue-related tools that incentivize parcel lockers, mode shift, and electrification present important avenues to decarbonize urban freight.

### *Parcel Lockers*

Picking up a package at a collection point or a parcel locker can reduce the carbon footprint of online shopping by 68.3 percent, assuming consumers can travel to the parcel locker by foot (Buldeo Rai, Touami, and Dablanc 2022).

### *Microfreight*

Microfreight and microhub pilots found emission savings between 30 and 45 percent in North American cities and up to 80 percent in European cities when compared to diesel LGVs (Katsela et al. 2022). However, the delivery vehicles that service the microhub from the suburban distribution center influence the overall emissions impact. One Seattle microhub pilot found that if carriers used only diesel cargo vans to service a microhub (rather than completing a full route), emissions would exceed a conventional delivery model, even if cargo bikes carried all of the subsequent delivery trips (Gunes, Fried, and Goodchild 2024). In other words, the environmental impact of microfreight is contingent on the middle-mile operations that serve the microhub.

### *Electrification*

The emissions impact of electrifying goods vehicles depends on the upstream energy mix (Giordano, Fischbeck, and Matthews 2018). Based on the European Union's current energy mix, a battery-electric HGV would avoid 63 percent of emissions. As power grids become fully renewable, the avoided emissions are likely to reach 90 to 98 percent (Irles 2023).

However, electrifying HGVs is complex because many zero-emission models currently have low levels of technological readiness, limited infrastructure availability, and high costs. Purchasing costs for new battery-electric HGVs could be 1.5 times higher than their diesel counterparts, at least for the next five years or so (Buysse 2022). Electric HGVs also possess higher intangible costs than diesel—such as range anxieties and lower cargo capacities—which constitute 27 to 40 percent of perceived zero-emission HGV expenditures (Hao et al. 2022).

In contrast, electric LGVs have already reached cost parity with their diesel counterparts, and their shorter ranges and lower load factors make them more readily adoptable (Mulholland 2022). In 2022, 60,000 MGVs and HGVs were sold worldwide, predominantly in China, representing only 1.2 percent of global truck sales (International Energy Agency 2023). Meanwhile, electric LGV sales comprised almost 5 percent of total LGV sales worldwide in 2022 and up to 26 percent South Korea. Worldwide, electrifying last-mile delivery (e.g., Figure 15) will likely occur at a faster pace than electrifying long-haul trucking.

## Distributional Impacts

If new goods delivery services increase options for people across socioeconomic categories to purchase goods, then the services can support a transportation system that distributes public benefits more widely. This can be the case in urban areas where carriers strive to serve all addresses. For instance, online grocery delivery can help reduce the challenges of food deserts, time constraints, and mobility-related impairments, which are often linked to food insecurity and nutritional inequality (Dillahunt, Simioni, and Xu 2019). As of this writing, SNAP benefits have largely become redeemable for low-income families on many goods delivery platforms.

If access to e-commerce is limited or revenue-related tools result in restricted access to e-commerce, then goods delivery and the associated revenue-related tools would not support goals related to improving distributional outcomes. Prohibitive delivery fees that go uncovered by SNAP, for


Source: Lawr/stock.adobe.com

***Figure 15. Amazon's electric delivery van.***

instance, are a major barrier for low-income households and older adults who stand to benefit from these services (George and Tomer 2022). Moreover, transportation agencies need to consider whether lower-income households could be disproportionately impacted if delivery services respond to revenue-related tools by reducing worker wages or raising the shipping fees on ordered goods. Like most consumption taxes, a tax or fee on goods delivery would be regressive, meaning the burden is greater for people with less income or other resources.

Additionally, improving the efficiency of receiving and consuming goods may disproportionately benefit wealthier, more educated households—demographics that are most likely to shop online (Figliozzi and Unnikrishnan 2021; Hood et al. 2020; Valarezo, López, and Amaral 2020). For instance, parcel lockers are less available near low-education, Hispanic population clusters, as observed in Portland, OR (Keeling, Schaefer, and Figliozzi 2021). And yet, these populations are disproportionately exposed to diesel particulate matter from freight traffic (discussed further in the next section) (Figure 16).

Additionally, infrastructure that concentrates freight activity—such as warehouses, distribution centers, and ports—has historically been located near politically and economically marginalized groups (Fried et al. 2024). Some policies seek to target pollution at the facility level. For instance, Southern California's South Coast Air Quality Management District (AQMD) passed the Warehouse Indirect Source Rule in 2021 to explicitly address emissions in freight-burdened communities. These place-based policies promote vehicle and operational efficiency improvements to mitigate the environmental impact of logistics.

## Health (Air Quality)

Air quality research estimates the health effects of chronic exposure to air pollution related to HGV traffic. Despite falling tailpipe emissions across high-income countries, diesel particulate matter (DPM) from freight vehicles remains significantly linked to onset and exacerbation of asthma as well as mortality from respiratory and circulatory illnesses (Boogaard et al. 2022). DPM exposure in the United States due to HGVs constitutes nearly 40 percent of public health damages related to transportation (Lathwal, Vaishnav, and Morgan 2022), which is not distributed equally across all populations. In the United States, populations of color account for about 75 percent of all PM2.5 exposure, which is a broader category of pollutants that includes DPM and other particulate matter with a diameter of 2.5 micrometers or less (Tessum et al. 2021). The impact of chronic DPM exposure is complex and confounded by factors that include the built environment, daily activity, meteorological conditions, medical susceptibility, and social vulnerability (Morello-Frosch et al. 2011).

DPM exposure is only a portion of the cumulative health effects of goods delivery. Nonexhaust emissions (e.g., road silica, particles from tire and braking wear) already exceed exhaust emissions

Source: Environmental Defense Fund

***Figure 16. Truck passing by houses in Newark, NJ.***

for many vehicle types (Harrison et al. 2021). Electrification can further exacerbate nonexhaust emissions from the wear and tear of roadways because batteries and related components add weight to delivery vehicles (Liu et al. 2022).

### Safety

Research generally finds a correlation between heavier vehicle weights and road crash severity, and revenue-related tools can have unfortunate effects. For example, carriers may respond to higher diesel taxes by consolidating their shipments into larger, heavier vehicles, resulting in greater crash severity (Nehiba 2020). External costs generated by increased crash severity could exceed the marginal gains of reduced emissions and congestion resulting from more efficiently loaded vehicles.

Freight policies can affect road safety in other unexpected ways as well. For example, hour-of-service (HOS) regulations are meant to reduce driver fatigue and improve road safety by limiting driving time. However, they do not address the underlying economic conditions that compel drivers to overwork, putting the drivers and other road users in danger (Soliani et al. 2024). HGV-related fatalities per mile have increased by 22 percent in the past decade, in spite of these measures (National Safety Council, n.d.). The rise of digital enforcement of HOS regulations across smaller carriers may have unintentionally encouraged truckers to speed and drive more dangerously to maximize their payable miles (Scott, Balthrop, and Miller 2019).

This trend has also been observed in the home delivery sector (Vecchio et al. 2022). Road deaths of pedestrians and cyclists related to urban freight increased by 28 percent between 2005 and 2015 (McDonald, Yuan, and Naumann 2019). These crashes occur disproportionally in neighborhoods with majority low-income populations and people of color, as research in Minneapolis-St. Paul finds (Yuan and Wang 2021).

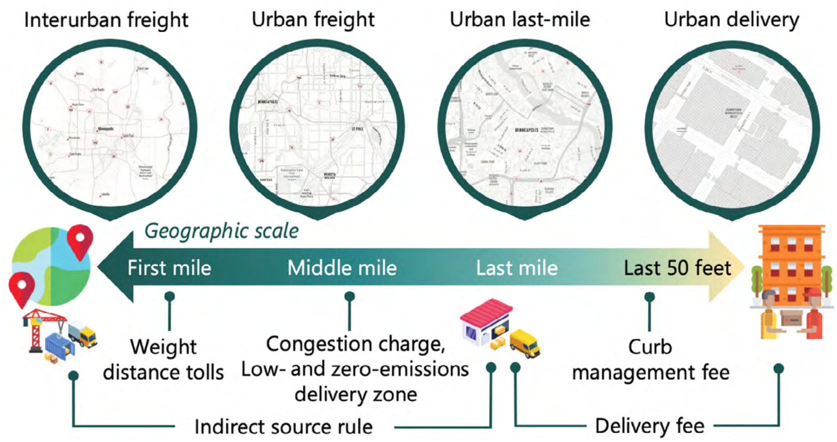
However, the linkage between growing road safety risks and e-commerce is less clear. There may be some associated safety benefits to e-commerce in that it favors a shift from HGVs to LGVs. However, if e-commerce increases the total VMT from HGVs or LGVs, there could be an increase in the frequency of severe or fatal road crashes. Moreover, policies could unintentionally incentivize more risky behavior.

## 3.5 Revenue-Related Tools

This section discusses specific revenue-related tools, narrative summaries of examples, their alignment with transportation policy goals, and assessments using the implementation evaluation criteria. This toolkit covers the following revenue-related tools that are relevant to goods delivery:

1. **Indirect source rule (facility access fee):** a fee related to pollution charged for accessing major logistical gateways and nodes, like ports and distribution centers.
2. **Weight-distance toll:** a road usage charge for interurban freight transport.
3. **Congestion charge:** a fee based on the time that a delivery vehicle spends within a designated urban area.
4. **Low- or zero-emissions delivery zone:** a fee based on emissions while a delivery vehicle is within a designated urban area.
5. **Curb management fee:** a fee for using curb space for loading or unloading in a last-mile delivery environment (also includes fixed access fees to operate a vehicle within city boundaries).
6. **Delivery fee:** a fixed fee that applies directly to the delivery provider or end consumer.

The organization of the tools reflect their geographic relationship. As shown in Figure 17, indirect source rule, weight-distance tolls, congestion charges, and low- and zero-emissions delivery zones are related to how goods move from ports and warehouses to urban areas. Curb




Source: Icons from www.flaticon.com

***Figure 17. Evaluated revenue-related tools for goods delivery and geographic scale.***

management fees regulate the use of public spaces in an urban area. Delivery fees apply to goods as they reach their destination.

This toolkit provides examples of evaluating these revenue-related tools using the revenue-related tools framework for new mobility (Figure 6) described in Module 1. Transportation policy goals are introduced in Section 1.4 and further described in Section 3.3. Implementation evaluation criteria are described in Section 1.6.

## Indirect Source Rule

### *Fee Description*

Indirect source rules (ISRs) refer to regulations that aim to reduce emissions generated by freight movement associated with logistics facilities, such as warehouses or ports. The pricing component of ISRs typically charges more emissions-intensive vehicles at higher rates and applies exemptions, discounts, or incentives to more energy-efficient modes. ISRs directly target freight-generating land uses and related development (i.e., buildings). The fees are charged for accessing major logistical gateways and nodes, like distribution centers.

In Europe, ISRs exist as an extension of low- and zero-emissions zone (LEZ/ZEZ) policies. For example, the latest revision to London's ultralow-emissions zone (ULEZ) doubled the number of industrial properties subject to the regulation and introduced penalties for noncompliant fleets regardless of whether they complete deliveries within the city (O'Reilly 2023).

In the United States, however, ISRs fall under a distinct legal framework that sets them apart from LEZs and ZEZs. Federal regulations do not permit states and municipalities to set policies that mandate compliance with emissions standards outside federal guidelines (Turner 2020). Only the State of California has applied for a waiver, which other states can then choose to adopt. ISRs are not preempted by the federal government because the fee is not a requirement; instead, the fee is one option within a flexible "menu" of compliance methods. This section describes two cases in California that offer creative policy approaches to these legal barriers. (Table 26 summarizes the implementation of the two programs and their exemptions.)

U.S. statute 42 U.S.C. § 7410 defines "indirect sources" of emissions as all land uses that can increase mobile-source emissions to an extent that interferes with a region's attainment or

**Table 26. Overview of ISRs in the United States.**

| Example | Regulating Authority | Fee Structure | Permitted Mitigations | Revenue |
|---|---|---|---|---|
| **San Joaquin Valley's Indirect Source Review Rule** | San Joaquin Valley Air Pollution Control District | Most land uses, light industrial >25K sq. ft.; $9,350 and $9,011 per unmitigated ton of NOx and PM10. Owners pay a $841 Air Impact Assessment (AIA) fee. | A nonexhaustive list that includes NZE/ZE truck procurement, charging installation, zero-emissions equipment, HEPA air filtration, and worker transit subsidies. | $12.3 million (FY 2023) |
| **Warehouse Actions and Investments to Reduce Emissions Program** | South Coast Air Quality Management District | Warehouse with floor space >100K sq. ft.; $1,000 fee per unspent point. Owners pay roughly $615 in compliance fees. | Procure and operate NZE/ZE truck (points vary by weight class); procure or use ZE yard truck; NZE/ZE truck visit; install or use a ZE charger; install or use solar panels; install or replace DPM filters in nearby land uses. | $5.5 million (FY 2023) |

maintenance of the National Ambient Air Quality Standards (NAAQS). In other words, air quality improvement must be a stated goal of implementing ISRs.

ISRs in the United States take different forms. Washington, DC, and Oregon have enacted ISRs that require developers to seek a permit based on anticipated parking demand and vehicle trip generation. California's Colusa County Air Pollution Control District (APCD) has an ISR that requires industrial developers to pay a permitting fee of $0.05 per square foot, with revenue allocated to air quality mitigation programs in the region. However, as of June 2024, only two air quality control districts incorporate pollution pricing into mitigation targets: California's San Joaquin Valley APCD and South Coast AQMD.

### *Example 1: San Joaquin Valley's ISR Rule*

San Joaquin Valley APCD enacted its ISR in 2005. Applicants submit an Air Impact Assessment (AIA) that calculates baseline emissions of nitrogen oxide (NOx) and PM10—particulate matter with a diameter of 10 micrometers or less—for both construction and future operation phases. The AIA also identifies on-site mitigations that reduce NOx and PM10 emissions by 33.3 and 50 percent, respectively, from the baseline. The operator must implement emission mitigations or pay a fee per unmitigated ton of pollutants (San Joaquin Valley APCD 2023).

San Joaquin Valley APCD's ISR generated $12.3 million in revenue in 2023 (San Joaquin Valley APCD 2023). This revenue helped fund 2,741 clean-air projects, including rebates for ZEV purchasing. San Joaquin Valley APCD estimates that NOx and PM10 emissions were reduced by 14,845 tons and 2,459 tons, respectively, from 2006 to 2022 as a result of ISR mitigations and funded grant and incentive programs.

### *Example 2: Southern California's Warehouse Actions and Investments to Reduce Emissions Program*

South Coast AQMD passed its Warehouse Actions and Investments to Reduce Emissions (WAIRE) program in 2021. WAIRE enacted a point-or-fee system for warehouse tenants who operate more than 100,000 square feet of working floor space. Tenants earn points by selecting from a "menu" of pollution mitigation items, such as procuring natural gas or zero-emissions (ZE) trucks; installing on-site solar panels; or installing DPM filtration systems for nearby land uses. They can also buy points at $1,000 per point. Roughly 3,200 warehouses in the region are subject to the regulation. Development owners must submit monitoring and compliance reports.

WAIRE is less comprehensive in its scope than San Joaquin Valley APCD's ISR. While the latter prices pollution from constructing and operating all major land uses, WAIRE only prices freight trip generation from large warehouses. However, WAIRE's advantage is its ease of implementation and administration. Rather than modeling baseline and projected emissions, operators simply report and tabulate their WAIRE Points Compliance Obligation, a function of the total trips made to and from the warehouse per year.

The WAIRE Mitigation Fee Program funds incentives toward the purchase of near-zero-emissions (NZE) and ZE trucks, as well as ZE charging and fueling infrastructure. Warehouse operators may apply for WAIRE funds. However, the incentivized vehicle or equipment may earn WAIRE points only for its operation, not the acquisition. Additionally, any ZE charging or fueling infrastructure funded by WAIRE must be publicly accessible and cannot solely be used by the operator's private fleet. New York has introduced similar legislation that considers ZE delivery zones in lower-income communities.

Table 26 compares the San Joaquin Valley's ISR to the WAIRE program.

### *Policy Goals Assessment for ISRs*

Table 27 shows potential policy goals achieved through ISRs. Since the explicit policy goal of an ISR is to reduce air pollutants—either through direct behavior change or revenue investments in incentive programs—and freight traffic is a major contributor to poor air quality, this revenue-related strategy is well-aligned to health outcomes in communities that reside near industrial developments. However, due to limited examples of implementation, it is still unclear how warehouse and fleet operators—both large and small—will adapt to comply with the policy.

### *Evaluation of Policy Implementation for ISRs*

Table 28 shows the implementation evaluation for ISRs. ISRs are an important source of revenue for air quality control district programs, with relatively low administrative costs.

**Table 27. Policy goals assessment for ISRs.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | Rather than contributing to cost recovery, ISRs are a component of state implementation plans aimed explicitly at reducing or maintaining air pollution levels. |
| **Economy (connectivity)**<br>Does it lower the cost of accessing a place? | South Coast AQMD calculates compliance points based on trips from and to the warehouse. Thus, operating costs are higher for larger, more productive warehouses. ISRs could potentially negatively impact economic productivity. However, there might not be any direct impact on businesses with smaller floor spaces if they are exempt from ISRs. |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | Theoretically, warehouse operators can lower compliance requirements by reducing vehicle trip generation and demand, thereby improving efficiencies. However, it is still unclear how operators will choose to respond to the policy. |
| **Environment**<br>Does it help reduce emissions? | San Joaquin Valley APCD's compliance requirements are indexed to NOx and PM10 emissions. There may be other co-benefits related to the environment. |
| **Health (air quality)** | ISRs reduce pollution through two avenues: (a) pushing warehouse operators to adopt cleaner vehicles and practices, and (b) revenue investment in pollution reduction programs (e.g., electric truck rebates). |
| **Distributional impacts, safety** | Population disparities in pollution exposure are tied to the location of warehouses and distribution centers. As such, ISRs have clear health-related benefits for communities that reside near these facilities. |

**Table 28. Evaluation of policy implementation for ISRs.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | Fees (and reinvestment of the fees) have so far achieved air pollution reduction (San Joaquin Valley APCD 2023). Pollution reduction largely stems from avoided emissions due to warehouse operators mitigating costs and from grant programs that are subsequently funded through ISRs. |
| **Fairness**<br>Who does it benefit or harm? | There are exemptions for certain business types. For example, facilities using less than 50,000 sq. ft. in a single building are exempt from ISR (Pillsbury Winthrop Shaw Pittman LLP 2021). Additionally, credit trading and alternatives to ZE fleet procurement can alleviate some fiscal pressure on smaller companies. |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | ISR's legality depends on the offered "menu" of mitigation items and a region's NAAQS attainment status. EPA preemption does not allow municipalities or states to mandate emissions standards outside of federal and California guidelines. |
| **Public acceptance**<br>Could there be organized support or opposition? | Political opposition may stem from property owners—who are required to submit compliance reports on behalf of the tenants—and warehouse operators. Since the NAAQS control district directly administers the funds, and funds go directly to mitigation programs, there is a clear delineation of political objectives. |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | Southern California's WAIRE program charges a 6.25 percent fee to cover administrative overhead (roughly $1.6 million out of $26 million in total FY 2024 revenues). WAIRE is administered by about 10 full-time staff, with a budget of $2 million in FY 2023 (Regional Air Quality Council 2023). |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | Fees must be spent in alignment with the state implementation plan and NAAQS attainment or maintenance status, typically disbursed to grant incentive programs. |
| **Revenue capacity**<br>How much revenue will it generate? | San Joaquin Valley APCD's ISR contributed 3.4 percent to the district's nonoperating revenues and 3.6 percent to grant incentive programs in FY 2022. It is one of the largest revenue sources outside state and federal grants. |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | Fee revenues are proportional to warehousing development and freight volumes. Thus, revenues are likely to fluctuate with the level of economic activity. |

## Weight-Distance Toll

### *Fee Description*

A weight-distance toll (WDT) or weight-mile tax is a type of road usage charge (RUC) that prices commercial transportation by miles traveled on public roads. While RUCs have seen growing political interest for applications in passenger services, WDTs for HGVs have been in practice in the United States and European Union for decades. According to the U.S. Congressional Budget Office (2019), three central components of WDTs are the tax base, rate structure, and implementation:

- **Tax base:** vehicle and road categories that are subject to the fee.
- **Rate structure:** setting rates for different vehicle and road types.
- **Implementation:** payment and collection mechanism. Collection methods and technologies have implications for administrative ease, political acceptance, and system overhead costs. These, in turn, can influence the tax base and the rate structure.

The emphasis of WDTs on interurban freight flows may at first suggest there is limited applicability for e-commerce and last-mile delivery. However, recent shifts to incorporate LGVs in pricing regimes and use cases for urban roads offer some important takeaways. This section explores WDTs in the European Union and United States.

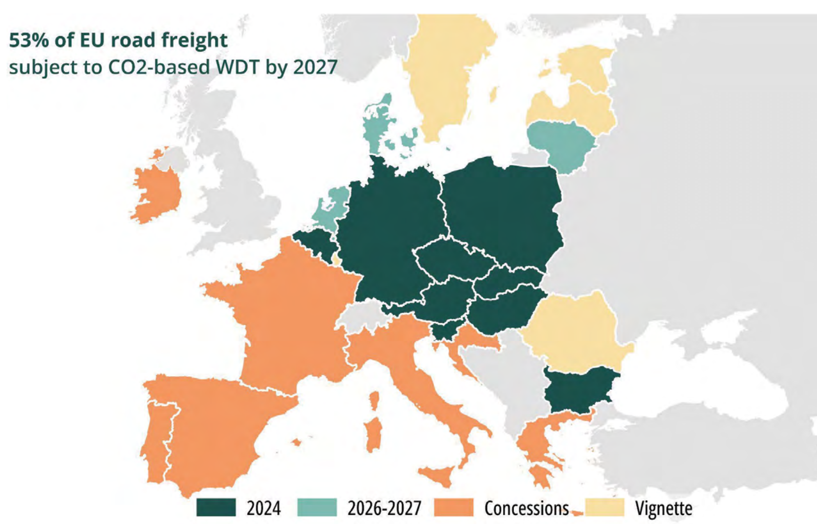
### *Example 1: Eurovignette Directive Reform*

In March 2022, the European Union reformed its Eurovignette directive to include HGV tolling as part of a broader freight emissions and pollution reduction strategy. The European Union introduced a time-based "vignette" system in 1993, primarily to recover highway infrastructure costs. The system's public acceptability hinged on establishing a new balance between domestic and foreign haulers. Today, Eurovignette subscribes to a "polluter pays" principle, but it still faces political opposition from commercial carriers who have been successful at limiting rate increases (Transportation & Environment 2024).

Given their high volume of freight traffic, "crossroads" countries in central Europe were the first to replace the vignettes with WDTs. In 2024, these countries were also the first to adopt the mandatory emissions charge based on $CO_2$. Denmark, Lithuania, and the Netherlands will replace their time-based vignettes by 2027 (Figure 18). Several countries (e.g., Germany and Switzerland) also incorporate air and noise pollution into their fee calculation. Western and southern EU countries contract with private concessionaires and are not required to adopt the $CO_2$ surcharge until contract renewal. By 2027, over half of road-based freight volume traveling inside and through the European Union is expected to be subject to the $CO_2$ surcharge (Transportation & Environment 2024).

Eurovignette reform includes the following directives (Transportation & Environment 2024):

- **Introduce $CO_2$ surcharge.** The EU members can either raise current fee rates to incorporate a $CO_2$ surcharge or add a $CO_2$ surcharge on top of existing fees. The directive assigns emissions classes based on $CO_2$ reduction targets; the most pollutive vehicles, Emission Class 1, are subject to a minimum of €0.080 to €0.091 per kilometer traveled. The EU members are permitted to charge more to incorporate the long-run costs of climate change. For instance, Germany's GPS-based WDT system (LKW-Maut) charges a standard, two-axle truck (<18,000 kilograms, Euro 6) €0.238 per kilometer for Emission Class 1 vehicles and €0.188 per kilometer for Emission Class 4 vehicles. Class 4 trucks include hybrid vehicles that are 50 percent less




Source: The Urban Freight Lab, adapted from Transportation & Environment (2024)

***Figure 18. Year of entry for carbon dioxide–based Eurovignette directive.***

emissions-intensive than the reference $CO_2$ level. The $CO_2$ charge represents 42 percent and 27 percent of the toll for Class 1 and Class 4 vehicles, respectively. Germany anticipates that the $CO_2$ charge for trucks weighing over 7,500 kilograms will generate €26.6 billion in additional revenue between 2024 and 2027 and €3.9 billion for trucks weighing between 3,500 and 7,500 kilograms.

- **Expand tolling to lighter goods vehicles.** The directive mandates the charging of goods vehicles over 3,500 kilograms, which encompass single-unit trucks and larger box trucks. This weight class typically does not include cargo vans, which are more likely to operate in the urban last-mile environment. However, the directive provides flexibility for members to charge cargo vans and vary rates based on environmental performance.
- **Apply exemptions and discounts for ZEVs.** Exempting battery-electric trucks from WDTs makes operating these vehicles 14 percent cheaper per kilometer than diesel trucks when considering total cost of ownership (Basma and Rodríguez 2023). As total cost of ownership remains a commonly cited barrier for ZEV procurement, Eurovignette allows members to use pricing as an incentive. While countries like Germany currently exempt ZEVs from the WDT, members are required to levy infrastructure charges by 2026.
- **Phase out vignettes within the core European network.** The directive seeks uniformity across core European highways but allows members to price regional and local roads differentially. Most countries vary tolls outside of the Trans-European Transportation Network. For instance, Belgium varies rates and exemptions by region: ZEVs are exempt in Flanders, but they pay €0.054 to €0.156 per kilometer in French-speaking Wallonia (as of January 2024). In Brussels, ZEVs pay €0.092 to €0.159 per kilometer on highways but pay a higher amount (€0.123 to €0.251 per kilometer) on some urban roads. The directive also allows flexibility in adjusting rates when a member country determines a toll that will divert traffic into sensitive areas. Switzerland is the only European country that has implemented a WDT on all public roads.

