

# The role of cargo bikes for independent contractors in construction?

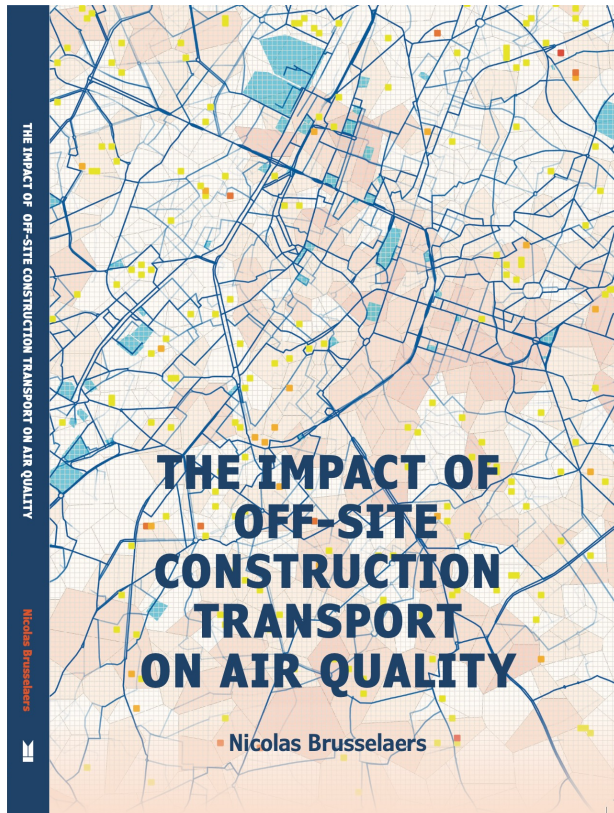
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Nicolas Brusselaers, *Ph.D.*

Post-doctoral researcher

# Doctoral thesis

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UNIVERSITY



Vrije Universiteit Brussel  
Faculty of Social Sciences and Solvay Business School  
Mobilise Research Group

