1 Executive Summary

Portland transformed the transportation status quo through its implementation of a SMART Delivery Zone (SDZ) Pilot. The Final Implementation Report describes Stage 1 accomplishments and lessons learned, a cost-benefit analysis, and how the Portland Bureau of Transportation (PBOT) would approach at-scale implementation.

At-Scale Deployment and Operational Costs Compared to Benefits and Savings
Technology, data integrations, and advanced sensors proved to be effective. At-scale implementation of this project would carefully consider how to mitigate technology upgrade costs for businesses and provide technical assistance. Workforce development investments, and educational and training opportunities would also be created to last beyond the project and ensure benefits outweigh operational costs.

Meeting Project Expectations
Portland's Stage 1 application proposed three objectives: 1) Establish SMART Delivery Zones; 2) Use data, sensors, and preferential curb access to manage the curb; and 3) Facilitate micro-distribution hub operations and last-mile solutions. The City has met or exceeded expectations on all three objectives through the duration of the project.

Performance Measures
Stage 1 identified 14 performance measures to track goals and evaluate success. For each goal, the pilot project achieved significant progress. One key takeaway is that this project demonstrated that drivers are incentivized to upgrade their vehicles and improve delivery efficiency with the right incentives through technology and proactive curb management.

Requirements and Feasibility of At-Scale Implementation
Portland's Stage 1 project laid a strong foundation to expand the SMART Zones concept through at-scale implementation. The project team has proven capable of managing a complex, multi-stakeholder project and anticipates an at-scale version would run smoothly given the successful prototype, excitement for the project among leadership and peers, and new internal processes. During at-scale implementation, PBOT would also continue to strengthen the relationships with business and community stakeholders who are already invested in this project.

At-Scale as a Response to Stage 1
The engagement conducted during Stage 1 created an opportunity to craft at-scale implementation plans that respond to feedback, build on successes, and more effectively manage the curb across a greater area.

Lessons Learned and Recommendations
Stage 1 demonstrated the City's commitment to provide reliable, modernized access to the curb for commercial delivery vehicles using a collaborative, data-driven approach.

2 Introduction and Project Overview

Project title: Portland, Leading by Example: A Technology-Enabled SMART Delivery Zone

Recipient name: City of Portland

Fiscal year of award: 2023 - 2024

Period of performance: September 15, 2023 – September 15, 2025

Organization(s) preparing the Implementation Report: Portland Bureau of Transportation

Date the Implementation Report is submitted: January 28, 2026

2.1 Project Description

Portland has long been an innovative transportation leader and was the first U.S. city to pilot regulated SMART Delivery Zones that offered preferred curb access to encourage commercial fleets to embrace technology-enabled, innovative goods delivery models.

Designed to modernize urban logistics and test new regulatory structures, the SDZ pilot utilized public- and private-sector partnerships, innovative curb management strategies, open-source data standards, alternative delivery models, and advanced sensor technologies to dramatically improve the efficiency of goods movement. Stage 1 interventions included establishing regulated SMART delivery zones that gave priority to new, technology-enabled delivery vehicles; used data and sensors to monitor and evaluate curb activity; and facilitated micro-distribution hub (microhub) operations for innovative last-mile solutions. Portland's Stage 1 pilot also offered the first known use case of data integration between a logistics company, an analytics platform, and the public sector.

Along with deploying new technology and developing new internal processes, PBOT found success in communicating these innovations with the public. PBOT surveyed delivery companies operating near SDZs and engaged dozens of different stakeholders through focus groups and industry one-on-ones. The PBOT team created the first known open-source data (using the Mobility Data Specification (MDS)) feed for a freight company in order to gather information on how microfreight vehicles use municipal infrastructure. The team also installed 16 sensors from two companies in eight locations to better understand curb use and evaluate data through INRIX's Curb Analytics platform. A variety of private sector partners are now utilizing both the implementation and curb usage data.

As part of this project, the University of Washington's Urban Freight Lab interviewed delivery carriers about existing operations and strategies to improve the efficiency of goods movement using new technologies. Interviewees expressed interest in this initiative, but they made clear that there were several factors that would determine changes to their current operations. B-Line, a local logistics and delivery companies, has extensive expertise in microfreight logistics

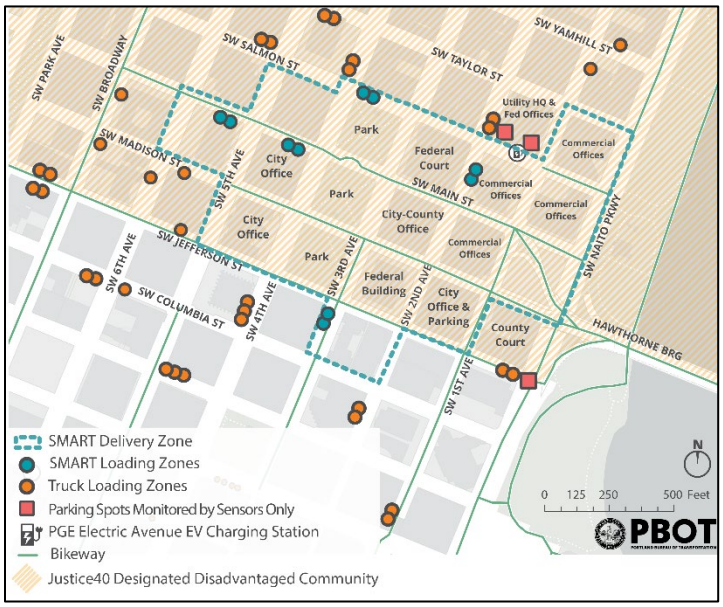
and its microhub near the SMART delivery zones also proved valuable resources for companies interested in innovative delivery models. IKEA and B-Line discussed developing a first-in-the-nation partnership to deliver small- and medium-sized parcels to downtown and other areas of Portland. The City also incentivized B-Line to help them purchase their first medium-duty freight vehicle.

The pilot sent a powerful market signal to companies to consider updating their goods delivery models. During the pilot, PBOT approved over 65 digital permits for new, modernized freight vehicles, allowing each vehicle to use the dedicated zones for six months. As a result of this pilot, Amazon and FedEx redeployed their newest delivery vehicles to Portland's downtown; DHL purchased a new fleet of medium-duty vehicles; HYPHN, a local delivery business, also purchased a new vehicle.

Project Area

As shown in Figure 1, the Stage 1 pilot was located in downtown Portland. The City intentionally chose this project area to test new, innovative strategies due to the high concentration of loading zone activity, existing loading infrastructure, and its viability for a mix of carriers.

Figure 1 Stage 1 Project Area Map



By the end of the pilot industry stakeholders were encouraged by the benefits of SMART Delivery Zones and wanted to extend these zones across the city. Given the variety of vehicles that compete for curb space citywide, the project team would like to address curb demand for all users. An at-scale implementation proposal takes the initial curb management ideas from Stage 1 and develops a broader curb management policy and continues to integrate additional city systems, and their data, into a more fully integrated curb platform.

Many companies reported the six-month pilot lacked sufficient time to implement changes on their end, and the initial geographic scale of the project was equally limited. At-scale implementation would expand the project area across the city and extend the timeline to three years allowing the city to more fully develop policy, integrate technology, and implement a more comprehensive digital permitting system.

The city also experienced challenges engaging commercial curb users due to the difficulty in connecting with a large, heterogeneous delivery community. In response, the city added scope to plan, design, and involve the public in a proposal for a citywide program that builds off the

learning gained in Stage 1. Program design work for at-scale implementation will also be responsive to Portland State University's (PSU) finding that loading zones are used by unauthorized vehicles 75% of the time they're occupied.

Technology Application Proposed in Stage 2

Technology provides a critical foundation for 21st century curb management. During Stage 1, Portland partnered with mobility data company INRIX to launch advanced sensor and data integration efforts to gain valuable insights into curb use. INRIX provided detailed maps of PBOT's parking and loading rules around the entire city using open-source data standards to update the City's out-of-date inventory.

The project also installed Automotus and Cleverciti computer vision sensors at eight zones that fed data to INRIX using the Curb Data Specialization (CDS) standard. CDS is a digital data standard stewarded by the Open Mobility Foundation that allows cities to clearly communicate their curb regulations and measure activity at the curb allowing cities to develop policies that create more accessible, useful curbs.[1] The goal of CDS is to help cities and companies pilot and scale dynamic curb zones that optimize commercial loading activities. Portland was among several other U.S. cities that tested the implementation of CDS as part of their Stage 1 pilot projects. CDS allows cities to work with one universal data format and simplified the process for both municipalities and private companies.

In Portland, CDS helped show that unauthorized vehicles parked in the city's truck loading zones was hindering access to the curb. 73% of the time the curb was occupied, it was by unauthorized vehicles. Delivery vehicles often responded by double parking or circling the block to look for an open parking space increasing negative impacts to safety and slowing down their operations. Data from sensor companies was sent to INRIX via CDS, allowing information about vehicles and loading zones usage to be combined with data on the City's curb inventory and other data.

During Stage 1, a first in the nation data integration between B-Line (using Internet of Things (IoT) devices installed on their delivery vehicles) and INRIX, resulted in visualizations of origin/destination data and route level data of all the deliveries made in the city by B-Line's microfreight vehicles. The data from B-Line also helped illustrate geographic areas where microfreight vehicles are the most efficient delivery option and could help identify ideal locations for future microhubs.

Together, the novel data integrations between INRIX, sensor companies, and B-Line demonstrated how technology and preferred curb access can be used to encourage companies to modernize and help them optimize their goods delivery practices. These learnings from Stage 1 have revealed the effectiveness of a low-cost, technical approach to curb management and

[1] The Open Mobility Foundation, "About the Curb Data Specification," About CDS | Open Mobility Foundation

how it can be scaled and replicated in other cities. Building on lessons learned during Stage 1, Portland's at-scale implementation (Stage 2) proposal would expand upon certain project elements, use technology to evaluate outcomes, and share project findings nationally for replication in other cities.

Stage 2 would advance SMART delivery zones, data integration, and create a strong foundation for automated vehicles by deploying new technologies and practices, for example:

- Digitizing curbs citywide and integrating other internal city systems with data about additional curb uses (emergency, parking permits, lane closures, etc.). PBOT will also consider dual data standard translation and integration.
- Using digital curb management systems and sensors to enable utilization tracking, dynamic pricing, digital permits, and broadcasting real-time availability data for commercial loading.
- Consolidating curb regulations, time-of-day rules, pricing, and special permits into a city-owned CDS rules engine. Developing governance and updating protocols for ongoing operations.
- Standardizing workflows and integrating data for occupancy, permits, construction, roadwork, special events and other closures into a centralized platform. This will allow real-time updates to mapping and navigation platforms to improve safety, routing and logistics.
- Converting curb policies into machine-readable feeds for AVs and logistics fleets. Developing API specifications and validation methods to ensure compliance and data integrity.
- Combining local data with data generated by INRIX and Passport to model occupancy trends. Piloting mobile data collection strategies to fill gaps without high-cost fixed sensors.

