Exploring the sustainability potential of urban delivery microhubs and cargo bike deliveries

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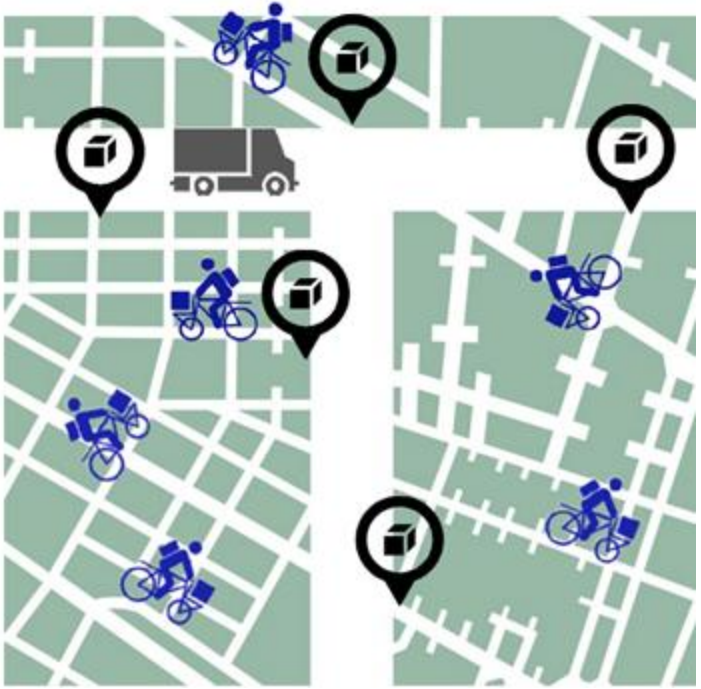
brightdrop REEF URBAN FREIGHT LAB UNIVERSITY of WASHINGTON College of Engineering AxleHire COASTER CYCLES

What is a microhub?

- Goods are consolidated to hub near the final delivery point
- Hub serves a limited spatial delivery area
- Allows for mode shift to clean vehicles or soft transportation modes
- Reduces truck travel in last mile



https://civitas.eu/sites/default/files/documents/cyclelogistics-civitas_final.pdf

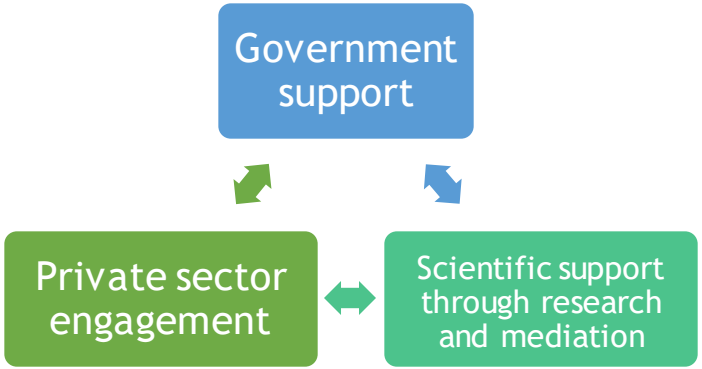
Background

- Freight delivery systems under pressure
  - Urban population and demand for online shopping is on the rise
- Earlier micro-consolidation initiatives
  - Urban Consolidation Centers (UCC) in Europe since 1970s
  - Key purpose: to avoid freight vehicles traveling into urban centers with partial loads (Allen et al.,2012).

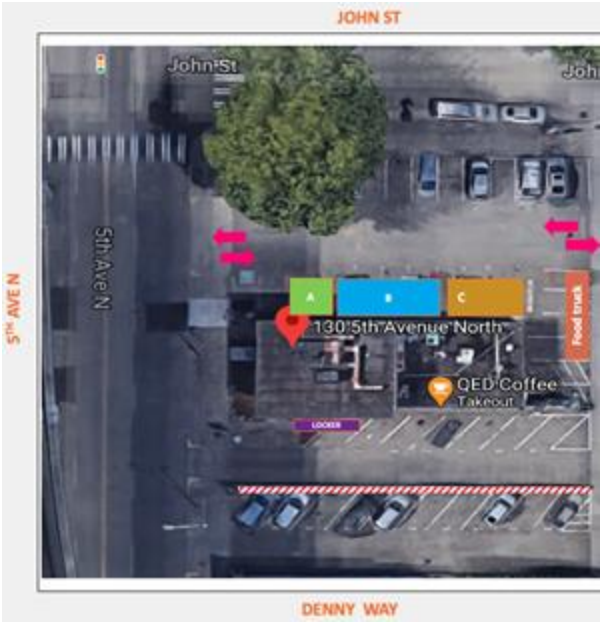
https://static01.nyt.com/images/2019/10/27/nyregion/27NYTECH-p1/00NYTECH1-mobileMasterAt3x.jpg

