

# Exploring the Household-Based Freight Demand - Travel Activity Nexus

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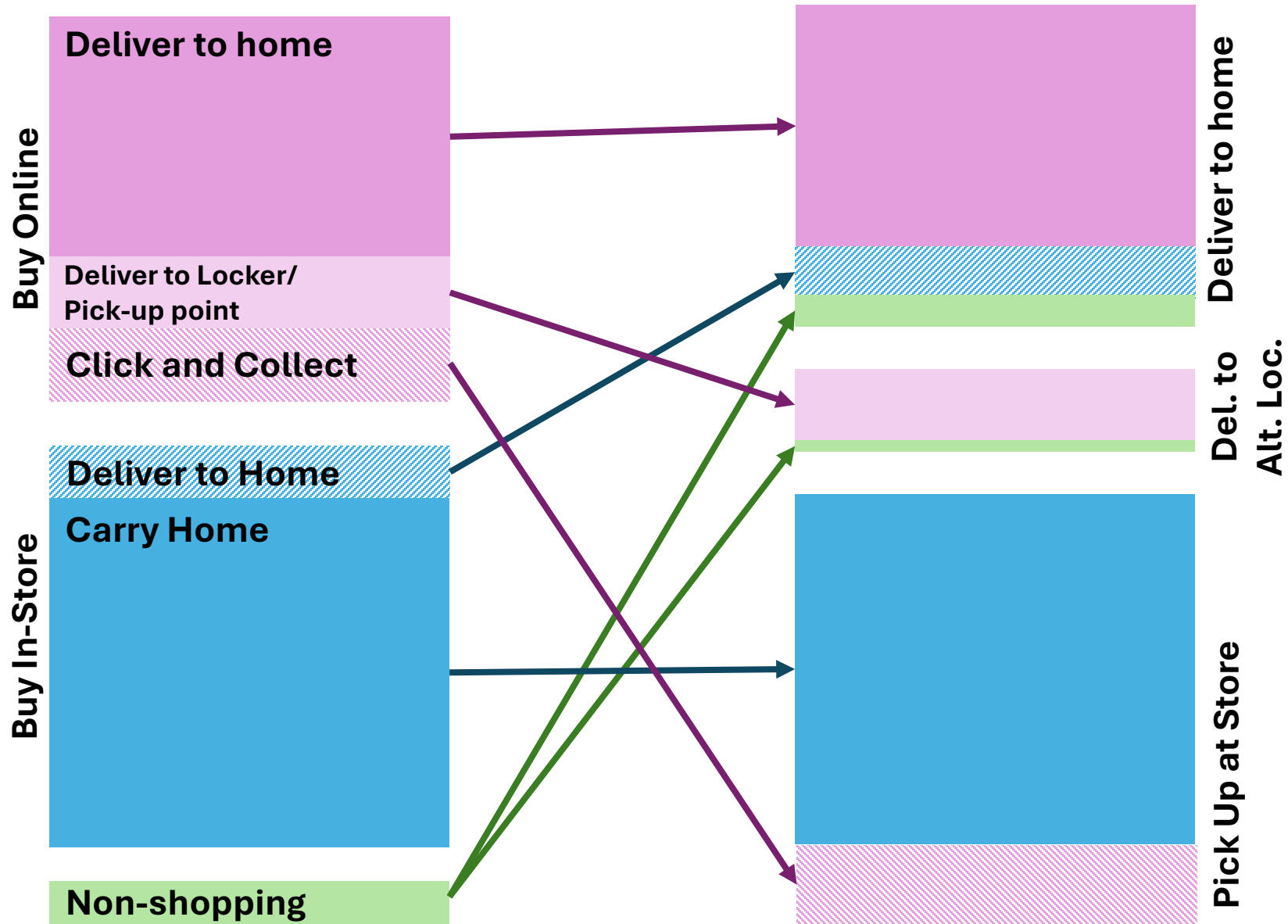


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of New York

Activity-Based Modeling Symposium  
Raitenhaslach, Germany  
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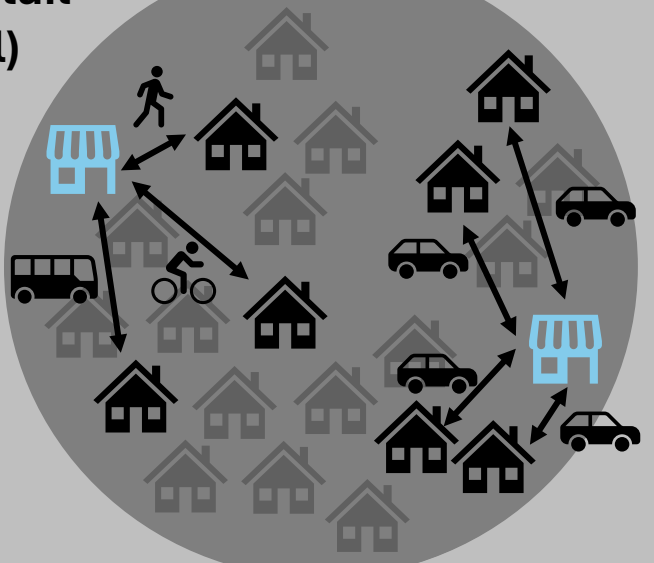


