

An Empirical Study on the Disposal and Acquisition of Second-Hand Products

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Advancement in Solid Waste Management

- Waste is seen as resource
- New concept for materials management: Zero waste
- General goals:
 - Increase resource recovery
 - Little or no resource disposal
 - Sustainable materials management
- Promotion of alternative processes that have the capacity to increase resource recovery

Product Reuse

Flea Markets



Thrift Stores



re-fashionNYC
NYC's official clothing reuse program in partnership with 212NYC



clean closets good cause green city

Collection Bins

Building materials reuse stores



Product Reuse



Online Platforms

Shop by category | Following Today Motors Fashion Electronics Collectibles & Art Home & Garden

celebrate **HER**

THIS IS HER TIME TO SPLURGE

GIFT CARDS UP TO 20% OFF

Find her favorites

There's still time!

\$50 Kohl's Gift Card... \$50.00

Nike Pre-Owned... \$22.50 | \$26.00

\$90.00 \$75.00 \$21.25 \$26.00

REUSE! DONATIONS EXCHANGE

HOME EXCHANGE ABOUT US OUR SERVICES CONTACT US

Navigation: Home, Browse Listings, Free, Contact Us, Help

Members: Post a Listing, Report an Exchange, Login, Create an Account, Password Help, Tell a Friend

Search: Find It, Available, Advanced Search

All Listings

Photo	Title	State	Quantity	Frequency	Posted
	Wood Cabinet		1	One-Time	Apr 26, 16
	2 Metal Filing Cabinets		2	One-Time	Apr 26, 16
	2 Couches		2	One-Time	Apr 26, 16
	Compressed Wood for Shelving		200	One-Time	Apr 26, 16
	Mismatched but good paint		100	One-Time	Apr 26, 16

Materials Exchanges

new york city | men brk que brx sdn jcy lgi wch fct

community: activities, artists, childcare, classes, events, general groups

housing: apts / housing, housing swap, housing wanted, office / commercial, parking / storage, real estate for sale, rooms / shared, rooms wanted, sublets / temporary, vacation rentals

for sale: antiques, appliances, arts+crafts, auto parts, baby+kid, barber, beauty+hth, bikes, boats, books, business, cars+trucks, cds+dvds+hds, cell phones, clothes+acc, collectibles, computers, electronics

jobs: accounting+finance, admin / office, arch / engineering, art / media / design, biotech / science, business / mgmt, customer service, education, food / bev / hosp, general labor, government, human resources, internet engineers, legal / paralegal, marketing / pr / ad, medical / health, nonprofit sector, real estate, retail / wholesale, sales / biz dev, salon / spa / fitness, security, skilled trade / craft, software / qa / dba, systems / network, technical support, transport, tv / film / video, web / info design, writing / editing (ETC)

Capture Value. Exchange Reusable Items. Save Money. Reduce Waste.

Home Exchange News (2) Resources Help

Post Listing | Tell A Friend | Create Account

Search: Anything | All | For Sale | Category | Commodity | State | County | Find

Sign In, or Create an Account

All Listings

A=Available W=Wanted E=Event S=For Sale R=For Rent

Type	Photo	Title	State	County	Qty	Frequency	Price	Posted
A/S		Metal Horizontal File Drawers	MA	Essex	100	One-Time	Free	May 04, 16
A/S		Laminate Office Desks	MA	Essex	215	One-Time	Free	May 04, 16
A/S		Norstar Telephone system	RI	Newport	1	One-Time	Negotiable	Apr 12, 16
A/S		Boiler	VT	Rutland	1	One-Time	Negotiable	Apr 05, 16
A/S		Envelopes & Paper	NJ	Somerset	250	One-Time	Negotiable	Mar 28, 16
A/R		Used 3000gal oil tanks	CT	Hartford	2	One-Time	Negotiable	Feb 25, 16

Exchange Info: Your exchange administrator is: Norm Rutan. Our Exchange has 5 New Listings, 11 Total Listings, 1778 Members.

Sponsors: NERC, Connecticut Department of Energy & Environmental Protection, All American Waste, QUANTUM BIOPAPER, HARVEST

- Product reuse has the potential to promote waste prevention by increasing recovery of products
- The promotion of reuse requires understanding household practices of disposal and acquisition of second-hand products