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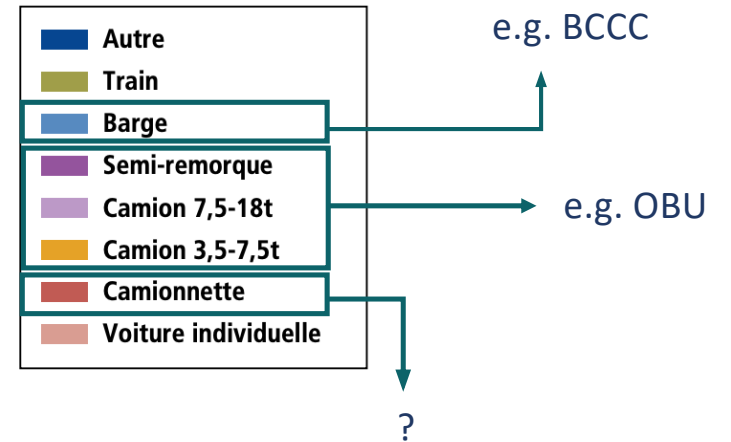
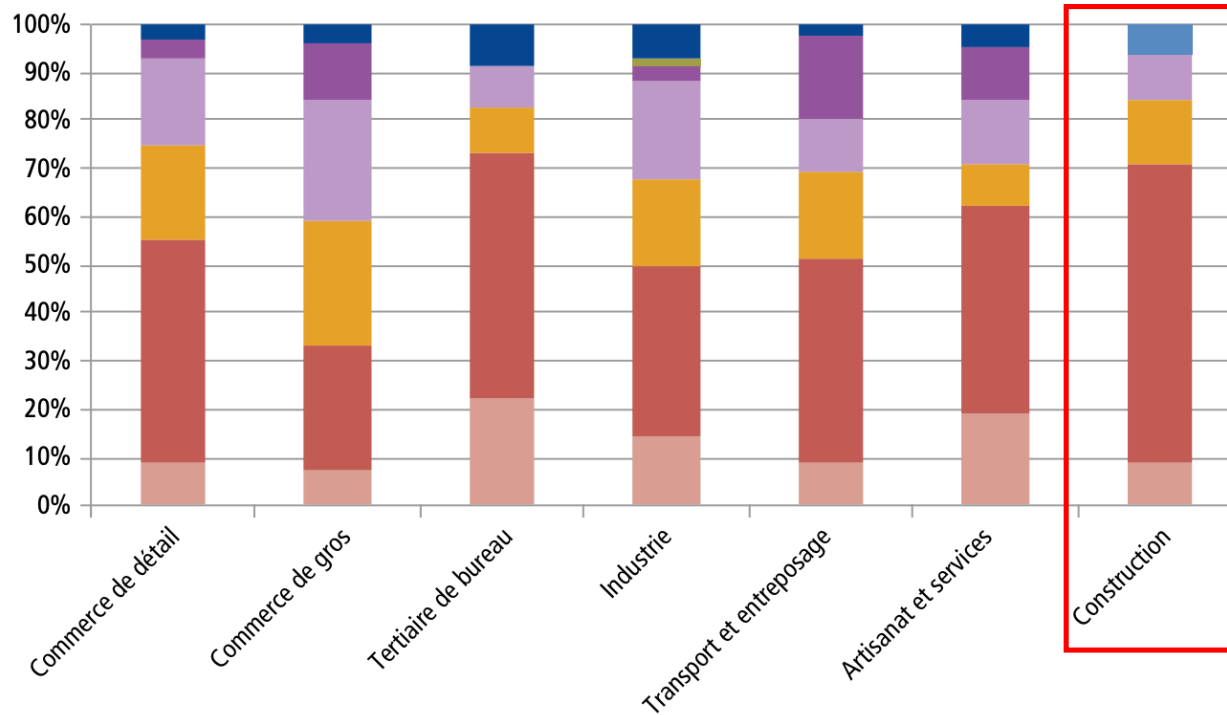
<https://researchportal.vub.be/en/publications/the-impact-of-off-site-construction-transport-on-air-quality-2>

# Types de flux & types de véhicules

Flow types	Description	Today's most used vehicles		
1. Concrete	This concerns liquid concrete that is poured from a concrete mixer on the construction site. About 30% of the rides in the traditional scenario is due to this construction flow type.		5. Finishing	Finishing, installations and smaller building materials transported on pallets or in containers. About 35% of the rides in the traditional scenario is attributable to this construction type.
2. Structural work Large	Larger and heavier elements, such as prefab, piles, floor elements, etc. Approximately 10% of the rides in the traditional scenario is attributable to this construction type.	 	6. Waste	Construction and demolition waste, but also packaging materials and packaging. About 5% of the rides in the traditional scenario can be attributed to this construction flow type.
3. Structural work Load carriers	Smaller elements on frames/pallets, for example facade parts, glass plates, etc. Approximately 10% of the rides in the traditional scenario is due to this construction flow type.	 	7. Equipment	For example, construction machinery, construction cranes and scaffolding. Approximately 10% of the journeys in the traditional scenario are to this construction flow type.
4. Bulk	For example, soil or gravel. Approximately 0% of the rides in the traditional scenario can be attributed to this construction flow type.		8. Personnel	Transport of personnel to and from the construction site.
				   

# Modal split in urban construction transport

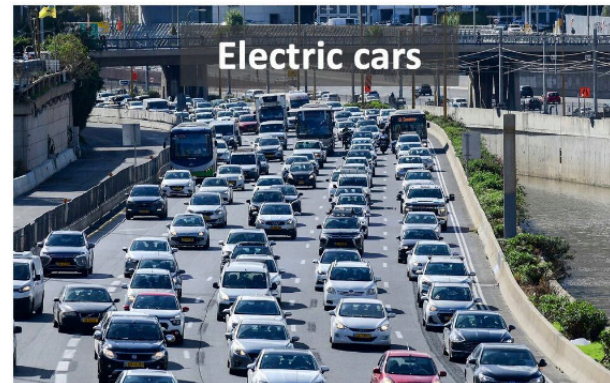
Estimation of the modal split of deliveries from the various economic sectors in the Brussels-Capital Region.