Desired Outcomes for At-Scale Implementation

Portland's at-scale implementation (Stage 2) proposal would aim to optimize freight operations and enhance safety and efficiency by addressing two program areas proposed by the SMART Grants Program: delivery logistics, sensors and how they interact with automated vehicles.

The project would seek to leverage digital curb management technologies to optimize curb efficiency with advanced sensors and a new citywide commercial loading program. This would create a unique opportunity to share real-time availability data with curb users, including goods delivery vehicles, automated vehicles, and the parking public via a municipal platform and private platforms such as INRIX. These efforts could result in more efficient traffic operations

and decreased congestion, reduced vehicle idling and circling times, and minimized conflicts with other vehicles and vulnerable road users.

Program evaluation would continue in partnership with leading academic researchers to assess the efficacy of the newly implemented strategies and technologies. The academic partners would also amplify the project through white papers and articles. Additional knowledge-sharing activities, including webinars, in-person workshops, and sharable resources would allow PBOT to promote this project as a model for other cities to consider.

2.2 Partnering with Stakeholders

The at-scale implementation project will expand curb management efficiency to all users by advancing replicable systems integration use-cases that merge existing efforts on curb management data, connected work zone data, and data standards. This would create a single platform for the benefit of the private sector, including automated vehicle operators, and the general public.

When the City announced the Stage 1 grant in April 2023, PBOT misstepped by not engaging enough key stakeholders before communicating externally about the project. PBOT corrected this by transparently sharing information with the public throughout the Stage 1 pilot regarding the needs, issues, concerns, and opportunities within this freight modernization effort. PBOT created a Public Involvement Plan that it posted on the project website, where the team also regularly shared project updates and meetings with stakeholders.

PBOT conducted robust conversations with stakeholders during Stage 1 to understand the barriers and opportunities regarding these new delivery zones as well as their perceptions of this project. This effort included discussions with major delivery companies, the City of Portland's Freight Advisory Committee, and at the Urban Freight Lab's Quarterly meetings. These conversations and more would be continued throughout at-scale implementation.

In addition, project partners Portland State University and the University of Washington also sent out surveys to hundreds of stakeholders in the project area and interviewed delivery companies to understand route logistics. The project team also held one-on-one meetings and multiple focus groups between May 31 and June 28, 2024 (Figure 2).

PBOT reconvened focus group participants several times throughout Stage 1. The first follow-up focus group was scheduled for three months into the demonstration project. These conversations revolved around how participants felt the pilot project was progressing, informing the evaluation plan, and potential next steps. PBOT convened final focus groups after the demonstration project closed to share key learnings, allow participants to provide further input, and to evaluate success. Key learnings from the focus groups are in the table below.

Figure 2 Stage 1 Focus Group Summary

Category of Focus Group	Name of Focus Group	Date	Outcome of Engagement
Business	**Local Private- and Public-Sector Businesses** (Alta Planning + Design, HDR, PSU, Fehr & Peers, Menashe Properties, TriMet, DKS, Multnomah County)	May 31, 2024; June 28, 2024; December 13, 2024; July 8, 2025	1) Commitment to draft Memorandum of Understanding to pursue collaborative strategies for sustainable procurement by entities adjacent to SDZs. 2) Interest for data on the overlap of various delivery companies serving private- and public-sector businesses adjacent to SDZs.
	Federal and County Government Partners (General Services Administration, U.S. Immigration Court, Multnomah County District Attorney, and Multnomah County Courthouse and Sheriff)	June 4, 11, 27, 2024; December 13, 2024; July 8, 2025	1) Concerns around limited curb space for the needs of the County Sheriff and time-sensitive deliveries. 2) Concerns around hazmat and deliveries that may microfreight need larger delivery vehicles or that need a liftgate to receive.
Industry	**Local Goods Delivery City Partners** (Office Depot, HD Supply, Momentum Procurement Group, and Veyer Logistics)	June 4, 2024; December 13, 2024; July 9, 2025	1) Education campaign around the benefits of alternative delivery models and how Requests for Proposals can incentivize innovative approaches. 2) Interest in data on impacts of electric vs diesel delivery. 3) Interest in infographics for customers to learn how their choices affect system efficiency.
	Local Goods Delivery (Columbia Distribution, Columbia Corridor Association, Titan Freight Systems, DHL Express, and Multnomah County)	June 4, 2024; December 13, 2024; July 9, 2025	1) Concerns around the cost of alternative delivery vehicles . 2) Concerns with the limitations of delivering large volumes of goods with some alternative delivery options.

2.3 Scale of Stage 1 Deployment and Anticipated At-Scale Implementation

Portland's Stage 1 pilot identified five existing truck loading zones in downtown Portland that could be reprioritized for technology-enabled commercial delivery models for a temporary, six-

month demonstration project. Stage 1 focused on three primary objectives to create a replicable, expanded project:

1. Pilot the nation's first regulated SMART Delivery Zones;
2. Trial sensors and other digital infrastructure to better understand how different types of vehicles use commercial loading zones and city streets; and
3. Expand microhub operations and the use of microfreight vehicles for "last-mile" delivery solution in select areas.

Stage 2's at-scale implementation would expand upon these objectives and incorporate feedback from the private sector received during Stage 1, strengthening industry support for the project. At-scale implementation would prioritize curb management for all users, use technology to optimize freight productivity, and integrate new technology systems within the city to consolidate rules and regulations. All of these activities would build upon relationships developed during Stage 1, and the project team would continue to work with trusted industry stakeholders to extend the benefits to more businesses and industry partners.

Summary of Project Activities

In Stage 1, PBOT challenged the goods delivery status quo and established the first SMART Delivery Zone in the United States regulated through digital permits. The top ten key milestones for the Stage 1 pilot project are described below:

1. Portland City Council approval of SMART grant contract (September 2023)
2. Submitted Evaluation Plan and Data Management Plan on-time to USDOT (December 2023)
3. Finalized partner scopes of work and convened a kick-off meeting for City staff and other partners (January 2024)
4. Completed Public Involvement Plan for the project (March 2024) and completed and summarized initial round of involvement (July 2024)
5. Integrated B-Line Internet of Things (IoT) hardware and created a Portland curb inventory (April-June 2024)
6. Launched digital permit process for the demonstration project (August 2024)
7. Installed 16 sensors at the SMART loading zones within Downtown Portland (July-August 2024)
8. Obtained final approval to launch demonstration project from PBOT's Director, the Deputy City Administrator, and Mayor's Office (August-September 2024)
9. Ended demonstration project (March 19, 2025)

Significant accomplishments for Stage 1 include, but are not limited to:

- **Project Management**
    - Supported the City's acquisition of a new medium-duty freight vehicle for its own Printing and Distribution deliveries.

  - Executed contracts with INRIX, B-Line Urban Delivery, Portland State University, University of Washington's Urban Freight Lab, Alta Planning + Design, Open Mobility Foundation, Automotus, and Cleverciti.
  - Conducted baseline video analysis of proposed loading zones for twelve days and summarized findings.
  - Conducted research of twelve camera sensor companies, interviewed four companies, and contracted with two companies for the duration of the demonstration project.
- **Knowledge Sharing**
  - Attended in-person convening of Open Mobility Foundation SMART Collaborative to share progress and lessons learned with other cities.
  - Coordinated with City of Portland Bureau of Planning and Sustainability to release the Micro-Delivery Hub Feasibility Study.
  - Presented on the success from the project at relevant conferences and webinars, including Urbanism Next Europe and CoMotion LA.
  - Presented the project at Portland State University's Transportation Research Center's Transportation Seminar.
  - Finalized University of Washington's Urban Freight Lab's technical report on carrier interviews.
  - Hosted in-person convening of Open Mobility Foundation SMART Collaborative for the ten participant cities in Portland.
  - Presented at the ITE Virtual Spring Conference to an audience of nearly 200 attendees.
- **Stakeholder Partnerships**
  - Convened multiple focus groups with dozens of stakeholders, including:
    - Private and Public Sector Partners
    - Federal Government Partners
    - Privacy and Personal Data Stakeholders
    - Local Goods Delivery City Partners
    - Local Goods Delivery Stakeholders
    - Procurement Partners
  - Sent out surveys to every office located within the proposed project area.
  - Worked with business partners in the project area to begin trialing deliveries via B-Line's microfreight vehicles. B-Line ultimately executed contracts with six organizations.
- **Technology innovations**
  - Installed 16 curb sensors from Automotus and Cleverciti (eight each)
  - Developed and implemented a new digital loading permit
  - Installed Internet of Things (IoT) devices on B-Line vehicles and integrated a new curb inventory into their operations

- Created the first known Mobility Data Specification (MDS), an open-source standard, feed for a freight company (B-Line Urban Delivery)
- Monitored and evaluated loading activities in the SDZs through sensor data.
- Published INRIX's Mid-Project Technical Memo outlining the technological advances made through the project
- Collected data and help Automotus train a vehicle detection model for their camera sensor to identify microfreight vehicles.
- Finalized development of an API with each of the sensor companies.
- Collected and analyzed video footage to help validate sensor data, using the same vendor who collected preliminary footage in April 2024.

Key outcomes for Stage 1 include, but are not limited to:

- Integration of IoT devices on B-Line Urban Delivery microfreight vehicles.
- Completed a loading zone analysis of compliant vehicles at proposed project locations.
- DHL, FedEx, and HYPHN purchased technology-enabled, medium-duty freight vehicles and deployed them within the SDZs.
- PBOT used incentives from the pilot project acquisition of new medium-duty delivery vehicles for B-Line internal logistics functions.
- Increased understanding of the city and external curb users of operational challenges in the industry and the positive impacts for upgraded fleets and goods delivery technologies.
- PBOT contracted with B-Line to trial deliveries from six businesses in Downtown Portland via microfreight vehicles. At least three of the companies have continued their contract after the grant ended.

2.5 Attention & Exposure

Portland's Stage 1 grant received significant media attention. Coverage has ranged from initial news stories that raised concerns, a wave of articles that assuaged fears to finally a host of laudatory articles highlighting the innovation surrounding Portland's efforts to establish the nation's first regulated SMART delivery zones.

Project team members and partners have participated in numerous conferences, webinars, and events to share information. Stakeholders around the U.S., including senior executives at several Fortune 500 logistics companies, remain interested in tracking future project developments.