Survey Main Goals

The main goals of the study were to identify

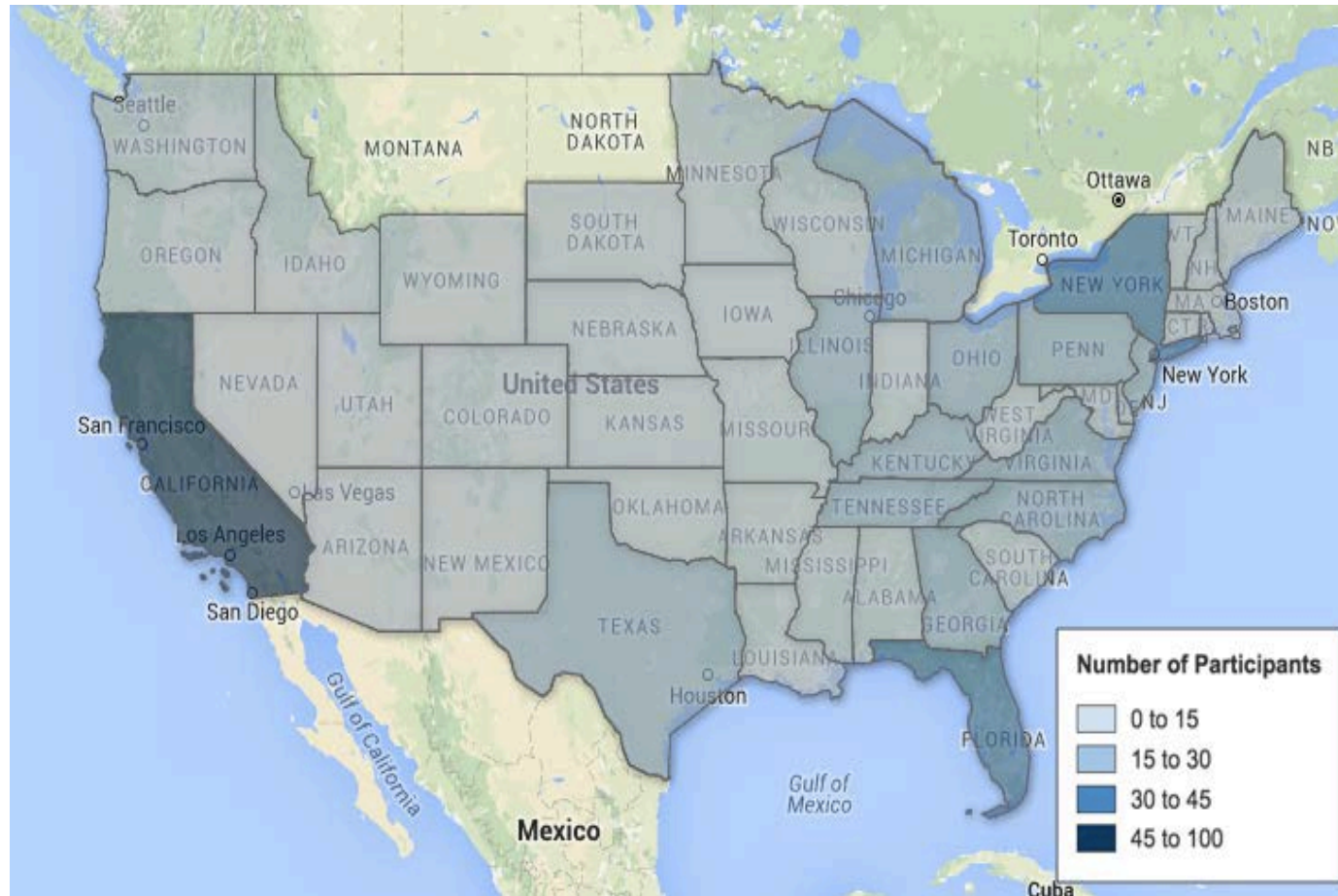
- preferred methods to discard and acquire second-hand products:
 - How products are disposed of and how are they acquired?
 - How are products transported?
 - How far do they travel?
- associations between the disposal and acquisition practices of second-hand products;

- Three surveys covering one type of commonly reused product:
 - Books
 - Clothing
 - Furniture
- Surveys were conducted using the Amazon Mechanical Turk (“MTurk”) online outsourcing platform where pre-registered users perform tasks posted on the website

- 17 questions, collecting data on:
 - Demographics (age, gender, education, income, household size)
 - Duration of ownership
 - Reuse potential
 - Methods used for discarding and acquiring products
 - Distance traveled and type of vehicle used
- Chi-square tests were conducted to investigate associations