### *Example 2: Statewide WDTs in the United States*

As of May 2024, there are five states in the United States with an active WDT program for commercial vehicles: Connecticut, Kentucky, New Mexico, New York, and Oregon. The fee structure for each system typically varies by GVW or the registered average laden weight for each vehicle configuration and tractor-trailer combination.

Oregon's weight-mile tax is currently the longest-running and most extensive WDT system in the United States. Oregon implemented the first WDT in 1933, requiring carriers to log laden weight and distance traveled on all public roads as part of monthly tax filings. The state switched to using GVW in 1947 and incorporated axle-based pavement damage estimates in their pricing regimes in 1999 (Oregon Department of Transportation 1999). This rate structure charges higher-axle truck configurations at lower rates. The tax and accompanying incentives have resulted in carriers procuring trucks with higher axle counts (Rufolo, Bronfman, and Kuhner 2000).

The state-funded Highway Cost Allocation study projects that about $461 million in WDT revenue would be generated between 2023 and 2025, roughly 28 percent of all transportation-related sources (ECONorthwest 2023). Although Oregon's WDT charges the highest rates per mile among U.S. states, the fee supplants the state diesel tax. In contrast, other states with WDTs also have diesel taxes.

Only New York and New Mexico's WDT rate structures differentiate between loaded and deadhead trips. For example, New Mexico charges deadhead trips, or "one-way" trips, 33 percent less than loaded trips ($0.017 versus $0.026 per mile), on average. This pricing structure attempts to reflect the differences in road usage—heavier, loaded trips have greater wear and tear on roads. However, higher fees on heavier vehicles may not reflect the *per ton* externality cost. For instance, if a carrier responds to an HGV fee by redistributing their load across a higher volume of MDVs and LDVs, this behavior would generate more wear and tear on the road (Holguín-Veras, Cetin, and Xia 2006). From this perspective, higher rates for under-capacity truckloads and unloaded backhauls would likely align more with external cost recovery goals. But the technical requirements and costs for such a system, such as utilizing weigh-in-motion stations to collect real-time data, are high and deemed "impractical" by even the more advanced WDT systems, like the one in Switzerland (Krebs and Balmer 2015).

In 2022, The Eastern Transportation Coalition, a federally funded partnership of 18 states primarily along the U.S. East Coast, launched the International Truck Pilot (ITP) focusing on the interoperability of revenue-related strategies across state and international borders (The Eastern Transportation Coalition 2023). It relied on a location-based distance reporting system that is integrated with each driver's on-board electric logging device.

ITP identified four weight categories and calculated rates as a fraction of the operating state's cent-per-mile diesel tax rate, proportional to an average Class 8 truck's fuel mileage. The pilot set rates for lighter commercial vehicles between 10,000 and 26,000 pounds GVW. This inclusion presents some administrative challenges, as many states do not require vehicles under 26,000 pounds GVW to maintain distance records or report operations.

### *Policy Goals Assessment for WDTs*

WDTs directly address policy goals for cost recovery and efficiency because they can generate more than sufficient revenue, and they are designed to use pricing to mitigate the incremental impact on congestion. The Eurovignette reform aligns with the goal of reducing emissions. This revenue tool may connect to goals related to distributional impacts, health, and safety as shown below in Table 29. These implications can vary by WDT system.

**Table 29. Policy goals assessment for WDTs.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | WDTs can be designed to generate revenues that match the cost of managing the transportation system, including the capital and maintenance costs of infrastructure. They can be structured to consider any disproportionate impact that HGVs might have, although lack of registration creates barriers for pricing LGVs. |
| **Economy (connectivity)**<br>Does it lower the cost of accessing a place? | On one hand, WDTs add to the cost of transportation. However, to the extent that WDT revenue supports the maintenance of roadways, the tax can connect markets. |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | An effectively designed WDT system can mean sufficient pricing signals to disincentivize road usage by freight vehicles if vehicle utilization improves. However, smaller companies may be unable to adjust operations to lower costs, resulting in costs either absorbed by the companies or indirectly passed on to consumers. |
| **Environment**<br>Does it help reduce emissions? | WDTs that disincentivize high-emissions vehicles and reinvest revenues in programs that lower barriers to green fleet adoption can help reduce emissions. This is the primary purpose of Eurovignette's $CO_2$ surcharge. |
| **Distributional impacts, health, and safety** | There may be some health and safety benefits to WDTs, such as fewer traffic-related crashes and deaths. However, evidence is scant, and the benefits of reduced VMT may not fall evenly across populations and geography. |

### *Evaluation of Policy Implementation for WDTs*

WDTs are likely suitable for cost recovery, and they can also be used to address other externalities. While substantial revenue could be generated from WDTs, they can be associated with a high administrative cost or a high evasion rate. Table 30 shows the implementation evaluation for WDTs.

## Congestion Charge

### *Fee Description*

A congestion charge is a road-based, zonal, or cordon-based fee for vehicles entering a specific geographic area, such as an urban or downtown area, to moderate congestion. Fees can vary by time of day to discourage peak-hour travel. For commercial delivery vehicles engaged in goods delivery, charges frequently scale by axle count or weight class to account for road wear and space usage. However, axle count and registered weight are imperfect proxies for actual pavement damage (Conway and Walton 2009). While larger vehicles are often penalized more heavily, some argue that an efficiently loaded heavy-duty truck may impose fewer total impacts than multiple smaller vehicles delivering the same volume (Holguín-Veras, Cetin, and Xia 2006). In this view, pricing schemes that disincentivize large trucks could unintentionally increase total vehicle trips and road occupancy.

**Table 30. Evaluation of policy implementation for WDTs.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | In the United States, fees are exclusively a cost recovery mechanism (and usually a supplement to fuel taxes, except in Oregon). The European Union offers more sophisticated calculations of external costs, allowing for dynamic pricing schemes to better align with policy outcomes. |
| **Fairness**<br>Who does it benefit or harm? | Both the EU and U.S. regimes focus on interoperability between jurisdictions. Fees are generally perceived as fair, as they charge international or out-of-state haulers for the usage of transited infrastructure. |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | In the European Union, countries are permitted to vary rates based on vehicle classes, emission standards, and road types outside of the core network. In contrast, U.S. states are currently not permitted to vary rates by vehicle type (beyond weight class or axles). Not all states have or allow WDTs. |
| **Public acceptance**<br>Could there be organized support or opposition? | Political opposition is likely to stem from carriers who may perceive they are overpaying relative to passenger services or domestic/in-state carriers who may perceive they are overpaying compared to carriers traveling outside the region. |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | The rate structure can be complex. Implementation requires a monitoring mechanism. The system overhead cost is about 12.5 percent in Germany's GPS-based system. It is closer to 4 percent for Oregon's self-reporting system, but underreported mileage results in lost revenues; about 5 to 7 percent of revenues were lost in 2016 in Oregon (Martin et al. 2021). |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | Fees are generally used for the upkeep of highway infrastructure. In the European Union, a portion of the fees goes toward rail and waterway projects, and in the United States, a portion goes to support transit. |
| **Revenue capacity**<br>How much revenue will it generate? | Revenue generation can be substantial. In New Mexico, which has the lowest average WDT rate, WDTs contribute 17 percent of state transportation revenues, whereas gasoline taxes contribute 19 percent (New Mexico Department of Transportation 2022). |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | Fees are generally proportional to freight volumes, so economic cycles can affect revenue streams. Moreover, improving fuel efficiencies will affect countries that charge for emissions. |

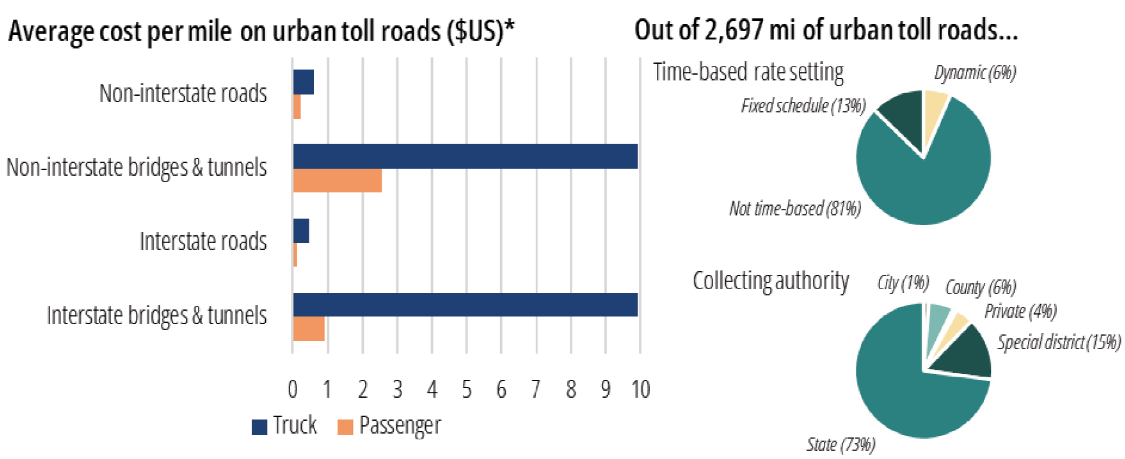
Figure 19 presents the extent of pricing on urban roads, tunnels, and bridges in the United States. As of 2021, nearly 20 percent of urban toll-miles incorporated some form of congestion-based charging, either on a fixed schedule or dynamically priced to real-time traffic conditions. While city agencies typically implement cordon- or area-based charges, state DOTs or interagency special districts (including MPOs) are the primary collection agencies for urban toll roads. Tolls are commonly earmarked for direct maintenance of the infrastructure or to pay for the bonds used to finance the road's construction.

Trucks are consistently charged at higher rates than passenger vehicles. On non-interstate and interstate roads, trucks are charged rates almost three times higher and four times higher, respectively, than passenger vehicles per mile, albeit at a much lower cost per mile than bridges and tunnels. Truck rates vary largely by axle count or GVW, but they typically do not include LGVs.

Although congestion charges can have a major effect on passenger route, mode choice, and travel demand, the effects of congestion charges on goods delivery are less studied (Axsen and Wolinetz 2021; Lehe 2019). Implementing time-based charges may have an intended policy outcome of shifting deliveries to off-peak hours. However, freight market conditions can make it difficult for carriers to shift operations in response to pricing, as described earlier in this module. Moreover, exorbitant charges can induce unintended or evasive behaviors, such as carriers redirecting on longer routes around an urban toll road or underreporting laden weights (Hang, Xie, and He 2013; Perera, Thompson, and Wu 2021). Carriers may be more likely to absorb added costs without altering their schedule, unless the fees accompany some form of incentive or investment program that encourages consumers and end-businesses to receive off-hour deliveries.

### *New York City's Congestion Relief Zone*

New York City is the first city in the United States to implement a cordon-based congestion charge for all vehicles. While the governor had temporarily delayed the launch of the program, it has been generating revenue since January 2025. The fee structure varies based on vehicle type, time of day, and method of payment (i.e., whether using E-ZPass or not). Delivery trucks could pay as much as $21.60 per day during a peak period. The fees are set to increase in 2028 and 2031 (Metropolitan Transportation Authority, n.d.).




* Does not include lane-based tolling (e.g., tolled High Occupancy Vehicle or express lanes), which typically does not permit truck usage. Due to data collection discrepancies, Rhode Island toll roads are not included. Not all state DOTs report average cost per mile, which is not pictured in the left-hand visualization.

Source: Adapted from Federal Highway Administration

***Figure 19. Congestion charges for U.S. urban roads.***

There are some important concerns about the distributional impacts of the program. Despite the program applying a discount for smaller trucks and off-hour deliveries, small carriers argued they would be unable to adapt their schedules, and the added costs would place them at a competitive disadvantage to large carriers (Chen and Ley 2024). Perceptions of competitive unfairness often lead to lower levels of political acceptability and, possibly, failure to implement revenue-related strategies (Rigot-Müller 2018).

Of the six major cities in the world that currently implement an area- or cordon-based congestion charge (Gothenburg, Sweden; London, United Kingdom; Milan, Italy; Oslo, Norway; Singapore; and Stockholm, Sweden), only Singapore's gantry-based system distinguishes rates between passenger and commercial vehicles. London's LEZ, separate from the city's Congestion Charge Zone (CCZ), is unique in that both HGVs and LGVs incur an additional, emissions-based fee.

Time-based tolls for commercial vehicles are centuries old and have been mostly successful at capturing revenue but less so in creating positive externalities (e.g., shifting delivery schedules to operate outside of peak congestion hours). New York City's Congestion Relief Zone program is the closest the United States has been to implementing a dynamic, area-based tolling system. However, the proposal was substantially different from other major systems in that it charges higher rates for goods delivery vehicles. One consequence of this implementation is that the program does not align with investment opportunities that support policy goals related to goods delivery.

### *Policy Goals Assessment for Congestion Charges*

Table 31 shows potential policy goals that can be achieved through congestion-based charges. While congestion charges have been successful in reducing passenger-related traffic volumes and financing multimodal transport and road safety projects, the implications for goods delivery are mixed. Freight market conditions and LGV adoption trends complicate the efficiency and environmental implications of congestion charges.

**Table 31. Policy goals assessment for congestion charges.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Dynamically priced toll roads are an increasingly popular tool for financing bridges, tunnels, and roads and recovering their costs. Meanwhile, cordon- and area-based charges have been successful in raising money for multimodal transport and road safety improvements in European cities and Singapore. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Congestion charges increase the cost of transportation. Goods delivery vehicles often have fewer alternatives than passenger vehicles to change their delivery times or destinations to lower their congestion charge expenses. |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | Congestion charges have a limited effect on delivery scheduling. As such, congestion charges may not result directly in either efficiency or accessibility improvements to delivery systems. However, if a congestion charge reduces passenger traffic volumes, it can indirectly help improve free-flow conditions for goods delivery vehicles. |
| **Environment** Does it help reduce emissions? | Congestion charges can accelerate LGV adoption if they disproportionately increase operating expenditures for HGVs and introduce traffic-calming measures on busy streets where LGVs typically operate. If these LGVs are predominately diesel powered, there would be an increase in emissions in the short term. Because LGVs are likely to electrify faster than HGVs, total emissions may be lower. |
| **Distributional impacts, health, and safety** | If congestion charge revenues are reinvested in road safety and "complete streets" programs that integrate the mobility of people and goods (e.g., protected loading zones), one can expect to see overall improvements in transportation safety. |

### *Evaluation of Policy Implementation for Congestion Charges*

Table 32 shows the implementation evaluation for congestion charges.

## Low- and Zero-Emissions Delivery Zones

### *Fee Description*

Low- and zero-emissions zones (LEZs/ZEZs) restrict access to entire municipalities or specific congested areas in cities for vehicles that do not meet certain emissions standards. Generally, these zones have applied to all road users, with access granted according to vehicle type. For instance, gasoline-powered passenger vehicles are subject to a different emissions standard and entrance fee than diesel-powered delivery vehicles. In addition to comprehensive LEZs/ZEZs, some cities have developed freight-specific low- and zero-emissions delivery zones (LEDZs/ZEDZs). These zones only apply to goods delivery vehicles.

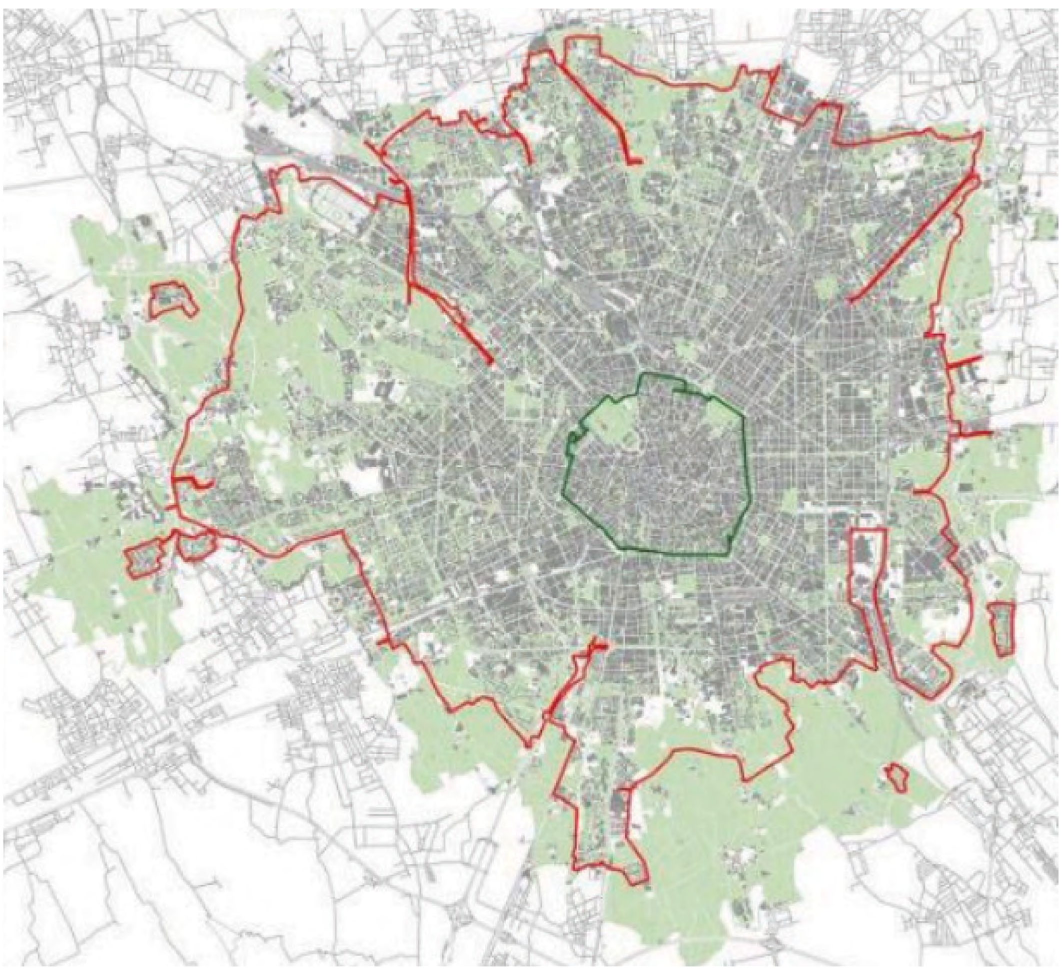
**Table 32. Evaluation of policy implementation for congestion charges.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness** Does it achieve the intended outcomes? | Congestion charges are effective in generating transport revenue, but without incentives on the receiver side, they are less effective in shifting delivery scheduling to off-peak hours. |
| **Fairness** Who does it benefit or harm? | Since exemptions and cost-mitigating behaviors are uncommon for goods delivery, charges will disproportionately impact revenues for small businesses and contract drivers. However, benefits can include increased delivery efficiency due to a reduction in the volume of passenger traffic and transport investments that reduce delivery costs (e.g., parcel lockers). |
| **Political Considerations** | |
| **Legality** Is it allowed? | While U.S. cities do not face obvious legal barriers in implementing congestion charges on roads or areas (though some regions may require approval via voter referendum), the NYC case has been challenged on constitutional grounds related to interstate commerce (Kaske 2024), an issue unique to governance in the United States (Davidson 2023). |
| **Public acceptance** Could there be organized support or opposition? | Political opposition among goods delivery stakeholders is likely to stem from small carriers, trade organizations, and contract drivers due to low profit margins and freight market conditions that make it difficult to adjust scheduling or pass costs to customers. Cities can generate support through revenue reinvestment that benefits delivery operations. |
| **Revenue Considerations** | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | Congestion charges are expensive to administer, and the monitoring technology can be complex. System upkeep and staffing accounted for roughly a third of the revenue generated by London's CCZ (Lehe 2019). New York City projected a system cost of $556 million over six years (New York City Independent Budget Office 2024). |
| **Flexibility** Can the revenue be spent in multiple ways? | The flexibility of congestion charges depends on the system. For instance, Singapore's Electronic Road Pricing system is allocated to a general fund, whereas New York City's proposed system is required to finance $15 billion in transit-related capital projects (New York City Independent Budget Office 2024). |
| **Revenue capacity** How much revenue will it generate? | Tolls on state-owned roads and bridges are a major source of direct funding. Area- or cordon-based charges, which can finance multimodal infrastructure and road safety improvements, generate an important, but less substantial, share of revenue. London's CCZ generates 6.2 percent of the region's transport-related revenue, not including system overhead costs (TfL 2022). |
| **Stability** Is the revenue stream resilient to economic cycles? | The stability of the revenue stream hinges on congestion. Agencies typically respond to charge-induced traffic reductions by increasing rates, leading to more stable revenues. Although stability would be affected by LGVs' increasing share of commercial vehicle traffic and the associated rates, reductions in goods delivery traffic due to a congestion charge are unlikely. |

Researchers have linked LEZs/ZEZs to reduced congestion and emissions, as well as shifts in mode choice for operators (Watkins et al. 2024). The entrance fee structure can lead freight carriers to make decisions about vehicle type. Larger vehicles are charged more because they are thought to have greater emissions than smaller vehicles (Wappelhorst and Cui 2022). The emissions standards by which motorcycles, cars, vans, and trucks are measured and granted access to the LEZ/ZEZ are often tightened over the course of a few years (Urban Access Regulations in Europe 2024). Correspondingly, entry fees are also increased over time. In response, some operators have switched to smaller vehicles and alternative modes. Despite that, revenue from LEZs/ZEZs far exceeds system costs (Marchetti and Antonelli 2024). This section discusses implementations in Milan, Italy; the Netherlands; London, United Kingdom; and the United States.

### *Example 1: Milan's LEZ, Areas B and C*

Milan, the capital of Italy's Lombardy region, has Europe's largest LEZ by geographic area. As in London, there are multiple concentric zones: Areas B and C (Figure 20). Area C was implemented in 2012 as a LEZ, with all vehicles excluding motorcycles and mopeds subject to an area-based charge. Milan's municipal government implemented the charges, after a popular ballot initiative, to reduce congestion in the densely populated area, as well as improve safety and mobility. Entry is restricted based on European emissions standards and has been successively



Note: Area C is a concentric zone, outlined in green, within Area B, which is outlined in red (LEZ).

Source: Charging, Low Emission Zones, other Access Regulation Schemes (CLARS)

***Figure 20. Areas B and C of Milan's LEZ.***

strengthened—or tightened—between 2012 and 2024, with plans to further strengthen emission requirements though 2030 (Urban Access Regulations in Europe 2024).

Each vehicle entering Area C is charged €7.50 per day (Marchetti and Antonelli 2024). Most delivery and goods vehicles fall under this category. The daily entrance fee means vehicles can enter and exit the zone multiple times in a day; some businesses, including delivery companies dispatched from Area C, are required to do so. Registered service vehicles are also charged a reduced rate of €4.50 per daily entry (Marchetti and Antonelli 2024). Unregistered road users whose payment is not automatically collected at the electronic entrance gates can purchase a daily ticket online for €22.50 or be subject to fines ranging between €70 and €285, depending on the emissions rating of the vehicle and whether this is a user's first offense.

Milan put incentives in place with the Area C LEZ to encourage the adoption of ZEVs. All electric, hybrid, bi-fuel, and natural gas vehicles were initially exempted from the entrance charge; as of this writing, only electric and hybrid vehicles emitting less than 100 grams of carbon dioxide per kilometer are exempt. Zero-emissions delivery vehicles are incentivized through access incentives. Delivery vehicles are restricted from entry and loading/unloading activities between 8 and 10 a.m., Monday through Friday (Green-Zones 2024). However, electric delivery vehicles can enter the zone during those hours and have free access to loading zones (Urban Access Regulations in Europe 2024).

Area B, implemented in 2019, expanded the coverage of low-emissions restrictions to almost 130 square kilometers. Unlike Area C, Area B does not generate revenue from entry charges (Marchetti and Antonelli 2024). Electronic gates have been installed at the boundaries to monitor emissions rating compliance, but revenue is restricted to fines (€163 to €658) for noncompliance.

Revenue from entrance fees and fines is earmarked for multiple purposes: 62 percent is allocated to public transportation improvements, inside and outside the zone; 22 percent to new sustainable mobility projects; and 16 percent to cover operating costs. Since 2018, revenue was around €30 million per year, excluding downturns in 2020 and 2021 related to the COVID-19 pandemic. Particulate matter and carbon emissions have been reduced in the zones; Area C has experienced a 10 to 18 percent decrease in particulate matter and 35 percent decrease in carbon emissions (C40 2015). Research has not fully determined the emissions impacts of Area B, but Marchetti and Antonelli (2024) suggest that particulate matter has been reduced by 50 percent in the first four years of its existence.

### *Example 2: The Netherlands' ZEZs*

The Netherlands has adopted a nationwide policy on ZEZs. Beginning in January 2025, every municipality can designate an area within the city where access will be limited to zero-emissions vehicles (ZEVs). Twenty-nine Dutch cities, including Amsterdam, Delft, Rotterdam, and Utrecht, have announced plans to do so, with 14 cities set to establish their zones in January 2025. Vehicle registration, which is required for entry, is free for compliant vehicles. Delivery companies are expected to comply with emissions regulations; however, it is not possible for every company to obtain a ZEV immediately. Companies that are unable to replace gasoline and diesel vehicles before ZEZs are incorporated, whether due to financial constraints or market conditions (e.g., ZEV supply fails to meet demand), are allowed to pay exemption fees. For example, exemptions for a Euro VI van entering Rotterdam's ZEZ will be €25.90 per day or €185.40 per year, per vehicle (assumes fleet activity) (Urban Access Regulations in Europe 2024).

These exemptions are not extended to diesel HGVs, which are already heavily restricted in Dutch urban areas. The Dutch government is offering €5,000 purchase incentives to companies adopting electric and alternative fuel (e.g., hydrogen) delivery vehicles (Netherlands Enterprise Agency RVO 2024). Fines for noncompliant vehicles have not yet been determined. By comparison, fines for diesel vehicles entering Rotterdam's existing lorry ZEZ have been set at €95, plus a €9 administrative fee (Urban Access Regulations in Europe 2024).

