

Number: 25-32

Proposed Title: Delivering Justice: Modeling the Equity Impact of Urban Freight Management Strategies

1. Concisely describe the **transportation issue** (including problems, improvements, or untested solutions) that Oregon needs to research.

From [East Portland](#) to [Red Hook, Brooklyn](#): meteoric demand for home delivery and blisteringly fast shipments spawned an urban warehouse building boom. In 2018, warehouses and distribution centers [surpassed office spaces](#) as the dominant commercial and industrial land use in both number of buildings and floorspace, following a nearly 100% growth trajectory since 2003. In 2020, real estate developers forecasted an additional [1 billion square feet](#) of warehousing space needed to meet home delivery demand by 2025.

Due to historical, racialized urban development practices and today's market forces, these mega-warehouses do not locate near the neighborhoods with the most frequent online shoppers (who are disproportionately white and higher-income), but rather in industrial zones near historically marginalized communities. Our recent studies, which are currently under review and available upon request, combined an Activity-based model (ABM) of online ordering behaviors with a Local Depot Vehicle Routing Problem (LDVRP) and confirm substantial disparities in ecommerce-related freight traffic (VMT) and health-adverse air pollution between these two populations. Our research proposal seeks to build on this model to evaluate a quiver of proposed urban freight management strategy scenarios, from [Indirect Source Rule](#) to commercial vehicle electrification and off-hour delivery, using an equity and environmental justice framework. In other words, what policies, practices, and investments can Oregon agencies and companies prioritize to promote an equitable urban freight system?

2. Document how this **transportation issue** is important to Oregon and will meet the [Oregon Research Advisory Committee Priorities](#)

Our proposal evaluation focus centers **equity**. Relating to the 2023 Oregon Transportation Plan, this proposal's cross-cutting objectives addresses ODOT's following goals (among others):

- **Policy SC.2.3:** Minimize transportation contributions to local airshed quality, prioritizing the most affected low-income communities.
- **Policy SE.1.2:** Document the impact of past decisions on current inequities and develop restorative strategies to shape future investments.
- **Policy SP.5.1:** Make decisions through transparent processes that are inclusive, engaging, and supported by data and analysis.
- **Policy SA.1.1:** Identify safety solutions that eliminate fatalities and serious injuries while curbing vehicle emissions and leading to equitable outcomes.
- **Policy EC.2.2:** Support efficient movement of freight to help keep delivery costs from increasing.

Freight traffic is the most prominent, mobile-source emitter of air pollution and related public health impacts in cities. Despite freight vehicles constituting less than ten percent of distance traveled on the road, their diesel exhaust generates over half of all Nitrogen Oxide (NOx) pollutants and equates to almost 10,000 years of life lost annually in [Toronto \(Canada\)](#). Freight traffic's deleterious health effects disproportionately befall historically marginalized communities. [Satellite estimates](#) suggest low-income populations of color in major U.S. cities are exposed to 28% more diesel traffic-related NOx emissions than high-income white populations. Urban freight traffic is also an accelerating source of [increasing road fatalities and injuries](#), especially among vulnerable road users such as

pedestrians and bicyclists. [Research in Minneapolis-St. Paul](#) finds fatal and injurious collisions with freight vehicles disproportionately occur in low-income and majority POC neighborhoods.

The heightening of these external costs has prompted environmental research on an array of sustainable “last-mile” or urban freight management strategies. For instance, the [World Economic Forum](#) found that a strategy integrating electric cargo vans, off-hour deliveries, parcel lockers, and IT-enabled routing and load-pooling could decrease freight emissions and congestion by 30% by 2030. However, historically marginalized populations likely benefit less from the interventions that reduce last-mile delivery traffic. In [Portland \(Oregon\)](#), parcel lockers follow a consumer-oriented geographic distribution that leaves cold spots in the city’s low-income and predominantly Hispanic neighborhoods. Furthermore, there is an urgent need for state, metropolitan, and municipal agencies to leverage modeling and scenario evaluation tools—including ODOT’s travel demand modeling methods, household travel surveys, Statewide Integrated Model, and freight forecasting models—to identify equity-centered urban freight management strategies to redress historical injustices and minimize disparities of exposure to freight’s external costs.