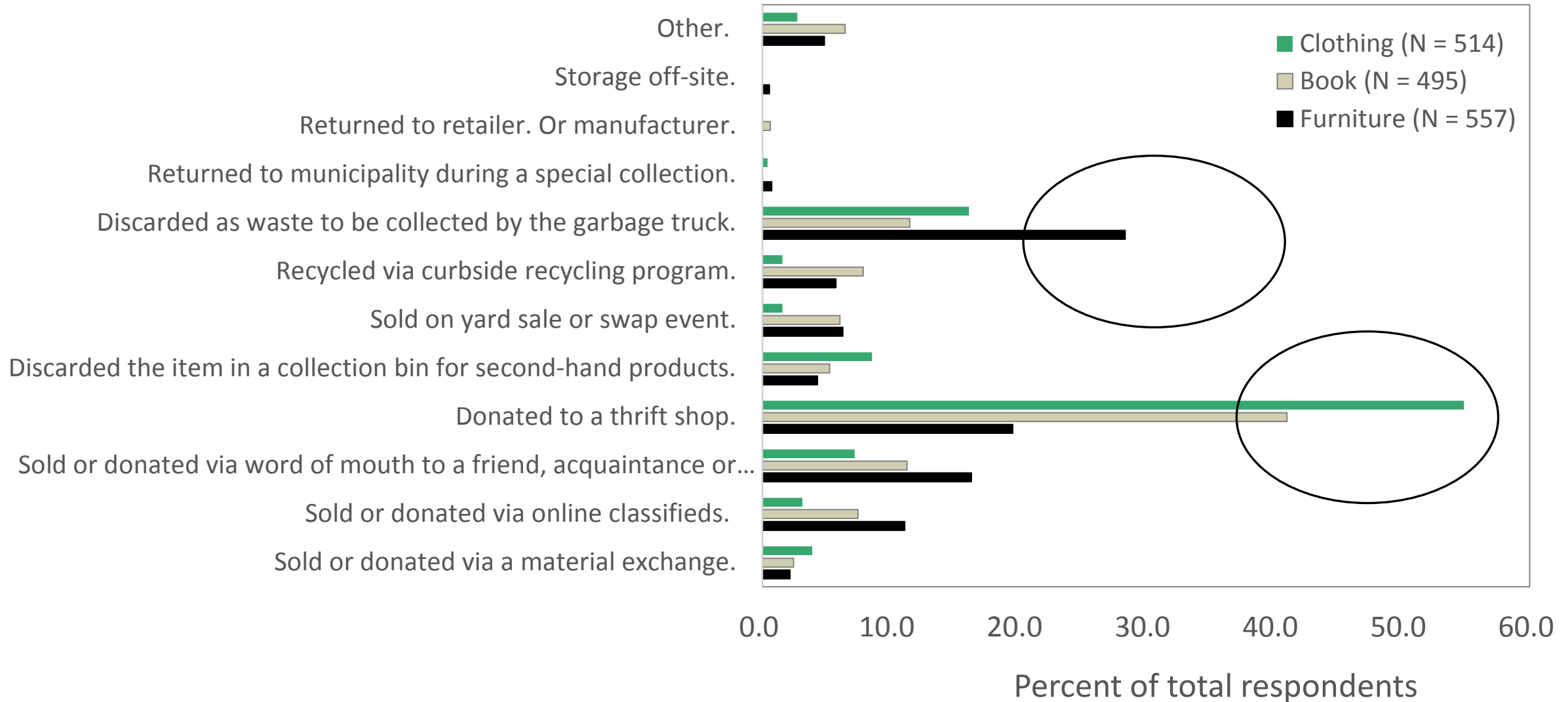
Demographics

- Number of participants: 564 (books), 559 (clothing), and 575 (furniture)