By 2019, 14 Dutch cities had introduced "Environmental Zones," which, as of this writing, now ban certain diesel HGVs from entry. Emissions standards for these zones were incrementally increased over time, much like Milan's Area C. Vehicles entering the zones are required to display a compliance decal or be subject to fines (Broaddus, Browne, and Allen 2015). Despite added costs in upgrading fleets, researchers found that companies operating zero-emissions delivery vehicles in Amsterdam reduced their operating costs through exemptions from congestion and parking charges and road taxes (Quak et al. 2016). Operations were streamlined in Amsterdam because the city granted electric delivery vehicles access to pedestrian zones, bus lanes, and parking areas other than loading zones (Maxner et al. 2022). Quak et al. (2016) noted that logistics companies in Rotterdam also opened urban logistics hubs that allowed the use of smaller vans and cargo bikes, while reducing the overall number of delivery vehicles required to service customer pools.

### *Example 3: London's LEZ Experience*

Transport for London (TfL) introduced Phase 1 of the low-emissions zone (LEZ) for HGVs in 2008. The policy came just five years after the city launched its CCZ, which, as of this writing, charges owners of nonexempt vehicles £15 per day to enter the downtown cordon (Figure 21).


Note: The area outlined in green is an LEZ, and the concentric zone within, outlined in red, is a CCZ.

Source: Transport for London

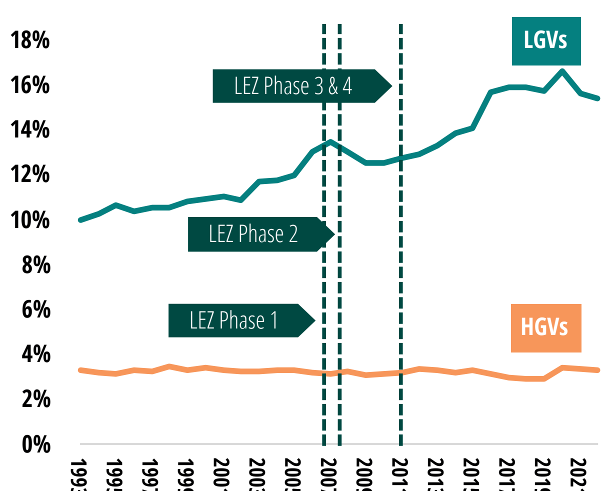
***Figure 21. Low-emissions and congestion charge zones in London.***

TfL's LEZ is more closely tied to air pollution reduction goals. At its outset, TfL projected the LEZ would lead to a 2 percent reduction in PM10 and a 4 percent reduction in NOx (Ellison, Greaves, and Hensher 2013). The program largely achieved its PM10 reduction goals, despite a growing share of fee-exempted, diesel-powered LGVs in the city (Figure 22) that likely contributed to an increase in NOx pollution (Ellison, Greaves, and Hensher 2013; Green, Heywood, and Navarro Paniagua 2020). The most substantial change in this regard occurred in 2012 when TfL introduced Phase 3, in which noncompliant LGVs (minimum Euro 3 emission standard for commercial vehicles up to 3,500 kilograms) would be subject to a £100 fee. Noncompliant HGVs (minimum Euro 4) pay three times that amount.

Even before the rise of e-commerce, LGVs constituted a major share of commercial traffic volume (Visser et al. 2018). Despite the vast majority of LGV trips being less than 150 kilometers, they account for 17 percent of total vehicle distance traveled on UK roads—over four times the share travelled by HGVs (UK Department for Transport 2023).

Though the rise of online shopping and home delivery played a role in increasing the adoption of LGVs, it is not the only factor (Visser et al. 2018). Research on the behavioral responses of London carriers to the LEZ expansions suggests most carriers chose to upgrade their fleets to comply with Phase 3. Between 2010 and 2012, the proportion of LGVs that are compliant with Euro 3 standards increased from 80 percent to 90 percent (Ellison, Greaves, and Hensher 2013). However, some companies indicated that they replaced their HGVs with LGV fleets due to excess fees (including those from the LEZ), licensing requirements, and labor costs (Broaddus, Browne, and Allen 2015). In the long run, the maneuverability of LGVs will become even more advantageous as London invests in multimodal and road safety improvements that narrow travel corridors and reduce the travel speed of vehicles (Allen et al. 2018). These improvements will likely boost LGV adoption even further.

In 2021, fines from LEZ noncompliance netted £34.6 million in gross income, or 0.8 percent of TfL's total revenue generation (TfL 2022). The cost to operate and maintain the system, which uses cameras to read license plates and bill the vehicle owner, was £800,000 in 2021, or 2.3 percent of generated revenue. These figures can be compared to London's ULEZ, the emission charge equivalent for passenger vehicles, which generated 5.4 percent of TfL's total revenue. There is limited evidence to suggest carriers are being disproportionately charged compared to passengers.




Source: Transport for London

***Figure 22. Share of United Kingdom's LGV and HGV traffic volumes in London region.***

### *Example 4: Low- and Zero-Emissions Zones in the United States*

U.S. legislation preempts the introduction of LEZs/ZEZs (Turner 2020). Two cities, however, have introduced similar concepts, like low-emissions delivery zones (LEDZs):

- **Santa Monica, CA,** created a voluntary pilot zone in 2021–2022 to serve as a proof of concept for several ZE goods delivery technologies. Companies that participated did so on a voluntary basis, so revenue was not generated.
- **Portland, OR,** introduced an LEDZ in 2023 in its government office district. Although the city introduced permits for authorized, ZE users, the charges for those permits have not been determined or made permanent.

### *Policy Goals Assessment for Low- and Zero-Emissions Zones*

Table 33 assesses the policy goal alignment of LEZ/ZEZ programs. Ultimately, LEZs/ZEZs have been successful in accelerating adoption of LEVs, and even ZEVs if paired with rebate programs (especially those that improve market access for small businesses).

### *Evaluation of Policy Implementation for Low- and Zero-Emissions Zones*

Table 34 evaluates the policy implementation for LEZs/ZEZs.

## Curbside Management Fees

### *Fee Description*

Revenue-related strategies for curbside management price commercial loading and unloading operations, varying rates by time, congestion conditions, and emissions standards (with green loading zones). Strategies are not limited to a pay-by-use charge structure. Cities can also offer pay-for-access schemes, such as issuing permits to access infrastructure like commercial vehicle loading zones (CVLZs).

**Table 33. Policy goals assessment for LEZs/ZEZs.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | LEZs/ZEZs have been designed to generate revenue that far exceeds direct operating costs. Revenue streams have been used to fund public transit infrastructure projects and ZEV incentives. The purpose of the zones is environmental rather than infrastructure maintenance. Entry fees are typically higher for vehicles that historically have higher emissions rates (MGVs and HGVs), but they can be waived for ZEVs. LGVs are typically charged at the same rate as passenger vehicles. |
| **Economy (connectivity)**<br>Does it lower the cost of accessing a place? | LEZs/ZEZs can increase transportation costs and influence goods delivery, though the effects may differ if the fees vary by vehicle type. |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | LEZs/ZEZs increase the efficiency of commercial activity by reducing congestion. In general, LEZs/ZEZs have resulted in lower traffic density, allowing delivery vehicles to have more mobility. Some companies choose to replace HGVs with LGVs or alternative modes, which also increases mobility. |
| **Environment**<br>Does it help reduce emissions? | LEZs/ZEZs have helped reduce emissions in many cities. |
| **Distributional impacts, health, and safety** | When LEZs/ZEZs correspond with a reduction in VMT and congestion, safety is improved. Negative health impacts are reduced within the zone, but effects are not as direct for marginalized communities that reside near warehousing and distribution centers, if these facilities do not fall within the boundary. Depending on monetary access to lower-emitting vehicles, smaller businesses can be at a disadvantage when attempting to comply with LEZ/ZEZ restrictions. |

**Table 34. Evaluation of policy implementation for LEZs/ZEZs.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | European models of LEZs/ZEZs have shown sizable reductions in emissions and pollution, as well as increased compliance with emissions standards (Marner et al. 2024). |
| **Fairness**<br>Who does it benefit or harm? | Charges are usually flat, daily fees. Exemptions or discounts for smaller carriers are rare. Therefore, LEZs/ZEZs would disproportionately impact smaller carriers. |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | European models of LEZs/ZEZs are not legal in the United States. However, several cities in the United States are testing new programs. |
| **Public acceptance**<br>Could there be organized support or opposition? | LEZs/ZEZs do not appear to have faced major political opposition in Milan nor the Netherlands. However, these examples have also paired the programs with substantial monetary and access incentives for commercial carriers (Rotaris et al. 2010). |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | Administration costs vary by implementation and enforcement technology. System overhead for the most extensive system—Milan's EcoPass, which uses video license plate readers—constituted 14 percent of revenues generated in 2016. The program is administered by 46 staff. |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | In the European Union, funds are usually earmarked to correspond to sustainable mobility goals. For the United States, the answer is unknown because there is insufficient experience. |
| **Revenue capacity**<br>How much revenue will it generate? | Revenues also vary by implementation. In 2016, Milan's Area C revenues amounted to €28 million; however, these revenues include both goods and passenger mobility users (Agenzia Mobilita Ambiente Territorio 2017). |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | Revenues are contingent on economic cycles and the strengthening of emissions standards as compliance increases and ZEVs are adopted in greater numbers. |

Source: The Urban Freight Lab

Often, these strategies accompany data-enabled reservations systems and open data standards that support city efforts to efficiently manage competing uses for the curb. Video and sensor data have additionally enabled advanced monitoring and analytics of the curb (Castrellon, Sanchez-Diaz, and Kalahasthi 2022). These digital tools can allow carriers to reserve parking spaces via smartphone app, with pilots launched in Washington, DC; Columbus, OH; and elsewhere. Simply knowing the curb availability ahead of time can reduce cruising times by up to 28 percent (Dalla Chiara et al. 2022). The technology has had low enough costs for smaller municipalities to implement it with limited support, and it has seemingly been effective in limiting the space that deliveries occupy in cities.

**Curb Data Specification (CDS)** is a data standard that provides a mechanism for expressing static and dynamic curb regulations, measuring activity at the curb, and developing policies that create more accessible, efficient curbs. CDS connects transportation agencies with private companies and aligned nonprofits, giving them a common language to communicate curb rules, occupancy, and, in the future, options like pricing and payment. CDS was created and is governed by the Open Mobility Foundation, the nonprofit that also created Mobility Data Specification. As of 2025, there are 10 U.S. DOT Strengthening Mobility and Revolutionizing Transportation (SMART) grant recipients that are participating in a SMART Curb Collaborative, facilitated by the foundation. They are piloting curb inventory in CDS and testing associated curb technologies, such as camera and occupancy sensors to support CDS scaling.

Cities have only recently begun integrating these curbside technologies to support revenue-related strategies. The following four examples explore access permits, dynamic parking pricing, green loading zones, and PDD permits.

### *Example 1: Access Permits*

Issuing commercial vehicle permits in U.S. cities is not common, but there are examples in Miami Beach, FL; Austin, TX; Minneapolis, MN; Seattle, WA; and Washington, DC. Cities determine fees by the size or class of vehicle. For example, Austin issues permits for vehicles involved in delivery activities (City of Austin 2024). Permit charges are listed as follows, and each reflects the cost per vehicle, per year (City of Austin 2024):

- **Small or "passenger" vehicles:** defined as vehicles less than 10 feet in length. Permits cost $125 if each parking duration is 30 minutes or less, $250 for durations between 30 and 60 minutes, and $400 for durations up to 2 hours.
- **Medium vehicles:** defined as between 10 and 26 feet in length, which is equivalent to a standard step-side van used by UPS or FedEx (McCormack et al. 2020). Permits cost $200 to park for 30 minutes at a time, $400 for up to 1 hour, and $800 for up to 2 hours.
- **Large vehicles:** defined as greater than 26 feet in length. Permits cost $300 to park for 30 minutes at a time, $600 for up to 1 hour, and $1,200 for up to 2 hours.

Vehicles with an appropriate permit in Austin can park in any loading zone or at a meter (without additional charges). CVLZ permits in other cities reflect the pricing design in Austin. Permit fees typically only recover the administration costs associated with the permit program. While additional revenue can be generated and allocated elsewhere, cities must balance the ability to collect higher fees against reducing demand for permits. Carriers can elect not to purchase permits and run the risk of fines for using CVLZs. Enforcement paired with higher permit fees can ensure that carrier behavior aligns with policy goals.

In addition to the cost of parking, Singapore requires that all HGV operators obtain a Vehicle Parking Certificate (VPC), which guarantees the operator has found acceptable overnight parking for the vehicle before it begins service. Introduced in 1994, VPCs have reduced this type of parking behavior in congested residential areas as well as highway shoulders (Rahman and Chin 2011). In the United States, this fee would mostly impact small companies and owner-operators. Large companies typically own or lease facilities with on-site parking; therefore, independent carriers would bear the entire cost of this permit system. In Singapore, these permits are priced at $6 per year and are renewed with vehicle registration (Changi Airport 2024).

The low price does not act as a barrier for entry into the logistics market, but it does protect residents from undesirable truck parking in neighborhoods. Many cities, especially those with ports, have challenges when it comes to truck parking. These could be alleviated if the permit system forces port authorities, terminal operators, and carriers to create overnight parking or risk driver retention.

### *Example 2: Dynamic Parking Pricing*

Cities introduce dynamic pricing to "encourage people to park in underutilized blocks and garages, helping open up spaces in busy areas at busy times" (San Francisco Municipal Transportation Agency 2024). By increasing the price to park at peak demand times, cities can increase parking availability (consumer demand reduces as prices increase) and potentially reduce emissions. The latter assumes that cruising, or searching, for parking would be reduced because (a) parking availability has increased, and (b) parking users avoid more congested (higher demand) areas because of the higher prices. Dynamic pricing can lead to increased sales tax revenue as well. In San Francisco, CA, the city's dynamic pricing pilot, SFPark, led to a surge in sales tax collection in the pilot area because stores became more accessible to customers (Descant 2018).

Deliveries are compulsory, so changes in parking pricing will not eliminate freight trips. Reduced demand from vehicles competing for curb space, including passenger and ride-hail vehicles, benefits carriers. In San Francisco, dynamic curb pricing reduced freight vehicle cruise time by 15 percent and reduced instances of double parking (Alemi, Rodier, and Drake 2018).

### Example 3: Green Loading Zones

Green loading zones (GLZs) are areas where cities designate certain commercial vehicle parking zones for use by zero- or low-emissions goods delivery vehicles. GLZs differ from ZEZs/LEZs in that GLZs are limited to curbside space, while ZEZs/LEZs can take up an entire neighborhood or wider geographic area (Maxner et al. 2022). Cities like Bremen, Germany; Los Angeles, CA; and Portland, OR, have created these zones, allowing ZEVs to be exempt from parking fees. In California, Santa Monica's voluntary ZEDZ also utilizes GLZs by designating certain parking areas for use by ZEVs only. Each of these projects has been small—Bremen designated just two zones (called Environmental Load Points) and Los Angeles designated five zones—but companies can recover some of the costs of investing in ZEVs by using the zones. For traditionally fueled delivery vehicles, a permit costs between $250 and $1,200 per year (City of Austin 2024; City of Seattle 2024; The District Department of Transportation 2024). ZEVs are exempt from these fees, and they gain increased mobility and access compared to competitors. Bremen paired the parking restriction with a reservation system, further improving the efficiency of carriers since they did not need to search for parking in the event that the spaces were already occupied.

### Example 4: PDD Permits

A different example of fees that mirror shared mobility pricing models (e.g., for shared bike and scooter fleets) is PDD permits, in which new mobility devices apply and are awarded some form of operating permit and may pay a lump sum or a "per device" fee. PDDs—also known as "sidewalk delivery robots"—are commonly defined as electronic devices that can be used (autonomously or not) to transport cargo. PDDs have seen considerable investment—of the $220 billion that global investors poured into new mobility start-ups between 2010 and 2018, 20 percent went to AV sensors, components, and related software, the second largest share of mobility start-up investments next to app-based ride-hail services (Holland-Letz et al. 2019).

These investments in AVs parallel a global surge in autonomous delivery pilots. The University of Oregon identified 18 autonomous, ground-based delivery pilots that launched in the United States between 2016 and 2019 (Steckler et al. 2020). These urban experiments are in a preliminary phase, mainly testing operational proofs of concept, public perceptions, and market viability (Steckler et al. 2021). Nonetheless, current AV pilots do represent a first step toward more efficient and economical deployment of AV deliveries.

To date, 22 states have passed legislation that enables the use of these devices, and most bills establish some minimum requirements for their operation, including speed limits, weight limits, equipment standards, insurance coverage, and accident reporting (Clamann, Podsiad, and Cover 2023; Kovacic, Marvin, and While 2024). While many of these state laws require no form of payment and may preempt local authorities from imposing any type of fee or tax on these devices, some examples do exist.

In the State of Washington, operators are required to self-certify, on an annual basis, any PDD being operated in the state and pay a $50 per device fee into the motor vehicle fund (Kloba 2019). In the District of Columbia, operators are required to submit an application and be approved prior to operating there (Council of the District of Columbia 2018). They must submit a $250 application fee and, if approved, they must remit $10 per device, per month in operation to the director of the DOT. The City of Los Angeles requires an application fee for annual operating permits that is tiered based on the number of devices in operation (i.e., $10,000 for up to 50 devices and $20,000 for more than 50 devices). Its requirements are very similar to the shared mobility permits in the city, with rules around areas of operation, insurance and indemnity, and data sharing (Los Angeles Department of Transportation 2021). Funding supports administrative oversight of these permits and self-certification programs.

### *Policy Goals Assessment for Curbside Management Fees*

Table 35 assesses the alignment of curbside management fees with policy goals. Most curbside management fees are revenue-neutral, covering the administrative costs of the operating permits (e.g., permit review, ongoing operational and compliance monitoring). In some cases, they stipulate a set of operating rules about how and where the device can be operated and parked in the public ROW (e.g., PDD permits).

Although revenue-related strategies in this space are relatively new, evidence from app-based reservation systems suggests that dynamic pricing could help improve efficiencies. However, similar to all other time-based pricing schemes, savings are not likely to come from altering schedules. Nevertheless, curbside management fees can help finance these digital systems.

### *Evaluation of Policy Implementation for Curbside Management Fees*

Table 36 shows the implementation evaluation for curbside management fees. These charges have been historically modest and provide few barriers to delivery companies' ability to operate, while benefiting local neighborhoods and the public.

**Table 35. Policy goals assessment for curbside management fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery**<br>Does it generate revenue to offset (partly or fully) the cost of managing the service? | There are limited examples of revenue-positive curbside management fees, as cities often have to balance carrier willingness to purchase permits and comply with parking regulations. |
| **Economy (connectivity)**<br>Does it lower the cost of accessing a place? | Curb management fees are expected to reduce the demand for access to typically congested areas. Some delivery services may be offered less often or at a higher price point, resulting in lower demand. |
| **Efficiency (mobility)**<br>Does it help manage demand and promote free-flowing movement? | Dynamic parking pricing can improve delivery efficiency by reducing cruising time and the frequency of double parking. However, the efficiency improvements may be due to reduced curb competition from other modes (e.g., passenger vehicles) or digital reservation systems rather than shifts in delivery scheduling toward less congested hours. |
| **Environment**<br>Does it help reduce emissions? | Since GLZs have only been implemented recently, it is unclear if they offer additional incentives to procure ZEVs. However, if utilized in conjunction with other access restrictions and incentives, they could create additional pressure to adopt cleaner vehicles. Pollution may also be reduced with less time spent cruising for parking. |
| **Distributional impacts**<br>Does it help make the transportation system more fair? | Currently, most curbside pricing programs are voluntary or maintain low costs. If rates increase, there is a risk of pricing smaller companies and contractors out of high-demand centers because they have fewer vehicles and trips over which they can spread parking costs. However, generated revenues can be reinvested to introduce new technologies and safer infrastructures that better manage curbside delivery demand, which can benefit all companies. |
| **Health, safety** | While health and safety goals are not the main purpose of curb management fees, there may be some incidental health or safety benefits. |

**Table 36. Evaluation of policy implementation for curbside management fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness**<br>Does it achieve the intended outcomes? | Curbside management can reduce congestion and illegal parking behavior. GLZs have not been proven to reduce emissions at a large scale and have only been available to early ZEV adopters. Revenue has historically been limited to municipal administrative costs, supporting some cost recovery. |
| **Fairness**<br>Who does it benefit or harm? | Permit charges are often determined by the size of the vehicle, so companies that rely on small- and medium-duty vehicles pay less per vehicle. But small businesses are at a disadvantage, regardless of vehicle size, because the fees are flat per vehicle type. |
| **Political Considerations** | |
| **Legality**<br>Is it allowed? | There are no obvious legal barriers for dynamic or emissions-based parking strategies. |
| **Public acceptance**<br>Could there be organized support or opposition? | As parking and permit fees are voluntary or have relatively low demand, there is generally little opposition. But opposition may grow from smaller businesses and contractors who are less able to adapt to or spread costs. |
| **Revenue Considerations** | |
| **Administrative ease**<br>Does it require new knowledge, staffing, or systems? | Dynamically priced curbs require digital curbside inventories, standardized data, and other monitoring equipment (i.e., Curb Data Specification). These technologies are available for many e-commerce carriers, and they help improve delivery efficiencies and systems management. |
| **Flexibility**<br>Can the revenue be spent in multiple ways? | The use of generated revenue depends on how the transportation agency sets up the fee. Fees sometimes go into specific budgetary accounts to fund particular programs. Fines generated from commercial vehicle parking violations are often allocated to a general fund, with no guarantee that it will improve curbside conditions (Fiscal Policy Institute 2021). |
| **Revenue capacity**<br>How much revenue will it generate? | Most parking pricing schemes for goods delivery have been revenue neutral thus far. |
| **Stability**<br>Is the revenue stream resilient to economic cycles? | As curbside management fees are unlikely to diminish commercial demand for curb space, revenues are largely stable. Still, there remains some uncertainty about this relatively new tool. |

## Delivery Fee

### *Fee Description*

Unlike sales taxes, delivery fees explicitly price for transportation-related costs, and the revenues are typically earmarked for transportation-related funds. Delivery fees include any charge levied on a retailer, carrier, or consumer that is politically packaged or fiscally administered as a transportation fee.

Delivery fees are distinct from fees that stem from "fair share" laws, which are fees set by companies in reaction to policies that seek to establish fair competition or minimum compensation rather than collect revenue. For example, app-based delivery companies reacted to Seattle's App-Based Worker Minimum Payment Ordinance by charging $5 per order.

This section examines three relevant policies:

- Barcelona, Spain's delivery fee for e-commerce (*tasa de reparto e-commerce* or TREC),
- Colorado's retail delivery fee (RDF), and
- Minnesota's RDF.

### *Example 1: Barcelona's TREC*

Barcelona introduced TREC in March 2023. Originally branded in media as the "Amazon Tax," TREC charges "postal operators" a 1.25 percent rate tax on deliveries made in the city

(Haeck 2023). Small businesses with revenues less than €1 million are exempt. The initial evaluation suggests that the policy should be applied to 26 operators, including FedEx, Amazon, and DHL. These companies accounted for 62 percent of the business-to-consumer delivery market (Dablanc 2023). However, the Spanish and European regulatory definitions of "postal operators" presented a legal challenge. Postal operations preclude back-end logistical services (e.g., packaging) and online or omni-channel retailers. Ironically, this legal definition exempts Amazon from the fee (García 2024).

TREC's 1.25 percent rate and payable cap benchmarks the economic value of street and curb usage. In that sense, TREC functions as a form of paid parking that is annual and proportional to the volume delivered to the city rather than time spent in the city (Dablanc 2023). One point of contention is that commercial vehicle parking is free in Barcelona. The city offers 10,000 loading zones, though most are time-regulated and managed using a municipally developed reservation app called SPRO. The lack of accurate pricing data leaves the TREC calculation open to challenges from businesses who suggest the fee may be an overestimation. An alternative might be to create and price exclusive parking areas for postal operations to more accurately and efficiently respond to operators' specific logistical requirements and road usage (García 2024).

Although the fee does not include the price of e-commerce's external costs, it applies exemptions for deliveries consolidated at UCCs and parcel lockers as well as deliveries made on cargo bikes. These exemptions align with the municipality's strategic plan for urban goods distribution, which identifies targets to reduce last-mile delivery emissions (Barcelona City Council 2022).

Since the fee is fixed, it is unclear whether it will be an effective pricing signal for retailers, e-commerce platforms, or consumers at home, who arguably have more market power in selecting their preferred delivery service. The fee also omits business-to-business (B2B) transactions, which constitute 64 percent of Barcelona's freight trips (Barcelona Regional 2024). As such, TREC's sustainability impact will likely manifest not in demand-side behavioral shifts but rather in how the revenues are reinvested to meet the city's strategic policy goals (Majoral, Gasparín, and Saurí 2021).

### *Example 2: Colorado's RDF*

Colorado passed the first statewide RDF in July 2022. As of April 2025, it charges $0.29 per order made on a digital retail platform. The fee was implemented soon after the 2018 U.S. Supreme Court ruling South Dakota v. Wayfair, which permitted states to collect remittance on online sellers that do not have an in-state storefront. The retail platform is responsible for administering, collecting, and reporting the fee. If online retailers collect the fee from the buyer, they can choose to itemize the fee during online checkout as they would a sales tax. Unlike sales tax, however, the delivery fee is nonrefundable.

The RDF was included in a broader transportation funding package. The revenues are portioned across several funding allocations or "enterprises." The largest enterprises include community access (i.e., EV charging and incentives), clean fleet (i.e., financial assistance for private and public fleet electrification), and general fund transfers. From state documentation, it is unclear how policymakers set RDF rates and allocations, therefore, they may not reflect any economic externalities. However, the fee does exempt orders for in-store and curbside pickup and deliveries made by nonmotorized vehicles. Rates may have been set to conform to state taxation laws that place limits on revenue generated by any one enterprise (Lopez 2022).