# Shopping vs. Deliveries

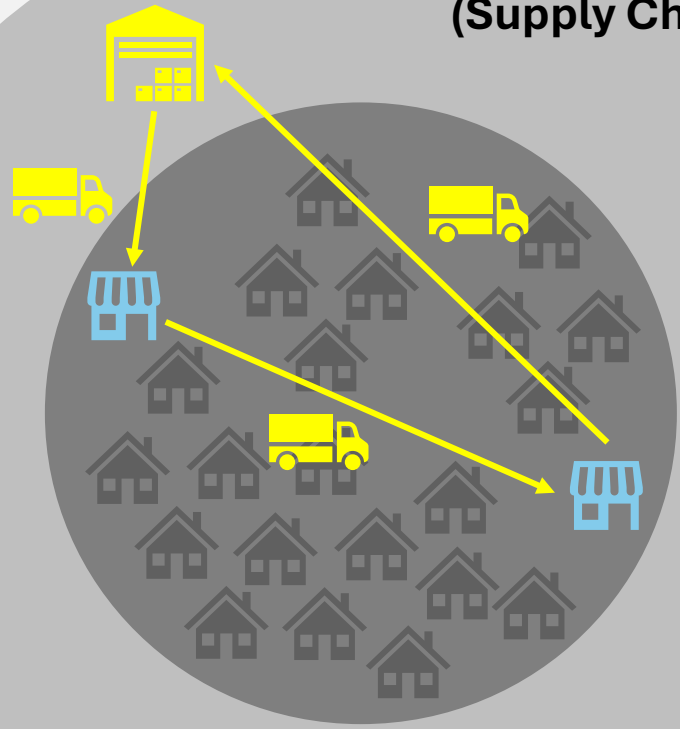


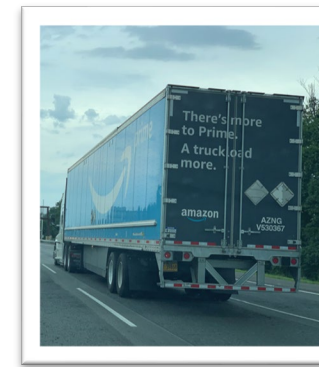
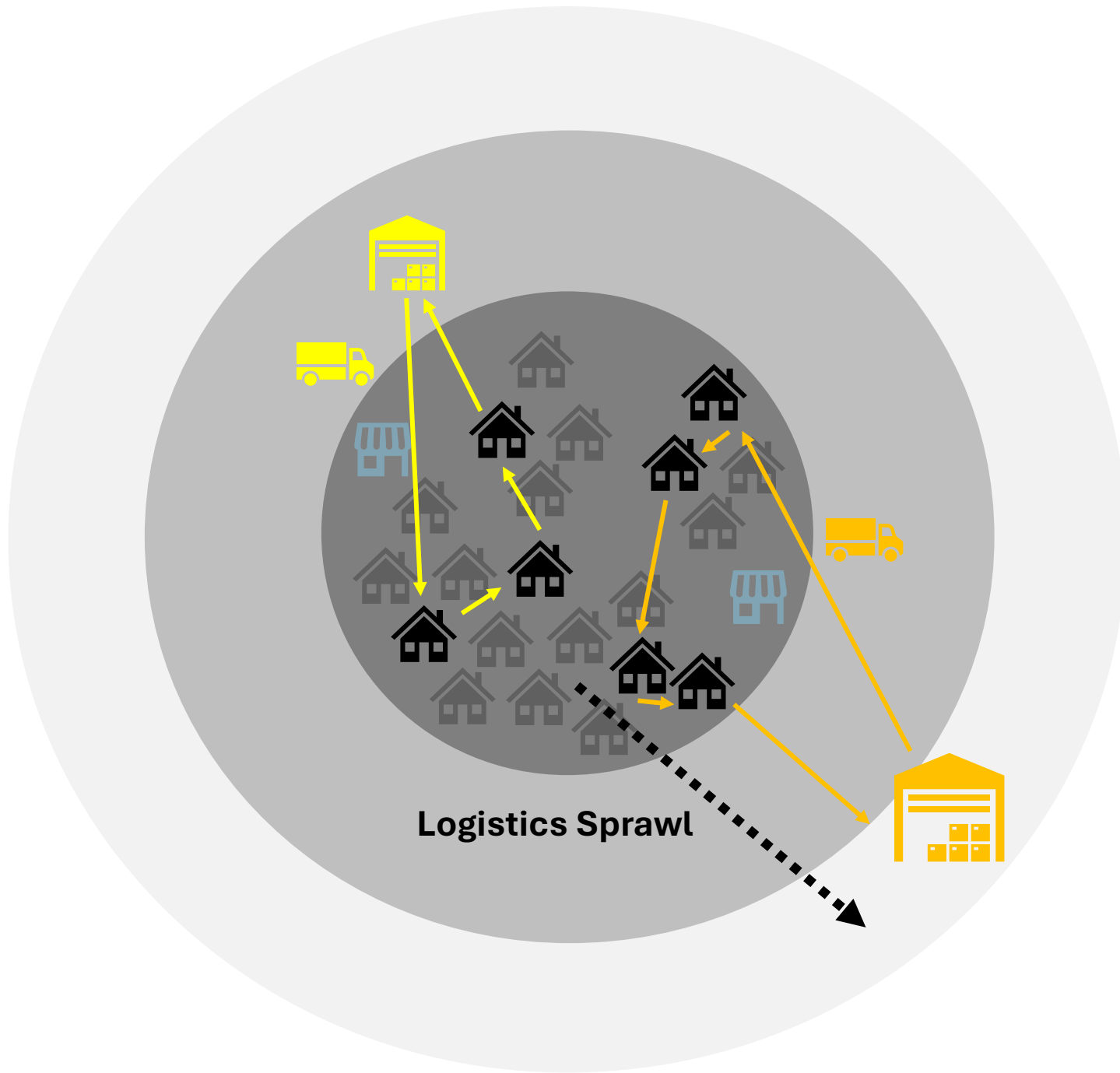
- Commodity Characteristics
  - Size
  - Value
  - Perishability/temperature sensitivity
- Other Common Considerations
  - Speed
  - Convenience
  - Security