Planning and Implementation

- Many previous UCC implementations failed to operate in the long term because of low throughput volumes, the inability to operate without financial support from government, and dissatisfaction with service levels (Allen et al., 2007; van Rooijen et al., 2010)
- Multi-sectoral collaboration is necessary to obtain a working, self-sustaining facility (Allen et al., 2012)



(Verlinde et al., 2012)



Urban Freight Lab hosts a Common Microhub Pilot Test in Seattle

Objectives

- Catalyze and support empirical tests of viable sustainability solutions
- Assess the performance of delivery microhubs and cycle logistics when compared with truck deliveries in terms of
  - VMT per package,
  - Tailpipe CO_2 emissions,
  - Time spent per package.

Approach:
(1)Respond to private sector request (2)Empirical analysis using pilot test data

Stakeholder Goals from Microhub (2/21)

What is your company's interest in piloting a microhub? How would a microhub align with your company's goals? What results do you expect from microhub utilization?

Reduce Congestion (6)

Reduce VMT

Reduce Number of Delivery Truck Stops

Quicker turnover of curbside space

Customer Accessibility (6)

Allow for customers to pickup and drop off packages

Storage (5)

Inventory storage (e.g. peak season backup inventory)

Storage for delivery e-bikes

Desired Characteristics (2/21)

What are the desirable operational and physical characteristics of a microhub for your company?

Security (8)

Secured with lighting, fence, surveillance

Security cameras

General Vehicle Access (5)

Sufficient space (and clearance) for box trucks to maneuver

Reliable access from the transportation network

Data Connectivity (5)