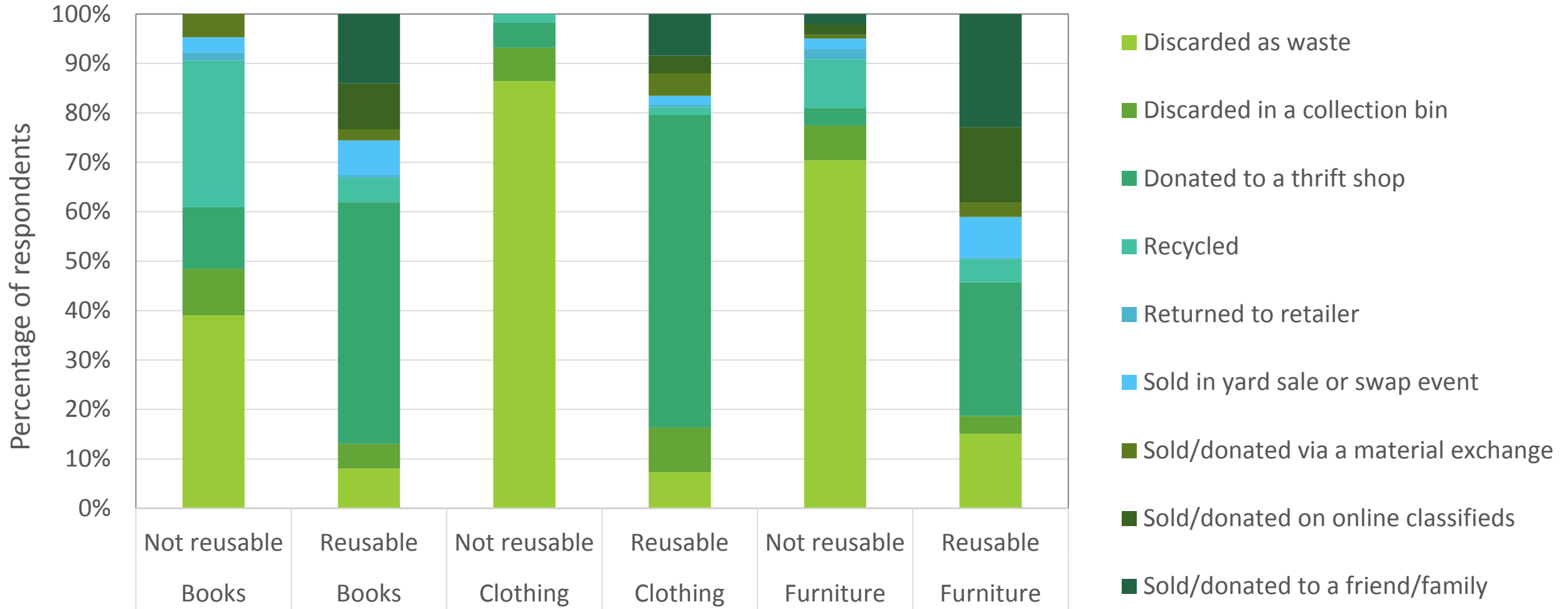


Disposal Methods

Disposal method



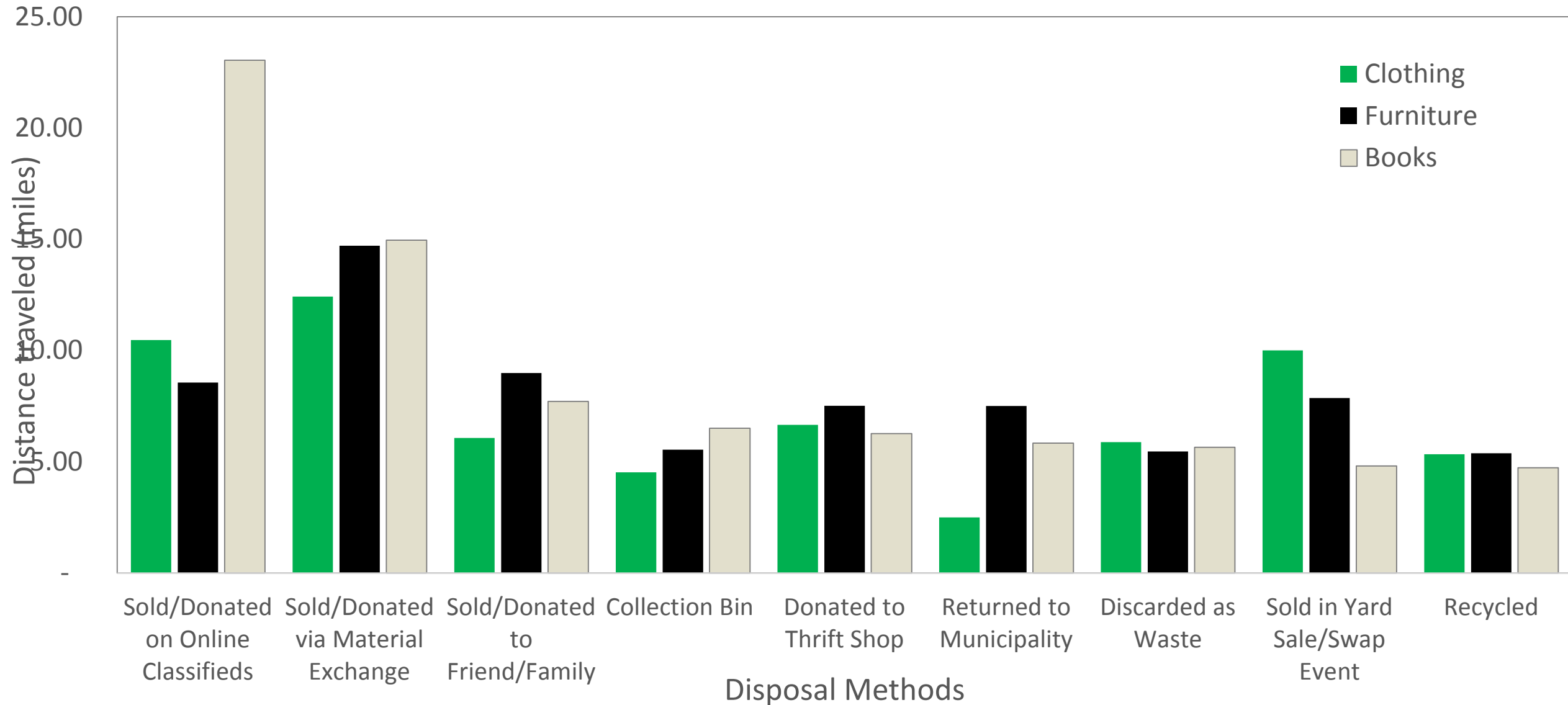
Reuse Potential vs Disposal Methods