**Traditional Retail  
(Person Travel)**



**Traditional Retail  
(Supply Chain)**

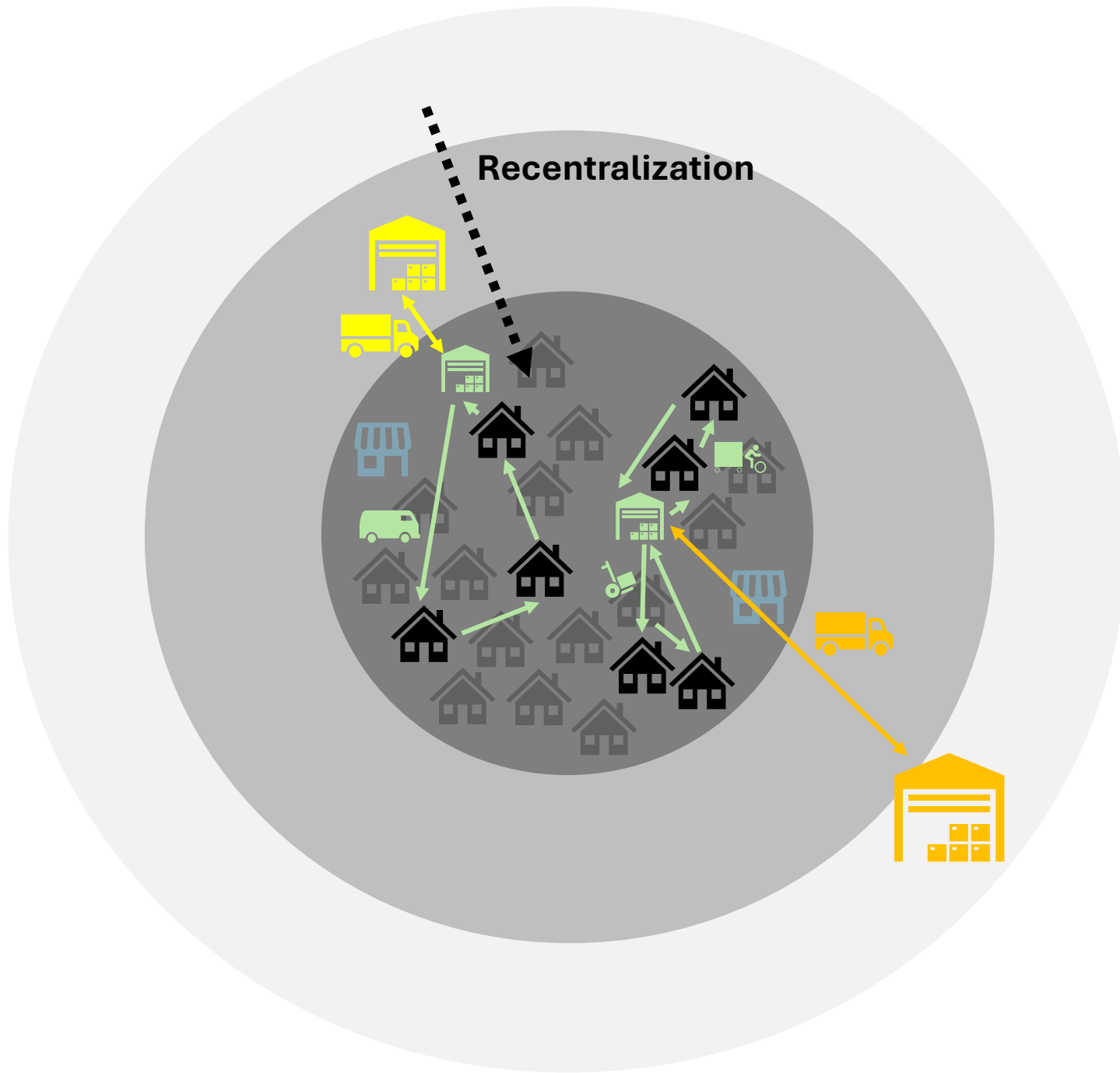




Why?

### Supply Chain Decision

- Increased warehouse size = More land required
- Access to:
  - Markets
  - Labor
- Benefit
  - Low land cost