Colorado's fee structure will likely serve as a blueprint for other state proposals. For example, legislators have attempted to introduce a $0.25 per package fee to fund highway improvements and a $3 per order fee to fund transit infrastructure in New York City (Colon 2023). California and Washington State are also conducting research into the policy.

### *Example 3: Minnesota's RDF*

Minnesota passed their version of an RDF, but it differs from Colorado's in several aspects. The fee is twice as high ($0.50 per order), and there are higher thresholds for exemptions: businesses with sales revenues under $1 million and orders under $100. Colorado and Minnesota cite the added administrative costs for small businesses as justification for their fee exemption.

Another point of contention is that per order fees remain flat regardless of basket size and the number of shipments necessary to deliver the items. As such, there is limited incentive to reduce or consolidate shipping. One trade organization suggests that Minnesota's $100 order threshold can also result in evasion: Consumers can portion a single order into several baskets under $100 to avoid paying the fee (Zdechlik 2023). This behavior would introduce inefficiencies that increase commercial VMT. While even small fees could influence ordering behavior, it is unclear for now if the fee is high enough to shift demand in any significant way.

Table 37 compares the three delivery fees discussed in this section.

### *Policy Goals Assessment for Delivery Fees*

Table 38 shows potential policy goals achieved through delivery fees. RDFs may be the first revenue-related strategy to levy a demand-side user fee for goods delivery. While conventional strategies have targeted carriers, RDFs charge consumers for carriers' usage of transportation infrastructure. However, since the fee itself is fixed and relatively small, it is unlikely to shift consumer behavior toward more sustainable delivery outcomes (e.g., better order consolidation, different pickup times, parcel locker pickup). Instead, the effectiveness of RDFs at realizing policy goals (outside of cost recovery) will hinge on how the state distributes revenues.

### *Evaluation of Policy Implementation for Delivery Fees*

Table 39 shows the implementation evaluation for delivery fees. RDFs have emerged as a remarkably popular, state-level strategy for pricing road usage related to e-commerce. This

**Table 37. Overview of delivery fee examples.**

| Example | Rate | Exemptions | Revenue |
|---|---|---|---|
| **Colorado's RDF** | $0.28 per order | Businesses with annual sales <$500,000; goods exempt from value-added tax (VAT); goods picked up at retailer location; goods delivered without the use of a motor vehicle (e.g., via cargo bike, PDD) | $69.7 million (FY 2023) |
| **Minnesota's RDF** | $0.50 per order | Businesses with annual sales <$1,000,000; goods exempt from VAT; food, beverages, medical and baby products; orders >$100; goods picked up at retailer location; goods delivered without the use of a motor vehicle | $59 million (FY 2025, projected) |
| **Barcelona's TREC** | 1.25 percent of sales turnover | "Postal operators" with annual income <€1,000,000;retailers and B2B; goods picked up at collection points; goods delivered without the use of a motor vehicle; goods delivered from UCC | NA; tax capped at €2.6 million per year, per operator |

Note: NA = not applicable.

**Table 38. Policy goals assessment for delivery fees.**

| Policy Goals | Goal Alignment |
|---|---|
| **Cost recovery** Does it generate revenue to offset (partly or fully) the cost of managing the service? | Cost recovery is usually the primary goal of RDFs. But revenue generation varies greatly by e-commerce adoption trends, rates, order value caps, and small business exemptions. One projected estimate for Washington State suggests annual revenues can range from $45 million to $112 million (Washington State and Joint Transportation Committee 2024). Since administrative costs are relatively low, cost efficiency is high. |
| **Economy (connectivity)** Does it lower the cost of accessing a place? | Because RDFs typically apply to a very small portion of purchased goods, they are unlikely to have a noticeable impact on access to goods. |
| **Efficiency (mobility)** Does it help manage demand and promote free-flowing movement? | As long as the impact to demand is expected to be minimal, road or curbside congestion is unlikely to be impacted. |
| **Environment** Does it help reduce emissions? | Depending on how states allocate and invest funds, RDFs can help reduce emissions. Future RDF considerations may include fee exemptions for consumers who select more environmentally sustainable pickup options. |
| **Distributional impacts, health, and safety** | Although high-income and urban consumers shop online more often than other groups, added delivery costs may reduce the home or near-home accessibility of some goods for vulnerable communities. Certain products are exempt from value-added taxes—and therefore RDFs—ensuring accessibility of some important products (e.g., baby and menstrual products in Minnesota). RDFs are unlikely to have a direct effect on goods delivery traffic related to health and road safety. States can mitigate concerns about regressive and small-business impacts through product and firm-size exemptions. |

**Table 39. Evaluation of policy implementation for delivery fees.**

| Evaluation Criterion | Evaluation |
|---|---|
| **Impact Considerations** | |
| **Effectiveness** Does it achieve the intended outcomes? | The fees have a clear link to the permitting service provided, and they help achieve some cost recovery. However, since the fees are fixed, their overall effectiveness in realizing other policy goals is limited by how the revenues are reinvested. |
| **Fairness** Who does it benefit or harm? | Smaller companies could be exempted from fees that would otherwise burden them with administrative and reporting costs. Since the delivery fee is a fixed amount paid by consumers, the fee is regressive, albeit small. |
| **Political Considerations** | |
| **Legality** Is it allowed? | TREC's legal definitions of "postal operator" may be out-of-date for e-retailers that vertically integrate logistics operations (e.g., Amazon). Colorado and Minnesota are the only states that have enacted RDFs in the United States, but an increasing number of states are exploring the option as well (Washington State and Joint Transportation Committee 2024). |
| **Public acceptance** Could there be organized support or opposition? | Political opposition usually stems from retailers due to the perceived burden of administering the fee. Opposition from consumers who must pay the fee is usually too dispersed to materialize into political action. |
| **Revenue Considerations** | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | RDFs are collected during usual business tax cycles by the department of revenue. Retailers report remittances using a digital form. As such, delivery fees are easy to administer for governments. |
| **Flexibility** Can the revenue be spent in multiple ways? | The flexibility of the revenue depends on how the transportation agency sets up the fee. Fees are sometimes deposited into particular budgetary accounts to fund specific programs. |
| **Revenue capacity** How much revenue will it generate? | The revenue capacity is relatively large since the fee is applied to most online orders. |
| **Stability** Is the revenue stream resilient to economic cycles? | Fee revenues are proportional to the volume of online consumption. On one hand, retail consumption is sensitive to economic cycles. On the other hand, online purchases are growing as a share of retail sales, presenting a potential offsetting factor during an economic downturn. |

popularity likely stems from its simplicity in administration, rate structure, and low levels of political opposition (largely due to its status as a low-cost fee, rather than a more substantial tax). However, this simplicity also limits its effectiveness as a pricing signal for consumers, and implementation outcomes will largely depend on how states distribute revenues.

## 3.6 Key Takeaways

This module synthesizes the state of revenue-related strategies for managing urban goods delivery, with a focus on technological and e-commerce-related transformations, policy goal alignment, and behavioral implications. The module demonstrates how city and regional agencies implement revenue-related strategies not just to recover costs for infrastructure but also to achieve policy goals that improve the cost efficiency, accessibility, road safety, and emissions and pollution impacts of goods delivery. Carrier-side behavior shifts (e.g., ZEV adoption, microfreight mode shifts, and off-hour delivery) and consumer-side behavior shifts (e.g., parcel locker pickup) are instrumental for achieving these policy goals.

Since revenue-related strategies primarily price carrier operations, charges may not be effective as a pricing signal for consumer behavior change. This is because freight market conditions often distort the ability of carriers—especially the small businesses, less-than-truckload shippers, and for-hire drivers that comprise the majority of the sector—to respond in ways that reduce cost burdens and introduce operational efficiencies to reduce negative externalities. In worst-case scenarios, added fees could result in market consolidation by larger carriers and delivery providers who are better able to absorb costs, or they could have perverse effects on labor stability or wages and service access by causing carriers to raise delivery fees and reduce profitability (Shetty et al. 2022). Consumers are highly sensitive to shipping costs, so keeping the fee low is often a loss leader for delivery companies.

The evaluations of individual tools are summarized in Table 40. The evaluations are discussed in detail in earlier sections for each tool. The evaluations and rankings presented in the tables are meant to be examples. The appropriate evaluations and rankings for each jurisdiction will be highly context dependent, so transportation agencies are encouraged to conduct their own evaluations of the revenue-related tools.

Overall, RDF is most likely to be the most feasible tool for pricing goods delivery. It is relatively easy to implement (administratively and politically), and it can generate significant revenue. Unlike other tools in this module, it directly impacts consumer behavior. ISR and WDT target freight transport at different points in the logistics chain, but they can both achieve their intended objectives, including raising revenue. WDT is more likely to generate substantial revenue that ISR. While there are limited examples of curb management fees, so the success of future implementation is unclear, previous experience shows that they may be easier to implement—administratively and politically—than congestion charges. Targeted congestion mitigation programs like LEDZs/ZEDZs can be more politically feasible than a broad congestion charge that affects nearly everyone.

Furthermore, the following conclusions can be made for revenue-related strategies with policy goals beyond infrastructure finance.

### Revenue-Related Tools

- **Indirect source rules:** ISRs are site-based revenue-related strategies for reducing air pollution. Their strength is in their policy alignment—evidence from San Joaquin Valley suggests they are effective in reducing pollution due to revenue reinvestment in grant programs—and their compliance flexibility, which protects against federal preemption (Turner 2024). Since disparities

**Table 40. Evaluations summary of revenue-related tools for goods delivery.**

| Evaluation Criterion | ISR | WDT | Congestion Charge | LEDZ/ ZEDZ | Curb Management Fee | RDF |
|---|---|---|---|---|---|---|
| **Impact Considerations** | | | | | | |
| **Effectiveness** Does it achieve the intended outcomes? | ↑ | ↑ | ↓ | ↑ | ↑ | ↑ |
| **Fairness** Who does it benefit or harm? | ↑ | ↑ | ↓ | ↓ | ↓ | ↑ |
| **Political Considerations** | | | | | | |
| **Legality** Is it allowed (in the United States)? | ↑/↓ | ↑/↓ | ↑/↓ | ↓ | ↑ | ↑ |
| **Public acceptance** Could there be organized support or opposition? | ? | ? | ↓ | ↑ | ? | ↑ |
| **Revenue Considerations** | | | | | | |
| **Administrative ease** Does it require new knowledge, staffing, or systems? | ↑ | ↓ | ↓ | ↑/↓ | ↑ | ↑ |
| **Flexibility** Can the revenue be spent in multiple ways? | ↓ | ↓ | ↑ | ↓ | ↑ | ↑ |
| **Revenue capacity** How much revenue will it generate? | ↑ | ↑ | ↑/↓ | ↑/↓ | ↑ | ↑ |
| **Stability** Is the revenue stream resilient to economic cycles? | ↓ | ↓ | ↑ | ↓ | ? | ↑/↓ |
| **Ranking** | 3 | 2 | 6 | 5 | 4 | 1 |

Note: Up arrow means the tool is likely to score **well** on the evaluation criterion. Down arrow means the tool is likely to score **poorly** on the evaluation criterion. Both up and down arrows means the scoring depends on the new mobility service or jurisdiction. Question mark means there is uncertainty due to lack of information. Rankings are numbered in ascending order from best to worst.

in pollution exposure are place-based and largely correlate to warehouse proximity, ISR has a higher potential to benefit historically marginalized populations compared to traditional LEDZs/ZEDZs, which may only target urban business centers. However, it is yet uncertain how warehouse operators will respond to the "menu" items offered (e.g., by procuring a ZE truck, installing a solar panel, or paying a fee), especially considering that most operators contract out their fleet and may have little control over upstream procurement.

- **Weight-distance tolls:** Outside of road-based tolling, WDTs for HGVs are the oldest and most common form of user-based charges in mobility. They generate high levels of revenue that either greatly supplement or can completely replace diesel tax-related revenues. At a state level, WDTs may face minor political opposition—at the same time, perceived cost imbalances between business size and passenger services have resulted in recent complaints from carriers. Given their lack of applicability to LGVs and local roads, WDTs primarily target interurban trucking and fund state DOT projects and maintenance. However, recent pilots are exploring interoperability between state and international jurisdictions (e.g., The Eastern Transportation Coalition's International Truck Pilot). Finally, EPA preemption does not allow U.S. states to incorporate the "Polluter Pay" principles observed in the European Union's recent Eurovignette reform.

- **Congestion charges:** There are limited examples of area- and cordon-based charges that differentially price goods delivery. New York City's proposed program would charge delivery service providers at higher rates than passenger services. Although the program would reduce the fee burden for carriers delivering off-hours, carriers point out that they would be unable to adapt operations due to aforementioned market conditions. Moreover, since the program earmarks funds for capital transit improvements, there is limited investment opportunity for programs that might improve delivery operations. Thus, carriers are less likely to benefit from the program, if they benefit at all (e.g., through improved delivery times): London's CCZ program helped reduce passenger vehicle traffic, but it did not improve travel times due to various traffic-calming measures.
- **Low- and zero-emissions delivery zones:** LEDZs/ZEDZs that effectively reduce emissions do not exist in a policy vacuum. For instance, European cases of LEZs/ZEZs have resulted in desired policy outcomes—mainly, through improved emissions standard compliance and ZEV procurement—by helping to fund monetary and nonmonetary incentive programs, such as procurement rebates or priority access to urban zones and infrastructure (Marcucci et al. 2017; Quak, Nesterova, and van Rooijen 2016). With public-private partnerships and more budgetary flexibility in how revenues are distributed, these examples reveal a direct link between the strategy, desired behavioral shift, and policy goal.
- **Curbside management fees:** This toolkit observes four types of curb management fees: dynamic parking pricing, green loading zones, access permits, and PDD permits. The first two have policy goals that extend beyond revenue generation, while the latter two have generally low potential to generate revenue. Given the concentration of LGVs in urban areas, their high utilization of curb infrastructure, and administrative difficulties in collecting fees for vehicles that do not require a commercial driver's license, curbside management fees may have the highest potential to capture LGV usage costs (International Transport Forum 2023). While few examples exist that evaluate this tool's long-term effectiveness in generating revenue and its operational impacts, dynamic reservation systems for commercial vehicle loading and unloading operations have the potential to reduce costs associated with cruising for parking.
- **Delivery fees** are a novel revenue-related strategy that prices the consumer for carriers' road usage. The fee is cost-efficient—generating high revenues with limited administrative costs—and has seen high levels of political uptake. The fixed fee exempts small retailers due to the cost burdens of administering it. However, it does not provide flexibility for consumers who select shipping options that are less road use–intensive and create less emissions. This inflexibility in rate structure may be a missed opportunity, especially for delivery fees implemented at the city level, where ordering behaviors have a major impact on last-mile operations (e.g., Barcelona's TREC). Like off-hour delivery, selecting sustainable shipping options (e.g., parcel locker pickup, time-flexible delivery) requires sufficient pricing signals to consumers for inefficient deliveries and changes in their pickup attitudes and habits. One possibility is a consumer-side RDF that offers exemptions or fee discounts for selecting more sustainable or less road use–intensive shipment options.

## Evaluation Considerations

- **Revenue considerations (flexibility):** Use of revenue will be highly context dependent. Local funding needs and decisions by elected officials will decide how public funds can be used. In some cases, revenues go into the general fund and can be used for multiple purposes (e.g., parking fees). In an ideal budgetary system, agencies extracting revenues from the goods delivery system would reinvest these revenues in programs that improve the system.

- **Impact considerations:** Effectiveness was evaluated on two fronts: revenue generation potential and policy goal alignment. WDTs, congestion charges, and RDFs have the highest potential to generate revenues. ISRs find a middle ground: raising revenues to support programs in alignment with state implementation plans and goals for reduction of air pollution. In European contexts, LEDZs/ZEDZs have improved emissions standard compliance and emissions reduction goals. However, shifting operating behaviors in ways that enhance progress toward policy goals will likely require regulations and public investments in demand- and supply-side incentives (i.e., subsidies). As with most fees, regressive and perverse effects are a concern. Tool users should be mindful of labor market conditions and apply the appropriate exemptions and incentives for small businesses and for-hire drivers.
- **Political considerations:** Major legality issues concern effects on interstate commerce and federal preemption if the tools elevate emissions standard compliance; however, flexible compliance requirements, as is the case with ISRs, may be a workaround. However, legality may be less of an issue than political acceptance, especially if carriers associate added costs with competitive disadvantages and a major loss of profitability. As discussed previously, tools can balance exemptions and incentives to alleviate pressure on small businesses and increase stakeholder involvement to improve private sector buy-in and business environments.

These conclusions do not suggest that revenue-related strategies for goods delivery are a lost cause for policy goals beyond cost recovery. Rather, revenue-related strategies alone are insufficient as a means to shift carrier behavior. The balanced use of fees and taxes can finance the incentives and apply the exemptions needed to nudge carriers and consumers into sustainable urban freight programs (Holguín-Veras and Aros-Vera 2015). Policymakers can utilize revenue-related strategies in conjunction with other supply- and demand-side regulations, subsidies, and monetary and nonmonetary incentives that can help transportation agencies achieve goals related to goods delivery sustainability and improved distributional outcomes.

MODULE 4

# Innovative Case Studies

## 4.1 Introduction

Modules 2 and 3 describe how the new mobility revenue framework applies to the most commonly used shared passenger and goods delivery services. Examples of these tools are relatively common across the United States. Where they are not in use, there is a growing interest in using the tools to generate revenue, achieve community goals, or influence behavior. The research demonstrates that, within and between these tools, there is a lot of variability in how they are implemented and the outcomes they can achieve.

Yet, there is much to be learned from innovative case studies that do not fit neatly into the new mobility revenue framework. Unlike previous modules that focus on revenue generation to fund infrastructure, operations, and maintenance or to incentivize behavior to achieve specific community goals, this module explores how different ownership and revenue models can be used to holistically provide mobility services. It examines U.S. and international case studies on innovative revenue strategies for shared passenger and goods delivery services. This module supplements previous modules with pilot and established funding and revenue-generating mechanisms that have been tested in different contexts and allow policymakers, agency partners, and private mobility providers to identify new strategies. This cross-comparison highlights adaptable models that could address universal challenges, such as congestion, mobility, safety impacts, and sustainability.

The case studies also provide insights into the effectiveness of subsidies, partnerships, governance, and pricing schemes, enabling key stakeholders to make informed decisions when designing and implementing their own policies and programs. For instance, lessons from cities that have implemented dynamic pricing or public ROW surcharges could inform pathways toward new revenue streams.

International examples showcase how different regulatory environments affect the success of these strategies. For example, cities like Amsterdam, Netherlands, or Barcelona, Spain, incentivize EV adoption using pricing signals, regulatory levers, and intensive engagement with local businesses and large third-party logistics (3PL) companies. International comparisons also reveal potential risks and unintended consequences, helping government agencies and their partners operating in different contexts avoid costly mistakes. Overall, learning from both national and international experiences can accelerate innovation, foster collaboration and knowledge sharing, and inform further refinement of future iterations of the strategies.

Module 4 is organized into the following sections:

- **Selection Criteria.** This section briefly describes the process employed to select the case studies as well as best practices covered in this module.
- **Subsidizing New Mobility Services Through Innovative Governance, Regulatory, and Procurement Frameworks.** A series of case studies illustrates the critical role that governance,

regulation, and procurement play in determining how mobility services are structured, operated, and sustained over time.

- **Fees, Taxes, and Surcharges.** Several cities and states have explored or are exploring how to leverage fees, taxes, and surcharges to promote and provide alternative funding streams for new mobility services while also incentivizing desired outcomes and behaviors and fostering financial resilience.
- **Curb Management.** With the surge in demand for curb access, cities have developed various curb management innovations to monetize the public ROW—specifically curb space—by creating dynamic and demand-responsive revenue models, platform-supported permit systems, and dedicated zones for deliveries, passenger pickups, and micromobility.
- **Programs to Address Environmental Goals and Improve Access.** Cities have designed new programs to advance goals related to reducing emissions, like $CO_2$, $CH_4$, and $N_2O$, and improving mobility access while also driving the creation of new revenue models that align financial mechanisms with sustainability and distributional outcomes.

## 4.2 Selection Criteria

When selecting case studies, the primary goal was to identify examples that are promising and potentially replicable across different borders and contexts. The initial screening criteria that were used to source a broad pool of case studies include

- Alignment with project objectives,
- Diversity of revenue models,
- Diversity in the application of revenue models,
- Geographic diversity (e.g., rural and urban), and
- National and international.

A second set of criteria was identified to ensure the case studies reflect the latest tactics, strategies, and best practices that public agencies and their partners have adopted to keep pace with the evolving new mobility landscape. The second set of screening criteria includes

- Adaptation to new procurement and contracting tactics, technological advancements, and changing market dynamics;
- Adoption of innovative business practices;
- Advancement of broader societal goals (e.g., congestion management, economic development, environment, and distributional impacts); and
- Involvement of and interplay between different stakeholder types (e.g., transit agencies, municipal and state planning bodies, and mobility and technology providers).

The case studies were then categorized by topic area. These topic areas reflect common strategies, tactics, and use cases for common revenue and revenue-related models as well as emerging mobility use cases where these strategies and tactics have been tested. The selected case studies are summarized in Table 41.

## 4.3 Subsidizing New Mobility Services Through Innovative Governance, Regulatory, and Procurement Frameworks

Governance, regulation, and procurement play a critical role in how new mobility services are funded. These frameworks determine how mobility services are structured, operated, and sustained, directly influencing the financial viability and scalability of these services. Governance frameworks establish the overarching policies and decision-making processes that guide mobility system design and service delivery. They may facilitate public-private partnerships, support

**Table 41. Overview of case studies.**

| Description | Category | Geography |
|---|---|---|
| **Subsidizing New Mobility Services Through Innovative Governance, Regulatory, and Procurement Frameworks** | | |
| District-based shared mobility financing and risk management model | Passenger services | Utrecht, Netherlands |
| New mobility integration with public transit | Passenger services | Vienna, Austria |
| | | Austin, Texas |
| Rural and Tribal area service models | Passenger services and goods delivery | Deinze, Belgium |
| | | Minnesota |
| **Fees, Taxes, and Surcharges** | | |
| E-scooter operator and mobility fees | Passenger services | Portland, Oregon |
| Retail delivery fee to fund mobility | Goods delivery | State of Washington |
| **Curb Management** | | |
| Curb management projects funded by the U.S. Department of Energy | Goods delivery | Los Angeles, California |
| | | Santa Monica, California |
| | | Pittsburgh, Pennsylvania |
| Dynamic parking and loading pricing model | Passenger services and goods delivery | Barcelona, Spain |
| Smart loading zones | Goods delivery | Oakland, California |
| Zero-emissions logistics zones | Goods delivery | Netherlands |
| **Programs to Address Environmental Goals and Improve Access** | | |
| E-bike program subsidy for food delivery | Goods delivery | San Francisco, California |
| Mobility wallets | Passenger services | Los Angeles County, California |
| | | Pittsburgh, Pennsylvania |
| | | Portland, Oregon |

mobility innovations, and enable shared ownership models to distribute the benefits and risks of new mobility more widely.

Regulatory frameworks create the legal structures and rules within which new mobility services must operate. Effective regulation helps to mitigate risks and ensures compliance with national, state, and local laws, while also providing clarity to service providers on what is required for them to operate.

Procurement frameworks can be structured to support innovative revenue models, and they can offer financial incentives or subsidies to promote the adoption of new mobility solutions. Together, these frameworks are crucial for creating sustainable and scalable revenue models that align with policy objectives.

## Case Study 1. District-Based Shared Mobility Financing and Risk Management Model in Utrecht, Netherlands

### *Background*

The Merwede District is home to a planned, large-scale, mostly car-free development project in southwest Utrecht, Netherlands, that will include 6,000 houses, limited parking spaces, shared mobility hubs, and an extensive bike and pedestrian network to encourage active transportation within and around the district (Figure 23). This former industrial area will accommodate 12,000 residents, transforming into a mixed-use urban district, and become one of the largest nearly car-free developments in Europe once completed (Boffey 2020). Densification of the district is heavily dependent on the success of its mobility strategy because the amount of space available to support traffic is limited. Project partners have implemented unique regulatory frameworks, governance structures, and financial risk mitigation strategies to develop, finance, and sustain robust shared mobility offerings to area residents and visitors—including carshare and bikeshare.

The construction of the Merwede District is currently in progress, with some blocks already designed and currently undergoing development. The project is expected to be completed by 2027.

### *Governance*

The municipality of Utrecht is a critical stakeholder and primary driver for this project. In addition to its statutory role, the municipality is one of several landowners, owning 30 percent of the land in the project area with the option to sell the land after the project is realized. With a financial stake in the project and ambitions to create one of the largest car-free districts in Europe, the municipality led the cocreation of a comprehensive plan and framework with private partners to support implementation of the project concept. The municipality also recognized that the involvement of all individual landowners is essential to ensuring that the project, as conceptualized, becomes operational across all parcels in the district. Therefore, the municipality spearheaded the establishment of an owners' collective that is responsible for implementing the development project as well as funding and executing the accompanying mobility concept (Van den Hurk, Pelzer, and Riemens 2021).

### *Policy Objectives and Model Supports*

The municipality of Utrecht is committed to densifying the inner city to create a healthy future in which economic vitality, quality of life, public safety, sustainability, and cultural vitality in neighborhoods and districts are closely linked. To realize this vision, the shared mobility enterprise is creating the conditions—leveraging policy, incentives, and strategic partnerships—to support the expansion and availability of clean mobility options in Merwede.

Critical to the design of the district are the distribution of parking and the availability of shared mobility and public transit. The shared mobility enterprise is exploring the development of a MaaS app to digitally connect future residents and visitors with shared mobility and public transit options. Car parking will also be sited 1 to 2 miles from the district at publicly owned parking garages at the edge of the district. These same garages will offer space for private mobility providers to store vehicles and pilot their services.