A partial list of known news and media, academic articles, and conference presentations is included below:

News Articles & Media Stories

- Digital Curb Data Deepens Understanding of Urban Activity (Government Technology, August 30, 2024)

- This One Delivery Switch Could Save UPS & Co. Billions – No, Really (Forbes, July 18, 2024)
- Digital Curb Management Can Make Streets Earn Their Keep (Government Technology, June 28, 2024)
- Legislative Update: June 28, 2024 (Minnesota House of Representatives: Legislative News and Views from Rep Larry Kraft (DFL), June 28, 2024)
- Alta Planning moves into major downtown office building (BikePortland, December 5, 2023)
- Delivery apps broke our streets. New tech might fix it. (Washington Post, July 13, 2025)

Webinars & Conference Presentations

- "Envisioning a Safer and More Resilient Future," ITE Virtual Spring Conference (Virtual: March 2025)
- Open Mobility Foundation SMART Collaborative Meeting (Portland, OR: March 2025)
- University of Washington Urban Freight Lab Research Meetup (Virtual: January 2025)
- Portland State University TREC Friday Transportation Seminars (Portland, OR: December 2024)
- CoMotion 2024 Panel – From Pilot to Program: Lessons in Creating Lasting Change (Los Angeles, CA: November 2024)
- "The Dynamic Right of Way: Lesson from the SMART Curb Collaborative" Open Mobility Foundation webinar (September 2024)
- "From the Physical to the Digital: Urban Right of Way Management" INRIX Virtual Customer Day webinar (August 2024)
- USDOT SMART Summit (Cambridge, MA: July 2024)
- University of Washington's Urban Freight Lab Quarterly Meetings (Seattle, WA: July 2024 and June 2025)
- "Curb Management for Policymakers" Open Mobility Foundation webinar (June 2023)
- Portland Freight Committee (Portland, OR: June 2024, March 2024, June 2023)
- National Association of City Transportation Officials (NACTO) (Miami-Dade, FL: May 2024
- Metro Oregon's TransPort Subcommittee (Portland, OR: April 2024)
- Open Mobility Foundation SMART Collaborative Meeting (Seattle, WA: April 2024)
- C40 Cities Urban Freight Working Group for North American Cities City Challenge (Virtual: March 2024)
- Open Mobility Foundation 2023 Summit (Los Angeles, CA: November 2023)
- Metro Oregon's TransPort Subcommittee (Portland, OR: September 2023)
- USDOT SMART Summit (Washington, D.C.: September 2023)

2.6 Deviations

During Stage 1, stakeholder input led to several minor deviations from the original proposal: changes in approach to parking policy, changes to SDZ sites, changes in technology approaches

along with a no-cost extension. The no-cost extension allowed the project team to add additional research, develop a framework for a new, citywide Commercial Vehicle Loading program and further validate data from the sensors.

The Stage 1 proposal identified several truck loading zones that would be outfitted with advanced sensors. One truck loading zone was located outside the Multnomah County Courthouse, which also houses State Court offices and the County Sheriff's Office. Through many conversations with Multnomah County's Facilities & Property Management Division, its Fleet Services Division, and its tenants like the State Courts and the County Sheriff's office, PBOT came to learn about the curb management challenges outside the Multnomah County Courthouse.

Unrelated, other stakeholder engagement resulted in feedback and questions about how a SDZ would function in settings with different land uses. While industry stakeholders recognized the Stage 1 project area was purposefully crafted around government offices, some suggested testing a mixed use/residential use case to understand how they vary from government and commercial office use cases. Together, both conversations provided an opportunity to replace the zones at the Multnomah County Courthouse with a nearby site on a block with mixed uses (several restaurants located on the ground floor below a multi-story apartment building).

On the technology front, three minor deviations occurred. One of the first tasks was building a Mobility Data Specification (MDS) Application Programming Interface (API) for B-Line. The original approach had B-Line solely responsible for building the API with INRIX leading oversight and integration of the data feeds. However, the teams at B-Line and INRIX quickly realized that a more effective division of labor was to have B-Line lead on implementation of the Internet of Things (IoT) hardware while INRIX would lead on API creation and develop a MDS Conversion Service. This means any future MDS integrations with other delivery companies would require significantly less effort since they would be able to leverage INRIX's new MDS Conversion Service.

Another minor deviation involved the implementation of the Curb Data Specification (CDS) API. As with any new data standard, there has been a variability in how individual companies and cities implement the standards. One sensor company involved in the project implemented a "push API" for CDS Events. While this is helpful for real-time data use cases (e.g., loading zones availability), it does not allow for historic "pulls" of information that a REST API would provide. It is also not compliant with CDS version 1.0. This resulted in some additional, unexpected work to ensure advanced sensor data is properly shared via the CDS Events API.

The project team also considered using Automated License Plate Reader (ALPR) functionality to monitor curb usage, but the project team pivoted its approach after two technical assistance calls with USDOT staff and learning there is a strict provision against any use of ALPR, regardless of its intention.

More recently, in preparing to launch the demonstration project in September 2024, the City's Fleet and Facilities Group raised questions about potential project impacts. City facilities managers expressed concerns about maintenance and the city's waste management vehicles' ability to comply with a SDZ outside the City of Portland's building, which does not have a loading dock or bay. In discussion with Fleet and Facilities, PBOT shared how current City code states that vehicles that do not perform commercial deliveries with commercial signage are not permitted to use Truck Loading Zones. This means maintenance vehicles generally are not allowed to use Truck Loading Zones. Additionally, since the city's Class 7 waste management and recycling vehicles would be too costly to replace with newer models given the duration of the demonstration project, but provide a critical service, the project team worked with Parking Enforcement to ensure exceptions for these vehicles so critical building functions would be maintained. PBOT requested, and was approved, for a no-cost extension to add additional research, develop a framework for a new, citywide commercial vehicle loading program and further validate data from the sensors.

PBOT also developed a framework for a new commercial vehicle loading program to help improve efficiency, safety, orderliness, and management of loading activities throughout the city. The program researched how to facilitate safe, orderly, and efficient curbside loading operations for freight and delivery vehicles, reduce conflicts between users, and improve compliance. This project assessed current conditions in the city, engaged industry and internal stakeholders, researched best practices from cities across the country, and developed an initial framework for a new program.

The no-cost extension also allowed the project team to extend the data validation period. The project team received one- and two-month data reports from the sensors to include when presenting the project to stakeholders and other interested members of the public; however, initial data presented to the City contained potentially inaccurate information about the total number of vehicles and average occupancy rate. Given that sensor data is integral to the Stage 1 findings, the project team determined additional validation was necessary.

Lastly, the project team worked with B-Line to secure delivery contracts with businesses within the project area to trial making their existing deliveries to SDZs using microfreight vehicles. The project team successfully identified three organizations that transitioned their deliveries to B-Line while the six-month demonstration period was active. Further conversations secured an additional three organizations that wanted to contract with B-Line for their deliveries after the demonstration period ended. Out of these six organizations, three businesses confirmed they would continue working with B-Line after the City's subsidized contract ended because the experience ended up being preferable to delivery with major delivery companies.

3 Proof-of-Concept or Prototype Evaluation Findings

As successful planning projects must adapt to public feedback, Portland consistently evaluated the progress of Stage 1 and adapted to reflect the perspectives of the City's stakeholders. The

Stage 1 grant proposal reflected an idea within a test tube; the city was able to garner information about data limitations, while also promoting the concept and building relationships. Stage 1 identified the real impacts of complicated curb demands and realistic measures the City could accomplish and replicate through at-scale implementation.

3.7 Prototype Performance

This section identifies performance measures and Stage 1 performance measure targets categorized by project goal. For each category, PBOT's Stage 1 project was successful in both reaching previously identified performance measures and uncovering new questions to research (Figure 3).

Figure 3 Stage 1 Accomplishments by Goal

Goal & Evaluation Question	Stage 1 Performance Measures and Targets	Stage 1 Accomplishments	Data Limitations
Overall Goal: Are Smart Delivery Zones an effective strategy for encouraging commercial delivery fleets to innovate and adopt new delivery models?	**Performance Measures:** Conversations with companies showing willingness and/or specific plans to adopt new technologies and use options like microfreight; Share of new, modern delivery vehicles operating in the City. **Stage 1 Performance Measure Targets:** Productive conversations with 5 companies	• Conversations with 15+ companies • Over 65 digital permits were approved, demonstrating responsive behavior to incentivize the adoption of new technologies in return for prioritized curb access. • In response to the project, large companies like DHL, Amazon, and FedEx, as well as small companies like HYPHN, procured and deployed the newest and most technologically advanced medium-duty delivery vehicles to use the SDZs. DHL purchased three new medium-duty freight vehicles and deployed them in March 2025. October 2024, Amazon redeployed their newest vehicles downtown. In February 2025, FedEx-branded delivery vehicles were spotted in SDZs. HYPHN obtained a new medium-duty freight vehicle in July 2025. • The City's internal logistics department, Printing & Distribution, bought a	• The project team learned the State of Oregon does not have a comprehensive database of delivery vehicle powertrains, and companies are generally unwilling to provide data on their fleet composition. • Project partners collected and analyzed baseline video footage of loading zones, but were unable to determine vehicle types. Sensor data provided a basic indication of vehicle types. However, this data is limited as there is no baseline data to compare against and is also skewed because it only presents data from a select number of loading zones. • Automotus was also not able to use ALPR and

Goal & Evaluation Question	Stage 1 Performance Measures and Targets	Stage 1 Accomplishments	Data Limitations
		medium-duty freight vehicle with SMART grant funds as part of the pilot project. • B-Line Urban Delivery also purchased a medium-duty freight vehicle with grant funds as part of the project. This is their first vehicle in this class and will help expand their service area. • PBOT, IKEA, and B-Line explored feasibility of a partnership that would result in B-Line delivering medium-sized parcels to SDZs and other areas of Portland.	therefore made their best guess at identifying vehicle type. But, again there was no baseline data to validate against.
Safety and Reliability: How can sensors in the SDZs help us understand potential risks for other street users, including pedestrians?	**Performance Measures**: Sensor data showing curb usage in the SDZs including delivery-related crashes, incidents of unsafe or illegal curb usage such as double parking, and the number of pedestrians and bicyclists using the curb. **Stage 1 Performance Measure Target:** Collect and analyze curb usage data from	• Created a cross-departmental working group to vet 12 sensor companies and select two who's computer vision sensors will monitor loading zones use. • 16 advanced sensors were installed in July and August 2024. • Automotus camera sensors identified a decrease in double parking events from 0.12% to 0.02%.	• Camera sensors tracked double parking events as well as active transportation events. However, they were limited in that vehicles who do not park are not counted as events so "close calls" may be challenging to determine.