Personnel transportation ?  
 Renovation vs. new construction ?  
 "forgotten materials" << planning  
*Van Merriënboer et al., 2020*

Source: BCI & Technum (2014); Brussels Mobility (2015)

# (Beyond) the status quo in the transport sector



# The potential of cargo bikes in construction

“*La popularité des vélos-cargos augmente chaque année. Les vélos-cargos sont déjà utilisés pour les livraisons B2C (Arnold et al., 2018), mais cette méthode reste encore méconnue du secteur de la construction.*”

**The potential of cargo bikes in urban construction transport**  
 Nicolas Brusselaers, Philippe Lebeau & Safia Saoud  
 Vrije Universiteit Brussel, Mobilise Research Group, Brussels, Belgium, nicolas.brusselaers@vub.be

**Context**

- Construction is often a transport-intensive for cost, material amounts in a time-restricted manner.
- Small companies, representing 90% of construction firms in Belgium, struggle to use heavy-duty vehicles for urban last-mile transport.
- Using a cargo bike as a last-mile solution is a new way to reduce environmental impact.

**What we know so far**

- 85% of firms and 50% of urban deliveries are accessible by cargo bikes.
- Professionals are open to using a cargo bike instead of a van for short distances in urban areas.
- 80% of firms are not ready for such a transition. It would require 10% for personnel and 40% for professional cargo bike equipment.

**Research gap**

- The adoption of CB in construction has not gained much traction to be explored in context of other sectors such as construction.
- Still very little known on the above analysis stage (potential of light commercial vehicles versus CBs) and cargo bikes.

**Methodology & materials**

- Identification and categorization of construction companies.
- Clear study methods.
- Transport data.
- Equipment used and vehicle fleet analysis.

**Conclusions**

- R1: Airlightness, acoustics and thermography**
  - Transport: better connected to electric bike, which can carry up to 200 kg of load up to 30 km/h.
  - Material: light, strong, portable and is adaptable. 50% of vehicles related to cargo bike.
- R2: Construction, electro-mechanics & special techniques**
  - Specialized long-haul cargo bike with two bags in the back and a big bag in the front for the interventions (e.g. boiler installation).
  - Specialized truck needed for the job (especially delivered on site by supplier, usually consolidated in HGV), incl. mufflers, a 40% plan, electromechanics.

**Results & conclusions**

- Both tasks transport similar material volumes & weights.
- CB is lighter than trucks, more compact and more maneuverable.
- CB is more suitable for narrow streets and tight spaces.
- CB is more suitable for short distances and tight spaces.
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**Limitations and future research**

- CB is more suitable for short distances and tight spaces.
- CB is more suitable for short distances and tight spaces.

**Discussion**

- In this transition, different needs and different methods.
- CB is more suitable for short distances and tight spaces.

**Let's connect!**

Learn more about the project: <https://carpbike.brussel.be>

# The potential of cargo bikes in construction

## Context

- **Construction** is reliant on transport deliveries for vast material amounts in a time-intensive manner.
- **Small companies**, representing **93%** of construction firms in Brussels, strongly rely on **LCV (<3.5t)** for urban last mile construction transports.
- Shifting to **battery-electric cargo bikes (CB)** is one way to reduce externalities.

# The potential of cargo bikes in construction

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- **Small companies**, representing **93%** of construction firms in Brussels, strongly rely on **LCV (<3.5t)** for urban last mile construction transports.
- Shifting to **battery-electric cargo bikes (CB)** is one way to reduce externalities.