Source: LOLA Landscape Architects, Merwede website

***Figure 23. Rendering of a green neighborhood square in the Merwede District.***

Additionally, the Utrecht city council also lowered parking standards from 1 to 0.3 parking spaces per dwelling unit. However, the shared mobility enterprise is required to provide the maximum number of required parking spaces in Merwede (Goudappel 2022). The high costs associated with building the parking structures underground, indoors, and in physically constrained spaces, in addition to using some of the spaces to support shared mobility services, created significant financial risk for private landowners.

To mitigate this financial risk as well as the potential for private landowners to withdraw from the shared mobility enterprise and owners' collective, the municipality purchased (at a rate less than estimated total construction costs) parking garages from private developers at the edge of the district (de Vries 2021). This approach will allow the municipality and its partners to retain control over the parking spaces and use some of the space to support the development of mobility hubs at those sites. Some of the spaces will be rented out to Merwede residents, while others may be leased to private mobility providers at a subsidized rate (de Vries 2021).

### *Geographic Extent*

Figure 24 is a map showing the location of the planned Merwede District, which is located between subarea (deelgebied) 4 and subarea 6 of the Merwede Canal Zone.


Source: Marco Broekman and OKRA

***Figure 24. Merwede District.***

### *Innovative Revenue Model Mechanisms*

District stakeholders sought to mitigate growth pressures on the transportation network by designing a well-functioning, and sustainably funded, mobility system. To that end, landowners collectively established a shared mobility enterprise, where private developers, investors, and public agencies plan, fund, and provide mobility services within the district. Landowners have committed to long-term engagement and contributing financially to the shared mobility enterprise, which is embedded within partnership agreements between landowners. Every landowner must fund a share of this enterprise. Their share is based on the percentage of owned land in Merwede—owning 5 percent of land means funding 5 percent of the enterprise costs (de Vries 2021). By working together through the owners' collective, the costs and risks are distributed between landowners and the municipality, with the municipality bearing a large proportion of the financial risk not only as a landowner but also as a public entity that bears the cost for the necessary infrastructure upgrades and public amenities to support the project.

The Merwede District's shared mobility fund generates funding for urban development, similar to tax increment financing (TIF) districts in U.S. cities. However, the shared mobility fund operates differently in terms of revenue generation, purpose, and governance. The Merwede District's shared mobility fund is directly financed by property developers, who are required to contribute as part of their development obligations. TIF districts in the United States capture the increase in property tax revenue that results from rising property values due to new development or public investments. This tax increment is then reinvested in infrastructure and economic development projects within the district. Additionally, the Merwede District's shared mobility fund is explicitly designed to subsidize and sustain shared mobility services as part of the district's car-free model. It helps reduce car ownership by ensuring the availability of and access to high-quality alternatives. TIF revenues, in contrast, are generally used for infrastructure improvements, land acquisition, or other development incentives, often to stimulate economic growth or revitalize blighted areas. Funds may be spent on transit, but they are not typically dedicated to mobility services. Finally, the financial burden of the Merwede District's shared mobility fund is placed upfront on developers, ensuring immediate funds for shared mobility from the start. Long-term sustainability may rely on ongoing contributions, fees, or adjustments. For TIF districts, the associated risk depends on future property value increases; this means that if developments do not generate sufficient tax increments, the TIF district may not produce the expected revenue.

### *What Makes This Innovative?*

Instead of relying solely on traditional taxation, the project leverages land value capture, MaaS revenue, and public-private partnerships to fund the infrastructure, transit improvements, and shared mobility services needed to sustain a car-free community. A unique feature of this initiative is that the financial risk for the development and accompanying mobility strategy is spread across public and private landowners, based on the proportion of land owned within the district. The more landowners and stakeholders involved, the more expertise and resources that are available to the collective.

The municipality operates as a landowner, developer, and regulator on this project and serves as the largest landowner and contributor to the shared mobility enterprise within the consortium. From this vantage point, the municipality is able to capture significant increases in land value resulting from zoning changes and infrastructure investments—for example, the municipality strategically rezoned the formal industry area into a dense, mixed-use urban district, making the land more valuable. Developers who purchase land or rights to develop from the municipality must pay fees to support public infrastructure and sustainable mobility measures, such as the development of mobility hubs and micromobility services.

At the same time, the municipality disproportionately bears the financial risk of subsidizing and leasing parking spaces to support private shared mobility providers. Their willingness and ability to absorb this risk promotes collaboration and gives private landowners greater confidence to remain in and support the collective. To offset these costs, the municipality is exploring revenue-share models to collect a portion of revenue generated from shared mobility services that operate within and will use mobility hubs in the district.

### *Downstream Impacts*

Merwede's shared mobility enterprise model enables public and private landowners to pool resources and expertise while spreading financial risk. It also expands the collective's financial capacity, enabling individual parties to take on more risks than they otherwise would be able to if operating on their own.

### *Challenges and Lessons Learned*

The project's parking policies were consistently raised as challenges for the project. Entrepreneurs and residents were strongly opposed to limiting the parking supply to areas outside of the district and the reduced spaces per dwelling unit (Van den Hurk, Pelzer, and Riemens 2021). From their perspective, this design feature meant not being able to park their cars near their house, which may disproportionately impact older adults and people living with disabilities. To manage this issue while also managing the financial risk of owning and operating the district's parking supply, the municipality and its partners are adopting a phased approach. During the initial phase of the project, the shared mobility enterprise will introduce shared mobility options to future residents and people residing near the district to socialize and raise awareness around clean mobility options (Van den Hurk, Pelzer, and Riemens 2021). At the same time, the municipality will temporarily lease a majority of its parking spaces to renters to offset the upfront costs for acquiring parking spaces. As the demand for shared mobility within the district increases over time, the municipality will convert parking spaces into spaces that are leased to shared mobility providers. This phased approach also allows private mobility providers to develop and test small-scale hubs that can be expanded over time based on demand.

## Case Study 2. New Mobility Integration with Public Transit in Vienna, Austria

### *Background*

Public transportation agencies and authorities across the globe are rethinking their mobility service offerings and the revenue mechanisms needed to fund their operation. For example, the City of Vienna invested significant public funding to support the regional transportation authority, Wiener Linien, and its role as the city's mobility integrator and public mobility service provider (Figure 25). Wiener Linien oversees the city's public transit, bikeshare, and carshare systems as well as the MaaS program that stitches together the city's various mobility services into a single app, allowing users to plan, book, and pay for trips seamlessly in one place.

### *Governance*

Wiener Linien is part of a municipal corporation (Wiener Stadtwerke) and a subsidiary of the Vienna city government. The city administrator for finance, economics, work, international affairs, and Wiener Stadtwerke oversees the corporation. Wiener Linien has the authority to issue public tenders with private mobility service providers and determine pricing structures for its portfolio of mobility services. Like the requests for proposals typically used in the United States, institutions of the European Union award public procurement contracts for services,

Source: Wiener Linien/Severin Wurnig

***Figure 25. Wiener Linien bikeshare service next to public transit.***

works, and goods through calls for tender. Wiener Linien and the municipality jointly created a start-up called Upstream to develop the city's MaaS platform, WienMobil. This publicly owned B2B organization strives to operate like a privately owned company but to benefit public interests.

Wiener Linien receives substantial financial support from both the City of Vienna and the national government. Annually, this amounts to €700 million to help subsidize public transportation services and maintain affordable prices. This funding is crucial for sustaining operations and supporting innovative mobility initiatives like the WienMobil app.

### *Policy Objectives and Model Supports*

The City of Vienna and Wiener Linien are invested in the agency's mission to become the city's full-service mobility provider. Wiener Linien is the only organization sanctioned by the City of Vienna via contract to manage public spaces in service of creating station-based bikeshare and carshare services and mobility hubs. Their approach, which combines public space management and digital integration of station-based services, enables the agency to exert greater control in shaping the market and to create the conditions that attract private mobility and technology providers.

Unlike many U.S. cities that invite multiple service providers to operate in their jurisdiction, Wiener Linien issues one tender to one operator per mode for station-based services. From the city's perspective, having Wiener Linien manage a limited number of contracts allows the agency to focus on its primary functions as the city's transit provider and mobility integrator. There is also less of an appetite politically and from the end users to have multiple mobility service providers per mode (APTA 2020).

### *Geographic Extent*

Wiener Linien's revenue models apply across new mobility program service areas. In the case of WienMobil Auto, the city's carshare program operated by Sharetoo Carsharing, the revenue model impacts the entirety of the program's fleet, which spans Vienna's metropolitan area. (See Figure 26, where the numbers in white represent the number of vehicles at each location.)


Source: WienMobil Auto

***Figure 26. Map of WienMobil Auto carshare locations.***

### *Innovative Revenue Model Mechanisms*

To gain access to the public realm, all contracted mobility service providers must offer a white-label solution—an unbranded, prebuilt product or service developed by a technology or mobility service provider—that can be customized to meet Wiener Linien's operational and branding requirements. Service providers must agree to integrate with Wiener Linien's customer-facing digital trip planning and booking app, WienMobil. Additionally, prospective contractors must also bid against a price range, which Wiener Linien explicitly includes, along with performance expectations and program requirements, in the public tender.

In exchange, contracted mobility service providers gain greater visibility and exclusive access to Wiener Linien's customer base via integration into the agency's trip planning and booking platform. They also receive a guaranteed floor of income per trip. If a service fails to meet the performance expectations outlined in the tender, the City of Vienna (through Wiener Linien) offers a per trip subsidy to sustain the service. The subsidy, while relatively minimal, is demonstrative of the City of Vienna and Wiener Linien's commitment to expand the reach of transit and create a cohesive, integrated ecosystem of public shared mobility services. With only one public tender issued per mode, mobility service providers are also incentivized to continue to meet expectations and reduce their need for public subsidies, otherwise Wiener Linien will issue the tender to another mobility service provider.

Wiener Linien, in partnership with Sharetoo Carsharing, operates the city's electric car-sharing program, WienMobil Auto, which currently includes over 100 EVs across Vienna. Sharetoo Carsharing provides a platform-based solution to power and manage its fleet of EVs, which are integrated into an intermodal trip planning and booking app along with Wiener Linien's other services. Wiener Linien also subsidizes every vehicle in service, depending on the revenue it generates on a monthly basis. Due to the city's high demand for car-sharing—with more than 3,000 bookings per month (on average) in its first 5 months of operation; a utilization rate of

2.1 rentals per day, per car; and an average rental time of 5 hours—two-thirds of the program's vehicles do not require any subsidy. Wiener Linien attributes the program's high utilization rate to the continuous usage of vehicles, attractive pricing, and the siting of vehicles in highly visible, public spaces. Any vehicles not generating sufficient revenue will receive a subsidy to keep the vehicle in service.

### *What Makes This Innovative?*

Public subsidization is directly tied to the performance and utilization of individual vehicles within the carshare fleet. This ensures both Sharetoo Carsharing and Wiener Linien are mutually invested in expanding utilization across the entire service area and particularly in areas outside of the central core where shared mobility may be less prominent.

Additionally, Wiener Linien's decision to develop, manage, and maintain the front- and back-end MaaS platform is unique. Because software development costs are high, many transit authorities and municipalities in Europe and North America have outsourced this work to platform vendors. Keeping this work in-house positions Wiener Linien as an IT development partner for anyone in the region's public sector looking to integrate regional mobility services with WienMobil or seeking guidance for managing integrated mobility programs within their own jurisdictions. This customer service offered to the public sector, in addition to software licensing and data analytics, enables Wiener Linien to generate additional revenue.

### *Downstream Impacts*

Providing a guaranteed, per trip subsidy for underutilized carshare vehicles can incentivize different behaviors and outcomes and influence how carshare services operate. When public, per trip subsidies are designed to incentivize adoption of a service during off-peak hours or in lower-demand areas (e.g., rural or suburban regions), the subsidy can help sustain service during times of day and in locations where it might otherwise be financially unfeasible for operators. This would improve access to mobility for residents and shift workers in these locations.

Over the long term, guaranteed, per trip subsidies for underutilized carshare vehicles may become financially unsustainable if usage does not increase sufficiently to offset the need for public funds. In this scenario, Wiener Linien will need to evaluate whether the subsidy delivers sufficient public benefit relative to its cost.

### *Challenges and Lessons Learned*

Wiener Linien's MaaS program relies heavily on partnerships with private mobility operators to ensure that mobility services are offered consistently throughout an area to create a robust public transportation network for residents, employees, and visitors. One of the major challenges is finding the right balance between offering an attractive price to draw in users and creating an enticing incentive package to draw in high-quality operators who are willing to assume comparatively smaller profit margins while maintaining competitive service quality. Providing guaranteed, per trip subsidies has been effective in attracting private mobility operators; however, potential financial risks to the city, should ridership drop, must be managed carefully. To mitigate this risk, the city has implemented several measures involving transportation demand management—including limiting parking supply, introducing mobility hubs, and creating incentive programs—to curb car use and to promote shared mobility services. Although the program may require ongoing subsidies from the City of Vienna to remain viable in the foreseeable future, Wiener Linien recognizes the need to explore diverse revenue sources such as ROW fees, subscription models, and value-added services.

**New Mobility Integration in Austin, Texas**

After several years of owning and managing the city's bikeshare system, the City of Austin transferred its 50 percent control of the system to Capital Metro Transportation Authority (CapMetro), the City of Austin's transit authority (APTA 2020). This transfer was in part prompted by the city's limited capacity to significantly expand the system. Going forward, the city will own the physical infrastructure while CapMetro oversees the operational and technological aspects of the program. Since 2020, both the City of Austin and CapMetro comanaged the system and split the operational costs, with each agency contributing $250,000 annually along with several hundred thousand dollars upfront to support equipment upgrades and to transition the fleet to e-bikes (APTA 2020). Upon assuming partial ownership, CapMetro rebranded the system to MetroBike, with the goal of integrating the bikeshare system with existing transit service, providing first- and last-mile connectivity, and simplifying ticketing and fares for customers transferring between transit and bikeshare.

## Case Study 3. Rural and Tribal Area Service Models in Deinze, Belgium

### *Background*

Innovative revenue models can help fund mobility services in rural and Tribal areas, as traditional funding mechanisms often fall short in addressing the unique challenges these communities face. The cost of providing public transit and new mobility services in rural and Tribal areas is often higher than in urban areas. Longer travel distances, limited infrastructure, and fewer economies of scale create challenging operating environments where conventional fare- or volume-based revenue models struggle to sustain services. Higher operating costs, low ridership, and limited awareness of new mobility services in rural, historically car-dominant communities can also limit the market draw for private mobility services. In response to these constraints, rural municipalities and Tribal communities have employed a mix of revenue models, subsidies, strategic partnerships, and community-based financing to fund new mobility services.

To enhance access to flexible, clean mobility options in a predominantly rural community, the municipality of Deinze in Belgium implemented mobility hubs or "mobihubs" (Figure 27).

Source: City of Deinze

***Figure 27. Mobipunt in Leiespiengel, Deinze, Belgium.***

These mobility hubs, also called "mobipunts," offer a variety of sustainable shared mobility services, including carshare, e-bikeshare, public transit connections, and charging facilities for EVs. Mobipunts are part of a broader effort to expand shared mobility across smaller towns and rural areas in Flanders, with the dual goal of reducing car dependency and expanding access to sustainable transportation options (Glotz-Richter 2018).

Mobility service providers operating at mobipunts are compensated through a mix of public and private funding, depending on the nature of the service. Carshare and bikeshare providers, for instance, receive subsidies from the Flemish government and municipality of Deinze, as well as support through public-private partnerships, to ensure that services remain affordable for users (Hached and L'Hostis 2022). Mobility service providers also generate revenue directly from user fees and by integrating their services into larger MaaS platforms. This mixed funding model enables mobility providers to sustain operations in challenging environments while fostering growth of shared mobility services in rural areas (Minnesota Department of Transportation 2024).

**Rural Mobility Innovation in Minnesota**

Similar to Flanders, the state of Minnesota is home to many rural communities that primarily rely on single-occupancy vehicles for their transportation needs. To address the lack of mobility options available in rural communities, the Minnesota Department of Transportation established the country's first innovative mobility incubator that specifically focuses on the mobility needs of rural, Tribal, and small urban areas with fewer than 200,000 people. This incubator, also called Moving Greater Minnesota Forward, identifies and supports partners with ideas for how to improve mobility in rural areas by leveraging shared mobility options.

The program consists of three phases:

- Phase 1: Early Idea Development. New partners can join a cohort twice a year, with the program supporting the incubation of 12 projects per year.
- Phase 2: Real-World Testing. Partners can apply for up to two years of pilot funding, which can be used to support implementation of pilot demonstrations, technology and equipment needs, and operational costs.
- Phase 3: Scaling Success. Funding to sustain or scale the pilot may come from a variety of sources, including private equity, federal and state programs, and public-private partnerships to leverage public, private, and philanthropic funding sources (Minnesota Department of Transportation 2024).

The program is funded through a combination of federal grants, philanthropic grants, and private funding sources. The Minnesota Department of Transportation also provides funding for the program, including $500,000 annually to support Phase 2 pilots.

### *Governance*

The Flemish government worked closely with several Belgian nonprofits to design and implement the region's mobihubs program. All nongovernmental partners enter into public service contracts. Mpact, formerly known as Taxistop, is a Belgian nongovernmental organization that operates a variety of shared mobility solutions in partnership with governments and organizations, including ride-sharing, community-based car-sharing, and on-demand services for older adults. Mpact is also part of the Flemish Advisory Board on Transport, and it advises the European Council on Shared Mobility. While developing Deinze's mobipunts, Mpact partnered with Autodelen.net, another nonprofit organization that oversees Belgium's free-floating car-sharing network, and Olympus Mobility, a MaaS provider that developed Deinze's app.

### *Policy Objectives and Model Supports*

Key policy objectives for the mobihubs program include facilitating mode shift from gas- and diesel-powered vehicles to those with cleaner fuels and shared mobility options in rural communities. To achieve this, implementation partners are keen on increasing the physical visibility of shared mobility options through urban design and branding and reorienting systems planning from a supply-oriented to a demand-oriented system.

Adopted in 2009, Flander's Basic Mobility Decree has been foundational to the region's mobility policy—it guarantees a minimum public transportation provision based on several factors, including serving priority residential areas, maximum distance to nearest stop, and frequency of services (e.g., peak versus off-peak, weekday versus weekend) (Milne and Gleave 2023). Since the initial mobihubs were launched in 2017, the Flemish government integrated the mobihubs concept in the Flemish Basic Accessibility Plan, which aims to create seamless connections between different transportation options. The Flemish Ministry of Transport is also in the process of refreshing the mobihub branding and securing substantial financial commitment to create 1,000 mobihubs across Flanders by 2025 (Karbaumer 2020).

### *Geographic Extent*

Mobihubs are found in rural communities across Flanders.

### *Innovative Revenue Model Mechanisms*

The Flemish government established a process that allows municipalities to apply for a subsidy for the construction or redevelopment of a mobihub along municipal roads. Municipalities are also encouraged to seek out financial support for local hubs through partnerships with surrounding businesses or by leveraging park and ride fees. Subsidies issued to private mobility service providers operating at mobihubs in rural areas are noted in contracts with the Flemish government.

### *What Makes This Innovative?*

The Flemish government and municipality of Deinze provide guaranteed revenue to incentivize mobility service providers to offer their services in rural areas. This arrangement also incentivizes public partners to leverage their own resources (e.g., public space, outreach and engagement) to connect more customers to the services to reduce the need for subsidies.

### *Downstream Impacts*

By providing guaranteed revenue to mobility service providers, providers can operate more consistently, even in low-demand areas. This improves the reliability and availability of transportation options for rural communities. Incentivizing providers to cover broader geographic areas also leads to more comprehensive coverage in rural regions, particularly those underserved by public transportation and lacking connections to the core network.

### *Challenges and Lessons Learned*

To ensure long-term sustainability, the municipality of Deinze explored various funding mechanisms, including government subsidies and partnerships with private companies and nonprofits. Balancing financial sustainability with program accessibility and affordability was a delicate but essential part of the project's success. Multistakeholder involvement was also a critical component to the project—the municipality of Deinze worked closely with the Flemish government, shared mobility providers, nonprofit organizations, the SHARE-North group, and residents to ensure that hubs were strategically sited and that services were well-coordinated.

## 4.4 Fees, Taxes, and Surcharges

Innovative fees, taxes, and surcharges are valuable tools for funding and promoting new mobility services because they create financial mechanisms that can both generate necessary revenue and incentivize desired behaviors. These strategies can provide a steady stream of funding that can be earmarked specifically for mobility infrastructure, operations, and maintenance, ensuring new mobility services can be adequately financed over the long term. Fees and surcharges can also be designed to encourage individuals to adopt cleaner mobility options and to advance broader societal goals, such as improved distributional outcomes, safety, and sustainability. By creating revenue opportunities through fees and surcharges, governments can incentivize private sector participation in new mobility markets.

### Case Study 4. E-Scooter Operator and Mobility Fees in Portland, Oregon

*Background*

Portland leverages various fees to fund new mobility programs as well as other transportation solutions that promote sustainability and improved distributional outcomes. For example, the Portland Bureau of Transportation (PBOT) has several flat and variable fees as part of its e-scooter program. Permit holders must pay a $500 application fee, $0.25 per-trip street use surcharge fee, and an ROW use surcharge fee that varies based on where scooters are made available (City of Portland 2020). Fees and penalties accumulated from the program are deposited into the city's new mobility account, which PBOT uses to help cover the cost of administering the program, including start-up costs, program administration, enforcement, program evaluation, safe travel infrastructure, and public outreach (City of Portland 2020).

More recently, the city also established the Parking Climate and Equitable Mobility Transaction Fee, which is designed to fund transportation solutions such as the city's bikeshare program, BIKETOWN for All; the Transportation Wallet; and efforts to research equitable mobility strategies (Figure 28). BIKETOWN for All is a program that offers affordable bikeshare memberships to Portland residents with lower incomes. Additionally, this fee aims to address the externalized costs of driving—such as traffic congestion and carbon emissions—by charging a $0.20 fee for every parking meter transaction, including parking on the street and in public lots (Portland Bureau of Transportation 2022). The fee sends a signal for drivers to consider the costs and impact of their transportation choices. The fee may vary based on factors like time of day, vehicle type, and surrounding land use contexts (e.g., parking fees may be higher in busy shopping areas to encourage people to walk, bike, or take transit). Revenue generated from this fee is reinvested into programs that improve transportation access and environmental outcomes, such as subsidizing transit passes for low-income residents.

*Governance*

PBOT establishes the overall goals, policies, and fee collection protocols for its e-scooter program and new mobility account. Specific programs associated with the account, including subsidies or incentives, are administered by PBOT and partner agencies.


Source: Portland Bureau of Transportation

***Figure 28. Parked e-bikes and e-scooters in Downtown Portland.***

PBOT also administers the Parking Climate and Equitable Mobility Transaction Fee and oversees the city's parking policies, including parking regulations and management, pricing strategies, enforcement, and implementation of parking meters. PBOT works closely with Portland City Council and advisory committees to develop and enforce these policies.

### *Policy Objectives and Model Supports*

Key policy objectives for both the e-scooter program and the Parking Climate and Equitable Mobility Transaction Fees include shifting more people toward sustainable, public mobility options; expanding access to affordable mobility options; and advancing the city's climate goals.

The e-scooter program fees and penalties are placed in the city's new mobility account. The municipal code establishes a strong nexus between program fees and administrative tasks. For example, application fees are used to support permit development and application review, and the Street Use Surcharge and ROW Use Surcharge fees can be used to fund safe travel infrastructure, dedicated parking, and expanding access to the program (City of Portland 2020). The ROW Use Surcharge fee is specifically designed to influence deployment in different areas of the city. New mobility service providers seeking to operate in high-utilization areas (i.e., Central City) would pay a premium ROW Use Surcharge fee, whereas those looking to advance the city's goals related to improving distributional outcomes would pay a discounted fee if they deploy devices in priority communities, like the inner, western, or eastern neighborhoods.

Specific to the Parking Climate and Equitable Mobility Transaction Fee, the $0.20 added fee aims to signal the cost of driving to help drivers understand the impact of their transportation choices and to consider shifting to other modes. PBOT will reinvest revenues generated from the added fee to further expand mobility programs that could improve distributional outcomes.

### *Geographic Extent*

The fees apply throughout Portland, though scooters and paid parking are in specific neighborhoods.

### *Innovative Revenue Model Mechanisms*

PBOT uses Mobility Data Specification (introduced in Module 2), a standard for exchanging data between mobility operators and cities or regulators, to determine the total ROW Use Surcharge fee that permittees must pay on a monthly basis. This data is also used to determine the number of trips, which informs the total Street Use Surcharge fee amount owed each month.

The Parking Climate and Equitable Mobility Transaction Fee is one of many strategies shaped by the recommendations of the Pricing Options for Equitable Mobility Community Task Force, whose primary objective was to inform the city's use of pricing strategies to create a transportation system that promotes sustainability and improved distributional outcomes. The Parking Climate and Equitable Mobility Transaction Fee is applied to parking transactions within regulated zones. The fee is primarily leveraged as a mobility funding tool to support ongoing investments in programs that promote transportation affordability and access. A secondary, but related, outcome of the fee is discouraging driving, especially in high-traffic or high-emissions areas. Fees are levied at the point of sale when drivers pay at the meter.

### *What Makes This Innovative?*

The innovative aspect of the parking fee is its dual focus on sending a price signal about the externalized costs of driving while promoting transportation policies that promote sustainability and improve distributional outcomes. Unlike standard parking fees, which are typically aimed solely at revenue generation or managing parking demand, this transaction fee serves as a behavioral nudge. By attaching a fee to parking, the City discourages car use and generates funds that are reinvested in sustainable alternatives, like public transit, biking infrastructure, and micromobility incentives. The fee revenue is also earmarked for specific programs, such as Transportation Wallets at affordable housing developments and BIKETOWN for All, ensuring that the funds directly contribute to the city's stated goals of promoting sustainability and improving distributional outcomes.