3. What final product or information needs to be produced to enable this research to be implemented?

The study evaluates Amazon’s distribution network in Oregon’s largest metropolitan statistical areas (MSAs), which encompass urban, suburban, and rural municipalities/townships: Portland-Salem, Medford-Grants Pass, and Bend-Pineville. The proposed study adopts a two-phased modeling and scenario evaluation methodology. Prior to the analysis, the research will overview the state of “sustainable last-mile delivery” interventions in North America (e.g. parcel lockers, cargo bicycles, electric goods vehicles, and etc.) and their linkages to equity-centered transport and land-use planning. Our team’s past research found that reducing VMT in the middle-mile segment of the delivery chain (i.e. goods transport between warehousing and delivery service areas) generate outsized reductions in traffic for marginalized populations than those that reduce pollution in the last-mile segment (i.e. intra-neighborhood circulation between consumers). This enables us to identify an evaluation framework with which to prioritize strategies based on the marginal equity/environmental justice (EJ) benefit they offer (*see Figure 1*)

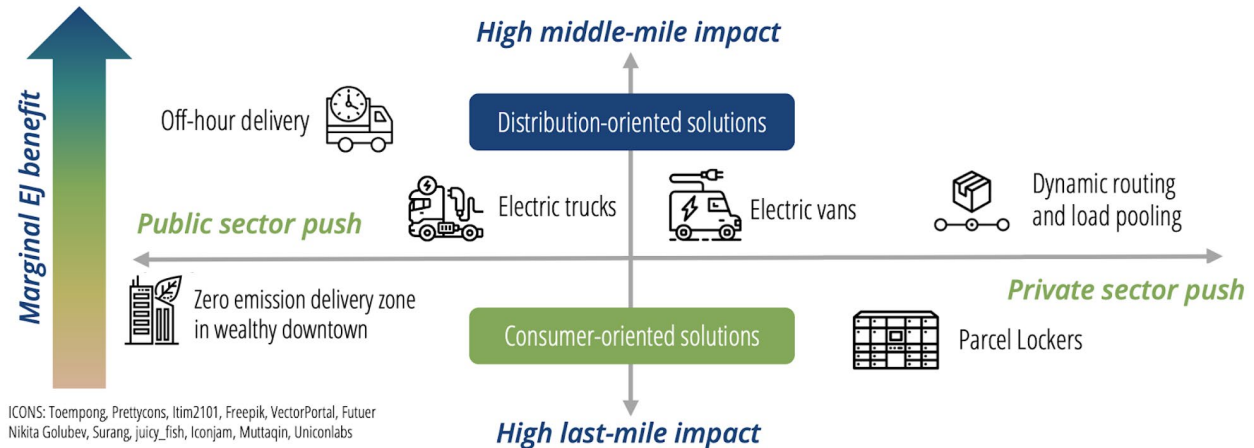


Figure 1: Hypothetical evaluation framework for evaluating marginal equity/EJ benefit of sampled interventions.

The proposed research further extends this framework and identifies effective urban freight traffic and warehousing strategies to improve equity outcomes through three research phases.

- *Phase 1 | Residential freight trip model and calibration:* Combines empirical methodologies from spatial microsimulation/ABM (e.g., population synthesis and network analysis) and residential freight trip generation (RFTG) modeling, which assigns delivery trips based on person- and household-level online ordering behavior. The purpose is to establish counterfactual conditions using ODOT/National Household Travel Surveys. Counterfactual analysis can include policy and spatial analysis of existing industrial land use, labor environments and political-economy, and can include model calibration with truck and van vehicle counts/traffic volume (if available to ODOT or budgeted).
- *Phase 2 | Scenario design and equity evaluation:* Estimates stochastic range of scenario/forecasted ordering behaviors and traffic impacts and disparities between target and control population groups, as identified by [ODOT’s Social Equity Index](#). Parameter sensitivities analyzed based on conditions unique to scenarios. For instance, a

modeled “off-hour delivery” program would require time-of-day alterations in a historic data traffic router, e.g., GoogleMaps Routing API. Meanwhile, parcel lockers and microhub+cargo bicycle delivery programs would involve sensitivity analysis of alternate spatial distributions of drop-off sites.

The proposed project will span 12-18 months and offers the following deliverables:

1. One academic article to be published in a peer-reviewed journal with ODOT acknowledgement;
2. one ODOT-branded report overviewing methodology, findings, and policy recommendation, which can be made public;
3. one to two blog posts published on Urban Freight Lab’s [blog platform](#), for media promotion;
4. invitations for ODOT members to present this work and/or participate in quarterly Urban Freight Lab workshops with [stakeholder members](#).

4. (Optional) Are there any individuals in Oregon who will be instrumental to the success of implementing any solution that is identified by this research? If so, please list them below.

Name	Title	Email	Phone
Rebecca Knudson	Senior Transportation Economist	rebecca.a.knudson@odot.oregon.gov	

5. Other comments:

Given that our ABM-based modeling approach outputs ecommerce-related van and truck traffic VMT at both the zonal and individual/household exposure level, this metric can be adapted to several external costs to serve ODOT’s departmental purposes: GHG emissions, criteria pollutants, road safety risk, and/or generalized cost. As such, this proposal centers *equity more broadly*, rather than a single externality.

6. Corresponding Submitter’s Contact Information:

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