Goal & Evaluation Question	Stage 1 Performance Measures and Targets	Stage 1 Accomplishments	Data Limitations
	each loading zone using sensors.		
Safety & Reliability: How do the newly established SDZs impact compliance with parking regulations as compared to prior commercial loading zones?	**Performance Measures:** Change of share of unauthorized parking incidents at the new loading zones; Change of number of double-parking operations inside the project area. **Stage 1 Performance Measure Target:** Develop a baseline of parking and curb usage in TLZs, and how the demonstration project impacted usage.	• Conducted 12 days of video monitoring of the proposed loading zones before launching the demonstration project. • Analysis showed that 75% of vehicles are noncompliant with existing truck loading zones regulations. • Permit developed to capture commercial vehicle information. City parking enforcement cited 97 unauthorized vehicles using permit data to determine authorized users between November 19, 2024 and March 19, 2025. • Automotus identified an average of 73% of unauthorized users during the demonstration project. • Automotus camera sensors identified a decrease in double parking events from 0.12% to 0.02%.	• Parking enforcement officers (funded by local dollars) were the only way to determine compliance on the ground. • Like many other cities, Portland's Parking Enforcement team is understaffed and unable to cite every unauthorized use. • PBOT's validation of Automotus data allows the city to feel confident in its numbers; however, it must be noted that they did not identify 100% accuracy. • Video data of some of the TLZs recorded before being transitioned to SDZs was analyzed by PSU researchers and provided the project team with a baseline.
Resiliency: How does the implementation of SDZs and related technologies,	**Performance Measures:** Delivery times; dwell time.	• Baseline data from video analysis shows that the average dwell time for compliant vehicles in the loading zones was 24 minutes, while it was 23 minutes for unauthorized uses.	• Sensors were able to track dwell times; however, if multiple deliveries were made during one parking event, the sensor

Goal & Evaluation Question	Stage 1 Performance Measures and Targets	Stage 1 Accomplishments	Data Limitations
including sensors, help us create a more accurate understanding of curb usage and delivery times?	**Stage 1 Performance Measure Target:** Develop a baseline understanding of delivery times through sensor data.	• Baseline sensor data from Automotus showed approximately 29% of parking events are by delivery and freight vehicles. • Average sensor data from Automotus during the demonstration project showed approximately 23% of parking events are by delivery and freight vehicles. • Average sensor data from Automotus during the demonstration project showed that the average dwell time of all vehicles was 19 minutes and 46 seconds. The average dwell time of delivery vehicles was 16 minutes and 48 seconds, and the average dwell time of passenger cars was 20 minutes and 46 seconds.	categorized all of it as one event and created one data point.
Access: What are the procurement and delivery interests of small businesses and government agencies using the SDZs?	**Performance Measure:** Companies' interest in access to carriers serving SDZs. **Stage 1 Performance Measure Targets:** Increased interest in using innovative delivery models; Increased number of stakeholders using	• Small businesses and government agencies are interested in making shift to newer delivery models, but have shared barriers to making that happen, like increased cost, expertise, purchasing delays, and contract length. • PBOT subsidized a contract with B-Line to trial making deliveries into the project area via microfreight. B-Line partnered with six organizations during the Period of Performance and three plan to continue their contract.	• Evaluating companies' interest in innovative goods delivery and procurement processes was limited to those who were engaged with the project through focus groups, survey participation, and email responses and may not represent the opinions of all companies operating in the city.

Goal & Evaluation Question	Stage 1 Performance Measures and Targets	Stage 1 Accomplishments	Data Limitations
	new, technology-enabled vehicles.	• PSU distributed 162 surveys to businesses adjacent to SDZs to gauge interest. • Focus group with private- and public-sector stakeholders demonstrated interest and willingness in coming together to collaborate on a common procurement policy for shared vendors in the project area during at-scale implementation.	
Partnership: To what extent does the microhub and partnership with B-Line shift deliveries using SDZs to microfreight?	**Performance Measures:** Deliveries originating from the B-Line microhub; Increased interest in using innovative delivery modes; Number of stakeholders using innovative delivery models before and after the implementation of SDZs. **Stage 1 Performance Measure Targets:** Increase in amount and variety of goods	• B-Line installed IoT hardware on their fleet vehicles and shared GPS data with INRIX to provide data on origins and destinations. • B-Line is interested in opening more microhubs to improve delivery time and customer satisfaction. • PBOT, IKEA, and B-Line explored feasibility of a partnership that would result in B-Line delivering medium-sized parcels to SDZs and other areas of Portland via microfreight vehicles. • B-Line contracted with six businesses in downtown Portland to trial making deliveries via microfreight.	None.

Goal & Evaluation Question	Stage 1 Performance Measures and Targets	Stage 1 Accomplishments	Data Limitations
	diverted to B-Line microhub; Increase in deliveries via microfreight in SDZs.		
Integration: To what extent has data integration and sharing among stakeholders helped to develop new insights that could inform new policies and protocols to improve efficiency of curb improvement?	**Performance Measure:** Insights that support a more knowledgeable approach to curb management policy and procedures. **Stage 1 Performance Measure Target:** Number of key insights that support a more knowledgeable approach to curb management policy and procedures.	• PSU video monitoring created a common understanding among stakeholders of problematic noncompliance issues occurring in truck loading zones. • Project team heard from building tenants about challenges various delivery companies face at the curb. • Project team determined building maintenance vehicles may have unique curb needs. • Project team learned that increased specificity on "push" vs "pull" CDS Event APIs may be necessary to help technology effectively scale. • Project team learned that business and industry are willing to innovate with their goods delivery models when incentives like priority curb access are available.	None.

3.8 Prototype Evaluation

PBOT's Stage 1 successfully met the expectations in the project proposal by achieving the three project objectives and crossing milestones in the project proposal criteria.

Establish SMART Delivery Zones

PBOT launched the nation's first SMART Delivery Zones regulated by digital permits on September 19, 2024 after extensive communication with stakeholders and key city partners. PBOT worked closely with staff across the Bureau and the City to determine the most strategic way to efficiently permit the temporary zones, how to measure the use of the loading zone incentives and regulations to increase accessibility for a broad range of vehicles and street users.

Using the zones as a demonstration project nestled within the larger pilot provided opportunities for PBOT to discuss optimizing freight and managing curbs more effectively. PBOT conducted outreach to inform project stakeholders and reached dozens of different stakeholders. This outreach helped initiate new city partnerships, business-to-business partnerships, and greater learnings about the needs of vehicles currently using the existing truck loading zones. The project team undertook an extensive planning process to inform stakeholders to select a maximum of five loading areas near government buildings and identify users of the existing loading zones to understand barriers to transitioning to a modernized, technology-oriented fleet.

As a result, the project team gained key insights around complicated curb demand that informed the development of the at-scale implementation proposal. The Stage 1 proposal revealed genuine interest from the delivery industry to embrace innovation, but conversations held during Stage 1 revealed that the industry also faces significant barriers. As noted elsewhere, PSU conducted video analysis of the proposed loading zones sites to understand occupancy, dwell times, and vehicle type. Results showed that 75% of the vehicles using the truck loading zones were not authorized users, which decreases delivery efficiency and creates safety hazards. In response, as part of its at-scale implementation, PBOT will address the basics of curb management through new curb policy development for all users citywide. Given company priority to move goods efficiently, at-scale implementation will focus on curb management strategy development, technology implementation, and data integration with private operators and other curb users.

For Stage 1, PBOT piloted a free digital permit system that complemented Portland's existing regulatory system and collected data about companies using the SMART Delivery Zones. PBOT issued over 65 permits for commercial vehicles to use the zones. This digital permit process was the first step to gathering data about the vehicles using the loading zones. For at-scale implementation, the project team will create a process to further expand the inventory of loading zones citywide. In addition, at-scale implementation will study how to incorporate

operations and maintenance vehicles who do not meet the City's current definition of vehicles allowed in truck loading zones but are integral to maintenance and operations across the city.

Using Data, Sensors, and Curb Access to Manage the SMART Delivery Zones

PBOT exceeded the technology objectives created in the Stage 1 proposal, making Portland a leading city in curb data nationwide. Through this project, the project team created the first known MDS (open-source standard) feed for a logistics company (B-Line) in the country. This data feed was then integrated into the INRIX/Ride Report visualization tools to gain a deeper understanding into their operations and provides unique insights into how microfreight vehicles use the transportation network. Additionally, MDS data allowed PBOT to verify trips and verify the appropriate payments for microfreight deliveries.

PBOT also partnered with INRIX to digitize all the parking and loading rules (formerly available only on physical signage), making this data available to private sector companies to use for routing and logistics planning. This was done using the Curb Data Specification (CDS), a data standard that allows cities to communicate curb regulations, measure activity, and develop policies to make curb use more efficient and accessible.

PBOT vetted 12 advanced sensor companies and selected two for contracts as part of the Stage 1 pilot project. In July-August 2024, PBOT installed 16 computer-vision camera sensors from two different companies on signal poles at eight locations to understand curb use in and around the SDZs. These advanced sensors allowed PBOT to understand critical metrics such as number of deliveries, time of day, duration, etc., and categorized by vehicle mode (freight, passenger, delivery, bus, or active transportation). Data from the sensors was integrated into the INRIX ecosystem using CDS, providing a unique ability to combine vehicle activity seen at the curb with the City's curb inventory and parking rules, as well as the MDS data from B-Line. In addition, these sensors gave the project team a better understanding of the use of digital permits through the remainder of the Stage 1 pilot project, including compliance and non-compliance, and findings from these activities will inform wider at-scale implementation.

The project team distributed licenses to INRIX's Curb Analytics platform to planners and analysts across the bureau and the platform was highly used throughout the project, speaking to the positive impact of greater data collection. Accessing this data addressed a key data gap to understanding citywide curb inventory, rules, and demand. Some uses discussed by planners and analysts that gained access to INRIX's platform include data analyzation of trips taken and traffic visualization. INRIX's platform created a baseline and collected ongoing implementation data for the project team to continually evaluate the efficacy of strategies in Stage 1.

Portland's curb data is now being ingested through CDS and used by a variety of private sector partners, including Amazon, Uber, Waymo, GrubHub, Google, Microsoft, Ford, Rivian, HERE, TomTom, and BMW. B-Line has accessed the CDS API and integrated it into their own operations.

3.9 Demonstrated Improvement

The demonstration project prioritized access to the 66 vehicles who applied for digital permits. This 6-month demonstration project made significant improvements in the following areas:

Figure 4 Summary of Demonstrated Improvements

USDOT Statutory Area	Stage 1 Pilot Project Improvement
Safety & Reliability	• Reduced conflicts between travel modes, as well as behaviors like idling, circling, and double-parking, which decreased from 0.12% to 0.02%. • Improved compliance in loading zones from 75% unauthorized users to 73%. • Increased the use of smaller, more maneuverable freight vehicles by providing access to targeted loading zones.
Resiliency	• Help to future-proof the freight industry by diversifying goods delivery vehicles
Access	• Supported small and emerging businesses procure new delivery vehicles with modern technology features.
Partnerships	• Worked with public and private partners to support and encourage adoption of new delivery vehicles. • Established new partnerships for last-mile delivery. • Acted as a model for other cities in the encouragement of modernizing transportation and delivery practices.
Integration	• Used data and technology tools to gain insight into and improve efficiency of curb management.
Workforce Development	• Created new job opportunities through workforce training and new industry growth.