- Disbenefits
  - Increased VMT
  - Increased externalities
    - CO2
    - Air Pollution
    - Safety Risk



Why?

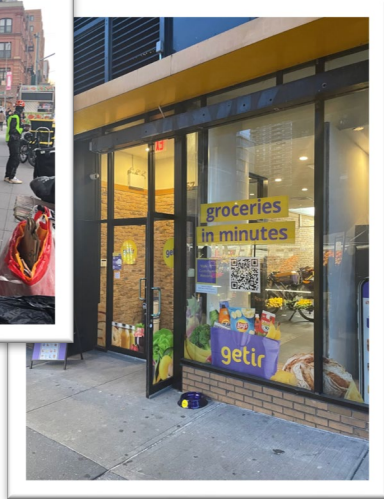
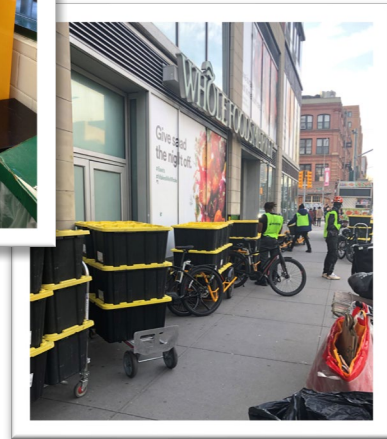
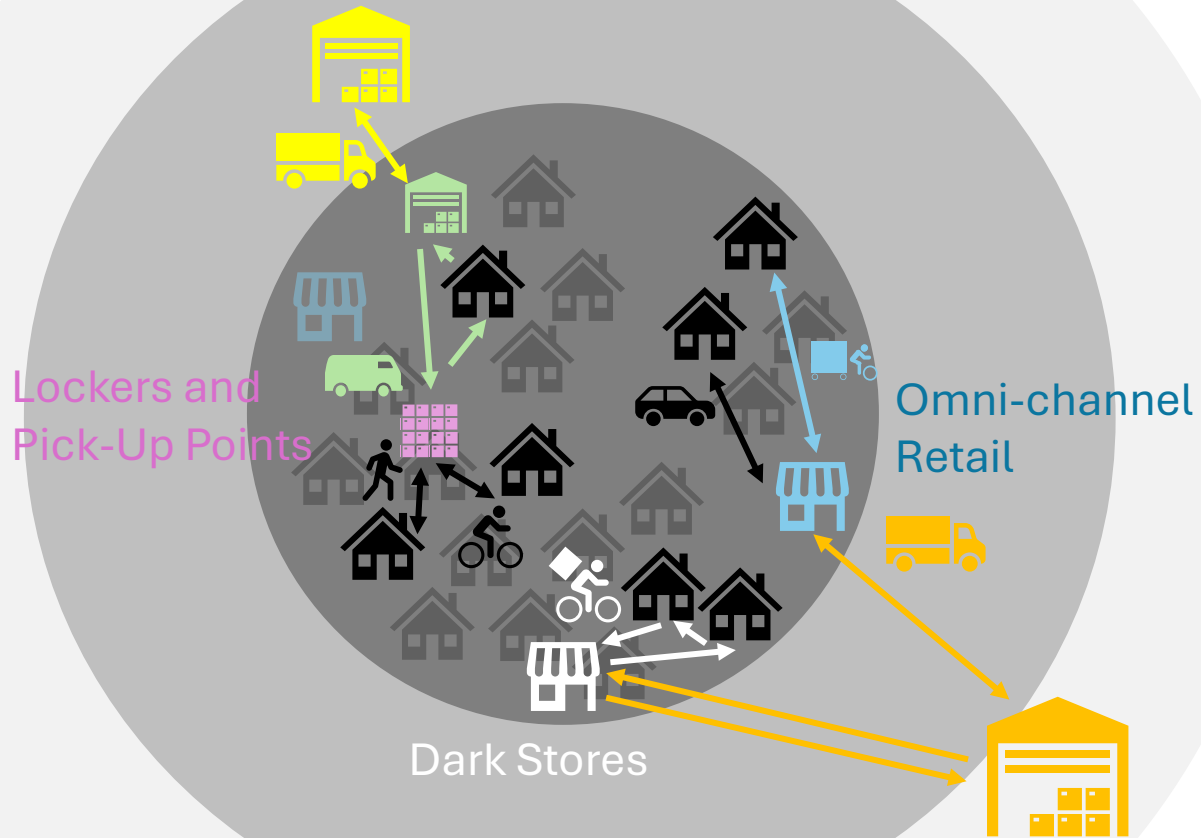
### **Consumer Demand**