Built-in power and internet connection

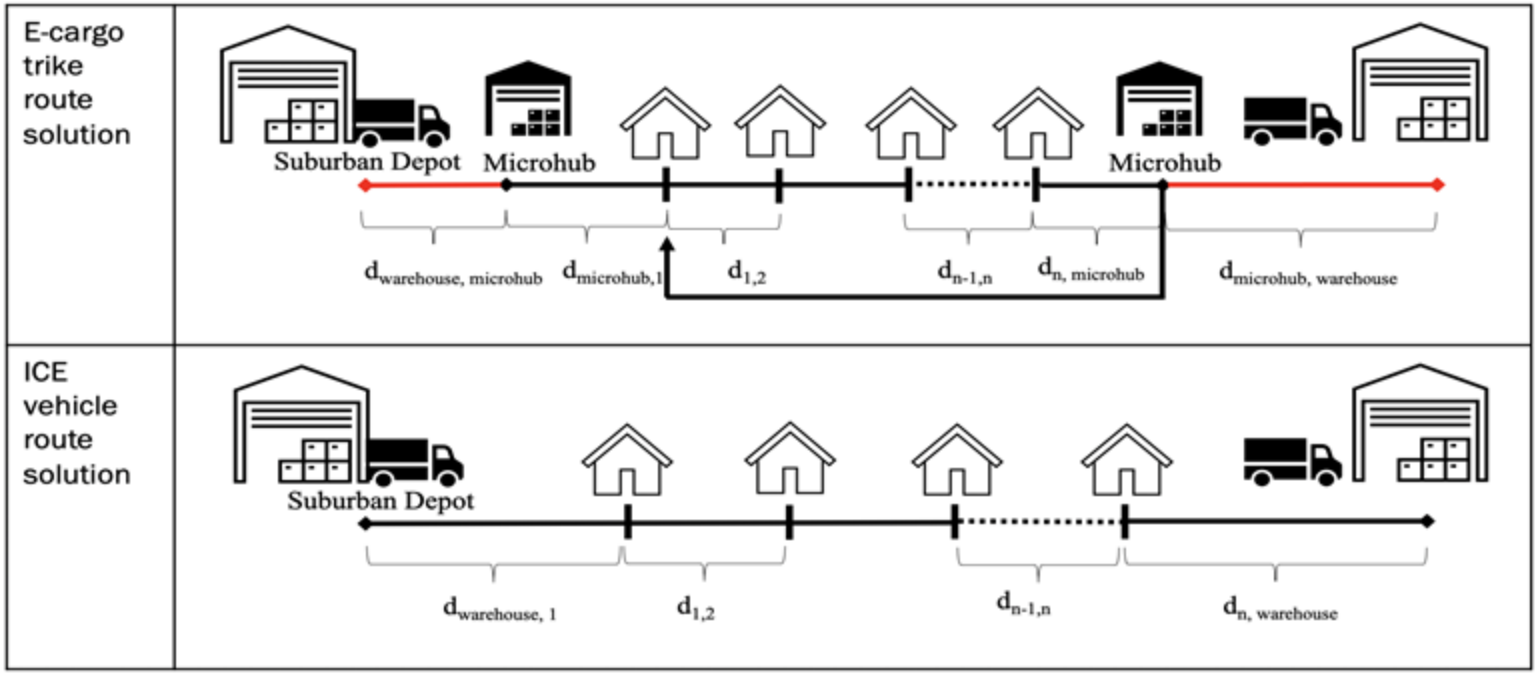
Smart and connected infrastructure

Inventory control system

Delivery dataset with timestamp, unique route and customer identifier for ICE vehicle and e-bike routes (AxleHire)

Measure	E-BIKE	ICE VEHICLE	% DIFFERENCE
Total number of routes	64	17	
Average number of packages per route	8.53	43.70	-80.48
Average number of packages per stop	1.21	1.13	7.08
Average estimated route distance (mi)	3.79	35.01	-89.17
Average time spent between first and last delivery (min)	47.89	162.74	-70.57

E-cargo bike route versus truck route



Key variables: 1) number of e-bike routes per truck arrival, 2) number of microhubs served by each truck