## What we know so far

- **81% of items** and **50% of urban deliveries** are acceptable for cargo bike transport.
- Professionals are open to daily **0-40km** travel distances by CB, with **payload, range, safety, comfort & weather conditions** as most decisive criteria.
- **96% of vans** are used for both personnel & material transport (4% for personnel only). **66%** of professionals using vans provide **services**.



# The potential of cargo bikes in construction

## Context

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## What we know so far

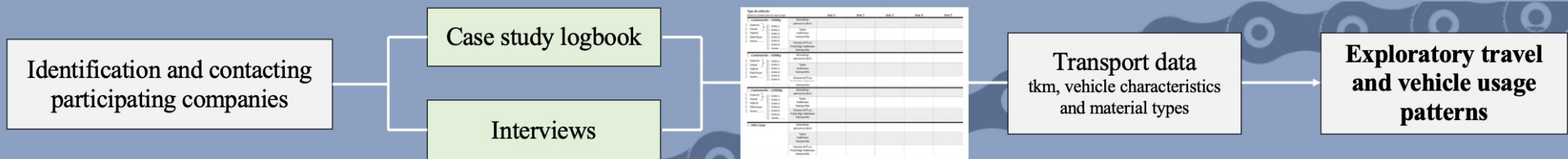
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## Research gap

The **adoption of CB in construction has not gained much traction** so far, especially compared to other sectors such as e-commerce or retail.

Still very little is known on the **share and/or usage (potential) of light commercial vehicles (vans/LCV<3.5t) and cargo bikes**.

# The potential of cargo bikes in construction



# The potential of cargo bikes in construction

## #1: Airtightness, acoustics and thermography

- Transport: trailer connected to electric bike, which can carry up to 200 kg of load (up to 170cm) + LCV.
- Material types: 50-120 kg, long, expensive and fragile equipment, incl. two large fans, smoke generator and a stepladder. 15% of activity is related to trainings.



# The potential of cargo bikes in construction

## #2: Construction, electro-mechanics & special techniques

- Transport: **long tail** cargo bike with two bags in the back and a big bag in the front for site interventions (e.g. boiler installation).
- Material types: tools needed for the job (materials delivered on-site by supplier, usually consolidated in HGV), incl. mallets, a drill, pliers, screwdrivers, tubes.



# The potential of cargo bikes in construction

	Data category	Data variables	Examples
TRIP	Origin-Destination Matrix	Total transport flows (vkm/tkm) given origin and destination points (minimal on municipality level) <sup>R</sup>	OD points; geolocations; distance travelled (vkm) etc.
		Road type <sup>A</sup>	Motorway, local road, etc.
		Environment <sup>A</sup>	Urban, suburban, rural, etc.
	Time of day	Hour of the day (differentiation day/night) <sup>A</sup>	Time stamps
	Traffic	Loss of time and traffic situation (thin/dense) <sup>A</sup>	Free-flow, heavy traffic, saturated, stop & go
VEHICLE	Vehicle type	Transport mode <sup>R</sup>	Barge CETM class 1; van type, HDV type; cargobike; etc.
		Vehicle capacity (size) <sup>R</sup>	14t-20t; 350t (CEMT II); 420m freight train ; etc.
		Vehicle propulsion type <sup>R</sup>	Diesel, electric, LNG ; etc.
		Vehicle consumption <sup>R</sup>	EURO-norm
		Vehicle speed <sup>A</sup>	Trip average speed
		Cargo type <sup>A</sup>	Pallets, bulk, etc.
	Loading rate <sup>A</sup>	Volume (tonne), %	

<sup>R</sup> Minimum data requirement.

<sup>A</sup> If no data is available, these could be based on solid assumptions or derived through geocoding or other calculations.