- On-demand delivery

### **Supply Chain Decision**

- Proximity to consumers =  $f(\text{expected speed})$
- Potential to integrate “city friendly” green last-mile vehicles

## Proximity Logistics



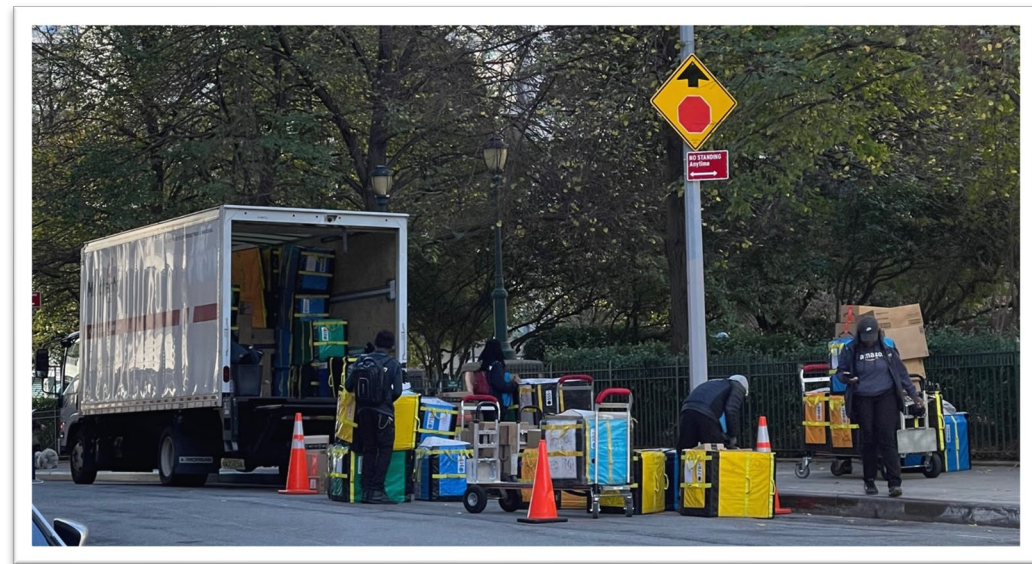
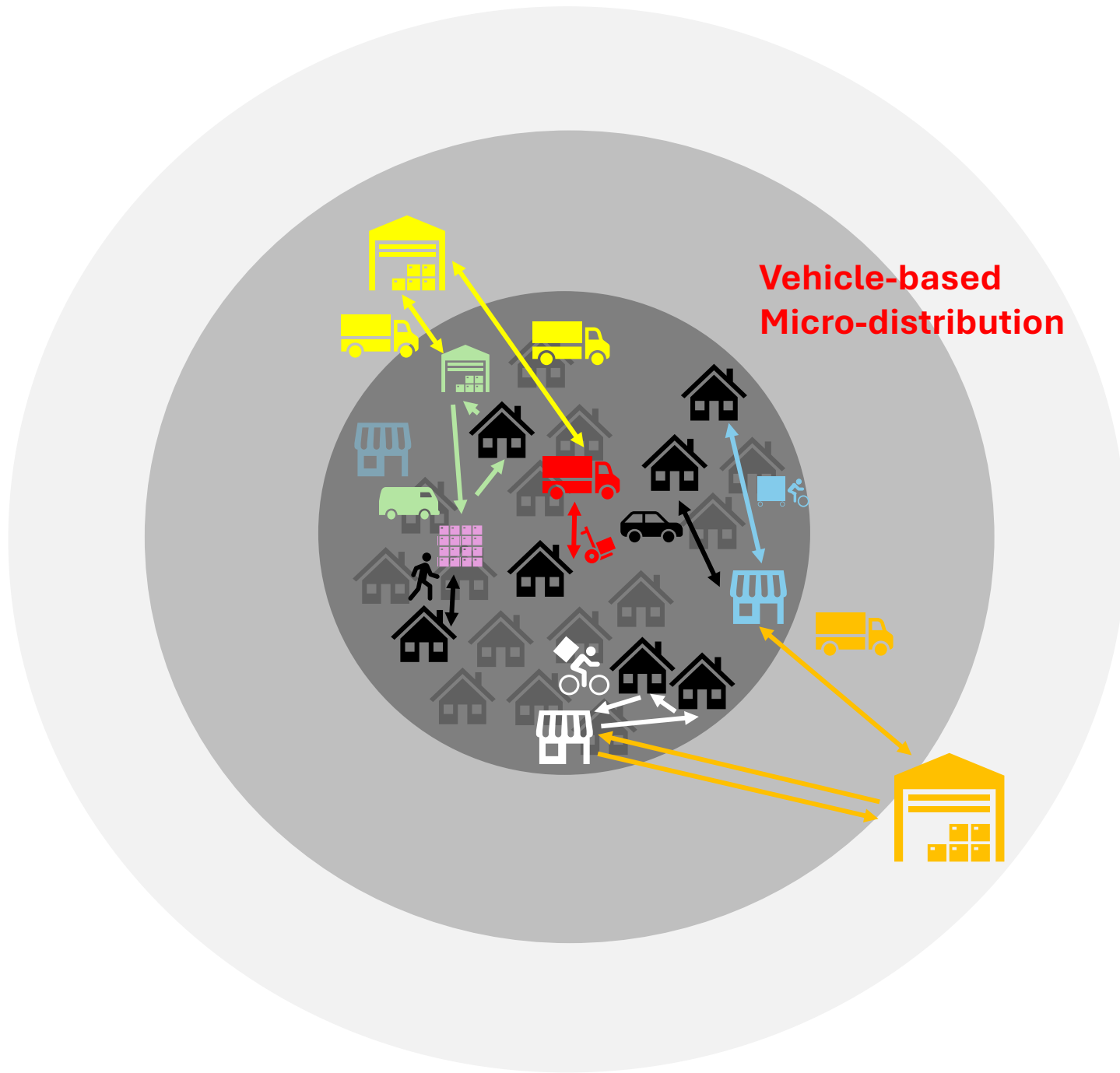
Why?

