Delivering Sustainability: Transporting Goods in Urban Spaces

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Image of a Sustainable City
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The Sustainable City:

– Dense residential development
– Few cars
– People live closer to where they work and shop
Current City Street – New York
Current City Street – Seattle
What is the current state of urban goods movement, and what role can it play in developing sustainable cities?
What is Sustainable Goods Movement?

- Compatible with urban living
  - Quiet
  - Low to no local pollutants
  - Safe for other users
  - Minimizes impact on local traffic
- Low to no GHG emissions
- Economically viable
What are the Current Challenges?

- Congestion
- Emissions
- Consumer demands
Congestion in Seattle

Source: TTI Mobility Data
US Criteria Pollutants Percentage by Vehicle Type

Roughly 50%

20-25%

Only 7-8%

NEI 2008 v1.5 GPR, 2011 US GHG Inventory - 2009 data, 2005 BTS Annual Report
What are the Current Challenges?

Shift in Shopping
A recent survey of online shoppers revealed that for the first time they bought more of their purchases online rather than in stores.

Source: UPS/comScore online survey conducted between Jan. 30 and Feb. 9, 2016 with 5,330 respondents who had have made at least 2 online purchases in a typical 3-month period.
What are the Current Challenges?

Sales revenue: Amazon vs major retail stores

USD Billion

- Total sales by major Retail stores*
- Total sales of Amazon in North America**

*Note: This includes major retail store houses: DDG, JCP, JWI, KSG and M
**Note: The estimated figures for 2015, 2016 and 2017 are the total global sales revenue projections for Amazon as reported by Bloomberg Finance LP.

Source: Bloomberg Finance LP; DB Global Markets Research

Credit: Business Insider
Can delivery services accomplish last mile delivery with:

– Less vehicle miles travelled?
– Less carbon dioxide?
– Less nitrous oxide?
– Less particulate matter?
How Might a Delivery Service Deliver Sustainability?
Random selection

Proximity assignment

Good Logistics Matters
Vehicle Miles Travelled can be Dramatically Reduced with Delivery

Distribution of and Service Type for Customers

- Random Selection
  - Passenger Travel: 8,004
  - Delivery Vehicle: 1,453

- Proximity Assignment
  - Passenger Travel: 6,374
  - Delivery Vehicle: 367

feet/customer

Vehicle Miles Travelled can be Dramatically Reduced with Delivery
Carbon Dioxide Reductions are Less Clear

![Carbon Dioxide Reductions Chart]

- **Random Selection**
  - Passenger Travel: 0.60
  - Delivery Vehicle: 0.33

- **Proximity Assignment**
  - Passenger Travel: 0.57
  - Delivery Vehicle: 0.08

**Distribution of and Service Type for Customers**

- Passenger Travel
- Delivery Vehicle
- Random Selection
- Proximity Assignment

- **Carbon Dioxide in Kilograms per Customer:**
  - Random Selection: 0.60, 0.57
  - Proximity Assignment: 0.33, 0.08

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*Note: The chart shows the distribution of carbon dioxide emissions (in kilograms per customer) for different service types and selection methods.*
Can delivery services accomplish last mile delivery with:

– Less vehicle miles travelled?
– Less carbon dioxide?
– Less nitrous oxide?
– Less particulate matter?
Research Questions

• Does a warehouse-based delivery model provide reductions in VMT, CO2, NOX and PM?

• Does a depot-delivery model provide reductions in VMT, CO2, NOX and PM?

• Are these results consistent across more and less dense neighborhoods?
Warehouse-based Delivery

Regional Warehouse

- Grocery Store
  - Home
  - Home
  - Home

- Grocery Store
  - Home
  - Home

- Grocery Store
  - Home
  - Home

- Combination Truck
- Single-unit Truck
- Passenger Car
Density of King County Municipalities

![Graph showing road density vs. address density for Black Diamond, Sammamish, and Seattle.](image-url)
## Delivery Reduces Vehicle Miles Travelled in all Municipalities

<table>
<thead>
<tr>
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<th>Nox (g)</th>
<th>PM10 (g)</th>
<th>Travel time (min)</th>
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### Categories
- Passenger Vehicles
- Local Depot Delivery
- Regional Warehouse Delivery
Delivery Increases Local Pollutants in all Municipalities

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Delivery Reduces Carbon Dioxide in Some Municipalities

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Passenger Vehicles
Local Depot Delivery
Regional Warehouse Delivery
Delivery Would Decrease Carbon Dioxide in Most Municipalities

- PV better
- Seattle
- Black Diamond
- Sammamish

Address density (address/mi²)

Road density (mi/sq mi)
Are Delivery Services Sustainable?

• Reduce VMT and CO2 in the vast majority of cases with current vehicle fleet
• Increase local pollutants
• Indirect effects
  – Reduce the need for personal vehicles
  – Reduce vehicle activity
  – Reduce parking requirements
How do Increasing Service Expectations Affect Sustainability?
10 miles

Serving all 24 customers in a day

Poor Customer Service
Better Customer Service Increases Delivery Distance Travelled

Serving 12 customers in each of 2 half days. Distance increased by 40%.
Are Delivery Services Part of a Sustainable Future?

• Reduce vehicle miles travelled and carbon dioxide in most communities
• More opportunity in less urban spaces
• Indirect effects
  – Reduce the need for personal vehicles
  – Reduce vehicle activity and parking requirements
  – Reduced conflicts with personal vehicles
• Must upgrade vehicle technology to reduce local pollutants
  – Lighter weight
  – More consistent with development patterns
Questions?

http://depts.washington.edu/sctlctr

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