Brusselsaers et al., 2020

# The potential of cargo bikes in construction

Type de véhicule

Notez le nombre dans la case rouge

		Jour 1	Jour 2	Jour 3	Jour 4	Jour 5
<input type="checkbox"/> <b>Camionnette &lt; 3500kg</b>		Kilomètres parcourus (km)				
<input type="checkbox"/> Essence } <input type="checkbox"/> Diesel } <input type="checkbox"/> Hybrid } <input type="checkbox"/> Electrique } <input type="checkbox"/> Autre:.....	<input type="checkbox"/> EURO 1 <input type="checkbox"/> EURO 2 <input type="checkbox"/> EURO 3 <input type="checkbox"/> EURO 4 <input type="checkbox"/> EURO 5 <input type="checkbox"/> EURO 6 <input type="checkbox"/> Année: .....	Types matériaux transportés				
		Volume (m <sup>3</sup> ) ou Poids (kg) matériaux transportés				
	<input type="checkbox"/> <b>Camionnette &gt; 3500kg</b>		Kilomètres parcourus (km)			
<input type="checkbox"/> Essence } <input type="checkbox"/> Diesel } <input type="checkbox"/> Hybrid } <input type="checkbox"/> Electrique } <input type="checkbox"/> Autre:.....	<input type="checkbox"/> EURO 1 <input type="checkbox"/> EURO 2 <input type="checkbox"/> EURO 3 <input type="checkbox"/> EURO 4 <input type="checkbox"/> EURO 5 <input type="checkbox"/> EURO 6 <input type="checkbox"/> Année: .....	Types matériaux transportés				
		Volume (m <sup>3</sup> ) ou Poids (kg) matériaux transportés				
	<input type="checkbox"/> <b>Camionnette &gt; 12000kg</b>		Kilomètres parcourus (km)			
<input type="checkbox"/> Essence } <input type="checkbox"/> Diesel } <input type="checkbox"/> Hybrid } <input type="checkbox"/> Electrique } <input type="checkbox"/> Autre:.....	<input type="checkbox"/> EURO 1 <input type="checkbox"/> EURO 2 <input type="checkbox"/> EURO 3 <input type="checkbox"/> EURO 4 <input type="checkbox"/> EURO 5 <input type="checkbox"/> EURO 6 <input type="checkbox"/> Année: .....	Types matériaux transportés				
		Volume (m <sup>3</sup> ) ou Poids (kg) matériaux transportés				
	<input type="checkbox"/> <b>Vélo Cargo</b>		Kilomètres parcourus (km)			
		Types matériaux transportés				
		Volume (m <sup>3</sup> ) ou Poids (kg) matériaux transportés				

# The potential of cargo bikes in construction

## #1: Airtightness, acoustics and thermography

- **Transport:** trailer connected to electric bike, which can carry up to 200 kg of load (up to 170cm) + LCV.
- **Material types:** 50-120 kg, long, expensive and fragile equipment, incl. two large fans, smoke generator and a stepladder. 15% of activity is related to trainings.



## #2: Construction, electro-mechanics & special techniques

- **Transport:** long tail cargo bike with two bags in the back and a big bag in the front for site interventions (e.g. boiler installation).
- **Material types:** tools needed for the job (materials delivered on-site by supplier, usually consolidated in HGV), incl. mallets, a drill, pliers, screwdrivers, tubes.