### Consumer Demand

- Instant delivery/pick-up
- Package security

### Supply Chain Decision

- High land cost
- Zoning restrictions
- Concentrate density
- Reduce losses to theft



Why?

### Supply Chain Decision

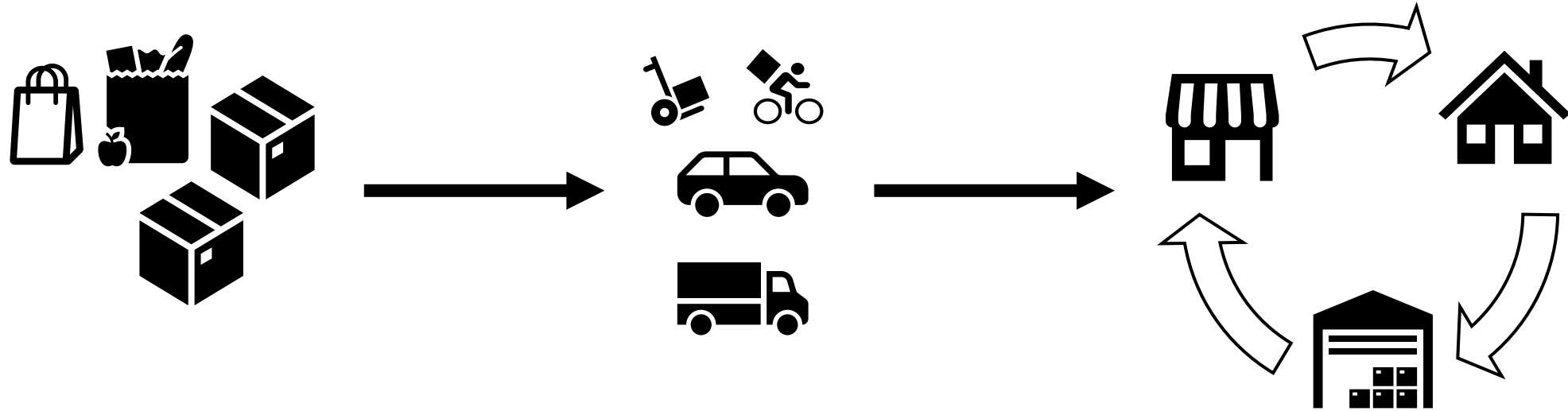
- Parking cost vs. building space cost



# Freight and Urban Planning Questions

- Estimate residential freight demand
- Understand passenger vs. freight tradeoffs
- Align infrastructure with modern freight (and passenger) demand
  - Loading docks
  - Curb regulations
  - Infrastructure
    - Parking
    - Distribution
    - Travel
    - Charging

# Household Related Freight Activity



## Traditional Data Sources

- Commodity flow survey
- Establishment survey
- Probe data (aggregated)

## Traditional Data Sources

- Carrier reported
- Manual counts

Emerging AI approaches to  
vehicle classification

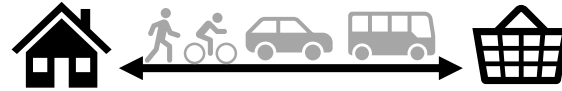