4 Anticipated Costs and Benefits of At-Scale Implementation

4.10 Anticipated Impacts of At-Scale Implementation

This project used advanced data and technology to invest in purpose-drive innovation to meet the challenges of the present and the future. It embodied several USDOT innovation principles, including serving the City's policy priorities, helping America win the 21st century, allowing for experimentation and learning from failure, and collaboration. This project also aligned with and supported Portland's 2040 Freight Plan, which charts a course for the maintenance, improvement, and further development of the city's urban freight system.[2] Likewise, the at-scale implementation proposal directly supports the 2040 Freight Plan.

[2] Portland Bureau of Transportation, "Portland 2040 Freight Plan," download (portland.gov)

Through a successful Stage 1 pilot, the project team built strong partnerships with leading industry partners, academia, and community-based organizations. At-scale implementation would implement regulatory frameworks and build sustainable financial tools to maintain project outcomes after the grant period of performance. If pursued, at-scale implementation could produce the following impacts:

Safety & Reliability

- Reduced conflict between freight vehicles and the broader traveling public by improving parking and loading operations of freight vehicles
- Reduced double parking and circling to search for parking
- Increased compliance in loading zones
- Increased presence of the next generation of technology-enabled freight vehicles, including microfreight and automated vehicles, which may help to reduce or eliminate truck-involved fatalities and severe injuries.

Resiliency

- Futureproofing the freight industry by diversifying goods delivery vehicles to include smaller and automated vehicles to ensure uninterrupted goods delivery after extreme weather events or natural disasters.

Access

- Increased economic opportunity for small- and emerging businesses interested in next generation delivery vehicles
- Improved access to education and jobs
- New job opportunities through workforce training and the growth of a new industry.
- Reduced congestion along select freight corridors

Partnerships

- New last-mile delivery partnerships to improve the efficiency of delivery operations
- Quarterly roundtable discussions with industry leaders to talk about innovation in goods delivery, with invitations to DHL, IKEA, FedEx, UPS, and Amazon
- Cost savings from reduced fuel consumption as companies utilize new technology and approaches to increase efficiency
- Potential for long-term savings from reduced costs for delivery companies
- Shifting to innovative delivery models may benefit reputation of companies who are “early movers” and increase trust with consumers as deliver on goals

Integration

- Coordinated data collection using advanced sensor and data technologies provides insights into curb activity to better understand how loading zones are used

- Improved integration of systems including City work order and asset management tools, sensor technologies, and INRIX's ecosystem of private-sector companies will lead to efficiencies

Workforce Development

- Expanded workforce development and training opportunities will positively impact the quantity and quality of jobs with next-generation vehicles and logistics
- Growing market of technology-related positions will be supported through accelerated growth in those industries
- Direct investment in high-quality jobs through commitments by partners to hire additional positions
- Creation of an Innovative Delivery Roundtable for businesses to continue to explore workforce issues and opportunities with major employers

4.11 Anticipated Costs of At-Scale Implementation

PBOT's prototype Stage 1 grant had a budget of $1,999,385. This included funding for staff support, travel, equipment and supplies as well as contracts to support and advance public-private sector partnerships, innovative curb management strategies, open-source data standards, and to deploy sensor technologies.

PBOT's proposed at-scale implementation would focus on expanding SMART Delivery Zones, refining technology and regulatory tools, and develop a new commercial vehicle loading program that can be applied citywide. The estimated total project budget for at-scale implementation as proposed in the City's Stage 2 SMART Grant would be $9,300,00 which includes $1,642,612 provided in local match and $7,657,388 in federal funding requested. The proposed Stage 2 budget for at-scale implementation included:

- **Staff time** to support day-to-day grant activities and overall management and execution of a 36-month project. Staff would coordinate various elements of the project, communicate regularly with team members and other departments, and coordinate the activities of multiple private-sector, university, and community stakeholders. Staff would also track and report overall progress, manage budgets and contracts, and ensure that project management milestones are met, and communicated with DOT as the grant progresses. Non-PBOT staff across the city would also support the project, coordinating with PBOT and community stakeholders on education and outreach about sensors and privacy/surveillance topics, on a vehicle transition program funded, and on microhub planning.

- **Travel** expenses to attend the SMART Summit in either Washington, D.C. or Cambridge, MA and take trips to domestic and global cities leading in curb management and freight logistics.

- **Participation and knowledge dissemination** at national transportation conferences held at a variety of locations for all three years of the project.
- **New mast arm poles** estimated to be installed to ensure that sensors can be mounted in the public right-of-way while complying with relevant engineering and safety standards.
- **The manufacturing of hundreds of** new informational signs.
- **Contracts** to support and advance public-private sector partnerships, innovative curb management strategies, open-source data standards, and deploy advanced sensor technologies to improve last-mile delivery efficiency. Including:
    - Deploying advanced sensors
    - Providing curb analytics
    - Creating data integrations
    - Issuing permits for commercial delivery vehicles using the SDZs
    - Hosting listening sessions
    - Engaging high school students to develop professional experience
    - Developing and administering a microfreight vehicle rebate program
    - Connecting local fleet operators with the many available resources for fleet transition
    - Expanding microfreight logistics and IoT deployment
    - Disseminating knowledge with national industry leaders
    - Research and evaluation on behavior shifts from the technologies and policies implemented; allocation of SDZs and their impact; technology validation; and municipal strategies to scale microhubs and microfreight logistics in the U.S.
- **Workforce opportunities,** including two PSU Hatfield Fellows, three PSU graduate student city positions, and three business or technology internships.

4.12 Cost-Benefit Comparison of At-Scale Implementation

The following section describes how the benefits and savings from at-scale implementation deployment will exceed the costs of implementation. The analysis focuses on direct and indirect costs and benefits (Figure 4).

The several local and regional benefits resulting from at-scale implementation are expected to far outweigh the costs, as shown in the table below. The initial upfront costs of implementation, including costs of sensors and signage and staff time to implement the new processes are outweighed by the benefits of improving efficiencies within the systems, including streamlining parking operations for unloading and loading of delivery vehicles.

Figure 5 Summary of Stage 2 Direct and Indirect Costs

Category		Benefits	Costs
Direct Costs	**Infrastructure & Equipment**	• Sensors provide insight on curb activity and ways to improve efficiency and safety	• Upfront cost of new signage design, creation, and installation • Upfront cost of sensors and installation • Upfront cost to establish a new digital permitting system and staff time to integrate it with existing processes.
	Vehicles	• Lower maintenance and operations costs through next-generation freight vehicles	• Upfront subsidy for companies to purchase of new freight vehicles
	Administration	• Digital permitting system may lead to system efficiencies and reduce staff time required to administer the program, reducing administrative costs • Updated commercial vehicle loading program could develop a revenue stream to support on-going operations and maintenance of truck loading zones spots	• Planning, management, and monitoring of SDZs • Planning and management of new loading program
	Workforce Development & Training	• Workforce training would be provided upfront and training materials will be made widely available. This would provide more opportunities for job growth and expansion of emerging industries over time.	• Costs to develop and host training to operate and maintain next-generation delivery vehicles

Category		Benefits	Costs
Indirect Costs	**Economic Impact on Businesses**	• At scale establishment of SMART Delivery Zones would send market signals to businesses, suggesting a need to accelerate the inevitable shift to new technologies and practices. • At scale implementation would demonstrate a replicable model to more than 19,000 cities and towns, some of which may want to use curb management as a strategy to accelerate progress on goods delivery efficiency. • The rebate program would support small and medium-sized businesses by reducing the upfront cost of vehicle acquisition.	• Possible near-term increased delivery costs to cover costs of fleet upgrades for companies not receiving rebates.
	Transition Costs	• Market and policy signals suggest a shift to a new era of tech-enabled goods delivery, and associated costs for companies to adapt their logistics and supply chains is on the horizon. Making this transition now may position companies to be more competitive. The local rebate program that would be provided through at-scale implementation would help defray these costs. • Newer freight vehicles, especially when outfitted with new technologies, have lower maintenance and fueling costs	• Costs for companies to adapt their logistics and supply chains in order to take advantage of SDZs.
	Consumer Impact	• Customers may see safety benefits as a result of tech-enabled new freight vehicles	• Potential for cost increases for businesses to be passed onto consumers and/or increases in delivery fees for consumers due to higher operational costs to comply with SDZ requirements.

4.13 Preliminary Baseline Data

The project team prioritized collecting baseline data around curbside use efficiency as part of Stage 1 to provide the team to inform at-scale implementation. The project team has evaluated current levels of performance by each of the key goal areas as described below.

Safety & Reliability

Stage 1 identified Safety & Reliability benefits through reduced conflict between freight vehicles and other transportation modes, reduced circling for a parking space, reduced unauthorized parking, and a decrease in truck-involved fatalities and severe injuries in the project area. While the Oregon Department of Transportation has a two-year lag in reporting crashes, collision data from 2014-2021 indicate a history of over 75 crashes within this area (Figure 6).

Figure 6 Vision Zero Crashes Within the ZEDZs

Researchers from Portland State University (PSU) collected baseline video data of the proposed loading zones and observed a total of 943 events across all loading zones. Video data analysis revealed that the loading zones were occupied by unauthorized users 75% of the time, including passenger pickup and drop-off, passenger vehicle parking, and trash collection among others. Only one-quarter of all activity in the zones qualified as authorized uses; in each SDZ, unauthorized uses comprised the majority of total observed uses (Figure 7). About two-thirds of the uses were categorized as “Other” uses. These uses varied from vehicle idling, passenger vehicle parking, service or maintenance vehicle parking, and unauthorized deliveries, such as Uber Eats or other packages. Pick-up and drop-off of passengers comprised around a third of unauthorized uses in all zones. PSU observations of compliance issues in loading zones was corroborated by project team conversations with Parking Enforcement supervisors.

PSU found that, across all zones, the average length of stay for authorized users was 24 minutes and 9 seconds, while it was 22 minutes and 43 seconds for unauthorized users. PSU also analyzed the average hourly weekday utilization of each zone (excluding SW 2nd Ave due to limited data). The utilization numbers indicate the percentage of the zones that are occupied (either for deliveries or other uses) by hour and consider the duration of each vehicle’s stay, vehicle length, and size of the loading zones. Peak utilization generally occurred between 8am and 11am (Figure 8).