	Day 1	Day 2	Day 3	Day 4	Day 5
<b>WEEK 1</b>					
<b>Van</b>	33,3km				
Type N-I	Transported material types				
Capacity	2 large fans, smoke generator, stepladder				
Diesel	120kg				
EURO-6					
<b>Cargobike</b>	15km				
Type	Airtightness, acoustics, thermography				
Capacity	50-100kg				
Electric	thermography + training				
	30km				
	Airtightness, acoustics, thermography				
	15km				
	Airtightness, acoustics, thermography				
	30km				
	Airtightness, acoustics, thermography				
<b>WEEK 2</b>					
<b>Van</b>	33,3km				
Type N-I	Transported material types				
Capacity	2 large fans, smoke generator, stepladder				
Diesel	120kg				
EURO-6					
<b>Cargobike</b>	15km				
Type	Airtightness, acoustics, thermography				
Capacity	50-100kg				
Electric	thermography + training				
	30km				
	Airtightness, acoustics, thermography				
	15km				
	Airtightness, acoustics, thermography				
	30km				
	Airtightness, acoustics, thermography				
<b>WEEK 3</b>					
<b>Van</b>	33,3km				
Type N-I	Transported material types				
Capacity	2 large fans, smoke generator, stepladder				
Diesel	120kg				
EURO-6					
<b>Cargobike</b>	15km				
Type	Airtightness, acoustics, thermography				
Capacity	50-100kg				
Electric	thermography + training				
	30km				
	Airtightness, acoustics, thermography				
	15km				
	Airtightness, acoustics, thermography				
	30km				
	Airtightness, acoustics, thermography				
<b>WEEK 1</b>					
<b>Van</b>	18km				
Type N-I	Transported material types				
Capacity	Plaster, metal				
Diesel	0.25m <sup>3</sup>				
EURO-6	66kg				
<b>Cargobike</b>	15km				
Type	Airtightness, acoustics, thermography				
Capacity	50-100kg				
Electric	thermography + training				
	42km				
	Laser metres, notas				
	1,5km				
	Foreuse, visseuse, disqueuse				
	0.12m <sup>3</sup>				
	10kg				
	3km				
	Foreuse, pinces				
	0.12m <sup>3</sup>				
	10kg				
<b>WEEK 2</b>					
<b>Van</b>	15km				
Type N-I	Transported material types				
Capacity	Waste				
Diesel	3m <sup>3</sup>				
EURO-6	450kg				
<b>Cargobike</b>	5km				
Type	(-)				
Capacity	(-)				
Electric	(-)				
	5km				
	(-)				
	(-)				
	3km				
	(-)				
	(-)				
<b>WEEK 3</b>					
<b>Van</b>	15km				
Type N-I	Transported material types				
Capacity	Raccords saitaires				
Diesel	0.25m <sup>3</sup>				
EURO-6	30kg				
<b>Cargobike</b>	15km				
Type	(-)				
Capacity	25kg				
Electric	12kg				
	(-)				
	25kg				
	15km				
	Tuyaux				
	2m <sup>3</sup>				
	60kg				
	15km				
	Pinces, perforance				
	0.12m <sup>3</sup>				
	30kg				

Check out the details at [https://cris.vub.be/ws/portalfiles/portal/105999684/20231010\\_BrusselsaersLebeauSaoud\\_VREF.pdf](https://cris.vub.be/ws/portalfiles/portal/105999684/20231010_BrusselsaersLebeauSaoud_VREF.pdf)

# Vans "and" cargo bikes

- 1 **Both cases transport similar material volumes and weights**
  - LCV: 30-650kg (heavy/bulky materials, tools and waste).
  - CB: (1)-25-100kg (lighter/smaller materials and tools).
- 2 **The importance of vehicle complementarity**
  - Cargobike used on 60-80% of workdays, 1.5-42km per day, replacing LCV roughly 90-100km per week.
  - As not all products types can be transported using cargo bikes due to its limitations, entirely shifting transports to cargo bikes is not always possible.
  - Both the van and cargo bike therefore co-exist for their own purpose, mainly defined by material volume and weight.
- 3 **Different days/weeks, different needs and different modes**
  - Cases suggest that the use of cargo bike has a potential to complement urban construction transport for self-employed firms, using less bulky and heavy materials.

## The potential of cargo bikes in urban construction transport

Nicolas Brusselaers, Philippe Lebeau & Safia Saoud  
Vrije Universiteit Brussel, Mobilise Research Group, Brussels, Belgium, nicolas.brusselaers@vub.be

**Context**

- Construction is reliant on transport deliveries for vast material amounts in a time-intensive manner.
- Small companies, representing 83% of construction firms in Brussels, strongly rely on LCV (€3.50) for urban last mile construction transports.
- Shifting to battery-electric cargo bikes (CB) is one way to reduce externalities.