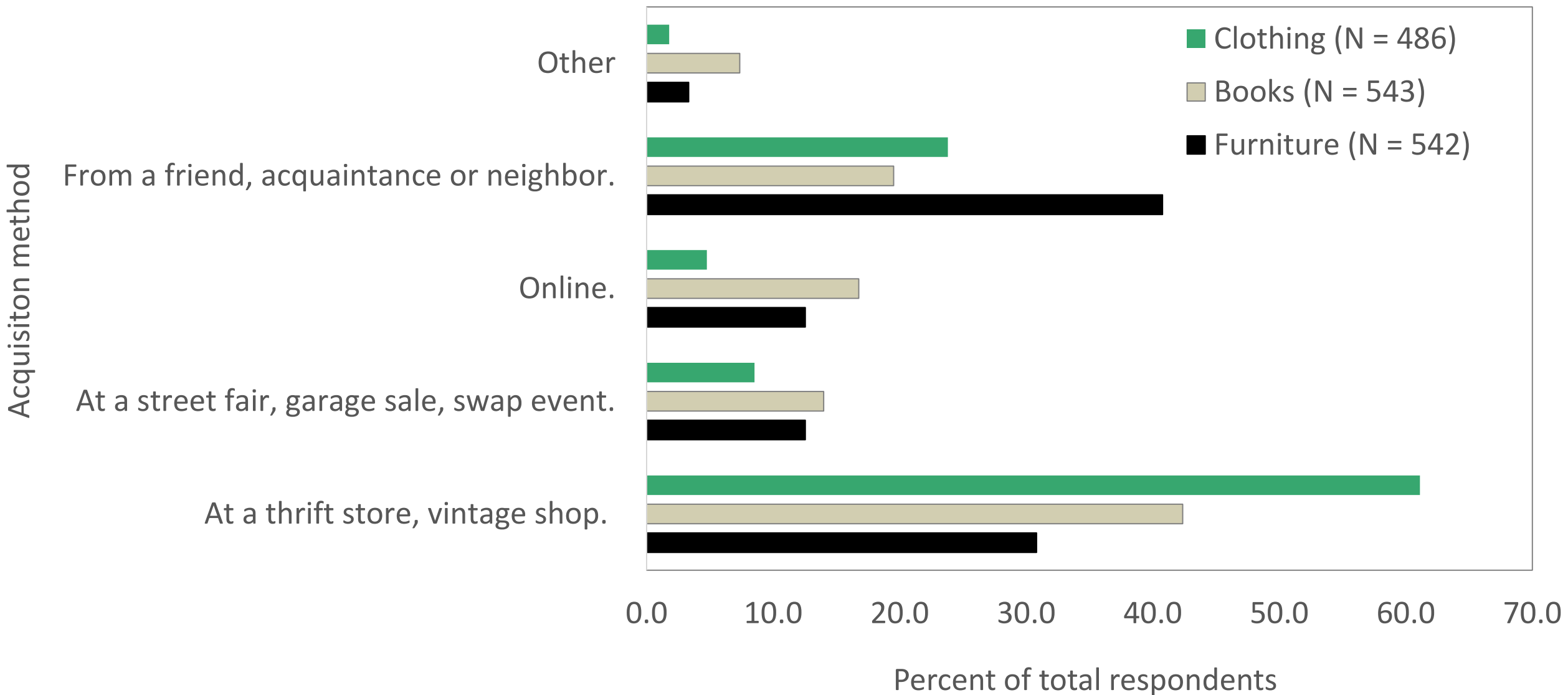
Disposal: Method of transportation



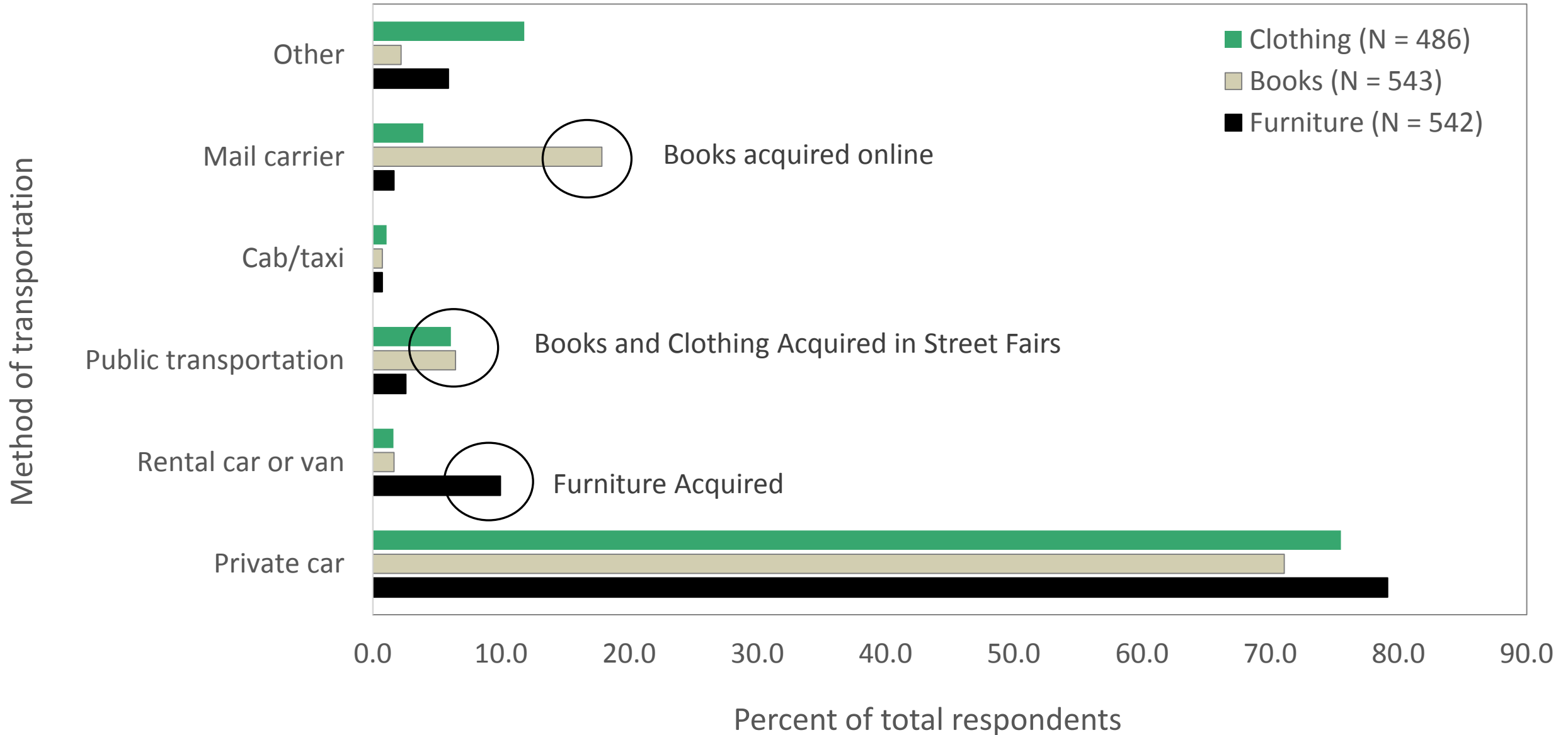
Disposal: Distance traveled



Acquisition Methods



