North American Zero Emissions Microhub Pilot

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The importance of efficient city logistics has never been greater. Two converging trends — the rise of e-commerce and growing urbanism — are creating major challenges for cities, putting tremendous pressure on the goods delivery system, overwhelming infrastructure, straining congested city streets, and contributing to increased air and noise pollution. The response to COVID-19 has only added new constraints and demands and highlighted the essential nature of delivery and distribution.

Forward-looking industry and government partners in the University of Washington's Urban Freight Lab (UFL), jointly decided to create a space for members to test and evaluate the operational impacts of a neighborhood delivery hub in Seattle. Using e-cargo bikes to make deliveries, the UFL's Seattle Neighborhood Delivery Hub project is one North America's first zero-emissions, last-mile delivery pilots, serving as a testbed for innovative, sustainable urban logistics strategies on the ground in the dense Uptown neighborhood. A neighborhood delivery hub is a central drop-off/pick-up location for goods and services at the neighborhood level that can be used by multiple delivery providers, retailers, and consumers. Goods are trucked to the hub from nearby consolidation centers, then prepared for last-mile delivery within a short bike ride. By moving delivery operations closer to the end customer and offering onsite services, hubs can alleviate congestion, lower emissions, consolidate freight vehicle trips, reduce vehicle miles traveled, and enable transfer to low- or zero-emissions fleets for last-mile deliveries. The Seattle project aimed to pilot new urban logistics technologies, vehicles, and delivery models to quickly bring to market new more fuel- and resource-efficient solutions; identify the benefits of neighborhood delivery hubs in urban delivery systems; and guide future development of similar sustainable city logistics solutions. These technologies are also an important part of the City of Seattle's Transportation Electrification Blueprint, including the goal of transitioning 30% of goods delivery to zero emissions by 2030.

The Seattle Neighborhood Delivery Hub tested:

1. Common Carrier Parcel Lockers

Common carrier parcel locker systems create delivery density, enabling carriers to transport numerous packages during a single stop, reducing dwell time and failed deliveries, both of which produce congestion, emissions, and increased costs. Customers complete their own final mile delivery.

2. Electric-Assist Cargo Bike Fleet

Electric-assist cargo trikes provide an agile, sustainable last-mile delivery solution in dense urban areas, mitigating the emissions, congestion, and noise produced by traditional truck delivery.

3. Electric Pallets

We tested a propulsion-assisted electric pallet designed to help reduce package touch points, costs, and physical strain on the labor force while optimizing the movement of goods over short distances.

4. Neighborhood Kitchen

Neighborhood kitchens are non-customer-facing modular vessels where food is prepared for mobile app or delivery orders. Removing front-of-house operations reduces a restaurant's footprint, increases sustainability, and gives food entrepreneurs a platform by reducing overhead costs.

5. Sensing Devices

We tested a comprehensive edge computing device that collects data on vehicle, pedestrian, and bicycle volumes, travel time, and speed estimates—enabling researchers to assess the performance of the Neighborhood Hub.

Key findings below show that, on balance, neighborhood delivery hubs can enable productive and more environmentally sustainable urban last-mile delivery compared to traditional cargo vans. These findings are extremely promising, particularly since researchers expect operational efficiencies only to improve as the e-cargo bike model undergoes future larger-scale testing and refinement.

To analyze hub performance, researchers used cameras with vehicle recognition technology, GPS tracking sensors, parking occupancy sensors, and video footage of e-cargo bike delivery driver behavior. The delivery logistics provider also shared GPS route data from the e-cargo bike routes for the comparison truck routes. From this, researchers gained a comprehensive understanding of delivery operations (miles traveled, number of packages delivered, number of stops per route, infrastructure usage, speed, battery usage, interaction with other vehicles, bikes, and pedestrians) and activities at the site itself (parking occupancy, parking duration, and distribution of vehicle types at the site).

KEY FINDING #1: When e-cargo bike operations were compared with traditional truck routes operating in the same neighborhood by the same carrier, researchers found that e-cargo bikes traveled 50% less miles per package. Extrapolating these findings to a full-time e-cargo bike operation (completing 4 delivery routes per day within 8 hours), researchers found that e-cargo bikes could replace trucks mile for mile. Specifically, 1 e-cargo bike mile could replace 1.4 truck miles. This shows that e-cargo bikes can replace trucks more than mile-for-mile; reducing vehicles miles of travel and replacing large vehicles with smaller ones.

KEY FINDING #2: Compared with the traditional truck routes in the area, researchers saw a 30% reduction in tailpipe CO_2 emissions per package delivered by e-cargo bike. With the e-cargo bike system, the only notable CO_2 emissions produced come from the internal combustion engine trucks re-supplying the hub. The electricity needed to charge the e-cargo bikes creates negligible carbon emissions. This demonstrates the potential for even a single hub to significantly reduce CO_2 in neighborhoods.

KEY FINDING #3: The e-cargo bike removed 0.65 truck miles per package delivered, leading to an overall reduction of 356 truck miles in the Uptown neighborhood. Neighborhood delivery hubs using e-cargo

bikes for last-mile delivery could help reduce congestion: They reduce truck miles per package and take up less space on the street than a truck. Less congestion could also improve traffic safety, air quality, noise pollution, and preservation of neighborhood cultural sites.

KEY FINDING #4: The e-cargo bike delivered fewer packages per hour than traditional trucks During the pilot, the e-cargo bike performed 8 deliveries per hour; a truck on a comparable route performed 19 deliveries per hour.