Performance Metrics

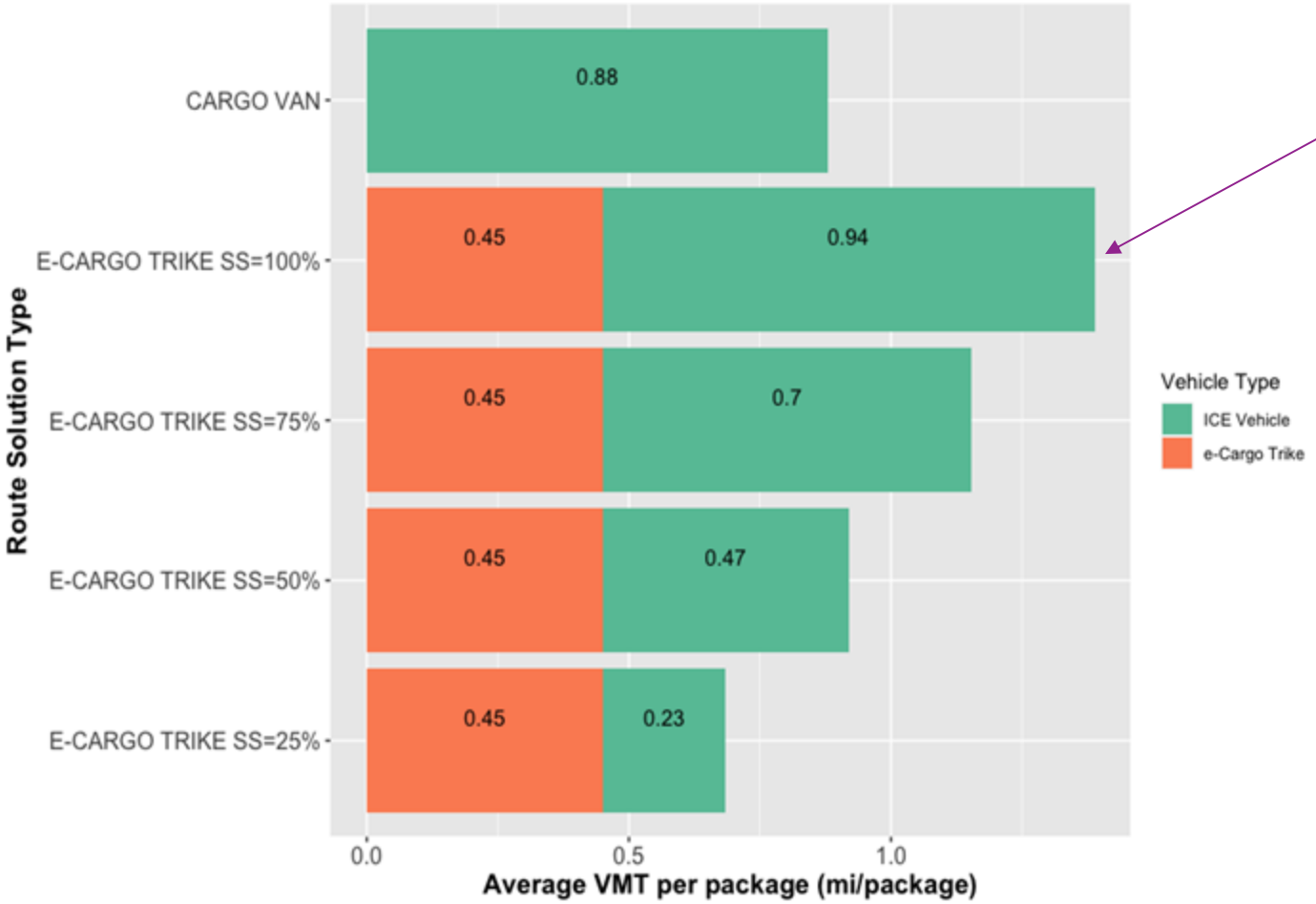
1) Vehicle miles traveled per package

- Stem share (SS)

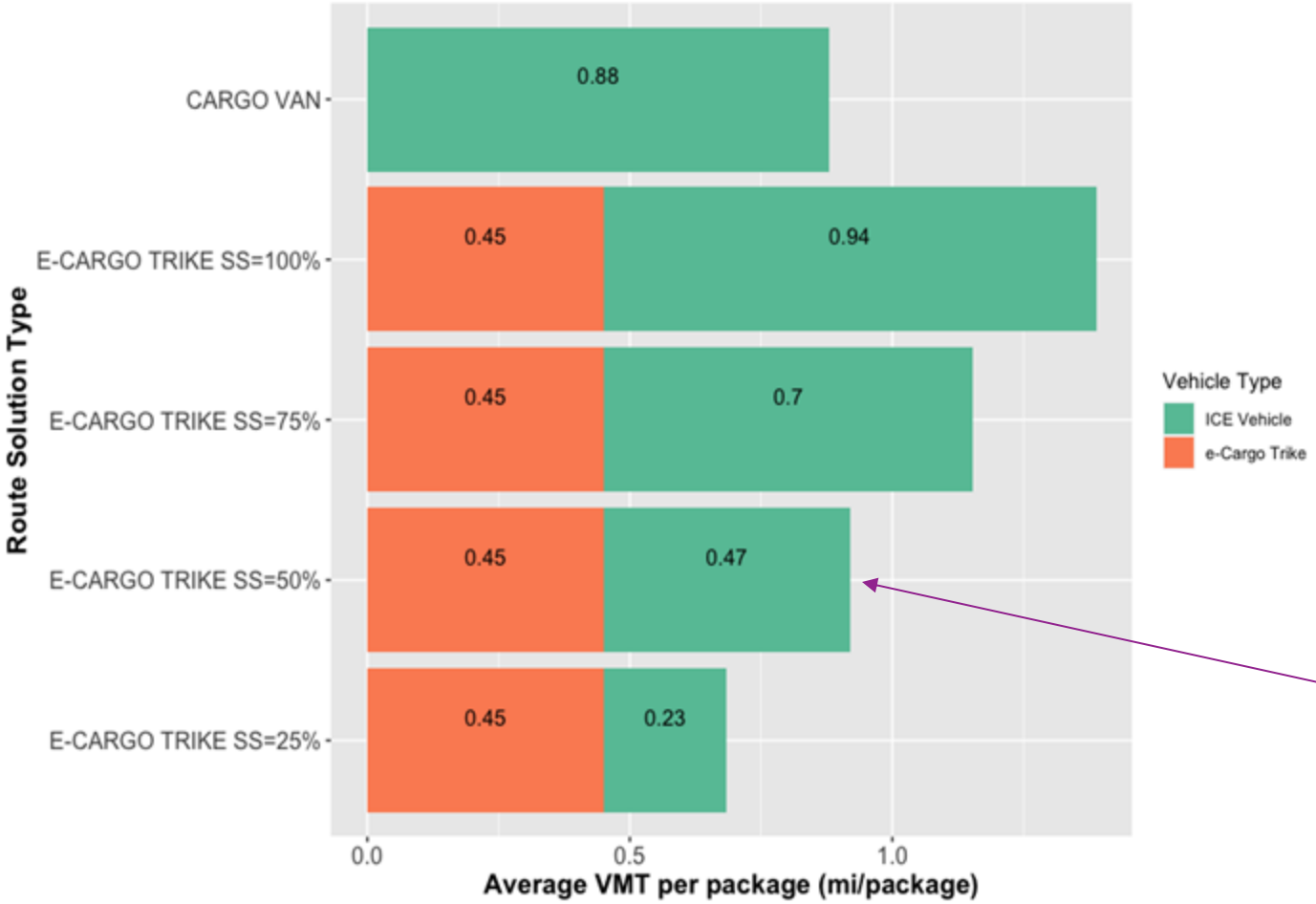
$$SS = \frac{number\ of\ packages\ delivered\ in\ e{-}cargo\ trike\ routes}{total\ number\ of\ packages\ in\ the\ cargo\ van\ doing\ the\ stem\ trip}$$