**What we know so far**

- 81% of items and 50% of urban deliveries are acceptable for cargo bike transport.
- Professionals are open to daily 0-40km travel distances by CB, with **payload, range, safety, comfort & weather conditions** as most decisive criteria.
- 96% of vans are used for both personnel & material transport (4% for personnel only). 66% of professionals using vans provide services.

**Research gap**

The adoption of CB in construction has not gained much traction so far, especially compared to other sectors such as e-commerce or retail.

Still very little is known on the **share and/or usage (potential) of light commercial vehicles (vans/LCV-3.5t) and cargo bikes.**


**Methodology & materials**

Identification and contacting participating companies → Case study logbook → Interviews → Transport data (data, vehicle characteristics and material types) → Exploratory travel and vehicle usage patterns

**Case studies**


**#1: Airtightness, acoustics and thermography**

- **Transport:** trailer connected to electric bike, which can carry up to 200 kg of load (up to 170cm) + LCV.
- **Material types:** 50-120 kg, long, expensive and fragile equipment, incl. two large fans, smoke generator and a stepladder. 15% of activity is related to trainings.



**#2: Construction, electro-mechanics & special techniques**

- **Transport:** long tail cargo bike with two bags in the back and a big bag in the front for site interventions (e.g. boiler installation).
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**Results & conclusions**

- 1 **Both cases transport similar material volumes & weights**
  - LCV: 30-650kg (heavy/bulky materials, tools and waste).
  - CB: (1)-25-100kg (lighter/smaller materials and tools).
- 2 **The importance of vehicle complementarity**
  - CB replace LCV roughly 90-100km/week & used 60-80% of workdays, 1.5-42km/day.
  - Entirely shifting transports to CB is not always possible due to the vehicle's payload limitations.
  - Both vans & CBs co-exist for their own purpose, mainly defined by material volume & weight.
- 3 **Different days/weeks, different needs and different modes**
  - Cases suggest that CB have potential to complement urban construction transport for self-employed firms, using less bulky and heavy materials.

**Limitations and future research**


- Only 2 firms were investigated for a limited period of 3 weeks. A broader assessment including a wider spectrum of firms, materials and construction phases is required.
- Environmental and financial benefits or losses can render more insights in the usage (potential) of cargo bikes in this sector.

**Discussion**

Is this transition **sufficient** to reach (transportation) zero-emission cities?  
How should we go about **adoption barriers**?  
Can CB transports be combined **across freight sectors** to limit empty trips?

Learn more about the project >> <https://cairgobike.brussels/>

Nicolas Brusselaers  
Post-doctoral researcher at Linköping University, Bregenz, Austria





# The potential of cargo bikes in construction



# Reflection

What about **context** and practical **limitations**?

Is this transition **sufficient** to reach (transportation) **zero-emission cities**?

How should we go about **adoption barriers**?

# Contact



## Construction Logistics and Supply Chain Management

We are researching how to create long-term sustainability and effectiveness in the built environment with a focus on logistics, digitalization, and resource-efficient construction.



## Urban development and logistics

The research focus on decreasing environmental impact and disturbances of city development, as well as utilization of capacity of time and space within the city in such a way that both goods and person transport can work efficiently and effectively.



## Transport Analytics

We are currently working with data from stationary radar sensors which measure speed and flow of traffic, GPS data from vehicles driving around urban areas, and mobile phone location data extracted from the mobile phone network.



## Traffic Modeling and Simulation

Our research includes both the development of new types of models, and the application of models to new situations. The models studied include both the demand and supply side of the problem and...



**Nicolas Brusselaers**

Post-doctoral researcher Construction logistics  
Chair NECTAR cluster Transport & Freight

[nicolas.brusselaers@liu.se](mailto:nicolas.brusselaers@liu.se) (+32 (0) 497327322)