Portland was among the early adopters in the United States to implement a surcharge for ROW access for its e-scooter program. The Electric Scooter ROW Use Surcharge fee is innovative in that it leverages pricing to influence the deployment strategies of private mobility service providers, with the aim of improving the distribution of mobility services across the city. Additionally, the fee is designed in such a way that resources generated from generally higher-income areas or users can be reallocated to improve services in underserved areas. By implementing these fees, Portland's e-scooter program strives to balance affordability, accessibility, and responsible usage and operations, setting it apart from similar programs in other cities.

### *Downstream Impacts*

By investing in low-carbon modes, the Parking Climate and Equitable Mobility Transaction Fee can contribute to reduced vehicle emissions while increasing transportation options for transit-dependent residents. Reinvestment into initiatives that expand sustainable transportation options in underserved areas can also help to reduce transportation disparities and promote greater social and economic mobility.

### *Challenges and Lessons Learned*

Because the fee is applied to parking meter transactions, PBOT is currently not able to create exemptions or offer discounts for low-income drivers. To mitigate the financial impacts to low-income communities, PBOT will leverage these funds to expand the agency's mobility projects focused on improving distributional outcomes, including the BIKETOWN for All program and the Transportation Wallet (Portland Bureau of Transportation 2022).

## Case Study 5. RDF to Fund Mobility in the State of Washington

### *Background*

In 2023, the Washington State Legislature enacted House Bill 1125 (HB 1125), which included a budget proviso for a study to understand how RDFs could be implemented in the state. A new delivery fee would be added to online retail orders to help fund transportation infrastructure projects. The RDF would apply to packages delivered by Amazon, or consumer goods delivered by 3PL companies like UPS, using a motor vehicle. According to the initial feasibility study, the RDF could generate as much as $112 million in 2026 and $160 million in 2030 if imposed on any order of taxable items and without issuing exemptions (CDM Smith 2024b). If the fee only applies to deliveries or purchases that exceed $75 and retailers with less than $1 million in sales are exempt, the estimated potential revenue is $49 million in 2026 and $70 million in 2030 (CDM Smith 2024b).

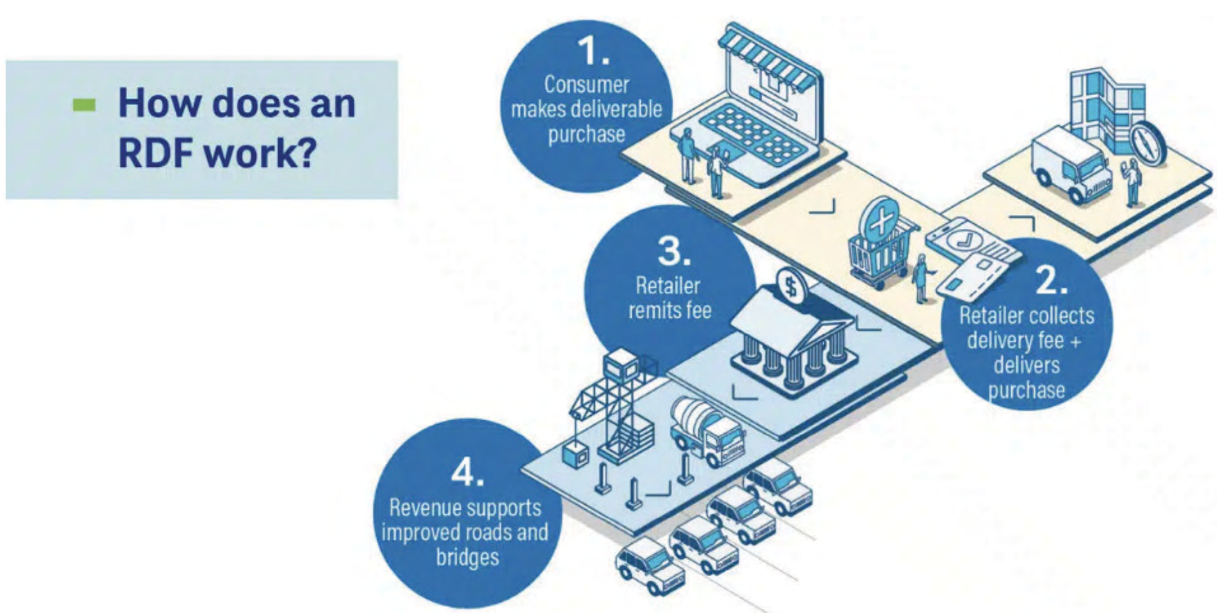
### *Governance*

The governance model for the RDF is currently under development through a legislative process led by Washington's Joint Transportation Committee (JTC). The fee is projected to be collected during online checkout and passed on to the state by retailers, 3PL companies, and last-mile delivery platforms. The state would distribute funds to local governments for transportation projects, and lawmakers would decide how to spend the allocated funds (Figure 29).

### *Policy Objectives and Model Support*

The JTC is exploring the possibility of replacing declining gas tax revenue, which is severely lagging behind rising roadway maintenance costs (CDM Smith 2024a). Like the gas tax, an RDF would have those who use delivery services (e.g., retailers, consumers, and delivery service providers) contribute directly to the costs associated with infrastructure and environmental impacts of deliveries. The study identified several factors to determine revenue distribution to county governments, including population (county's share of the state's population), total deliveries, roadway miles (as a proportion of the jurisdiction's share of all city, town, and county roads), VMT, and e-commerce sales (CDM Smith 2024b). Counties would then distribute funds to individual cities and towns based on population and roadway miles.

Urban residents generally spend more on online retail purchases than those in more rural communities, and households with an average income above the state median tend to spend




Source: CDM Smith

**_Figure 29. Infographic on proposed RDFs._**

approximately $500 more per year on e-commerce purchases compared to households in lower-income census tracts (CDM Smith 2024b). Thus, it is plausible that more affluent urban consumers are subsidizing mobility investments in more rural parts of the state. However, the study does not propose a definitive weighting scheme across identified factors for county-level revenue distribution. The study does include a forecasting tool that can be used to adjust weighting of the different factors, model various revenue distribution scenarios, and assess the potential impact of future policy decisions.

Washington State modeled the structure of its RDF similarly to Colorado's, where the RDF is distributed across several funds—notably the general fund, which makes grants available for multimodal transportation projects that enhance mobility and accessibility and reduce emissions, and the community access fund, which promotes widespread adoption of EVs and electric alternatives to motor vehicles (e.g., e-bikes) by supporting the expansion of EV charging infrastructure and distributing financial incentives for the purchase of EVs and electric micromobility devices (CDM Smith 2024b).

The potential designs for Washington's RDF could also incentivize more sustainable behaviors—introducing fees on deliveries can lead to businesses encouraging customers to consolidate orders or choose more sustainable delivery methods to reduce the overall environmental impact and improve delivery efficiency.

### *Geographic Extent*

The RDF applies throughout the State of Washington.

### *Innovative Revenue Model Mechanisms*

The JTC-commissioned study assumes the RDF applies to any item of tangible personal property delivered to a customer in Washington State. The seller is responsible for remitting the RDF to the state, regardless of whether the seller delivers the goods themselves or hires a third party to complete the delivery (Cornfield 2024). The study also assumes that revenue generated from the fee would be divided among three recipients: the state, counties, and cities and towns. The general allocation arrangement, similar in structure to both Minnesota's and Colorado's programs, suggests that both urban and rural areas could benefit from improved transportation infrastructure funded by this fee.

For example, in Minnesota, a portion of the Transportation Advancement Account (TAA) funds, where RDF revenues are deposited, is allocated to small cities with populations under 5,000. Specifically, beginning in FY 2024, these small cities received 27 percent of the TAA's revenues (Minnesota Department of Revenue 2024). While these funds are directed toward transportation infrastructure projects in small cities, the specific allocation toward new mobility programs and services, particularly in rural communities, is not explicitly detailed in the available sources. However, the infusion of funds into small city–transportation projects suggests a commitment to enhancing infrastructure in rural areas, which could directly and indirectly support and improve rural mobility. A forecasting tool was created as part of the study that can calculate county-level allocations, which are determined by various factors including population, roadway miles, VMT, equal share, and proportion of e-commerce sales. Allocations to cities and towns would be calculated based on population and roadway lane-miles.

### *What Makes This Innovative?*

RDFs tap into the rise of e-commerce, online shopping, and evolving consumer habits. They also target specific economic activities—unlike broad-based sales taxes, RDFs allow governments to generate new sources of revenue from a growing segment of the economy without having to raise taxes across multiple sectors. Additionally, RDFs force those who use delivery services to contribute directly to funding the infrastructure (e.g., roads, transportation networks, environmental mitigation) and other public services that support that activity. RDFs can also be adjusted in a variety of ways based on the volume of deliveries, distance traveled, or types of delivered goods, giving government agencies flexibility to scale fees based on funding needs.

#### *Downstream Impacts*

While it is still to be determined how an RDF might impact different stakeholders, small-business owners have raised concerns that levying an additional fee at the point of sale could deter customers from patronizing their business. Owners of the smallest businesses may be exempt if the adopted fee applies only to retailers with gross revenues greater than $1 million, the same as the exemption threshold set in Minnesota but higher than what is in place for Colorado's program. Additionally, the administrative process for small retailers can also be challenging and costly.

Because the fee would be applied to all retail that is delivered within Washington State, the delivery fee will also impact out-of-state retailers. In Colorado and Minnesota, out-of-state retailers were required to register with the state's department of revenue, administer the fee, and remit funds to the state.

#### *Challenges and Lessons Learned*

Rising concerns over potential impacts to low-income households and older adults who rely on food and medicine delivery services have led the states of Minnesota and Colorado to create exemptions. The State of Minnesota created several exemptions to the fee for deliveries involving pharmaceuticals, medical devices, food (including prepared food), and baby products (Minnesota Department of Revenue 2024). The State of Colorado created several exemptions to protect small businesses, including an exemption for retailers with annual sales less than $500,000 and new businesses (Colorado Department of Revenue 2024).

In addition, Colorado also encountered significant administrative challenges when implementing its RDF, particularly regarding complex compliance requirements, software limitations, and varying tax jurisdictions. Businesses were required to collect the fee, itemize it on invoices, and remit it to the state, which necessitated updates to invoicing systems and caused operational difficulties (Cole 2023). Additionally, some businesses faced challenges with software that could not accommodate the RDF, and the fee's varying application based on local tax rules added further complexity. These challenges prompted legislative changes to simplify compliance for businesses.

## 4.5 Curb Management

Curb management innovations are reshaping how cities view and monetize curb space, creating dynamic, demand-responsive revenue models that better meet the needs of current mobility ecosystems. These models generate new funding sources while promoting efficient, sustainable, and fair use of public space. As demand for curb space increases due to the rise of new mobility services, e-commerce deliveries, ride-hailing, and micromobility, innovative management strategies that overlay incentives and pricing are becoming crucial for optimizing the use of this valuable public asset.

### Case Study 6. Curb Management Projects Funded by DOE

#### *Background*

The Los Angeles Cleantech Incubator (LACI) launched a city challenge in partnership with Climate Mayors and C40 cities to pilot a variety of ZE delivery projects with cities across the country. The initial cohort of participating cities, which included Los Angeles, CA; Pittsburgh, PA; and Santa Monica, CA, launched several projects that leveraged curb monitoring and pricing tools to manage curb outcomes, increase space utilization, and generate revenue for emerging curb activities (LACI 2023). The projects also tested new strategies to bolster new mobility and EV adoption to support last-mile delivery and to reduce air pollution in certain communities. Several projects also served as a cleantech demonstration opportunity for automated curb management solutions using Automated License Plate Recognition technology.

Los Angeles established a ZEDZ in the downtown area (Figure 30). This program designated certain streets and neighborhoods where only ZEVs are allowed for delivery. The pilot includes the installation of EV charging stations and micromobility hubs, encouraging the use of e-cargo bikes and EVs for last-mile delivery.

Pittsburgh's project focused on implementing sustainable delivery strategies in collaboration with local start-ups and mobility companies. The city aimed to enhance last-mile delivery by incorporating electric delivery vehicles, including e-cargo bikes and smaller electric vans. Pittsburgh is also exploring the feasibility of establishing a ZEDZ in targeted commercial areas, similar to Los Angeles.

Santa Monica is one of the leading cities in adopting a comprehensive network of ZEDZs. The project covers a significant part of the downtown area and surrounding neighborhoods, where only ZEVs are permitted for deliveries. The program also tested the deployment, implementation, and utilization of various types of light-duty ZE delivery methods, like e-cargo bikes, electric delivery vans, and PDDs, to assess their effectiveness in reducing urban congestion and pollution.

The LACI program employed a combination of public funding, private investment, dynamic pricing, usage fees, and other funding sources to develop a financially sustainable model for ZEDZs. This includes working with the initial cohort of cities to secure a $3.7 million grant from


Source: Los Angeles Cleantech Incubator

***Figure 30. Sign for ZEV loading zone in Los Angeles, CA.***

the U.S. DOE Vehicle Technologies Office to expand curb access initiatives (LACI 2023). As of June 2025, the pilot program was still active.

### *Governance*

LACI established the Zero Emissions Delivery City Challenge in 2023. In its role, LACI supports participating cities in developing innovation sandboxes tailored to their local context and selecting, deploying, and scaling zero-emissions delivery technology, policy, and business innovations. Cities participate in a multicity cohort that receives staff and consultant guidance and has the opportunity to engage in facilitated cohort-based learning sessions. Cities also get access to other shared resources such as assistance in securing funding, pilot grants for start-up innovation, support for pilot deployment, and policy advocacy to scale solutions. LACI will host convenings between public sector partners and technology providers and large retailers to foster cross-sector collaboration.

### *Policy Objective and Model Support*

All three cities aim to reduce emissions from delivery vehicles by accelerating the transition to ZEVs. A greater emphasis is placed on the first and last miles of the delivery journey, as these segments predominantly impact low-income communities disproportionately exposed to pollution and congestion. In addition to these objectives, the LACI program aims to explore and deploy technology, business model, and policy innovations for curb management and last-mile delivery that provide cities with insight and control of commercial activities at the curb. These innovations may include shaping and establishing financial incentives for first- and last-mile zero-emissions deliveries or cordoned pollution pricing zones in key areas of a city's logistics network.

### *Geographic Extent*

The ZE delivery projects are located throughout Los Angeles, Pittsburgh, and Santa Monica.

### *Innovative Revenue Model Mechanisms*

The initial launch of the ZEDZs in each city was supported by grants and public funds, particularly from environmental and transportation agencies. The California Air Resources Board (CARB) funded a portion of the programs in Los Angeles and Santa Monica, while other state and federal environmental initiatives aimed at reducing emissions supported projects throughout the country. The programs also relied heavily on partnerships with private companies that were interested or already investing in the transition to ZEVs. These companies might not have directly contributed funds, but they provided in-kind support through their participation and data sharing.

While the initial phases of each city's program did not rely on user fees, implementing fees or charges was considered for the future. For example, as part of its broader sustainability efforts, Los Angeles had considered implementing congestion charges in high-traffic commercial areas, with exemptions or reduced rates provided for ZEVs entering the cordoned zone. All three cities explored various incentives to encourage businesses and delivery service providers to transition to ZEVs, including subsidies for purchasing or leasing ZEVs, grants for installing charging infrastructure, and tax benefits for companies adopting sustainable delivery practices.

Pittsburgh was the only pilot participant that deployed user fees, which it did as part of its Smart Loading Zone program. In 2024, the city used license plate reading technology to automatically monitor how long vehicles stay at designated curb spots, charging users based on the time spent there. When drivers used these metered loading zones, they were billed by the minute for the exact time they occupied the space. The Smart Loading Zone pricing structure features a graduated fee based on parking duration, with the first 15 minutes being free, then increasing charges per minute for longer stays, typically with the highest rates applied for parking durations exceeding 30 minutes.

### *What Makes It Innovative?*

The program structure and its arrangement with cities encourage them to test and deploy a variety of curb monitoring and to explore various pricing tools to manage their curbs while also developing revenue-generating models for emerging curb use cases.

For example, the City of Pittsburgh received in-kind contributions from Automotus, a curb management software technology platform, through their Commercial Curb Challenge. The project also established potential future revenue generation pathways for the city—the program includes a graduated pricing model that incentivizes delivery drivers to make their stop at the curb quick and efficient, as well as a revenue-sharing agreement between the city and Automotus that supports program administration and the continued expansion of smart loading zones beyond the pilot period (City of Pittsburgh 2023). In the next phase of the pilot, the city intends to incorporate incentivized pricing for ZEVs to facilitate the transition to more sustainable vehicles for goods delivery.

### *Downstream Impacts*

The success of the pilot and cohort-based model has influenced policy discussions around scaling ZEDZs to other parts of the pilot cities beyond initial testing sites. Data and insights gathered from the pilot are also being used to shape future regulations and incentives to further advance clean logistics solutions.

### *Challenges and Lessons Learned*

Establishing the necessary charging infrastructure and other supportive technologies to support the pilot programs requires significant upfront investment. This is a challenge, especially when trying to scale the zone across larger areas. Additionally, ensuring that only ZEVs operate within the zone requires robust monitoring and enforcement mechanisms, adding to the cost of the pilot programs. The reliance on public funding, especially in the early stages, raised concerns about the long-term sustainability of the ZEDZs, further elevating the importance of securing continuous funding or establishing a self-sustaining revenue model.

Some cities are transforming early piloted ZEDZs into priced zones that regulate vehicle access and charge daily based on their emissions, thus pairing strong policy and pricing levers and incentivizing travel in more urbanized areas using less-polluting vehicles. For example, London, an early adopter of ZEDZs, is now operating two concentric pricing zones—the inner cordon or ULEZ that makes up 22 square kilometers in Central London and the outer cordon, which is a citywide LEZ that applies to trucks. Electric, hydrogen, and plug-in hybrid vehicles are allowed in the ULEZ free of charge (Transport Decarbonisation Alliance, C40, and POLIS 2020).

**Zero-Emissions Zones for Freight**

A study by Transport Decarbonisation Alliance, C40, and POLIS (2020) produced a how-to guide for implementing zero-emissions zones for freight (ZEZ-Fs). The guide identifies the following keys to success:

- Align policies across different levels of government,
- Create incentives and other supporting measures,

*(continued on next page)*

**Zero-Emissions Zones for Freight *(Continued)***

- Develop charging infrastructure for electric freight vehicles, and
- Obtain the necessary data.

It also includes the following case studies:

- London, from "ultra low" to zero emissions.
- Santa Monica, with a voluntary ZEDZ.
- Shenzen, China, with Green Logistics Zones.
- Rotterdam, Netherlands, with a ZEZ-F in 2024.
- The Netherlands, with 30–40 cities to implement harmonized ZEZ-Fs by 2025.

## Case Study 7. Dynamic Parking and Loading Pricing Model in Barcelona, Spain

### *Background*

Barcelona's Àrea Integral de Regulació de l'Estacionament (AREA) program is a comprehensive parking management initiative aimed at improving urban mobility, reducing traffic congestion, and promoting sustainability that includes new mobility passenger and urban delivery elements. The program, established in 2005, divides the city into different parking zones, each with specific regulations and pricing based on demand, location, and time of day. Primary goals of the program are to prioritize parking for neighborhood residents, encourage short-term parking, and discourage long-term vehicle stays in congested areas. An increasingly central goal is to use pricing to manage the characteristics of the car (e.g., EVs pay less than vehicles that pollute at higher rates) and to reserve specific spaces for people living in the municipality as a way to constrain supply and prioritize access for local neighbors (Jordi Jové Palou, personal communication, 2025).

The program is divided into three main types of parking zones:

- **Green zones:** These zones primarily serve residents, offering discounted parking rates and the ability to reserve dedicated spaces, while nonresidents can park for a limited time at higher rates. This ensures that residents have access to parking close to their homes while reducing competition for commuters and visitors.
- **Blue zones:** Designed for short-term parking, usually near commercial areas, these zones allow for higher turnover, ensuring that parking spaces are regularly available (similar to the blue zones in Gran Canaria, depicted in Figure 31). Nonresidents can park for a limited time, paying by the hour.
- **Exclusive areas for residents:** In highly congested neighborhoods, certain areas are restricted solely for residents to further ease parking pressures.

A key feature of the AREA program is the use of digital payment systems, enabling drivers to pay for parking via mobile apps or kiosks to enhance convenience and support enforcement. Additionally, the program supports the city's environmental goals by offering incentives for electric or low-emissions vehicles, including free or discounted parking in designated zones (Yanocha et al. 2021).

The city has also established Urban Goods Distribution (DUM) spaces to support commercial loading activities. The space is limited to certain commercial delivery vehicles, which must be categorized in the city's municipal code. The use of a DUM space is limited to 30 minutes to facilitate

Source: Archivo

***Figure 31. Blue zone in Las Palmas de Gran Canaria.***

turnover. To park in the DUM parking spaces, prior telematic validation through a web-based app or by sending a text message is required. Plans are being drawn up to institute curb payments for AREA logistics and loading activities (Jordi Jové Palou, personal communication, 2025).

AREA also dedicates specific parking spaces within its controlled zones for electric shared passenger services, such as EV carshare, and offers free parking, particularly in blue zones (MEC Electric Carsharing, n.d.). This encourages residents to opt for car-sharing services instead of owning private vehicles in the city's most congested neighborhoods. Shared mobility operators are also encouraged to register with the city, which grants them access to these preferential parking areas. Additionally, the AREA program facilitates access to develop mobility hubs that offer services beyond parking. These hubs provide secure bicycle parking (BiciPark) for personal vehicles, EV charging points through the Endolla Barcelona network, and spaces reserved for shared mobility operator fleets (Ajuntament de Barcelona 2024a).

### *Governance*

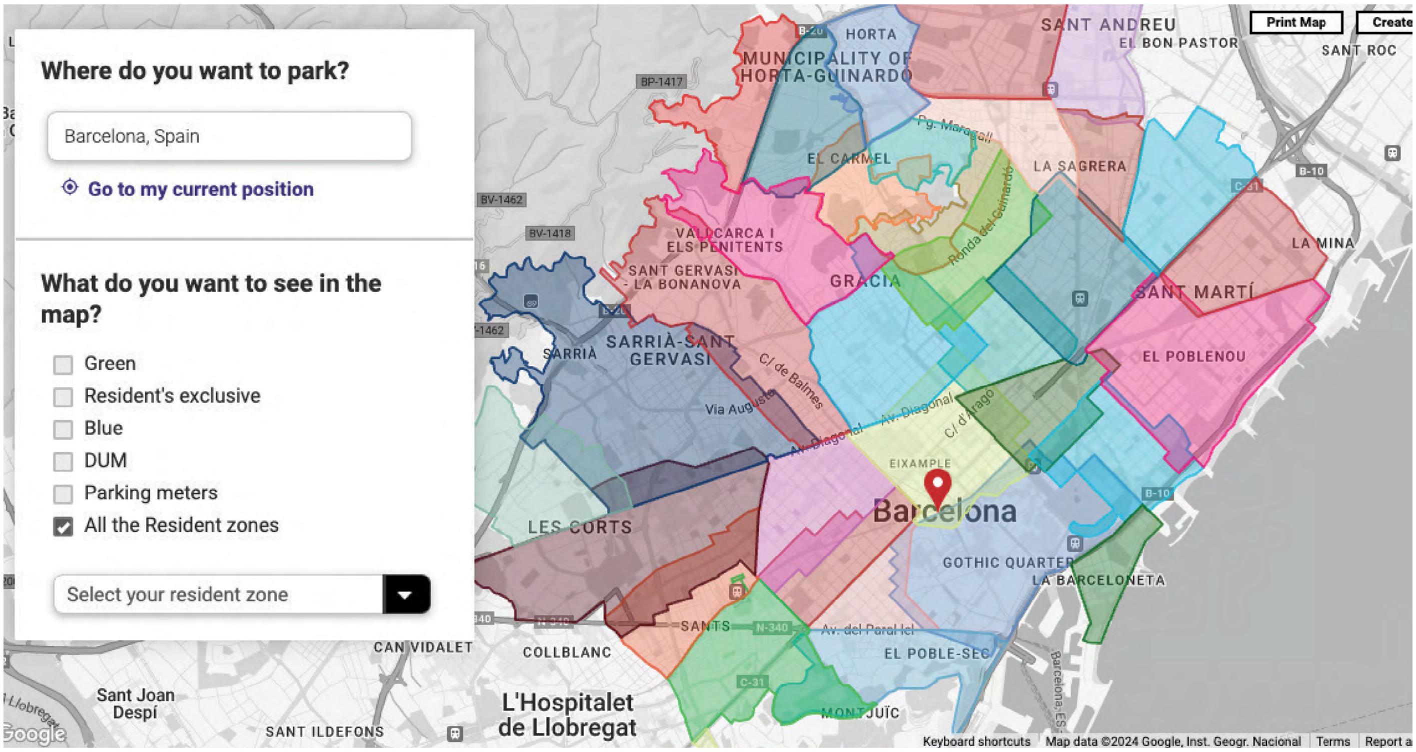
Governance of the AREA program is a multilayer structure involving several public agencies and private sector partners. The Ajuntament de Barcelona (Barcelona City Council) is the primary authority governing the AREA parking program—it sets the policy framework and decides on parking zones, pricing, and regulations. Barcelona de Serveis Municipals is a public entity fully owned by the Barcelona City Council. It is tasked with the operational management of the parking program, including maintenance, enforcement, and the administration of parking permits and fines. It also oversees contracts with private service providers who assist in program delivery. SGA (Sociedad General de Aparcamientos) handles the operational tasks related to on-street parking, such as meter maintenance and the collection of parking fees. SGA also works with technology platforms like Parclick, a parking reservation application, that allows users to pay for parking and monitor parking spaces.

### *Policy Objectives and Model Support*

Key policy objectives for the program include reducing traffic congestion and lowering the number of vehicles circulating in the densest parts of the city, giving residents priority when parking in their neighborhoods, and advancing the city's sustainability goals by incentivizing the use of electric or low-emissions vehicles (Ajuntament de Barcelona 2024a).

### *Geographic Extent*

Figure 32 is a map of Barcelona's parking zones.




