

# What is the most environmentally sustainable solution: home deliveries or locker deliveries?

Sara Verlinde – Bart De Maere - Heleen Buldeo Rai - Cathy Macharis

11<sup>th</sup> International Conference on City Logistics  
19 June 2019  
Dubrovnik, Croatia



# Economic gains

- Decreased contribution to congestion:
  - Less traffic in city centres
  - No double-parking in front of customers' homes
- Efficiency gains:
  - No failed home deliveries
  - Consolidation
  - Off-hour deliveries
- Additional income for the land or shop owner

# Environmental gains

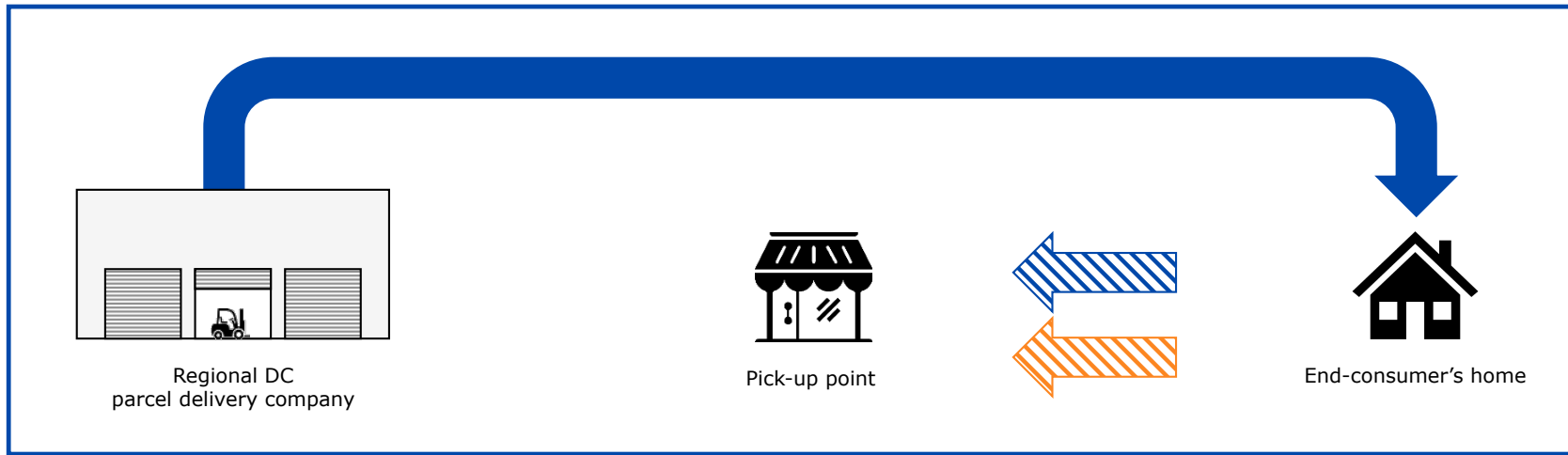
Less pollutant emissions because of fewer vehicle kilometres by delivery vans

- < no failed deliveries
- < consolidation

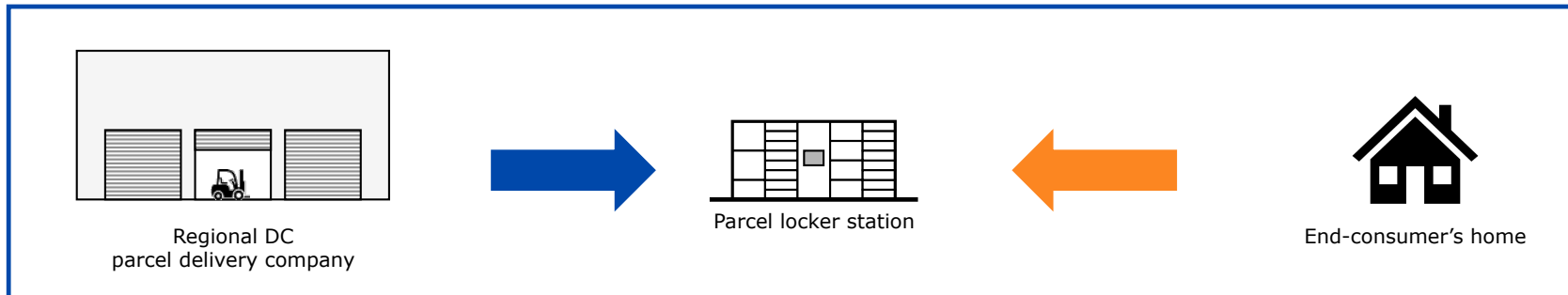
**Assumption for environmental gains:**  
consumers pick-up their purchase in a locker  
close to home or combine their visit to the locker  
box with other activities (trip chaining)