Acquisition: Method of transportation



Acquisition: Distance traveled



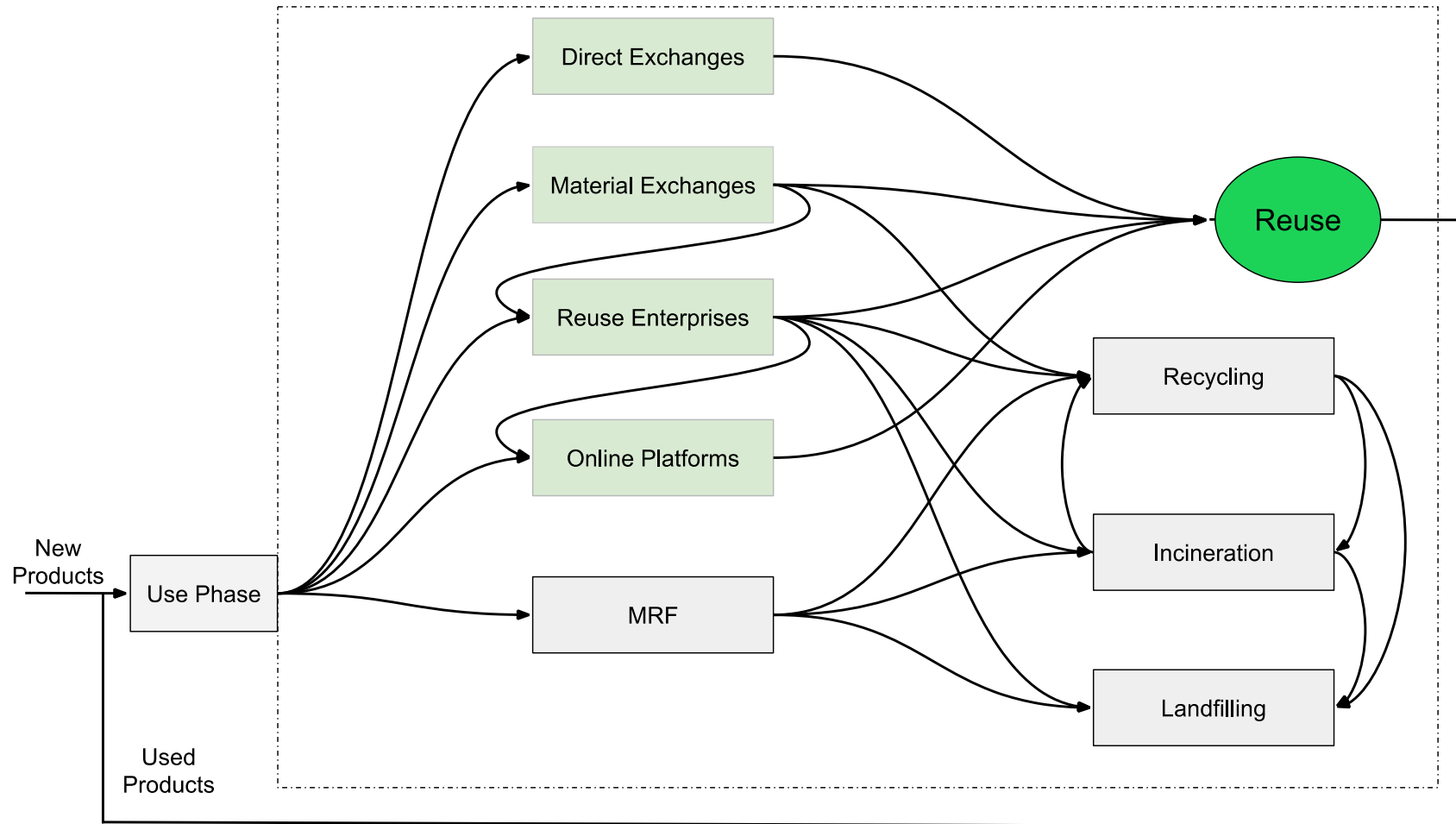
Association between acquisition and disposal