Source: Areaverda

***Figure 32. Map of Barcelona's various parking zones.***

### *Innovative Revenue Model Mechanisms*

Parking regulations, time limits, zones, fees, and penalties are outlined in the city's municipal code and determined by the Barcelona City Council. Residents paying for long-term parking permits in their designated green zones participate in a subscription-based model where they pay a monthly, discounted fee. This generates consistent revenue while also providing affordable, dedicated parking spaces for local residents (Jordi Jové Palou, personal communication, 2025).

The program is also supported by digital payment platforms and apps to manage parking transactions, which streamlines the payment process and reduces operational costs related to physical meters and traditional enforcement. This digital-first approach also facilitates real-time data collection on parking trends, enabling more informed decision-making and adjustments to pricing strategies (Ajuntament de Barcelona 2024b).

### *What Makes This Innovative?*

The revenue model for Barcelona's AREA parking program is considered innovative due to its multifaceted approach that integrates dynamic pricing, environmental incentives, and digitalization to optimize urban mobility and sustainability while generating income. The AREA program adjusts parking fees based on factors like location, time of day, and demand. This model helps maximize revenue by charging higher prices in busy areas or during peak hours, while lowering costs in less congested areas.

The system also categorizes parking into tiered zones, each with distinct pricing. This zonal differentiation allows for a more granular approach to pricing and ensures that different user groups (e.g., residents, nonresidents, commuters) are charged appropriately, contributing to a fairer revenue distribution. Additionally, the program's incentives for LEVs, including dedicated, preferential parking spaces and reduced pricing, are helping to expand the adoption of sustainable shared mobility services.

Additionally, the revenue generated from AREA parking fees supports the creation of mobility hubs, which are increasingly being used for shared mobility services. These hubs replace traditional parking spaces with infrastructure that supports a wide range of ZEV and shared mobility options, promoting sustainability. Revenues are also reinvested in projects that support mobility transformation, including improving public transportation infrastructure, expanding EV charging stations, and enhancing shared mobility services.

### *Downstream Impacts*

Revenue from parking fees is funneled back into the city's broader mobility initiatives, such as improving public transportation infrastructure, enhancing shared mobility services, and expanding bike lanes and pedestrian areas. This circular revenue model ensures that funds generated from parking are used to reduce the city's overall dependence on cars and promote more sustainable modes of transportation. The AREA program's revenue also supports the city's green initiatives, such as increasing the number of charging stations for EVs and enhancing air quality monitoring.

### *Challenges and Lessons Learned*

The shift toward more regulated and paid parking areas, particularly with the introduction of environmentally focused tariffs, faced resistance (Valerio 2016). Residents and visitors were often unfamiliar or frustrated with the new system, particularly when trying to adjust to the different pricing schemes in various zones. Also, in spite of efforts to encourage the use of greener vehicles by offering reduced parking rates, many drivers were slow to adapt. The city needed to enhance communication strategies to better inform the public of the benefits of transitioning to LEVs and ZEVs.

## Case Study 8. Smart Loading Zones in Oakland, California

### *Background*

In 2023, the City of Oakland converted 380 loading zones (like the one in Figure 33) into smart loading zones to allow commercial fleet operators to digitally book and pay for curbside


Source: Iringa Strelnikova

***Figure 33. Traditional loading zone in the City of Oakland.***

space by the minute using GPS technology from their vehicles (Descant 2023). The program is implemented in partnership with a digital data analytics platform that equips cities with the information and data analytics capabilities to more effectively manage their public ROW. To participate, commercial fleet operators can register for a permit on the platform's website. The first 15 minutes of parking in a smart loading zone are free, after which the city charges by 15-minute increments. Permit holders will not need to pay each time they park at a metered space. Instead, parking fees will be calculated automatically, and an invoice will be provided quarterly. Operators pay $3.00 per vehicle each year and $0.03 per minute of parking, with the goal of incentivizing faster loading and unloading times and improving delivery efficiency on congested commercial corridors (Populus 2024). The total cost for installation over a two-year period is estimated at $450,000 and is anticipated to generate $450,000 in annual revenues (Oakland Department of Transportation 2022).

### *Governance*

In partnership with platform providers, the City of Oakland's DOT oversees program administration. The department establishes the policy objectives of the program and ensures alignment with the city's goals related to safety, sustainability, and distributional impacts. The platform provider supplies the smart sensors, data management platforms, and analytics capabilities to support the program. The platform provider also manages permit applications and invoicing as well as facilitates the sharing of real-time information on regulations and curbside activities between commercial fleet operators and city partners through its platform.

### *Policy Objectives and Model Support*

Goals for the Smart Loading Zone pilot program include curbing dangerous parking behavior to improve road safety, correcting the misuse of commercial loading zones by noncommercial vehicles, streamlining parking enforcement, reducing traffic congestion, and better managing curb access as on-demand delivery services continue to grow (Castillo 2023). The program is supported by the city's Zero Emission Vehicle Action Plan, a roadmap to support the city's transition to an emissions-free system by 2045 (Kerby Olsen, personal communication, 2025).

The platform provider uses its platform to manage permit applications, issue invoices to commercial fleet operators, and to collect and manage curbside activity data within the loading zone. The program also uses CDS, a data standard used to pilot and scale dynamic curb zones. CDS enables cities to digitally express static and dynamic curbside regulations, measure activity at the curb, and develop policies that expand access to the curb. This allows the program to gather critical insights that can inform pricing changes and adjustments to the city's supply and distribution of commercial loading zones.

### *Geographic Extent*

The zones are found throughout Oakland.

### *Innovative Revenue Model Mechanisms*

To support this model, the City of Oakland established a new permit program that is comanaged by the platform provider. Populus supports the city in collecting permit fees and calculating per minute parking fees based on vehicle location data. Handling permits, fees, and payments through a platform reduces the administrative burden on city staff and on delivery drivers, who often do not have the time or company-provided resources to pay meters.

### *What Makes This Innovative?*

The city designed the program to function much like regular parking meters in terms of user experience, ease of enforcement, and intent. In crafting the approach, Oakland consulted with other Bay Area cities that had implemented similar programs. They found that while metered loading zones improved turnover and curbed illegal use, their revenue often lagged behind that of surrounding parking meters. With this in mind, Oakland opted for a preregistration system, eliminating the need for drivers to interact with meters while also ensuring cost recovery. Traditionally, 3PL companies do not provide employees with payment cards for parking; instead, they assume citations as a cost of doing business and pay them after the fact. The program shifts this dynamic by ensuring that companies pay automatically, creating mutual benefits for the city and delivery drivers—no tickets or citations for drivers and a more efficient, predictable revenue stream for the city (Kerby Olsen, personal communication, 2025).

Additionally, by levying a per minute fee, commercial delivery drivers are disincentivized to dwell for extensive periods of time when conducting loading activities, and loading zones are made available to legitimate commercial delivery drivers. Administering the fees without the use of hardware also saves time for commercial delivery drivers and, if a citation is warranted, enforcement officers. The city will have up-to-date information on the demand for commercial loading spaces in key neighborhoods, which can help staff identify corridors within those neighborhoods that need more loading zones (Oakland Department of Transportation 2022).

In addition to usage-based fees, which are the primary revenue mechanism, the city's technology platform partner also works with the city to collect valuable data on delivery vehicle activity. Oakland has considered using this data to analyze traffic patterns and identify bottlenecks as well as potentially selling the data to logistics companies for optimizing delivery routes to generate additional revenue; however, this would require more delivery companies to regularly use the zones (Kerby Olsen, personal communication, 2025).

### *Downstream Impacts*

Commercial delivery operators and businesses that are smaller and rely on frequent deliveries may be financially impacted since they would face higher operational costs due to the permit fee and per minute parking charges. This could lead to higher prices for goods and services as businesses pass on these costs to customers. On the other hand, levying fees and requiring permits to access curb space not only generates new revenue streams but also supports the city in facilitating efficient management of loading zones.

Given the program's time-based fee structure, which includes no charge for the first 15 minutes followed by a per minute fee, integrating vehicle location data with digital payment systems is necessary to reduce the administrative burden associated with running the program. The downstream impacts of supporting multilayered fee structures may increase the use of app-based solutions to track parking time and facilitate payment.

### *Challenges and Lessons Learned*

Dedicating time, staff resources, and funding to conduct extensive stakeholder engagement with local businesses, residents, commercial fleet operators, and delivery drivers was critical to the success of the program. However, adoption among delivery drivers was a primary challenge, not due to lack of interest but because enrollment was limited. The city relied on its partners to engage with delivery companies, but outreach efforts fell short. In practice, a handful of major delivery companies account for a majority of commercial loading activity in the city, meaning there was not a broad audience to engage with. Yet, few companies signed up, limiting the program's impact. Potential reasons for limited enrollment may be attributed to hesitation among commercial fleet operators to share vehicle location data and changes that would require drivers to shift away from the paper-based systems they often use to collect and manage delivery information (Kerby Olsen, personal communication, 2025).

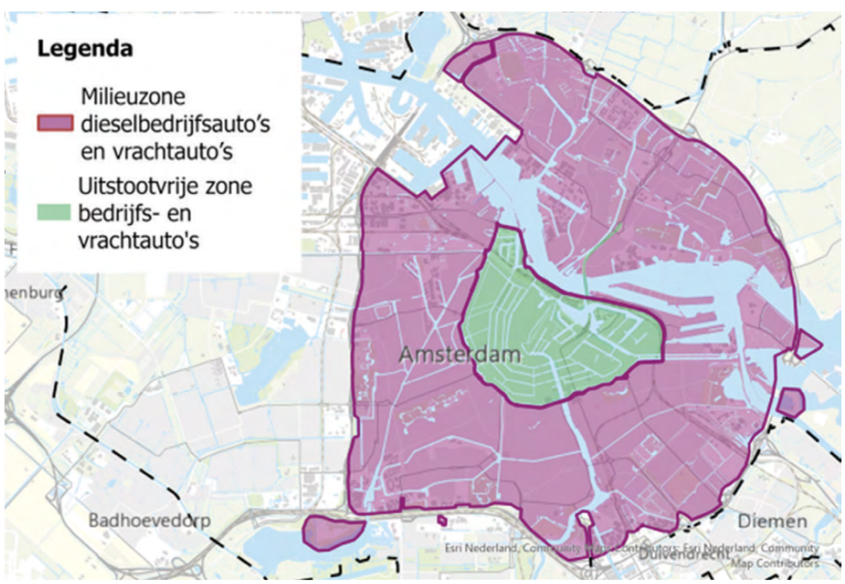
While the program achieved its goals of reducing illegal parking in commercial loading zones, minimizing occurrences of double parking, and increasing curb access for commercial vehicles, the revenue model still needs refinement. Since the pilot, Oakland is considering integrating multivendor systems and partnering with parking operators to expand payment options and support program management. Additionally, the city is also exploring enforcement strategies, such as automated enforcement, as a means to drive participation, recognizing that the design of the revenue model itself will not address the need for greater program participation (Kerby Olsen, personal communication, 2025).

## Case Study 9. Zero-Emissions Logistics Zones in the Netherlands

### *Background*

The Netherlands' ZEZs are small, designated areas (1.5 to 11 square miles) where only ZEVs (e.g., bicycles, electric cars and trucks, and e-cargo bikes) and pedestrians are granted unrestricted access. Gas- and diesel-powered vehicles are either prohibited or forced to pay an access fee to enter the zone. ZEZ boundaries must capture at least the city center and its surrounding neighborhoods. Current iterations of ZEZs, such as those implemented in Amsterdam (Figure 34), Rotterdam, Utrecht, and Nijmegen, have banned certain logistics vehicle types and delivery vehicles of a specific size.

The implementation of ZEZs is anticipated to have ripple effects across the logistics and mobility industries. For example, ZEZs are driving the creation of urban logistics hubs at the peripheries of cities. These hubs serve as transfer points where goods are offloaded from large vehicles travelling regionally to smaller, light-duty ZEVs or cargo bikes for last-mile delivery within the ZEZs. Secondary effects include the growth of shared electric mobility services, such as electric car-sharing programs, e-scooters and e-bikes, and automated shuttles, and the electrification of privately owned, diesel-powered fleets. Cities are deploying a variety of policies and incentives to help logistics companies, freight operators, and e-commerce providers transition to using ZEVs. For example, Amsterdam is providing incentives to businesses to use e-cargo bikes




Note: As of January 1, 2025, Amsterdam's LEZ spans the A10 ring road (outer boundary), while the ZEZ covers the city center within the S100 (inner boundary).

Source: City of Amsterdam

***Figure 34. Amsterdam's LEZ and ZEZ.***

for last-mile delivery as well as generous subsidies to help small businesses transition their fleet over a five-year transition period. Starting January 1, 2025, municipalities across the Netherlands will be allowed to designate ZEZs where all new logistics vehicles must be emissions-free. Currently, 14 Dutch cities have launched ZEZs, and at least 30 cities are anticipated to develop ZEZs for all logistics vehicles in 2025 (Netherlands Enterprise Agency RVO 2024).

### *Governance*

Governance for the Netherland's ZEZs is a multitiered approach involving national legislation, regional implementation, and local management. The Dutch government, led by the Ministry of Infrastructure and Water Management, establishes the legal and regulatory framework and provides guidelines for the creation of ZEZs. Regional or provincial governments ensure alignment between ZEZ implementation and broader regional mobility plans. They also guide and support municipalities in their implementation of ZEZs, making sure there is some consistency across the region. This might include regional infrastructure development for EVs and charging stations. Municipalities are responsible for implementing and managing ZEZs. They set the specific boundaries of the ZEZs, determine which vehicles are affected, manage the permitting and compliance process, and monitor the effectiveness of ZEZs by collecting data on vehicle emissions and traffic patterns. Local governments may also enter into voluntary agreements with private logistics companies to phase in ZEVs during the early stages of implementation.

### *Policy Objectives and Model Support*

The primary objectives of ZEZs include reducing particulate matter and $CO_2$ emissions in urban areas and gradually banning the use of fossil fuels for commercial deliveries. The Dutch government's National Climate Agreement (Schone Lucht Akkoord) sets ambitious targets to reduce $CO_2$ emissions by 49 percent by 2030 and 95 percent by 2050 relative to 1990 levels (Grantham Research Institute 2019). ZEZs for urban logistics play a major part in helping to achieve these targets and in supporting the country's ultimate goal of gradually banning the use of diesel. Additional policy objectives of ZEZs include promoting the adoption of ZEVs for both goods delivery and passenger services by creating demand for electric and hydrogen-powered vehicles and encouraging businesses to replace diesel and petrol vehicles with ZE alternatives.

In addition to defining ZEZs, the National Climate Agreement has also established a framework guiding the application of national policies in municipalities leading up to the 2025 rollout. Providing a framework at the national level is meant to avoid creating a patchwork of different rules in various municipalities. National policy also requires city councils and municipal governments to provide at least four years' notice before imposing bans on all gas- and diesel-powered vehicles to align with national plans for emissions-free road traffic by 2050 (Broom 2021). Some cities have established transition periods for some types of logistics vehicles until 2030, allowing carriers to enter ZEZs until the transition period ends.

During this transition period, national and local governments are also providing subsidies and incentives to support the transition to zero-emissions logistics, including issuing grants and rebates for purchasing or leasing commercial ZEVs as well as tax breaks and subsidies for charging infrastructure (Xue and Ke 2024). Many cities and provincial governments are also rolling out a network of EV charging stations before the ban comes into effect in 2025. Additionally, smaller cities like Nijmegen are leading by focusing on a three-pronged approach of integrating clean vehicles, smaller zero-pollution vehicles (like e-cargo bikes), providing education to promote the ZEZs and supporting shifts in business operations. Small cities like Nijmegen are trying to advise small-business owners of their options for shifting to clean logistics (F. Schneider, personal communication, 2025).

While most other cities are trying to manage the panic around ZEZ implementation, the City of Arnhem has taken a more measured approach. Arnhem will open their ZEZs in mid-2026, over a year later than most other large Dutch cities. Their approach has been to learn from the other cities' experiences and spend more time engaging the delivery chains and local businesses on fleet transition and operational changes (F. Schneider, personal communication, 2025).

### *Geographic Extent*

The zones are found in cities across the Netherlands.

### *Innovative Revenue Model Mechanisms*

The National Climate Agreement of 2019 set out a requirement for the largest 30 to 40 Dutch cities to implement ZEZs by 2025. By 2025, all vehicles except for passenger cars must be zero-emissions to access the ZEZ, and by 2030, all modes need to be zero-emissions to access the citywide ZEZ. To facilitate the transition and advance national clean energy goals, cities can apply for national funding to support program rollout and preliminary infrastructure implementation. National funding, which requires a local match, can be used to hire project advisors and to purchase cameras and enforcement technology. Cities do not receive any fine or enforcement revenue once the ZEZ has been implemented. Instead, this revenue is directed to the Openbaar Ministerie, part of the Dutch judicial branch (F. Schneider, personal communication, 2025).

While revenue generation is important to ensure ZEZs become financially self-sustaining, it is considered less of a focus than reaching desired emissions reduction targets and improving air quality. To sustain the program once implemented, Dutch cities are adopting a multitiered revenue model that generates funding from a combination of access fees, dynamic pricing, public-private partnerships, and government subsidies (F. Schneider, personal communication, 2025).

For instance, the City of Amsterdam plans to regulate diesel vehicles that do not meet certain emissions standards (e.g., EU Standard Euro 4 or better for cars and vans, or the latest EU Standard Euro 6 for heavy-duty vehicles) by limiting their access to the city center through fees. The City of Amsterdam has also deployed smart loading zones where variable fees for curb access and loading zones based on vehicle type, time of day, and location incentivize the use of vehicles with zero-emissions for intra-ZEZ travel and logistics. In cities like Rotterdam and Utrecht, urban logistics hubs are financed through public-private partnerships, with private companies leasing space at hubs and cities collecting rental income or service fees in return for offering preferential access to the ZEZs (Xue and Ke 2024).

The Dutch government also established national laws that empower cities to create and set the parameters for their ZEZs as they move toward a zero-emissions future. Cities are authorized to impose restrictions on business vehicles initially, followed by private vehicles. They also have the authority to tailor access restrictions based on local needs and challenges. Cities can also grant exemptions, particularly during the early stages, to minimize the impact that ZEZs might have on residents and businesses living or operating in or near a zone.

The revenue collected is reinvested into expanding charging infrastructure to support EV adoption, logistics hubs, and subsidies to support fleet transitions to ZEVs. Cities are also finding opportunities to explicitly include these access restrictions in public tenders for transportation service providers (Xue and Ke 2024).

### *What Makes This Innovative?*

The revenue model for the Netherlands' ZEZs leverages a mix of national and municipal regulatory frameworks, incentives for businesses, and integration with broader environmental and economic development strategies. It also combines dynamic pricing, public-private partnerships, digital enforcement, and subsidies to create financially sustainable solutions for reducing emissions and improving urban mobility. This model not only helps to generate funds for green infrastructure projects but also incentivizes behavior change in goods delivery and shared passenger services. By restricting access to high-emissions vehicles and potentially charging fees or penalties for those that do not comply with emissions standards, cities are encouraging businesses and individuals to adopt cleaner vehicles or pay a price for continuing to pollute.

### *Downstream Impacts*

By combining regulatory frameworks and financial incentives to support the transition to zero-emissions, ZEZs are stimulating demand for clean technologies and green industries, opening up new business opportunities and jobs in green technology. ZEZs are also pushing the logistics sector to innovate and adapt by employing new practices, such as deploying a variety of last-mile delivery solutions (e.g., e-cargo bikes, micromobility, automated delivery systems, electric delivery bots, and delivery trucks that are more sustainable) within city centers, transitioning fleets to ZEVs, introducing new business models, and using urban consolidation centers. In doing so, ZEZs are helping to drive the growth of light-duty electric trucks, e-cargo bikes, charging stations, and micromobility services among local businesses.

Even with incentives, the transition to ZE fleets can be expensive, particularly for small- and medium-sized enterprises in the logistics, retail, and transportation sectors. Without the appropriate mix of incentives and support, these businesses might struggle to afford new vehicles or compliance costs since they are operating with low margins.

Given that ZEZs in the Netherlands are still in their infancy, it is unclear how ZEZs are impacting individual delivery trips and load capacity per trip. Measuring this level of impact is challenging due to growing demand for goods delivery and continued population growth. Universities of applied sciences and industry players themselves are funding research to glean insights from ZEZ implementation.

### *Challenges and Lessons Learned*

Cities are structuring future funding allocations for ZEZs by separating investment (capital projects) from operations budgets, with both receiving support from national and municipal governments over the next two years. However, it is anticipated that subsidies will decline in the coming years. From now until 2026, it is expected that additional funding will be necessary to support local implementation, business fleet transition, and operational changes, beyond what is already accounted for in both national ministry and local municipal budgets. Additionally, it is expected that an increasing share of national funding will need to go toward power supply and charging infrastructure, as this remains a critical challenge in both the near and long term (F. Schneider, personal communication, 2025).

Recognizing the ongoing costs and maintenance required for ZEZs, some cities gradually shifted from a more aggressive to a more measured implementation approach. For example, early on, Amsterdam had considered applying access restrictions to all gas- and diesel-powered vehicles—including private passenger vehicles—within their city centers to bring transportation emissions closer to zero by 2030, rather than limiting access restrictions to just commercial vehicles. However, due to concerns around public acceptance and to minimize potential impacts to residents and small businesses near and within the ZEZ, Amsterdam ultimately adopted a phased approach. This involves applying access restrictions first to commercial light-duty trucks and vans and postponing restrictions on private vehicles until after 2030, giving the city ample time to raise awareness, solicit feedback from carriers, and foster public support (C40 and Transformative Urban Mobility Initiative 2020). This approach would also allow cities as large as Amsterdam and as small as Nijmegen to make adjustments while working to create a self-sustaining program, one in which municipal and national governments step back over time (F. Schneider, personal communication, 2025).

Other lessons learned include implementing ZEZs in smaller, high-visibility areas of the city (e.g., urban districts with high levels of air pollution and traffic congestion, plus limited parking supply) and expanding the boundaries over time.

## 4.6 Programs to Address Environmental Goals and Improve Access

Programs designed to address environmental goals and to improve access by expanding the availability of mobility options are driving the creation of innovative revenue models by aligning financial mechanisms to those goals. Some programs issue green bonds or set up climate funds specifically to finance sustainable mobility options. The revenue generation from these financial instruments is used to promote environmentally friendly shared mobility solutions. Public-private partnerships focused on the environment and access to transportation often introduce revenue models that blend private investment with public funding. These partnerships might offer mobility services in exchange for exclusive rights to operate in certain areas (or to participate in certain programs). Subsidies also play a critical role in financing programs that provide targeted financial support to lower mobility costs. These financial mechanisms help bridge the gap between the actual cost of these services and what users or operators can afford.

### Case Study 10. E-bike Program Subsidy for Food Delivery in San Francisco, California

*Background*

An overwhelming majority of delivery workers in San Francisco rely on cars to complete deliveries. In 2020, just over one in four San Francisco delivery workers used bicycles as their primary mode for deliveries, and of those workers, 11 percent used an e-bike (Benner et al. 2020). With ambitious mode-shift goals, rising unaffordability, and congested curbsides stemming from the growth of food delivery services, the city wanted to prove that e-bikes (Figure 35) could address some of its congestion and emissions problems while supporting worker wages.


Source: Mission Local

***Figure 35. E-bike leveraged for food delivery services.***

In 2023, the San Francisco Environment Department received a $2.4 million grant from the California Energy Commission to develop a one-year e-bike delivery pilot program that provides e-bikes, safety equipment (e.g., helmets, bike locks, bike bags), and training on using e-bikes to up to 30 San Francisco food delivery workers to complete deliveries (Carey 2023). Phase 1 of the pilot program, which included the first cohort of e-bike riders and the driver control group, ran from June 2023 to March 2024. The second cohort of e-bike riders for Phase 1 launched in September 2023. The city received an additional $600,000 from the U.S. DOE to launch Phase 2 of the program in fall of 2024, which builds on the success of the initial pilot phase and will include more than 60 participants. The pilot program seeks to understand the impact that e-bikes have on bike safety, delivery efficiency, and worker revenues.

### *Governance*

The San Francisco Environment Department administers the pilot program in partnerships with GRID Alternatives (implementation partner), the San Francisco Bicycle Coalition (safety training partner), and Driver's Seat (data collection partner). Driver's Seat is a mobile-based application used to compile data on worker, community, and climate outcomes.

### *Policy Objectives and Model Support*

The key objective for piloting subsidization of e-bikes to support on-demand deliveries is to understand how expanding access to e-bikes might impact

- **Delivery efficiency:** Can low-emissions micromobility devices help to increase the number of trips a delivery worker can complete?
- **Local traffic congestion:** Can the shift from cars to e-bikes reduce the occurrence of double parking along commercial corridors?
- **The city's transportation emissions:** Can shifting more delivery drivers from cars to e-bikes help reduce emissions?
- **Worker earnings:** Can the shift to e-bikes boost the income of delivery workers by enabling more deliveries?

This initiative aligns with San Francisco's Climate Action Plan, which seeks to have 80 percent of trips taken through low-carbon modes of transportation (San Francisco Municipal Transportation Agency 2023).

### *Geographic Extent*

The subsidy applies to operations in San Francisco.

### *Innovative Revenue Model Mechanisms*

To participate, delivery workers must apply and agree to work an average of at least 20 hours a week with mobile food ordering platforms like GrubHub, UberEats, or Doordash over a four-month period (San Francisco Environment Department 2023). In exchange, participants receive a bike helmet, bike lock, bike bags, and safety training on how to use e-bikes, the cost of which was covered by grant funding. They were also required to complete surveys and participate in data collection to help inform future environmental policy for the city. At the end of the program, participants who complete the required tasks get to keep the e-bike and accessories.