Figure 7 SDZ Authorized and Unauthorized Uses (n= total observations)

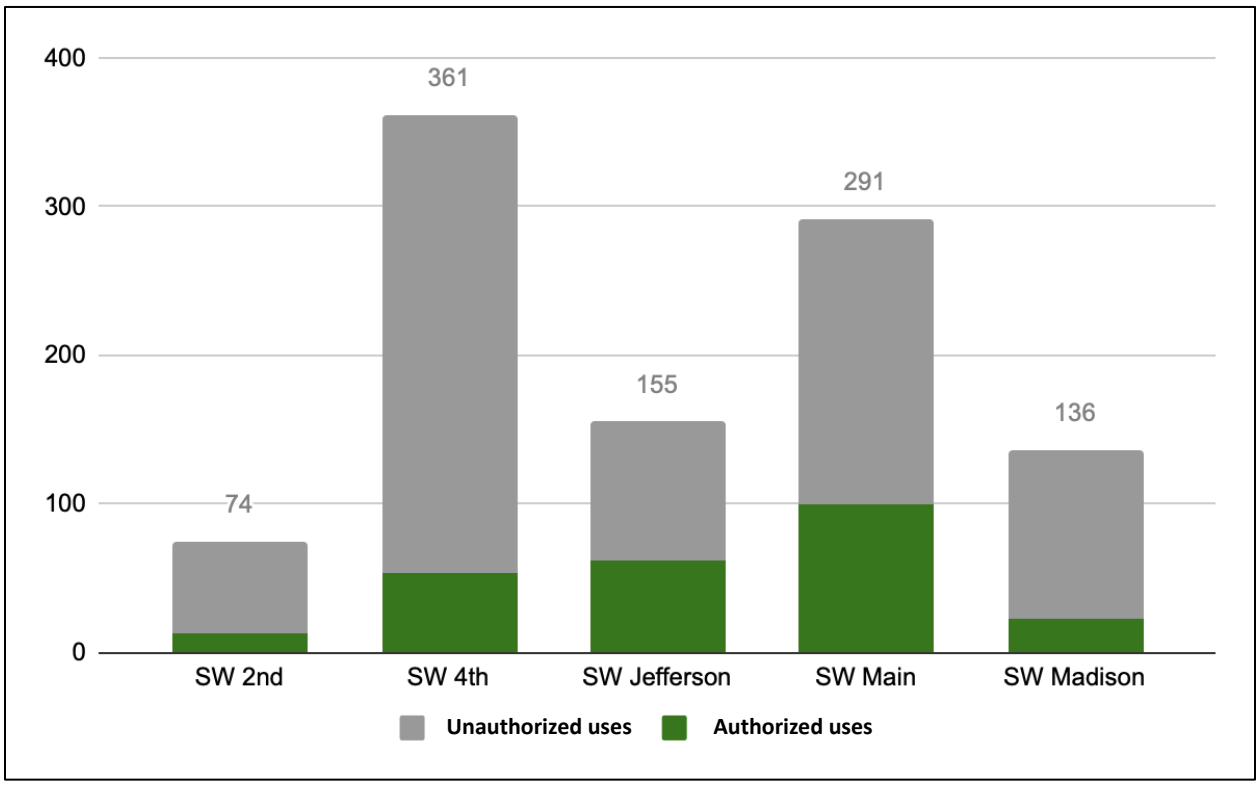


Figure 8 SDZ Average weekday zones utilization and proportion of utilization by authorized uses

Location	7 - 8 AM	8 - 9 AM	9 - 10 AM	10 -11 AM	11 AM - 12 PM	12 - 1 PM	1 - 2 PM	2 - 3 PM	3 - 4 PM	4 - 5 PM	5 - 6 PM	6 - 7 PM
Utilization (as proportion of available zones space)												
SW 4th Avenue	32%	60%	52%	43%	33%	42%	54%	49%	27%	14%	12%	14%
SW Jefferson	86%	61%	98%	85%	86%	61%	75%	59%	68%	54%	3%	8%
SW Madison	30%	29%	39%	37%	33%	27%	33%	17%	7%	12%	2%	14%
SW Main	55%	51%	79%	87%	71%	64%	41%	53%	46%	6%	7%	4%
Proportion of utilization by authorized uses												
SW 4th Avenue	65%	78%	65%	50%	32%	37%	38%	34%	24%	0%	28%	5%

Location	7 - 8 AM	8 - 9 AM	9 - 10 AM	10 -11 AM	11 AM - 12 PM	12 - 1 PM	1 - 2 PM	2 - 3 PM	3 - 4 PM	4 - 5 PM	5 - 6 PM	6 - 7 PM
SW Jefferson	77%	60%	48%	28%	28%	26%	29%	6%	44%	48%	57%	0%
SW Madison	0%	8%	14%	48%	22%	2%	19%	9%	49%	0%	59%	7%
SW Main	60%	59%	63%	56%	43%	54%	48%	57%	47%	0%	0%	0%

Automotus installed sensors at each of the selected loading zones in July and August 2024. Sensor data was largely in line with many of the trends observed by PSU. As the project team considers at-scale implementation, key data points referencing the total curb events include:

- Approximately 27% were made by commercial delivery vehicles (identified as “delivery” and “freight”).
- Approximately 11% of vehicles dwelled for more than 25 minutes.

Access

Stage 1 identified access benefits as increased economic opportunity for small and emerging carrier businesses, increased transition to newer, technology-enabled vehicles, and increased demand for freight vehicles to support small and emerging businesses.

During Stage 1, PBOT convened multiple focus groups over three different public involvement periods (pre-launch, during the demonstration period, and after the demonstration ended). One of the focus groups targeted small- and medium-sized businesses within the project area. The project team worked with this group to identify challenges and barriers to transitioning to a modern fleet or prioritizing innovation-driven vendors. Conversations led to consensus among participants about wanting to update their delivery vehicles but feeling unable to do so. As part of the pilot project, the City convened a “procurement” focus group where these businesses agreed to share existing procurement policies. Facilitated by PBOT, private- and public-sector representatives noted interest in creating a shared Memorandum of Understanding that prioritizes contracts with vendors that utilize innovative delivery models within the SDZs. The Stage 1 project sent out successful market signals. It led to exploration between PBOT, IKEA, and B-Line to test the feasibility of a first-in-the-nation partnership that would result in B-Line delivering medium-sized parcels to SDZs and other areas of Portland via microfreight. Additionally, the City purchased its own technology-enabled medium-duty freight vehicle for internal delivery purposes and DHL responded by purchasing three advanced freight vehicles to be used in the SDZs. After discussing the project, Amazon decided to redeploy its newest

vehicles downtown and FedEx-branded delivery vehicles were also spotted in SDZs. Meanwhile, small, local moving company HYPHN obtained a new medium-duty freight vehicle.

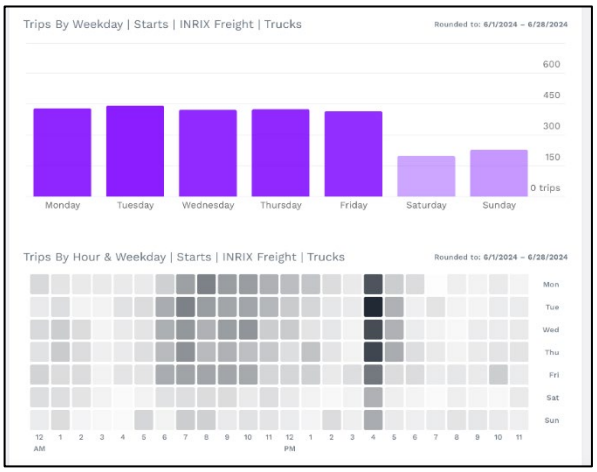
Integration & Partnerships

Stage 1 identified integration & partnership benefits as new data collection, expanded services at an urban consolidation center (the microhub), and new last-mile delivery partnerships to improve delivery operations efficiency.

Figure 9 IoT Data Used to Track B-Line Trips

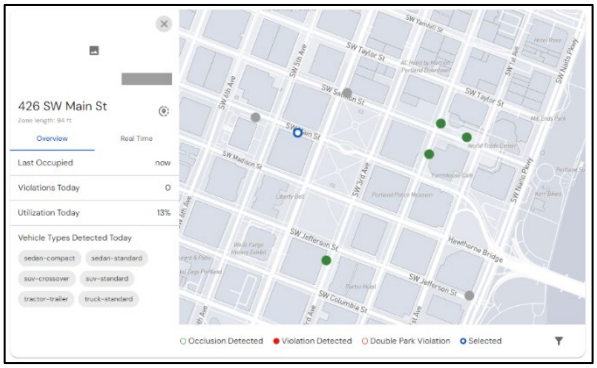
Aside from partnerships previously discussed, PBOT joined nine other U.S. cities in the Open Mobility Foundation SMART Curb Collaborative who worked together to tackle challenges in curb management, reducing congestion, and improve safety on city streets with support from the open-source mobility tools, including the Mobility Data Specification (MDS) and the Curb Data Specification (CDS). The Curb Collaborative was a helpful place to meet with peer cities to discuss strategies, gain trusted insights about technology solutions on the market, get advice and solve challenges, and more. The Curb Collaborative's programmatic activities, like regular virtual and in-person convenings, also helped strengthen relationships between peer-cities, transfer knowledge, and develop shared innovation strategies. One notable Collaborative outcome was the development of a cooperative purchasing agreement for "Smart Cities Technologies" with Sourcewell that is now available for public sector agencies to buy from.

Figure 10 Freight Trips by Day



PBOT also partnered with INRIX to manage access to the data collected in SDZs and to better understand who is using the SDZs. Stage 1 accomplishments included creating the first known MDS API for a freight company to understand trip distance (Figure 9) and trips by day (Figure 10), and providing citywide curb inventory and demand predictions (Figure 11). INRIX's work provided an opportunity to digitize Portland's parking rules and share new insights with influential private sector partners.

Figure 21 Example of Curb Analytics Dashboard



5 Challenges & Lessons Learned

This section describes the key project challenges, lessons learned, and recommendations the City experienced throughout Stage 1.

5.14 Challenges, Lessons Learned, Recommendations

The project team experienced challenges around each category described below throughout Stage 1. However, none of these challenges proved unmanageable. The project team has been creative in thinking through solutions and taking advantage of lessons learned that will make at-scale implementation a success.

Legal, Policy, and Regulatory Requirements

Vehicle acquisition and sensor installation were crucial to the success of Stage 1, which surfaced questions around the Build America, Buy America (BABA) process. Many vehicles and sensors are made abroad. The project team needed to utilize the Commercial-off-the-Shelf Waiver to source materials to meet the BABA requirements. Additionally, the City used SMART funds to procure a medium-duty van for internal logistics operations and the BABA and Buy American process required a few more steps including identifying the Vehicle Identification Number (VIN), ensuring the VIN would clearly state the van is a product of the U.S., and communicating between the SMART grant team, the City's Fleet team purchasing the vehicle, and USDOT grant compliance staff.

Truck Loading Zones are already regulated and enforced by the City. When looking to create the nation's first regulated SMART Delivery Zones, the project team navigated complicated boundaries to ensure any enforcement activities did not use any SMART grant funds or technologies and occurred solely through local funding. The project team clarified these requirements and its approach to move forward through two technical assistance meetings with USDOT SMART Grant staff. Looking forward to at-scale opportunities, PBOT would need to explore how local funding might be used independently of SMART Grant funds to support enforcement activities.

Procurement and Budget

While other cities struggled with procurement and contracting delays in Stage 1, PBOT's project team proactively collaborated with procurement staff, identified priority contracts, elevated issues to Bureau leadership, and moved the procurement process forward at an impressive clip. The project team even gained support from the Mayor's Office at one point to resolve any bottlenecks.