- Associations observed:
 - Books exchanged via friends or acquaintances
 - Clothing exchanged via thrift shops
 - Furniture exchanged online

Conclusions

- Tendency of people to choose disposal methods that are convenient and require low effort on their part
- The size and weight of products will impact the selected disposal method
- The existence of preferred disposal and acquisition methods for second-hand products can be explored to improve recovery of products from the waste stream
- Characterization of disposal methods can be applied to quantify the benefits of product reuse

Integrated solid waste management system



Model to optimize emissions from solid waste management including flow due to product reuse

$$E(M, EF, d)min = \underbrace{\sum(EF_{x,y} \cdot d_{x,y} \cdot M_{x,y})}_{\text{Emissions associated with transportation}} + \underbrace{E_{de} + E_{op} + E_{me} + E_{re} + E_{rec} + E_{land} + E_{inc}}_{\text{Emissions associated with processes}}$$

- $EF_{x,y}$: emission factors due transportation from process x to y
- $d_{x,y}$: distance between processes x and y
- $M_{x,y}$: mass of products transported
- E_{rec} E_{land} E_{inc} : emissions for recycling, landfilling and incineration
- E_{de} E_{op} E_{me} E_{re} : emissions for reuse processes

Emissions of Reuse Processes

$$E_{de} = DR \cdot EF_{prod} \cdot M_{de}$$

$$E_{op} = DR \cdot EF_{prod} \cdot M_{op}$$

$$E_{me} = DR \cdot EF_{prod} \cdot M_{me}$$

$$E_{re} = (DR \cdot EF_{prod} + EF_{re}) \cdot M_{re}$$

- EF_{prod} : emission factor for the manufacture of new products. $EF_{prod} < 0$
- DR : displacement rate describes the amount of products substituted by reuse. Typically, $0 < DR < 1$

Simulate waste diversion goals

- Compare emissions for different diversion goals:

- Zero waste

$$M_{land} + M_{inc} \leq 0.05 M_0$$

- Waste prevention

$$M_r + M_{rec} \geq 0.50 M_0$$

Where:

M_r : Mass diverted to reuse

M_{rec} : Mass diverted to recycling

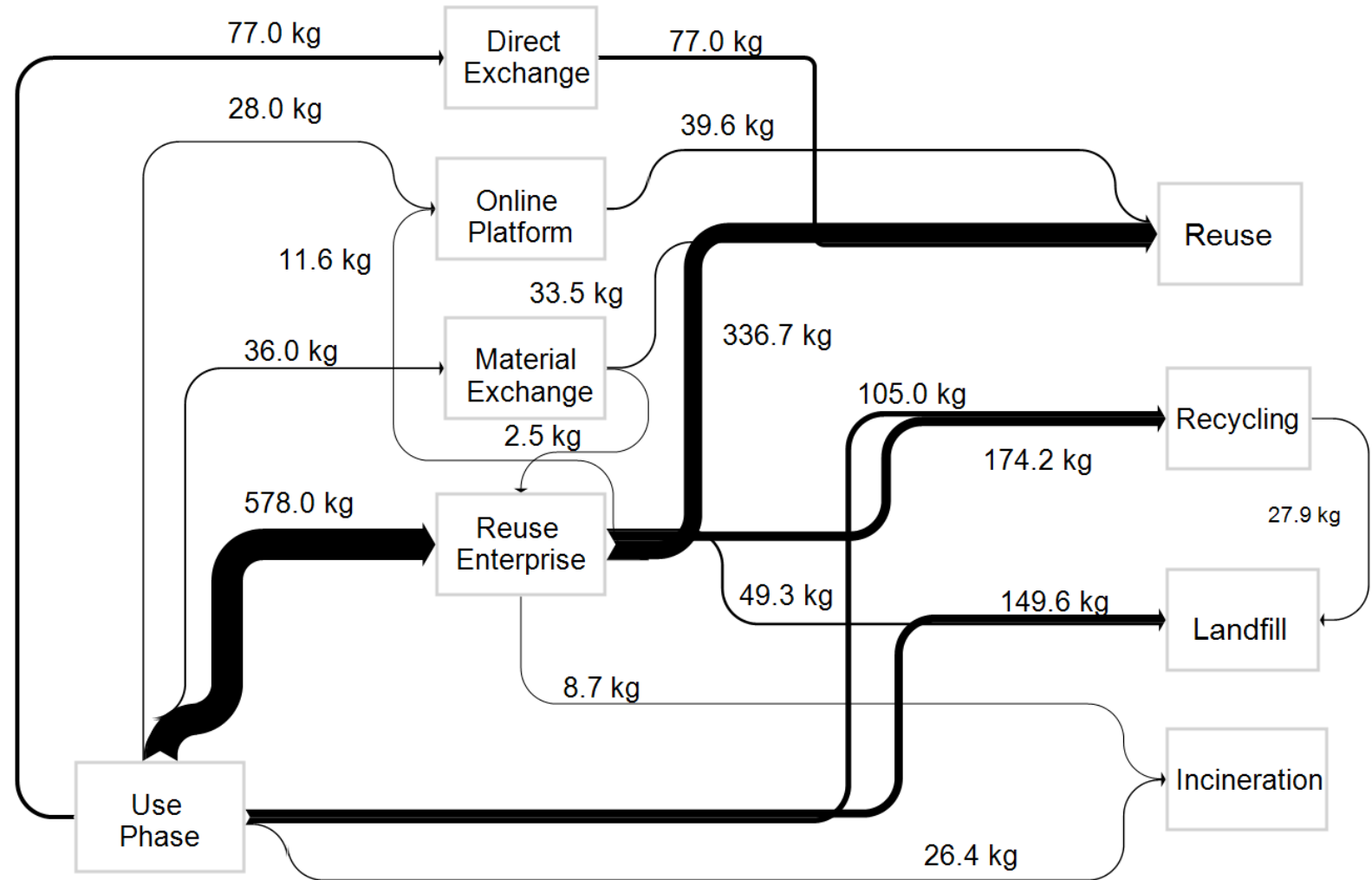
M_0 : Initial mass

M_{land} : Mass diverted to landfill

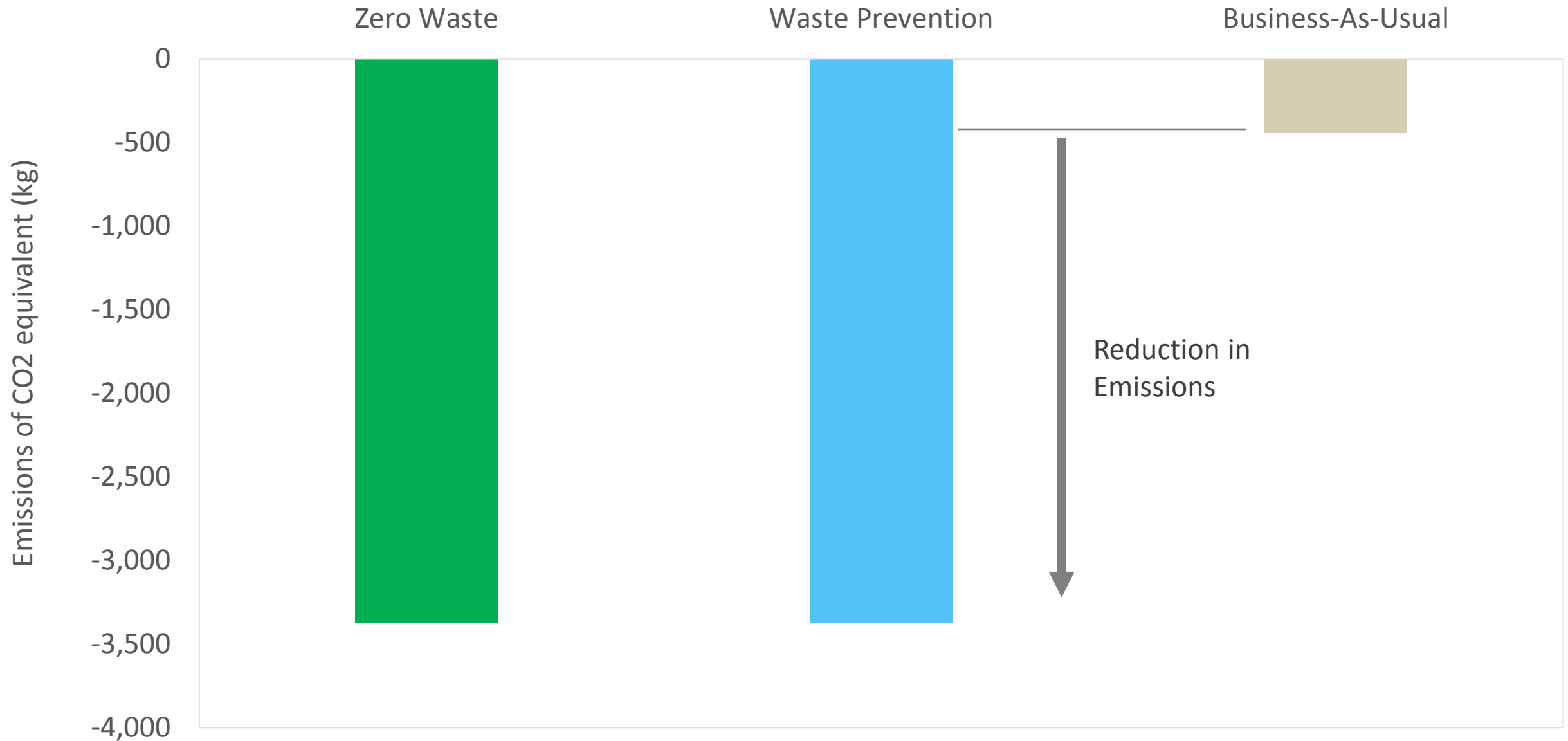
M_{inc} : Mass diverted to incineration

Model Application

- Textiles, 100% cotton
- Initial mass = 1,000kg
- DR = 0.50



Model Application



Next steps

- Apply the model to different municipalities
- Investigation of low impacting reuse routes

Questions?

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