### *What Makes This Innovative?*

Subsidizing e-bikes for food delivery workers using grant funding that is focused on advancing local and state climate goals is innovative in that it combines climate and safety objectives with support for the urban delivery service workforce. The funds are also used to address a specific, often underrepresented group of workers who may not have the means to invest in low-carbon mobility solutions on their own. San Francisco's on-demand delivery workforce is highly diverse, with nearly 75 percent identifying as people of color and 36 percent as immigrants (Benner et al. 2020). Additionally, one in four delivery workers reported receiving some form of public assistance (e.g., SNAP, housing assistance, Cal Works) (Benner et al. 2020). Providing them with e-bikes, supportive gear, and safety training increases access to low-carbon and low-cost transportation. The funding also supports data collection and analysis to understand how the investment impacts key performance measures (e.g., worker earnings and delivery efficiency of e-bikes).

### *Downstream Impacts*

Leveraging grant funding to purchase and distribute e-bikes to pilot participants supports the transition to clean mobility options within a population that may not otherwise be able to afford e-bikes. The success of the program could also prompt on-demand delivery platforms to incentivize the use of e-bikes and other low-emissions micromobility options to complete deliveries.

### *Challenges and Lessons Learned*

By negating the upfront cost of an e-bike, the pilot program reduced access barriers for delivery workers who otherwise would be less likely to shift from using cars to more sustainable modes for delivery work. All pilot participants responded positively when asked about their experience using e-bikes for deliveries during the pilot. Every participant reported they would use their e-bikes for more than delivery work, including traveling around the city, commuting to other jobs, general exercise, and leisure trips (Sciaruto, Trewn, and Lin 2024). More than three-quarters of participants also reported they would continue to use their e-bikes for delivery work.

Additionally, the study found e-bike deliveries eliminated 2,296 VMT and produced a fraction (1.6 grams) of carbon dioxide equivalent emissions ($CO_2e$) per mile compared to deliveries completed by gasoline-fueled cars (390 grams of $CO_2e$ per mile) (Sciaruto, Trewn, and Lin 2024). This 99 percent reduction in emissions is partly attributed to the urban efficiencies from using e-bikes for deliveries. E-bike couriers reported that they spent less time in traffic, that traffic was never an issue, and they had an easier time parking in smaller spaces, reducing the likelihood of double parking or needing to cruise for available curb space.

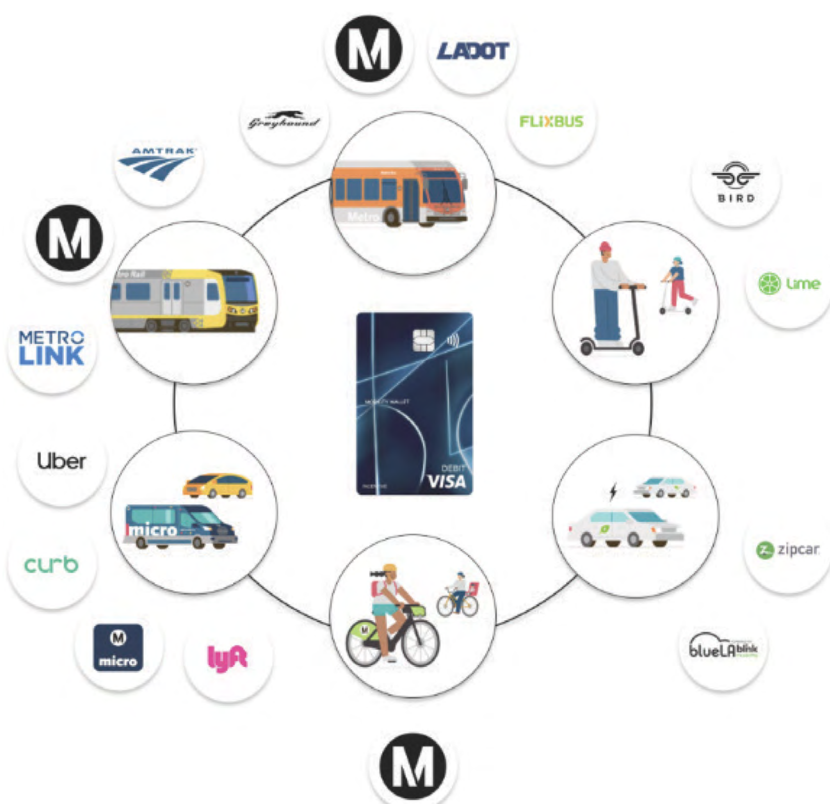
Although pilot participation was largely positive, several factors could impede the long-term scalability and financial sustainability of subsidizing e-bikes for delivery work. For instance, the study found e-bike participants generally worked fewer hours and earned less per delivery than their car-based counterparts (Sciaruto, Trewn, and Lin 2024). The earning disparity between e-bike and car-based couriers is partly attributed to receiving fewer deliveries per shift and long wait times between orders. While it is unclear why e-bike delivery workers received fewer deliveries, the study suggests it may be due to lower ratings and cancellations resulting from longer delivery times via bike (Sciaruto, Trewn, and Lin 2024). In some cases, e-bike couriers reported having to cancel orders due to a mismatch between the delivery load and the load capacity of their e-bike. Despite average lower earnings per delivery, the study found that, due to lower operating costs, the average profit gained per delivery for e-bike couriers ($10.69) was relatively close to those completed by car ($11.47) trips (Sciaruto, Trewn, and Lin 2024). Taking into account maintenance, fuel, insurance, depreciation, and other factors, the study noted that e-bike couriers could earn a greater profit margin in the long run compared to car-based couriers.

Although the study's primary focus was to compare the environmental and labor impacts of using e-bikes versus cars for delivery work, it also recognized that subsidizing and distributing e-bikes alone is not a sustainable solution. Additional public policies and operational changes are needed for courier services to address the earning disparities and other obstacles to long-term adoption. One key recommendation from the study was for the City of San Francisco to consider funding an e-bike rebate program that would include other form factors, such as e-cargo bikes, safety-certified e-bike conversion kits, adaptive bikes, and used e-bikes (Sciaruto, Trewn, and Lin 2024). By supporting access at different price points for different form factors, the city would be able to connect more residents, including delivery workers, to green mobility options. The study did not explore funding options to support the e-bike rebate program; however, potential pathways to consider may include imposing a green delivery fee or tax on delivery platforms, similar to the city's tax on ride-hailing companies to fund public transit. The study also recommended that the city work with courier service platforms to right-size orders by load capacity and to prioritize e-bike couriers for shorter, urban trips within city centers while having car-based couriers handling longer trips (Sciaruto, Trewn, and Lin 2024).

## Case Study 11. Mobility Wallets in Los Angeles, California

### *Background*

In 2022, Los Angeles' Universal Basic Mobility (UBM) program launched the Mobility Wallet pilot program (Figure 36) as part of a broader effort to increase access to affordable and sustainable transportation solutions for underserved communities. The pilot offers prepaid "mobility wallets" to income-eligible residents in South Los Angeles, which come in the form of physical debit cards and are preloaded with funds that can be used to pay for trips across various modes of transportation, enabling participants to choose the most suitable options for their travel needs. Mobility services that can be paid for with the mobility wallets include public transit, shared scooters and bikes, ride-hail, commuter rail, and taxis. Funds from mobility wallets can also be used to purchase merchandise at local bike shops. The program primarily focuses on residents in areas with limited transportation options, high poverty rates, and significant car dependency.




Source: The Source

***Figure 36. Mobility Wallet ecosystem within Los Angeles' Universal Basic Mobility program.***

Both phases of the pilot program are funded through state grants and supported by partnerships with community-based organizations and transportation providers. CARB awarded the Los Angeles Department of Transportation (LADOT) $13.8 million in 2022 as part of their Sustainable Transportation Equity Project grant, with LADOT providing an additional $4 million to support Phase 1 (LADOT 2022). Community-based organizations, such as South LA EcoLab, also allocated a grant portion to LADOT as a subrecipient of their Transformative Climate Communities planning grant, another California state grant, to expand several UBM program elements, including EV carshare, e-bike libraries, and EV charging infrastructure (LADOT 2022).

During Phase 1 of the Mobility Wallet pilot program, 1,000 residents in the South LA UBM pilot area received a prepaid debit card with $150 a month for 12 months to spend on transportation needs. Phase 2 of the program will involve 1,000 additional residents across Los Angeles County who will receive $1,800 over 12 months (LADOT 2022). The Los Angeles Mobility Wallet pilot program is currently the largest mobility wallet program in the nation.

**Mobility Wallets in Pittsburgh, Pennsylvania, and Portland, Oregon**

Los Angeles' Mobility Wallet pilot program is the latest iteration of several mobility wallet pilot programs that similarly sought to improve distributional outcomes while increasing access to low-carbon mobility options. These programs also generated one-time funding using a variety of sources, including a heavy reliance on local, state, and federal grants.

Pittsburgh's Mobility Wallet program was supported by a collaboration between public and private entities, including funding from the RK Mellon Foundation and Spin, a mobility service provider that offered residents in underserved neighborhoods a mix of free and subsidized transportation options (Shared-Use Mobility Center 2022). Revenue-sharing in Pittsburgh's Mobility Wallet program is tied to partnerships with mobility providers, including Spin, POGOH bikeshare, and Zipcar, which collectively receive subsidies through the program. These mobility providers offer discounted services to participants (City of Pittsburgh 2023). This model aims to balance offering affordable mobility for residents with ensuring that mobility service providers maintain a steady income.

Portland's Transportation Wallet Program was initially launched to reduce parking congestion, achieve transportation policy goals related to environment and distributional impacts, and provide low-income residents with discounted fares. About $300,000 is allocated to the program annually from city parking revenue, state gas taxes, vehicle registration fees, and other sources. Additionally, the wallet is partly funded by a 20-cent transaction fee levied on metered parking, generating about $2 million per year (Griggs 2022).

### *Governance*

The Mobility Wallet pilot program is jointly administered by LADOT and the Los Angeles County Metropolitan Transportation Authority (Metro), the county's public transit provider. LADOT oversees the day-to-day operations, manages funds, and coordinates with service providers, ensuring that the program aligns with the policy framework for the UBM program. Metro played a critical role in securing funding for the Mobility Wallet program, leveraging local, state, and federal grants and managing contributions from public and private partnerships. Metro ensures that the Mobility Wallet is interoperable with existing transit services.

LADOT and Metro also solicited the support of local, community-based organizations (e.g., South EcoLab and South Los Angeles Transit Empowerment Zone) and nonprofits and advocacy groups (e.g., LACI, LA County Bicycle Coalition, People for Mobility Justice, and Ride-On! Bike Cooperative) to inform the program design and to perform outreach and community engagement (California Air Resources Board 2024). The Southern California Association of Governments—the region's MPO—along with several council districts, the mayor's office, the California Department of Transportation's California Integrated Travel Project, and several other city departments also provided in-kind and, in some cases, financial support to kickstart the program (Mitteenn 2023). LA Metro also partnered with the University of California, Los Angeles, to support data collection and program evaluation.

### *Policy Objectives and Model Support*

The primary objective of LADOT's UBM program and the Mobility Wallet pilot program is to "eliminate functional and/or structural immobility people experience due to systemic marginalization, cost burdens, and other forms of exclusion by adopting a UBM approach to transportation," with the end goal of helping people in underserved communities become more mobile and improve their connections to jobs, services, and opportunities (LADOT 2022).

While distributional impacts are the cornerstone of the project, the Mobility Wallet pilot program also seeks to leverage existing and emerging technology solutions to integrate access across existing and new transportation options, introduce new shared mobility options to residents and workers, expand and integrate fare payment subsidies, and expand electrification in some of the city's most polluted neighborhoods.

### *Geographic Extent*

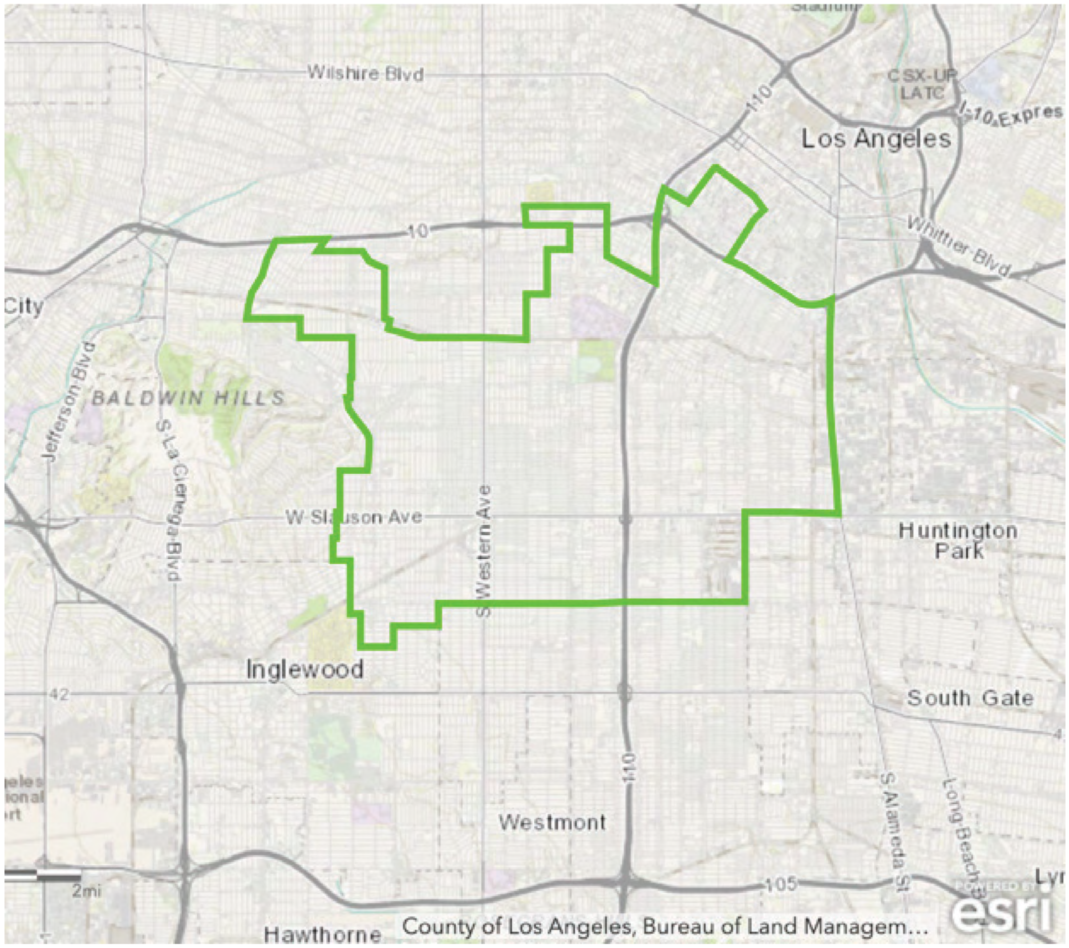
Phase 1 of the Mobility Wallet pilot program was limited to the South LA UBM pilot area (Figure 37), an area that is home to over 370,000 residents, with 29 percent of households below the poverty level and 19 percent receiving SNAP benefits (Mitteenn 2023). All of the project area also qualifies as either a Disadvantaged Community under Senate Bill 535 or a Low-Income Community under Assembly Bill 1550.

### *Innovative Revenue Model Mechanisms*

The Los Angeles Mobility Wallet pilot program has multiple funding streams that collectively support its operations and growth. The initial phases of the program were paid for by seed funding from federal, state, and local grants aligned with LADOT and Metro's goals of improving mobility access, promoting sustainable transportation, and reducing emissions, along with city partners allocating budgetary resources. Due to its strong focus on distributional impacts and a desire to explore integrated technology solutions, the program currently does not employ revenue-generating strategies (e.g., service charges, commissions from mobility providers, subscription fees, data monetization).

### *What Makes This Innovative?*

The Mobility Wallet pilot program is innovative in that it enables residents to pay for various transportation options, including public transit as well as new mobility services like ride-hail and bikeshare, using a unified prepaid debit card. The ubiquity and interoperability of using bank cards with a major provider like Visa seemed to be the most feasible delivery mechanism to support payments across different mobility service providers and different fare structures. Using a prepaid debit card also allows customers to use the same medium to purchase merchandise




Source: Los Angeles Department of Transportation

***Figure 37. South LA UBM pilot area boundaries.***

to support their mobility needs. By using prepaid debit cards rather than metro transit cards, LADOT and Metro have the option to stack non-mobility-based benefits that customers might use in the future (e.g., to pay for groceries or medication) and to subsidize other services for specific population groups to achieve broader goals related to improving distributional outcomes. The program is also innovative in its use of a mix of federal, state, and local grant funding to subsidize participants' payments for different mobility services. By leveraging its extensive network of partners, LADOT and Metro are able to directly pursue or be identified as subrecipients for a variety of grant opportunities.

### *Downstream Impacts*

Phase 1 of the pilot garnered positive feedback from participants, who praised the program's flexibility and reported that the program made it easier to get to work, school, and medical appointments and to explore the city. The program also saw significant spending, not only on rideshare but also on public transit—Phase 1 participants purchased over 140,000 trips with their mobility wallets, including 80,800 public transit trips; 60,700 rideshare trips; 2,600 scootershare or bikeshare rides; and 169 bike shop purchases (City of Los Angeles 2024). These spending patterns raised the question of whether mobility wallets should restrict low-income program participants to solely clean mobility options, highlighting the tension between increasing access to mobility while promoting sustainable mobility options (Rodier, Tovar, and Fuller 2024).

The pilot program also demonstrated that the UBM concept could be implemented successfully in large urban settings. It proved that, when provided with sufficient financial support and flexibility, underserved populations could significantly benefit from expanded mobility options, which could be replicated in other regions or cities.

### *Challenges and Lessons Learned*

Key lessons learned include building significant contingencies into timelines and budgets to account for contracting delays and other unanticipated capital and labor cost increases, respectively. During Phase 1 of the pilot program, LADOT, Metro, and their partners recognized the need to provide robust community outreach and engagement and customer service to support participants in the Mobility Wallet pilot program. Many participants expressed confusion and skepticism when they received the prepaid card by mail (Rodier, Tovar, and Fuller 2024). The distribution of funds also had more administrative costs than anticipated. LADOT and Metro are considering providing an option to use digital cards in addition to physical cards.

## 4.7 Key Takeaways

This module describes some of the innovative revenue-related tools for new mobility passenger and goods delivery services being explored or used by local and state public agencies, both nationally and internationally. The innovative mechanisms explored, from fees and surcharges to partnerships and regulatory frameworks, offer valuable insights into how public agencies can generate revenue while enabling cleaner, more inclusive, and more financially resilient mobility systems.

One key takeaway is the importance of designing policies that align with broader societal goals, such as environmental protections and improving distributional outcomes. The case studies demonstrate that new revenue models, such as parking surcharges, dynamic pricing, and mobility wallets, can be effective tools for generating new forms of revenue and guiding customer behavior toward more sustainable choices. These strategies also underscore the importance of creating flexible frameworks that can adapt and keep pace with technological advancements and evolving market conditions.

The case studies further highlight the critical role of governance in shaping successful mobility solutions. Whether through municipal leadership or collaborations between public and private stakeholders, strong governance ensures that revenue models are implemented effectively and in a way that improves distributional outcomes. Several case studies, including those from cities like Vienna and Utrecht, exemplify how strategic public investment, well-structured partnerships, and strategically leveraging access to the public ROW can lead to scalable and sustainable shared mobility ecosystems.

Curb management also emerges as a powerful tool for optimizing city infrastructure and generating revenue. Innovations in Barcelona and Oakland show how dynamic pricing models, platform-supported permitting, and dedicated loading zones can improve traffic flow in congested parts of the city while creating new financial streams of income. Additionally, integrating data-driven tools and further supporting programs with policy is crucial for managing the rising demand for curb space, deliveries, and shared transportation options.

Strengthening the alignment between environmental objectives and improving access is another recurring theme, especially in programs that subsidize services like e-bikes or ZEV adoption. San Francisco's e-bike program for delivery workers and the Los Angeles Mobility Wallet are examples of how grants and strategic partnerships can fund innovative mobility solutions that also promote sustainability goals and transportation access for underserved populations.

However, public subsidies and grant funding are often time-limited and subject to changes in government priorities or budget allocations. Programs that are highly dependent on these funds may face difficulties when the funding cycle ends or when the program needs to transition from pilot to full-scale operations. Therefore, it's crucial to design programs that are diversified in funding sources, integrating both public funding and private sector investments where possible. There also needs to be greater emphasis on long-term sustainability through clear pathways for transitioning from subsidy-dependent models to financially self-sustaining systems.

Overall, these case studies demonstrate how innovative revenue models can play a crucial role in supporting a wide range of goods delivery and shared passenger services, as well as equipping public agencies with the necessary financial resources to better manage services within the wider transportation system, from rural areas to dense urban centers. By learning from the successes and challenges of these case studies, cities can refine their approaches and continue to innovate in response to the ever-evolving mobility landscape.

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# Abbreviations and Acronyms

| | |
|---|---|
| 3PL | third-party logistics |
| AIA | Air Impact Assessment |
| APCD | Air Pollution Control District |
| AQMD | Air Quality Management District |
| AREA | Àrea Integral de Regulació de l'Estacionament |
| AV | autonomous vehicle |
| B2B | business-to-business |
| CARB | California Air Resources Board |
| CCZ | Congestion Charge Zone |
| CDS | Curb Data Specification |
| CVLZ | commercial vehicle loading zone |
| DDOT | District Department of Transportation |
| DOT | department of transportation |
| DPM | diesel particulate matter |
| DUM | Urban Goods Distribution |
| EV | electric vehicle |
| FY | fiscal year |
| GLZ | green loading zone |
| GVW | gross vehicle weight |
| HGV | heavy goods vehicle |
| HOS | hour-of-service |
| ISR | indirect source rule |
| ITP | International Truck Pilot |
| JTC | Joint Transportation Committee (Washington State) |
| LACI | Los Angeles Cleantech Incubator |
| LEDZ | low-emissions delivery zone |
| LEV | low-emissions vehicle |
| LEZ | low-emissions zone |
| LGV | light goods vehicle |
| MaaS | mobility-as-a-service |
| MBUF | mileage-based user fee |
| MDS | Mobility Data Specification |
| MGV | medium goods vehicle |
| MnDOT | Minnesota Department of Transportation |
| MPO | metropolitan planning organization |
| NAAQS | National Ambient Air Quality Standards |
| NOx | nitrogen oxide |
| NZE | near-zero-emissions |

| | |
|---|---|
| OHD | off-hour delivery |
| O&M | operations and maintenance |
| PBOT | Portland Bureau of Transportation |
| PDD | personal delivery device |
| PM2.5 | particulate matter with a diameter of 2.5 micrometers or less |
| PM10 | particulate matter with a diameter of 10 micrometers or less |
| RDF | retail delivery fee |
| ROW | right-of-way |
| RUC | road usage charge |
| SNAP | Supplemental Nutritional Assistance Program |
| sq. ft. | square feet |
| STSFA | Surface Transportation System Funding Alternatives |
| SUMP | Sustainable Urban Mobility Plan |
| TfL | Transport for London |
| TREC | *tasa de reparto e-commerce* |
| UCC | urban consolidation centers |
| ULEZ | ultralow-emissions zone |
| VMT | vehicle miles traveled |
| VPC | Vehicle Parking Certificate |
| WAIRE | Warehouse Actions and Investments to Reduce Emissions |
| WAV | wheelchair-accessible vehicle |
| WDT | weight-distance toll |
| ZE | zero-emissions |
| ZEDZ | zero-emissions delivery zone |
| ZEV | zero-emissions vehicle |
| ZEZ | zero-emissions zone |
| ZEZ-F | zero-emissions zone for freight |

APPENDIX A

# Revenue Calculator User Guide

Appendix A: Revenue Calculator User Guide can be found at nationalacademies.org/publications by searching for *NCHRP Research Report 1165: Revenue-Related Tools for New Mobility*.

*Abbreviations and acronyms used without definitions in TRB publications:*

| | |
|---|---|
| A4A | Airlines for America |
| AAAE | American Association of Airport Executives |
| AASHO | American Association of State Highway Officials |
| AASHTO | American Association of State Highway and Transportation Officials |
| ACI–NA | Airports Council International–North America |
| ACRP | Airport Cooperative Research Program |
| ADA | Americans with Disabilities Act |
| APTA | American Public Transportation Association |
| ASCE | American Society of Civil Engineers |
| ASME | American Society of Mechanical Engineers |
| ASTM | American Society for Testing and Materials |
| ATA | American Trucking Associations |
| CTAA | Community Transportation Association of America |
| CTBSSP | Commercial Truck and Bus Safety Synthesis Program |
| DHS | Department of Homeland Security |
| DOE | Department of Energy |
| EPA | Environmental Protection Agency |
| FAA | Federal Aviation Administration |
| FAST | Fixing America's Surface Transportation Act (2015) |
| FHWA | Federal Highway Administration |
| FMCSA | Federal Motor Carrier Safety Administration |
| FRA | Federal Railroad Administration |
| FTA | Federal Transit Administration |
| GHSA | Governors Highway Safety Association |
| HMCRP | Hazardous Materials Cooperative Research Program |
| IEEE | Institute of Electrical and Electronics Engineers |
| ISTEA | Intermodal Surface Transportation Efficiency Act of 1991 |
| ITE | Institute of Transportation Engineers |
| MAP-21 | Moving Ahead for Progress in the 21st Century Act (2012) |
| NASA | National Aeronautics and Space Administration |
| NASAO | National Association of State Aviation Officials |
| NCFRP | National Cooperative Freight Research Program |
| NCHRP | National Cooperative Highway Research Program |
| NHTSA | National Highway Traffic Safety Administration |
| NTSB | National Transportation Safety Board |
| PHMSA | Pipeline and Hazardous Materials Safety Administration |
| RITA | Research and Innovative Technology Administration |
| SAE | Society of Automotive Engineers |
| SAFETEA-LU | Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (2005) |
| TCRP | Transit Cooperative Research Program |
| TEA-21 | Transportation Equity Act for the 21st Century (1998) |
| TRB | Transportation Research Board |
| TSA | Transportation Security Administration |
| U.S. DOT | United States Department of Transportation |

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