## Traditional Data Sources

- Probe data (single carrier)
- Shipper/carrier records (single carrier)

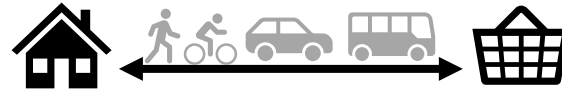
# Grocery Tradeoffs



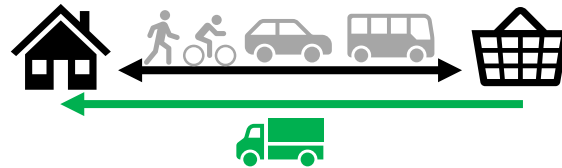
- Shop in Store



- Click and Collect

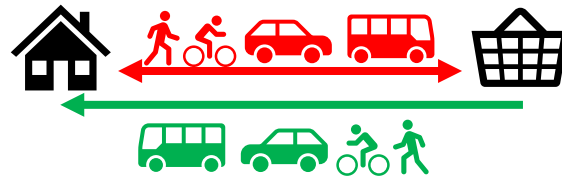


- Shop in Store and Request Delivery

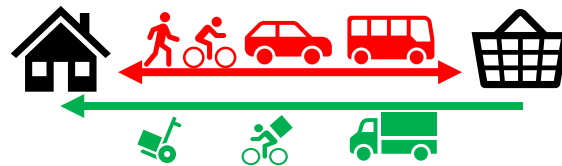


- Shop Online

- On-Demand App



- Omni-Channel Retailer

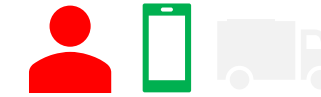
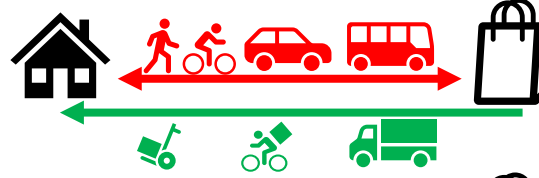
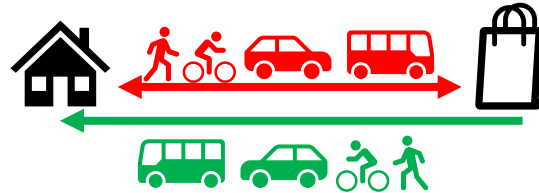
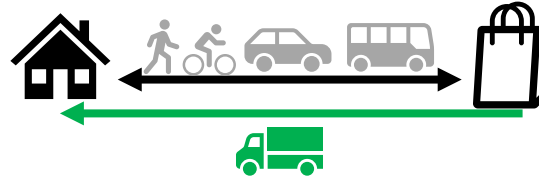
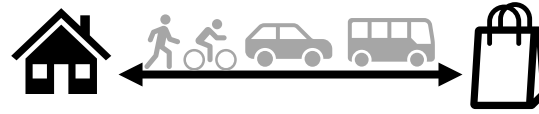
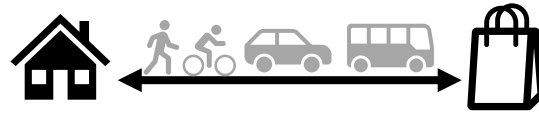


- Online Retailer



# Package Tradeoffs

- Shop in Store
- Click and Collect
- Shop in Store and Request Delivery
- Shop Online
  - On-Demand App
  - Omni-Channel Retailer
  - Online Retailer
- Delivery to Alt. Loc.