**Research question:** What is the most environmentally sustainable solution: home deliveries or locker deliveries (considering trips by end-consumers and professionals)?

## Home deliveries



## Locker deliveries



# Methodology

**Average emitted transport related CO2 per parcel in case of home deliveries =**

$$\left( (D_{\text{courier}} \cdot E_{\text{van}}) + (P_{\text{round-trip}} \cdot F \cdot \sum M_{\text{collection}} \cdot E_{\text{mode}} \cdot D_{\text{customer collection}}) \right) / P_{\text{round-trip}}$$

Couriers by van

End-consumers in case of failed deliveries/various transport modes

**Average emitted transport related CO2 per parcel in case of locker deliveries =**

$$\left( (D_{\text{courier APS}} \cdot E_{\text{van}}) / P_{\text{APS}} \right) + T \cdot \sum M_{\text{APS}} \cdot E_{\text{mode}} \cdot D_{\text{customer APS trip chain}} + (1-T) \cdot \sum M_{\text{APS}} \cdot E_{\text{mode}} \cdot D_{\text{customer APS dedicated}}$$

Couriers by van

End-consumers for pick-ups/various transport modes/trip chaining

End-consumers for pick-ups/various transport modes/dedicated trips

D = distance

E = emission factor

P = number of parcels

F = % failed deliveries

M = % modal choice

T = % trip chaining

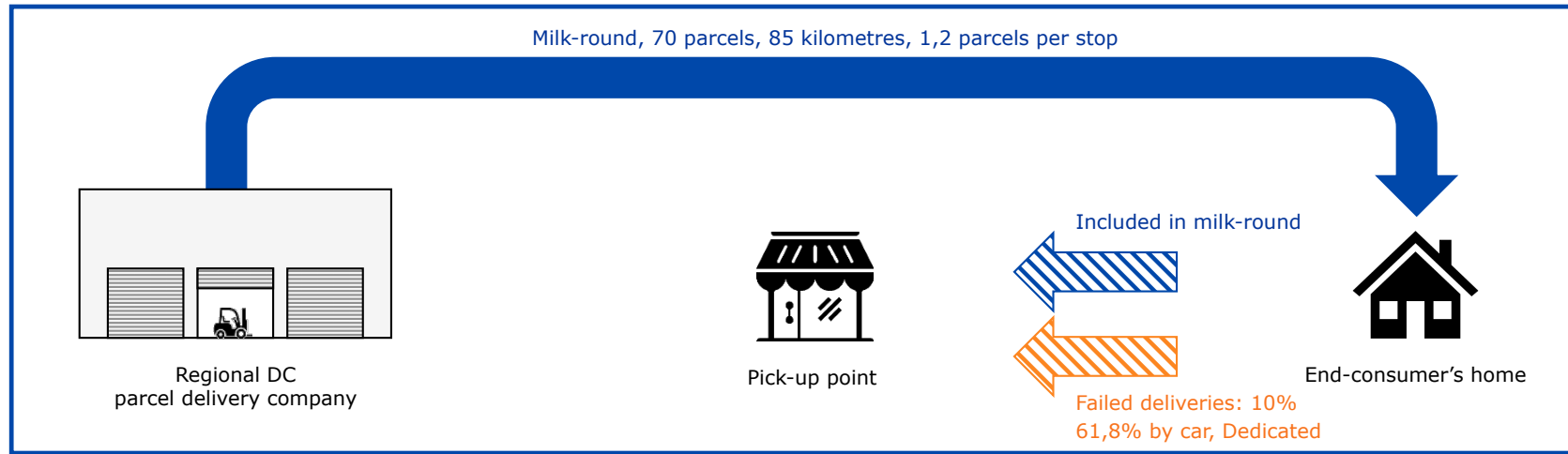


# Methodology

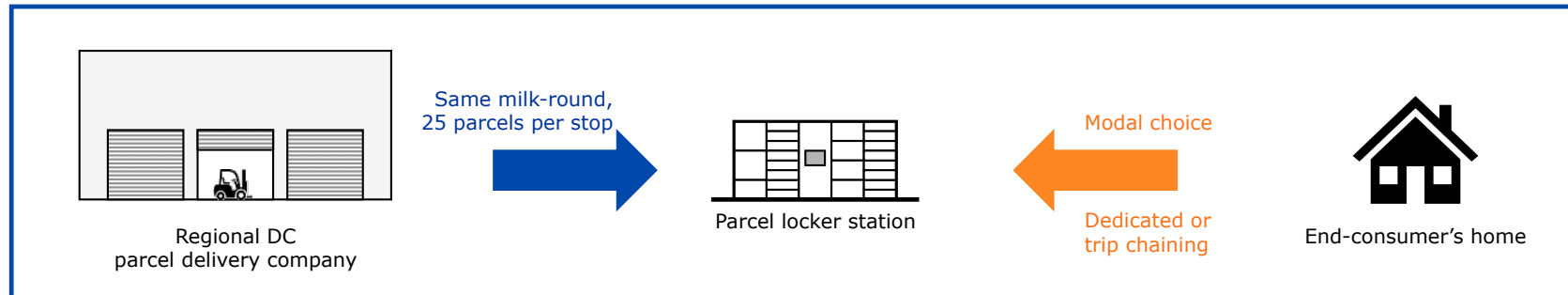
Quantification of the contributions to transport related CO2 emissions:

1. A non-structured interview with a logistics expert from Belgium's postal company on loading rates, types of vehicles and average distances travelled by delivery vans
2. An online survey among 121 users of lockers in parcel stations on trip chaining behaviour, modal choice and travelled distances the last time they had an online purchase delivered to an parcel locker station
3. Secondary sources on emission factors of delivery vans and passenger transport modes in Belgium.