Portland and a few other cities worked with the Open Mobility Foundation and Sourcewell to craft a cooperative purchasing agreement for "Smart Cities Technologies" to help solve for procurement bottlenecks at local agencies and to create a competitive solicitation that any public agency could use to procure advanced sensors, transportation data platforms, and more. This was an early but significant accomplishment that will prove valuable for at-scale

implementation and for many other cities around the U.S. who may be interested in testing or deploying curb management technologies.

Partnerships

Private sector partnerships were key to the success of the project and would be just as critical for at-scale implementation. PBOT already had relationships with delivery providers, but the pilot helped catalyze new discussions around innovative freight strategies.

For example, project staff took time to discuss and workshop the pilot with the Bureau's Freight Advisory Committee. Over the past two years, project staff worked to strengthen their relationship with the Freight Advisory Committee members, gaining their support by tackling truck loading zone compliance issues that have negatively impacted goods movement.

Another challenge that surfaced during the project stemmed from the fact that the city does not have a comprehensive database of commercial vehicles that use loading zones, making it difficult to engage commercial curb users. Despite this obstacle, the project team worked hard to engage local industry stakeholders and build strong relationships with delivery companies and businesses. Given this learning, the project team used the no-cost extension to develop preliminary recommendations for a potential new commercial vehicle loading program that could include a permit in the future to allow the PBOT to identify, communicate, and collaborate with commercial curb users.

At-scale implementation will benefit from the time and effort spent building trust in Stage 1, as reflected by the fact that critical stakeholders have already agreed to participate in strategic meetings with PBOT during at-scale implementation.

Technology Suitability

As part of Stage 1, PBOT determined the scale of technologies required for expanding the SDZs from a pilot to larger-scale implementation. Rather than building internal data systems, tools, and software that could limit the replication and scaling of the pilot, the project team worked with technology companies to use commercially available products and turnkey solutions. Working with these sensor technology and mobility data experts, the project successfully integrated disparate technology systems, offering a well-defined blueprint for other cities to replicate should they make the necessary policy choices and allocate sufficient resources.

One of the first tasks was building a MDS API for B-Line. The team's original approach was to have B-Line solely responsible for building the API with INRIX leading oversight and integration of data feeds. However, the team quickly realized that there was a more efficient division of responsibilities, and to have B-Line lead on implementation of the IoT hardware while INRIX would lead creation of the API. This means future implementations would reduce the effort required for delivery companies to implement this integration because they could leverage INRIX's MDS Conversion Service. INRIX has worked with dozens of shared mobility providers over the years, and MDS formatting and API creation can be challenging for smaller, often under-resourced operators.

As with all new data standards, there has been variability in implementation of MDS and the CDS. For example, one sensor company implemented a push API version of CDS Events. While this is helpful for real-time data use cases (e.g., zones availability), it does not allow for pulls of historic information that a REST API would provide. It is also not compliant with CDS which calls for a REST API. This has resulted in some additional work to implement the CDS Events API.

Additionally, another significant milestone was the creation of citywide curb inventory and predictions about curb demand through INRIX's Curb Analytics platform. This allowed staff to quickly understand specific curb rules and relative demand for curbs, both in the demonstration zones and areas surrounding them. This citywide perspective will be useful for identifying potential expansion areas during at-scale implementation. As staff started using the tools, new use cases emerged that were specific to other divisions within the bureau and different than INRIX's existing enterprise and automotive customers. For example, staff wished to download data for use in GIS tools to layer with other data sets and visualizations.

Data Governance

One of the Stage 1 interventions used data and sensors to monitor and evaluate curb activity, which revealed improper curb usage and double-parking behaviors in the SDZs. Additionally, the pilot created the first-known data integration between a logistics company, analytics platform, and a public sector agency. Intellectual property, ownership, use, and sharing of the data was clearly defined in contracts between PBOT, INRIX, and B-Line. To address feedback regarding privacy concerns, project staff created a publicly available Privacy Impact Assessment (PIA) on advanced sensor technologies. The PIA documented how the City will use collected information from the sensors, details data governance, the full lifecycle of data management, and outlined legal obligations and compliance issues for the public. PBOT would update the appropriate PIAs with any at-scale implementation.

Workforce Capacity (e.g., impacts on jobs)

The Stage 1 project created one new job at PBOT and significantly contributed to the development of workforce demands and economic opportunities. The project also helped retain jobs and strengthen the economic position of INRIX, Automotus, and Cleverciti. In addition, collaboration with PSU facilitated valuable research opportunities, engaging students and faculty in data sensing and monitoring, urban planning, and goods movement analysis. Partnerships with private technology and data companies, such as INRIX, generated new business prospects, allowing these companies to apply their technology solutions in real-world usage. During at-scale implementation PBOT would aim to continue positively impacting the job market by maintaining existing demand and increasing workforce capacity through training opportunities.

Internal Project Coordination

One of the project's many successes was internal project coordination throughout the City and region. The project team engaged front-line staff including electricians and parking enforcement officers, coordinated with several other City offices and bureaus, and briefed every level of

leadership—from the Bureau Director to the Deputy City Administrator to the Mayor's Office. The project team received support from key advisors to ensure the project continues to be a citywide effort and is not limited just to PBOT. The project team also coordinated with regional stakeholders through Oregon Metro's TransPort subcommittee, which is charged with advancing the Transportation System Management and Operations Plan. Finally, the team worked with the City's Office of Government Relations Department to brief staff from the state's Congressional delegation who requested more information about the pilot project.

Community Impact
Stakeholders voiced interest in extending the safety benefits of SDZs to other areas of the city; however, aligning these benefits with local land use and delivery patterns was a challenge in Stage 1. In response to this feedback, at-scale implementation of the project would expand its geographical area beyond downtown.

Public Acceptance
One of the challenges in Stage 1 was forming partnerships in the delivery industry, as the team lacked a comprehensive list of delivery companies. This knowledge gap hindered efforts to engage key stakeholders and secure their participation. However, the team learned from the experience and carefully engaged industry stakeholders when appropriate. In addition, the team increased industry acceptance of the project by sharing data that showed 75% noncompliance in existing loading zones and by sharing efforts to secure additional funding specifically to help private-sector fleets modernize.

Data helped define a common problem and the private sector is generally supportive of an at-scale implementation project, especially one that would aim to reduce improper parking, increase industry efficiency, and support fleet modernization through rebates and technical assistance. During the pilot, the project team built trust by continually returning to industry stakeholders to give updates on the project, making a clear effort to understand their concerns, and showing how their feedback has been incorporated.

Project Scale & Timeline
Many companies shared that the small scale and short six-month timeframe of Stage 1 were limitations for them to plan and implement the changes necessary to participate, reducing the overall project efficacy. Although this was a barrier, it did not prove a significant limitation to the original goals of the pilot project since the project area was intentionally designed to be small-scale so a "minimum viable product" could be created, managed, and tested before future expansion or scaling. In response, at-scale implementation would include planning and implementation across the city, focused in areas with high curb demand. Importantly, at-scale implementation would also span a longer period of performance than the six-month pilot demonstration project of Stage 1.

6 Deployment Readiness

This project delivered significant accomplishments in 24 months, laying a strong foundation for at-scale implementation. At-scale implementation would build on existing partnerships established with core partners, enabling the project team to continue collecting and analyzing logistics and curb use data, as well as deploy additional sensors, data collection methods and technology solutions. In many ways, the technology work completed in Stage 1 set the stage for successful at-scale implementation, where the technology systems could be further optimized for an even greater impact. Additionally, the project team has already invested significant time to build trusted, effective relationships with business and community stakeholders. PBOT would continue to strengthen those relationships and collect feedback during at-scale implementation.

PBOT has proven itself capable of planning and implementing a complex, multi-stakeholder project throughout Stage 1 and demonstrated how the team was able to create and manage a successful demonstration project. At-scale implementation would begin with project initiation and planning before the technology implementation, regulations, and operations start. Research, evaluation, and knowledge sharing would last the entire project and a toolkit would be created to support replication and adoption by other U.S. cities.

6.15 Successful Implementation

Legal, Policy, and Regulatory Requirements

Given the similar nature of the interventions in Stage 1 and for at-scale implementation, the team would not anticipate significant new legal, policy, or regulatory requirements. PBOT used and would continue to use technology for curb management, which is squarely within its local department of transportation authorities. The project team worked diligently to understand and clear relevant legal, policy, and regulatory hurdles in Stage 1, paving the way for success for at-scale implementation. The project team worked closely with parking and regulatory staff to work within existing city policy to create new SDZ regulations and signage.

Further, the anticipated NEPA class of action for Portland's at-scale implementation project would likely fall under a Categorical Exclusion (CE), the same class of action applied to the Stage 1 project, thus avoiding lengthy federal regulatory hurdles and enable faster implementation. Depending if any program requirements shift under a new administration, PBOT may still need to consider Build America, Buy America (BABA) and Buy American (BA) requirements for an at-scale implementation.

Procurement and Budget

PBOT would use at-scale implementation funding to scale its project approach citywide and transform the pilot project into a sustainable, long-term program. During at-scale implementation, the project team would build on procurement and contracting experience gained during Stage 1. Budget management and compliance reporting would continue to be a team effort involving project staff with direct support from PBOT's Finance and Business Services teams, and the Office of Management and Finance's Grants Management Division.

By continuing existing partnerships, and establishing multi-year contracts at the outset, and using existing cooperative purchasing agreements through Sourcewell when available, the project team would be able to accelerate some of the initial contracting and hit the ground running. In sum, the project team anticipates these practices will help alleviate some of the typical procurement challenges faced by cities in Stage 1.

Partnerships

Partnerships are critical to the planning efforts of any at-scale implementation and would build on the effective, trusted relationships cultivated during Stage 1. During at-scale implementation, PBOT would remain committed to consistently working with our partners in the expansion and extension of the project, as well as in the development of new loading zones and a new citywide program. The project team would continue to build relationships with private industry partners that were been established during Stage 1, including the participants the Portland Freight Advisory Committee and other industry leaders like Amazon, IKEA, DHL, and UPS. The project team would also continue working with researchers from the University of Washington's Urban Freight Lab and PSU in project development and evaluation during at-scale implementation.

Technology Suitability

During at-scale implementation, PBOT would plan to continue its strategy of public-private partnerships. PBOT would maintain its collaboration with established technology companies, which include utilizing sensor technology for curb monitoring, expanding the current digital permit system, and integrating other mobility and logistics data for comprehensive mobility analyses.