# Understanding Package/Parcel Demand: First Attempt

- Does teleworking increase deliveries to home?
- 2022 NYC Citywide Mobility Survey
  - Daily deliveries **to home**: 3,147 days (packages); 303 days (groceries); 989 days (prepared food)
  - Delivery or no delivery
- Binary Logit Model
  - **Household**: size, income, building type
  - **Individual**: age, gender, race, ethnicity
  - **Activity Participation**: work (commute, other, tele- (any, 6+)), shopping, and meal activities
  - **Security**: delivery alternative
- Provide insights for:
  - Variables of interest
  - Potential model structures
  - Data needs

## Data Challenges

- Small sample sizes
- Data from day, trip, household, and person tables
- Weekly vs. daily activity
- Delivery/No Delivery vs. # Packages
- Correlation between online shopping & deliveries – daily vs. weekly
- Definition of teleworking unclear/not location specific
- No distinction between retail and grocery store trips
- Geographic aggregation limits inclusion of additional built environment factors

Variable	Packages	Grocery	Prepared Food
<b>Household Size</b>	+		+
<b>Income</b>	+ (over 100k), - (< \$25k)	+ (over \$200k)	+ (< \$25k, over \$200k)
<b>Building Type</b>	- (5 to 9 units)	+ (other housing)	
<b>Alt. Del. Loc.</b>	+ (doorman), - (alt. loc)		
<b>Age</b>	+ (35 - 44, seniors)	- (45-54, seniors)	- (18-24, 45-54, seniors)
<b>Gender</b>	+ (Female)		
<b>Race</b>		+ (Afr. American)	+ (African American)
<b>Ethnicity</b>	- (Hispanic)		
<b>Telework</b>	+ (+ intensity)	+ (- intensity)	+ (- intensity)
<b>Commute Trip</b>	+	-	-
<b>Other Work Trip</b>			-
<b>Shopping Trip</b>		-	-
<b>Meal Trip</b>			+

More coordinated  
within the  
household?

Variable	Packages	Grocery	Prepared Food
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Ethnicity	- (Hispanic)		
Telework	+ (+ intensity)	+ (- intensity)	+ (- intensity)
Commute Trip	+	-	-
Other Work Trip			-
Shopping Trip		-	-
Meal Trip			+

Primarily attended vs. primarily unattended deliveries

Variable	Packages	Grocery	Prepared Food
Household Size	+		+
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Gender	+ (Female)		
Race		+ (Afr. American)	+ (African American)
Ethnicity	- (Hispanic)		+ (Hispanic)
Telework	+ (+ intensity)	+ (- intensity)	+ (- intensity)
Commute Trip	+	-	-
Other Work Trip			-
Shopping Trip		-	-
Meal Trip			+

f (delivery location choice)

Household Structure?  
Time?

Time?  
Household Structure?  
Access?



Variable	Packages	Grocery	Prepared Food
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Income	+ (over 100k), - (< \$25k)	+ (over \$200k)	+ (< \$25k, over \$200k)
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Telework	+ (+ intensity)	+ (- intensity)	+ (- intensity)
Commute Trip	+	-	-
Other Work Trip			-
Shopping Trip		-	-
Meal Trip			+

\$ = consumption

luxury

luxury or necessity?

Variable	Packages	Grocery	Prepared Food
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Telework	+ (+ intensity)	+ (- intensity)	+ (- intensity)
Commute Trip	+	-	-
Other Work Trip			-
Shopping Trip		-	-
Meal Trip			+

Time tradeoffs, multi-tasking

Variable	Packages	Grocery	Prepared Food
Household Size	+		+
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Telework	+ (+ intensity)	+ (- intensity)	+ (- intensity)
Commute Trip	+	-	-
Other Work Trip			-
Shopping Trip		-	-
Meal Trip			+

Activity tradeoff vs. complementarity

# Takeaways (so far) for future research and data collection

- Important to capture commodity types/characteristics
- Important to carefully define “trade-off” activities
- To **interpret current results**, need to examine factors influencing delivery decisions (e.g. available time, access to in-person shopping opportunities, cost, handling difficulty, security, coordination between household members)
- To **link demand to supply chains**, need to capture:
  - Pickup/delivery alternative
  - Delivery speeds
  - (If possible) online retailer type (app, omni-channel retail, online retailer)
  - (If possible) last-mile mode

# Next Steps

- Refine/revisit current dataset
  - Time use – complete activity set
  - Household structure/characteristics
  - Timeframe – daily vs. weekly
- Explore modeling structures: unobserved variables/error terms
  - Location-specific delivery frequency
  - Commodities and commodity groups
  - Activity tradeoffs (e.g. consumption, virtual activity participation)

# Thanks! Questions?

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