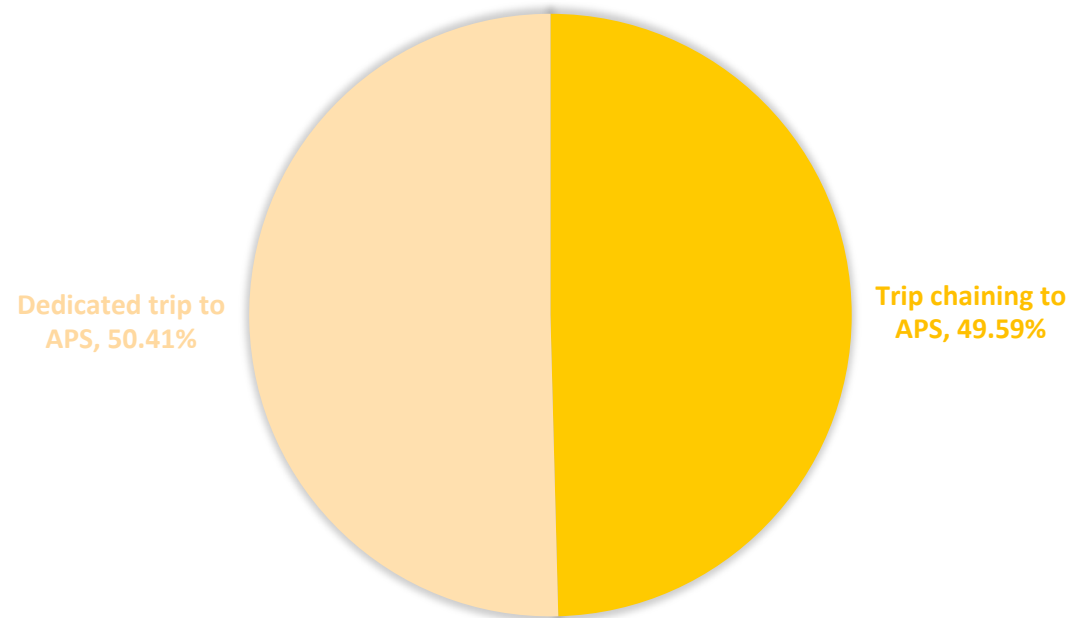
## Home deliveries



## Locker deliveries

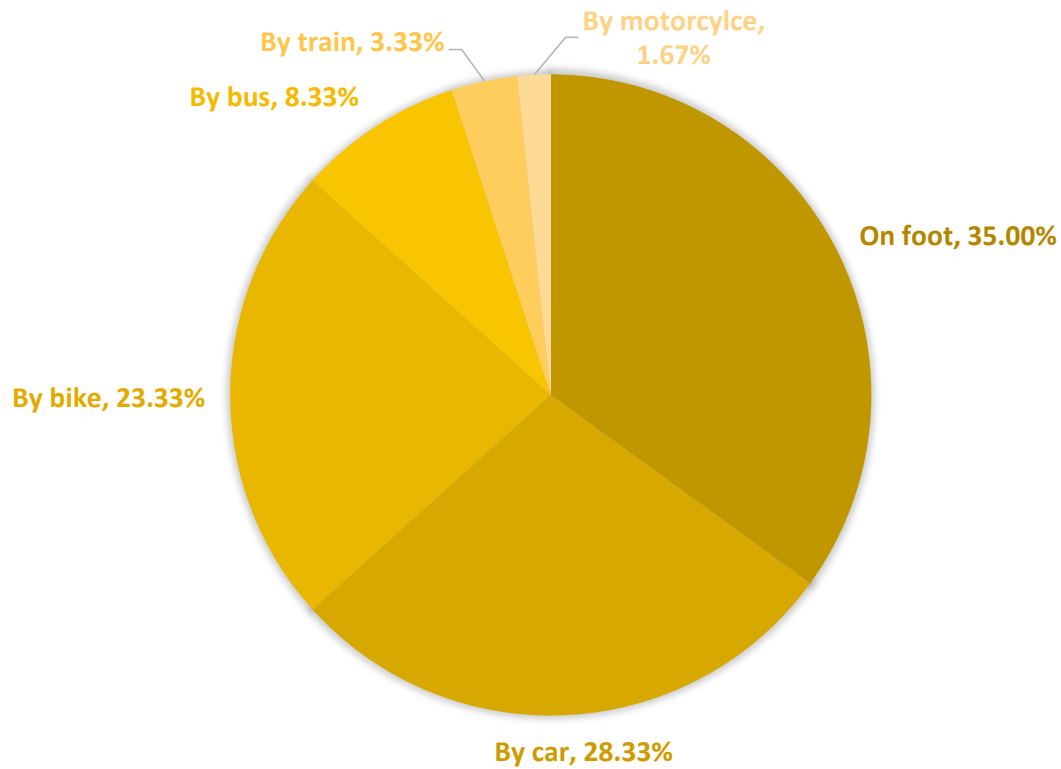


# Trip chaining or dedicated trip to APS



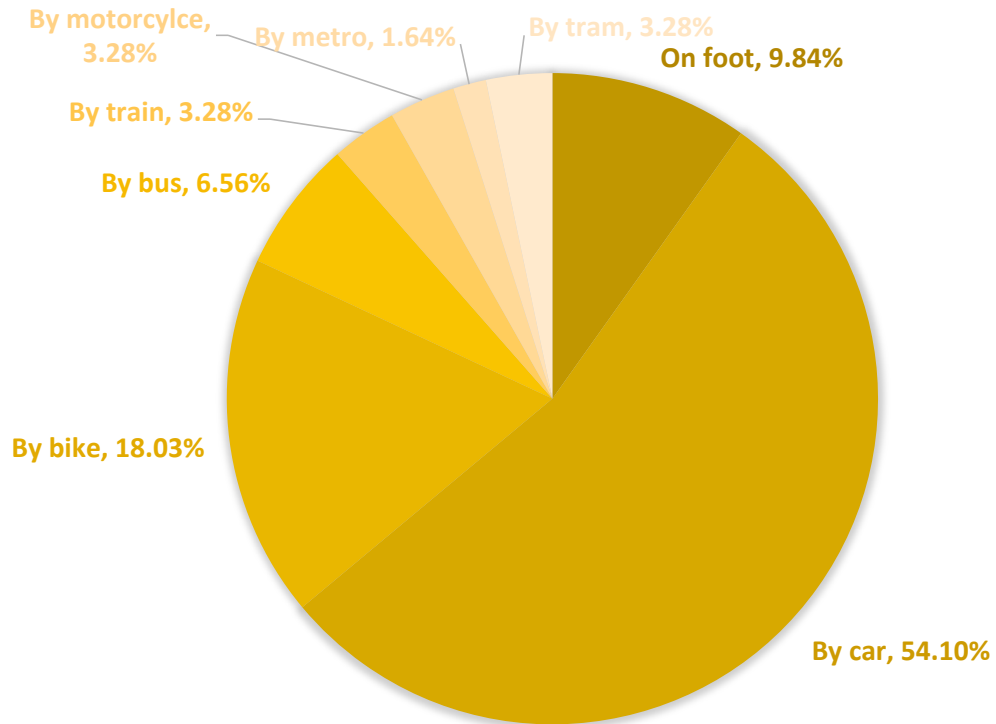
Parcel collection by consumers (literature)		
Trip chaining	Dedicated trip	Reference
80%	20%	Esser & Kurte, 2005
40%	60%	Edwards et al., 2009
74%	26%	McLeod & Cherret, 2009
62%	28%	Belet et al., 2009
50%	50%	Liu et al., 2017
63%	37%	Lemke et al., 2016

# Modal choice (trip chaining to APS)



Modal choice by consumer when collecting a parcel (literature)		
Modal choice	%	Reference
Car	62%	Edwards et al., 2010
Car	70%	Liu et al., 2017
Foot/Car	44%/56%	Moroz & Polkowski, 2016
Foot	40%	Edwards et al., 2010
Foot/Car	41%/59%	Lemke et al., 2016