- During the pilot test, the stem trip was carrying packages for at least 2 e-cargo trike routes per day, which means the stem share was at most 50%.

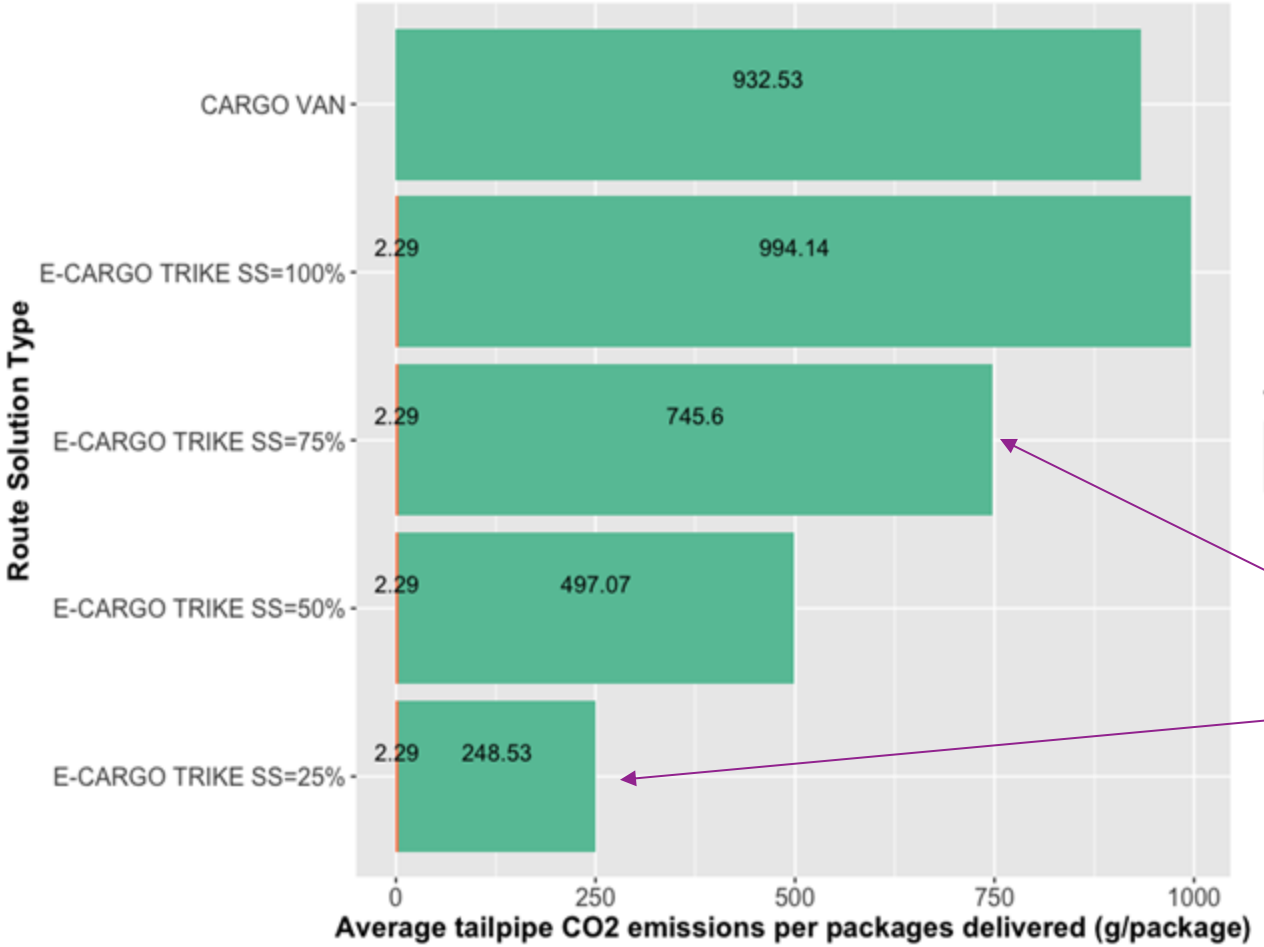
2) Tailpipe CO_2 emissions per package



e- cargo trike solution not favorable when the stem trip is used only for 1 route