PBOT's project excelled in bringing partners to the table to make use of the new technologies to create a digital ecosystem resulting in new interest from other freight companies to participate in data sharing. The use of open data standards has also made it easier to bring these new partners on board. INRIX's scale as a global company created value for many more private sector companies than PBOT would be able to achieve on its own with its curb inventory data. Furthermore, INRIX's customer ecosystem means that a number of private sector operators and vendors are already ingesting Portland's CDS data, including Amazon, Uber, Waymo, GrubHub, Google, Microsoft, Ford, Rivian, HERE, TomTom, and BMW. Providing tangible benefits to partner businesses allows the digital ecosystem to scale quickly. Lastly, data and technology integrations between INRIX, Automotus, Cleverciti, and B-Line created a turn-key technology stack that could be efficiently adopted in other U.S. cities. Together, PBOT and its technology partners will continue to pursue a comprehensive approach for technology integrations during an at-scale implementation.

Data Governance

At-scale implementation would offer four innovative technology solutions: 1) continue to use CDS to standardize curb data; 2) collecting data from partner companies and translating it into the MDS/CDS data standards for use in analytics platforms; 3) collecting data on other users

through computer vision/AI sensors to monitor curb use, travel patterns, and safety; and 4) a new commercial vehicle loading strategy.

Workforce Capacity (e.g., impacts on jobs)
Through at-scale implementation, the project would expand workforce capacity through strategic partnerships, creating diverse job opportunities across multiple project facets. This would include internships, fellowships, research collaborations, apprenticeships, and full-time positions in fields such as planning, computer science, vehicle mechanics, infrastructure planning, installation, and maintenance. For further information, please refer to Section 6.17: Job Creation.

Moreover, at-scale implementation would foster ongoing dialogue with industry leaders, through individual conversations and larger convenings such as an Innovative Delivery Roundtable. These conversations would be a place to explore workforce issues with some of the biggest employers in the industry.

Internal Project Coordination
PBOT knows effective project management is critical for a transformative project of this magnitude and has demonstrated success in change management throughout its Stage 1 project. PBOT has strong expertise in data management and analysis, urban freight operations, innovation, and curb management. Jacob Sherman, a skilled project manager and national leader in data and new mobility solutions who managed the Stage 1 grant, would provide direction and oversight, managing budget, schedule, and project delivery. He is supported by members of his team, executive leaders within PBOT, and partners across the City enterprise.

Community Impact
During at-scale implementation, the project team would plan to establish SDZs around the city, which would be individual zones that will be added or repurposed for loading and unloading activities for delivery activities. The selection of these locations would be aligned with local land use and delivery patterns and in conversation with industry stakeholders. PBOT learned in Stage 1 that business and community members were excited about the pilot but wanted to see it expanded to additional neighborhoods, not just downtown, and this strategy is designed to increase project impact across the entire city.

Public Acceptance
During at-scale implementation, the project team would continue to maintain open and ongoing conversations with the public, building upon the trust established during Stage 1. The project team developed and maintained relationships through the initial engagement progress that was critical to understanding challenges and opportunities. The project team's decision to return to those stakeholders to give project updates and show how their feedback has influenced the project throughout the pilot project. Several groups influenced elements of the project, such as organizations who contributed to loading zones site selection, such as helping to surface the challenges of reprioritizing a loading zone outside of the County Courthouse and instead see the

opportunity with including a mixed-use building with residential and commercial uses. These specific insights will be expanded upon to include more, similar use cases during at-scale implementation.

At-scale implementation would be shaped by partner feedback, and partners have already expressed excitement for this approach. Overall, transparent and proactive communication will continue to be essential to help the community understand the benefits of this project and foster broad support and ensure project success.

6.16 Maintenance & Operations Requirements for Project Continuation

The project team foresees the following maintenance and operation requirements would be necessary to continue this project after an at-scale implementation:

- **Sensors**: Ongoing costs and technical needs associated with operating sensors, including regular maintenance, calibration, and potential replacement due to damage or as technology advances. Ongoing staff time may also be necessary to analyze findings and use them to inform future policy.
- **Signage:** Maintaining and potentially replacing signage that is damaged or at end-of-life will be critical to ensuring consistent and clear communication of SDZs.
- **Digital Infrastructure:** Outsourcing curb data inventorying and MDS/CDS data management to a third-party company, INRIX, would mean that continued access to data will require a long-term funding commitment from PBOT. As technology advances there may be opportunity in future to further use this digital infrastructure beyond the project, such as to manage data shared by taxis and Transportation Network Companies (TNC) or when using digital systems to manage automated vehicles.
- **Partnerships:** Maintaining relationships with businesses formed as part of this project will require investment of staff time.
- **Commercial vehicle loading program:** While the no-cost extension allowed for the development of an internal framework for an updated program, any new programs based on that framework would include new operational costs, software updates, user support, and system security. Maintaining and updating these systems will be required to maintain their efficiency and effectiveness.

6.17 Job Creation

At-scale implementation would provide a growing market for innovative delivery models that will increase job opportunities in mechanics and repair, planning, installation, and maintenance of facilities and infrastructure. The project would connect workers to local high-quality workforce development resources. Industry conversations would allow for continued opportunities to explore workforce issues with major employers. Together, these opportunities and federal financial resources will increase access to good-paying jobs.

7 Wrap-Up

7.18 Reflections, Changes, and Advice

During its two-year run, the Portland SMART Delivery Zone pilot achieved successes in each of its three objectives:

Establish SMART Delivery Zones

- Portland established the first regulated SDZs in the nation following extensive outreach and communication with stakeholders and key City partners.
- PBOT approved 66 permits for new delivery vehicles.

Use Data, Sensors, and Curb Access to Manage the SMART Delivery Zones

- PBOT partnered with INRIX to digitize all the parking and loading rules (formerly available only on physical signs), making this available to private sector companies.
- The PBOT team created the first known MDS (open-source standard) feed for a logistics company (B-Line) in the country.
- PBOT used sensors to monitor use of existing loading zones to better understand the issues surrounding them.
- Video monitoring helped create a common understanding among stakeholders of problematic noncompliance issues in truck loading zones.

Facilitate Micro-Distribution Hub (Microhub) Operations and Last-Mile Solutions

- PBOT facilitated conversations and initiated partnerships between major commercial suppliers and B-Line Urban Delivery for provision of last-mile delivery services.
- B-Line partnered with six businesses within the project area to trial deliveries using the SDZs.
- B-Line procured their first medium-duty freight vehicle with assistance of SMART funding. B-Line can now serve greater distances and a larger variety of delivery goods with this new vehicle.

The Stage 1 project also demonstrated PBOT's commitment to provide reliable, modernized access for commercial delivery vehicles at the curb using a collaborative, data-driven approach. PBOT has completed baseline curb data collection and analysis; conducted robust stakeholder engagement with a wide set of participants, including SDZ tenants and delivery companies; installed advanced sensors to monitor curb use; and created a free digital parking permit for delivery companies utilizing innovative delivery models.

Baseline data collection effort demonstrated:

- Approximately 73% of vehicles utilizing the proposed loading zones during the demonstration project were noncompliant with existing truck loading zones regulations.
- The average length of stay for authorized vehicles in the loading zones was about 17 minutes, while it was about 21 minutes for unauthorized users.
- Approximately 11% of vehicle loading sessions took more than 25 minutes.

Stakeholder engagement demonstrated that:

- Numerous stakeholders are interested in SMART zones and some felt that the initial geographic scale of the project was too limited to have widespread effect.
- There is a need to offer transparent communication regarding sensor monitoring, and the city is committed to working alongside concerned communities to determine the appropriate path.
- Stakeholders have expressed interest in continued clear updates and communication about the project as well as an informational graphic about the benefits of the project.

Early data integration efforts and third-party technology solutions demonstrated:

- The utilization of data and sensors to monitor and evaluate curb activity has revealed new insights to PBOT about improper curb usage and double-parking behaviors.
- There are many benefits of using a standardized data format to manage curb data management ecosystems.
- Public-private partnerships with technology companies can provide scalable solutions to enable a technology-driven network of SMART zones.

Successes from Stage 1 confirm the need and the opportunity to expand the project during at-scale implementation to a citywide geographic scale, extend the length of the demonstration period, and promote adoption of the next generation of delivery vehicles. Additionally, digital tools and technology solutions can help build a data-driven approach to improving curb access. Based on overcoming obstacles and initial project success, PBOT recommends the following strategies to other cities interested in pursuing technology-enabled SMART Delivery Zone:

1. **Identify your assets and challenges.** Cities control the curb, create and approve permits, and manage lane use, which are all valuable assets and potential tools. At the same time, pilot projects may also reveal unexpected internal challenges, such as procurement or other process constraints. Understanding all the assets cities can leverage, as well as any limiting factors, is critical for success.
2. **Engage with peer cities.** Collaboration provides insight, inspiration, and lessons learned from experience on the ground. It can also help cities develop common standards and strategies that can better facilitate cooperation with nationwide freight and logistics companies. Portland has found it helpful to collaborate with other cities through organizations like the Open Mobility Foundation.

3. **Establish partnerships with key industry stakeholders.** Cities should find out the interests, concerns, and operations of industry partners, so they can productively shape project design and be better positioned to collaborate and succeed.
4. **Have an engagement plan from the beginning.** Establishing trust and building effective relationships with stakeholders from the beginning is key to a smooth process. Cities should proactively engage businesses and community members, have clear communications, respond promptly to concerns, and provide regular updates on progress.
5. **Use data to illustrate the problem for stakeholder buy-in.** A clear understanding of the problem(s) a pilot project will address can be a strong catalyst for building support among stakeholders. For example, in Portland, data collected from cameras showed that commercial loading zones were occupied by unauthorized users 75% of the time, an issue that causes challenges for authorized users.
6. **Find your champions.** Having strong local support and interest from policymakers, as well as external stakeholders, will increase the odds of success and make it easier to weather inevitable challenges. Industry leaders aren't the only ones interested in improving freight systems; community groups often support efforts that result in fewer negative impacts in their neighborhoods.
7. **Start small but plan to scale.** Portland designed its six-month pilot knowing the project would not address all challenges or execute the complete vision of a SMART loading zone, so it is crucial to plan for expansion. A second phase could span two years, allowing companies and the project team time to adapt as the program expands to additional corridors and neighborhoods.
8. **Use tools that are easy to access, replicate, and scale.** Advanced technology may not always be necessary; in some cases, lower-tech options are less complicated and labor-intensive to employ. Where technology is justified, understand how internally or externally purchased or developed data systems, tools, and software will be managed, maintained, and scaled.
9. **Understand the things that are out of your control.** The terms of the SMART grant forbid the use of any funds for ALPR or direct enforcement. Without the ability to increase enforcement in the loading zones, fostering compliance was significantly more difficult. Understanding these limitations before the grant period allowed the project team the opportunity to collaborate with the City's parking enforcement division to address violations independently.

The City of Portland's Stage 1 SMART grant demonstrated significant accomplishments throughout the pilot period, and we appreciate USDOT's investment in this project. PBOT firmly believes that project outcomes can not only be scaled effectively through at-scale implementation but that it also has strong potential to replicated by other U.S. cities, which would exponentially increase this SMART grant project's impact.