# Modal choice (dedicated trip to APS)



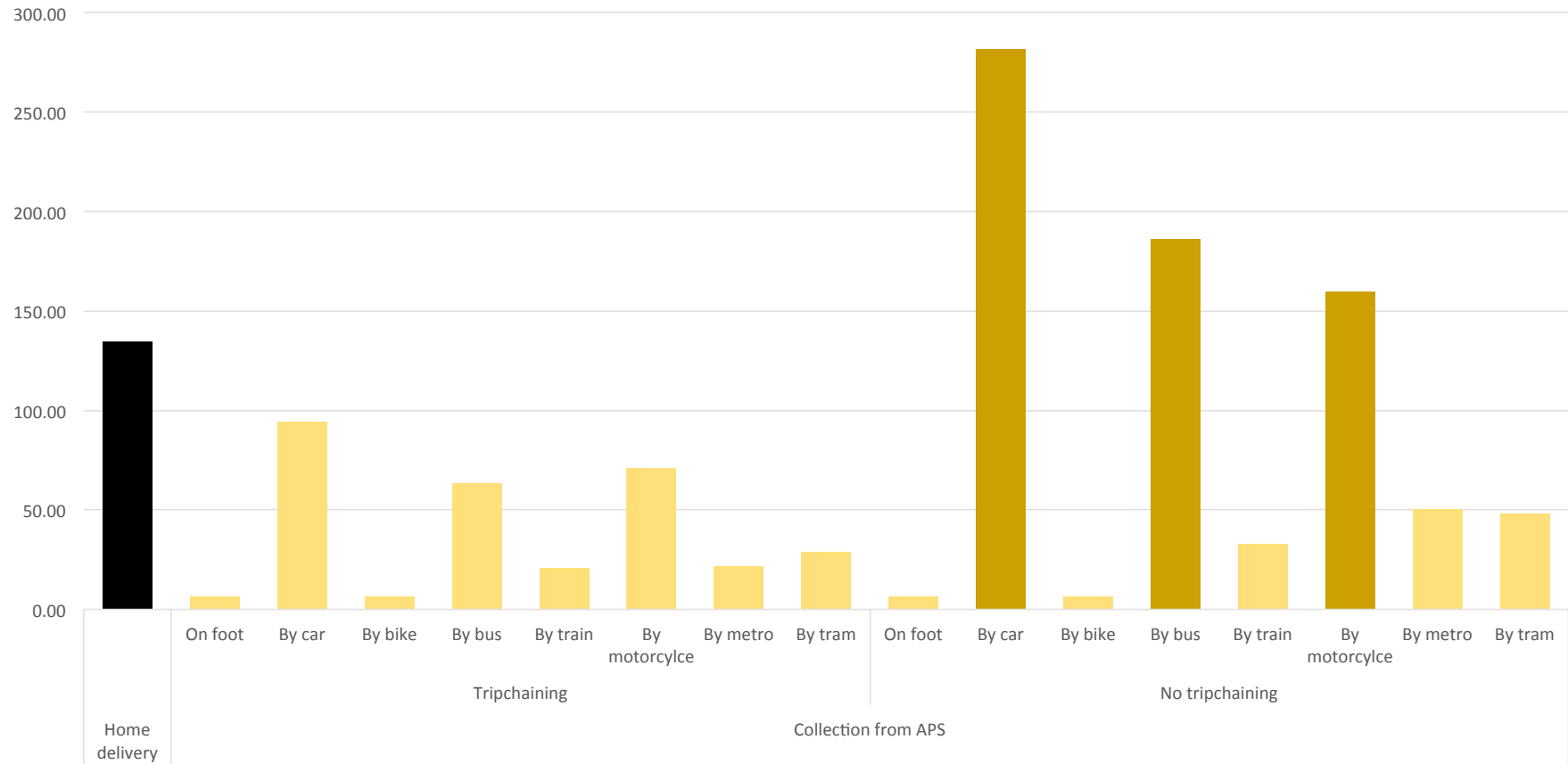
Modal choice by consumer when collecting a parcel (literature)		
Modal choice	%	Reference
Car	62%	Edwards et al., 2010
Car	70%	Liu et al., 2017
Foot/Car	44%/56%	Moroz & Polkowski, 2016
Foot	40%	Edwards et al., 2010
Foot/Car	41%/59%	Lemke et al., 2016

# Results

**Average emitted CO2 per parcel in case of home deliveries = 134,63g**  
**Average emitted CO2 per parcel in case of locker deliveries = 105,80g**



# Results (total g CO2 emission/parcel)



# Conclusions

- Home deliveries can outperform locker deliveries when it comes to transport-related CO2 emissions
- It depends on:
  - Whether the consumer trip chains or not when collecting a parcel from a parcel locker station
  - Transport mode of the consumer => dedicated trips by car and motorcycle (and bus) score worse
    - => Don't apply the solution everywhere.

## Limitations:

- Results depend on combination of emission factors for passenger and freight vehicles
- We do not know whether our sample is representative for parcel locker station users in Belgium