74% reduction in cargo van VMT when packages were delivered by e-cargo tricycles and the stem share was 25%



When SS is at least 75%; 19%-73% reduction in carbon emissions

Conclusion

- Last-mile delivery via e-bike provides significant opportunity to reduce neighborhood impacts
- Private sector motivated to learn and scale
- Middle mile operations are as important as last mile to achieve lower emissions and VMT
- Further experimentation will support
  - Workforce development
  - Policy framework
  - Robust business models

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Questions?

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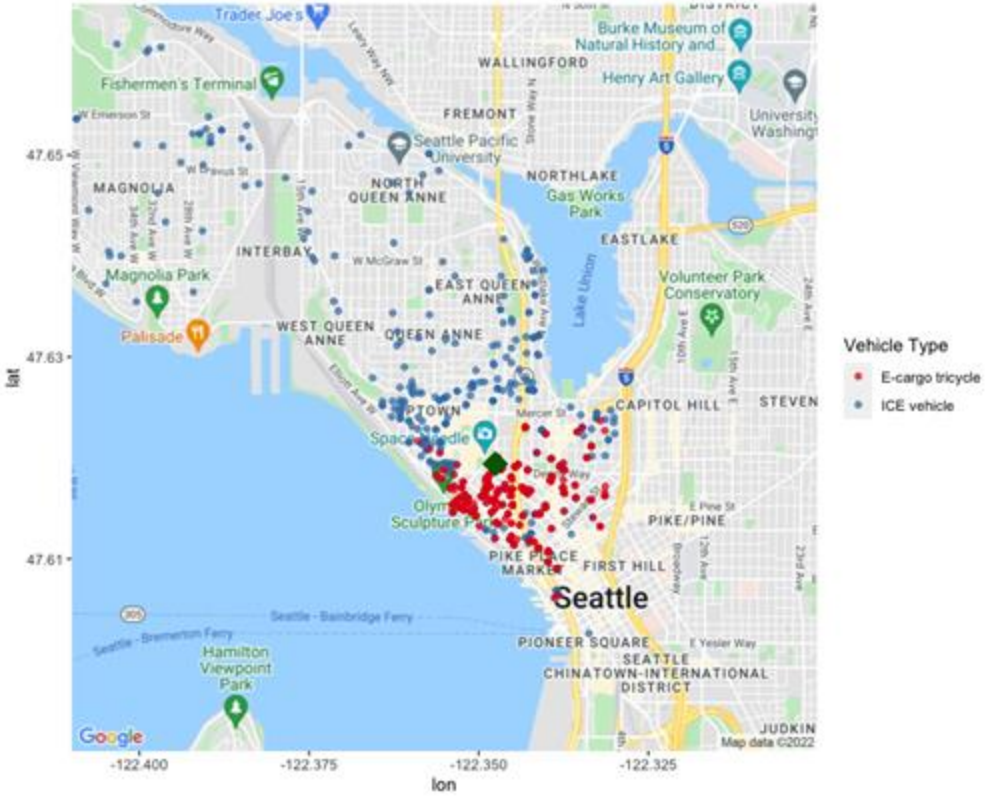
Study Area


Trader Joe's
Burke Museum of Natural History and...
Fishermen's Terminal
WALLINGFORD
Henry Art Gallery
FREMONT
Seattle Pacific University
NORTH QUEEN ANNE
NORTHLAKE
Gas Works Park
MAGNOLIA
EASTLAKE
INTERBAY
Magnolia Park
EAST QUEEN ANNE
Volunteer Park Conservatory
Palisade
WEST QUEEN ANNE
QUEEN ANNE
Lake Union
CAPITOL HILL
STEVEN
PIKE/PINE
PIKE PLACE MARKET
FIRST HILL
Seattle
Seattle - Bainbridge Ferry
Seattle - Bremerton Ferry
PIONEER SQUARE
SEATTLE CHINATOWN-INTERNATIONAL DISTRICT
Hamilton Viewpoint Park
JUDKIN
Google
Map data ©2022
47.65
47.63
47.61
lat
-122.400
-122.375
-122.350
-122.325
lon
Vehicle Type
E-cargo tricycle
ICE vehicle

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