LESSONS LEARNED IN FOUR EUROPEAN CITIES

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Abstract

This deliverable presents the final assessment and lessons learned from the four CodeZERO Living Labs in Milan, Oslo, Utrecht and Antwerp. The pilots tested different sustainable last-mile delivery solutions in real operating conditions: cargo-cycle delivery, mobile pick-up points, micro-hub distribution with light electric vehicles, and out-of-home delivery through PUDO and networks of shops.

The assessment combines two components: the implementation and performance of delivery options, based on the WP3 Delivery Options Assessment Framework, and the evaluation of communication measures and consumer behaviour. The results are interpreted from the perspectives of consumers, retailers, logistics operators and local authorities.

Findings show that zero-emission delivery solutions can work in urban e-commerce logistics, but not as universal replacements for existing models. Their performance depends on demand density, delivery profiles, operational maturity, consumer behaviour and local constraints. Across the pilots, the most promising results emerge when each solution is used selectively: cargo cycles for dense and suitable loads, mobile pick-up points where demand is concentrated, micro-hubs in restricted areas, and PUDO or shop delivery where customers can collect parcels without dedicated car trips.

The main lesson is that sustainable last-mile logistics requires a flexible delivery ecosystem, supported by strong stakeholder cooperation, operational data, local adaptation and clear consumer communication.

Executive summary

This deliverable presents the final assessment of the CodeZERO Living Labs in **Milan, Oslo, Utrecht and Antwerp**. The four pilots tested different solutions to reduce the impacts of last-mile e-commerce logistics while maintaining operational feasibility and consumer attractiveness.

The assessment uses the WP3 framework, which includes **63 KPIs** covering demand, supply, spatial context and impacts. For each Living Lab, the full KPI set was assessed, while the report focuses on the KPIs that changed between the reference and pilot options. Results are then interpreted through stakeholder-specific weights for consumers, retailers, logistics operators and local authorities. The operational assessment is complemented by communication data, surveys, interviews and partner observations.

In **Milan**, the pilot compared a two-wheel cargo-bike fleet with a mixed fleet integrating the TricyLift cargo tricycle. At aggregate fleet level, differences were limited. However, when used on higher-load routes, the tricycle carried more weight, more parcels and more stops with limited additional distance, although with longer route duration. The pilot also improved consumer information by updating the IKEA checkout message to include both environmental and social benefits.

In **Oslo**, Click & Collect Near You was compared with home delivery. CCNY reduced kilometres driven, vehicles and drivers required, and offered a lower delivery price. Its main weakness was lower flexibility for customers, due to fixed pick-up locations and time windows. The assessment also shows that customer travel to pick-up points is critical for evaluating the real sustainability of the service.

In **Utrecht**, the mobile micro-hub with light electric vehicles showed potential in restricted inner-city areas, especially for reducing environmental and spatial impacts. At the same time, the pilot confirmed that grocery delivery is operationally demanding for this model, requiring efficient routing, sufficient density and further adaptation before scale-up.

In **Antwerp**, PUDO and shop delivery performed well as alternatives to home delivery, particularly in terms of delivery success, flexibility and cost. However, their environmental advantage depends strongly on consumers' collection behaviour. Walking, cycling and trip chaining support the benefits of out-of-home delivery, while dedicated car trips can reduce them.

Across the four pilots, the assessment confirms that no solution performs best on all dimensions. Consumers prioritise cost, convenience, flexibility and reliability. Retailers and logistics operators focus on efficiency, resources, costs and scalability. Local authorities give more weight to environmental, transport and spatial impacts. The framework makes these trade-offs visible, but the results should be read as decision support, not as a mechanical ranking.

Communication activities increased visibility and awareness, especially when messages were close to the delivery decision, such as checkout information, delivery-choice options or targeted incentives. However, information alone rarely produced measurable behaviour change. Convenience, price, time and habit remained the strongest drivers of consumer choice, while sustainability messages were most effective when linked to practical benefits.

Overall, the Living Labs show that zero-emission and sustainable delivery options are feasible, but conditional. They require the right operational context, sufficient volumes, stakeholder alignment, consumer visibility and time to integrate into existing logistics processes. The key lesson is not to replace one delivery model with another, but to combine different solutions according to where they perform best results.

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List of abbreviations and acronyms

Acronym	Meaning
AHP	Analytic Hierarchy Process
B2C	Business to consumer
CCNY	Click and Collect Near You
CO_2	Carbon Dioxide
CTA	Call To Action
HDV	Heavy Duty Vehicle
LDV	Light Duty Vehicle
LSP	Logistics Service Providers
LEV	Light electric vehicle
NPS	Net Promoter Score
PUDO	Pick-Up Drop-Off
KPI	Key Performance Indicator
QR	Quick Response
WP	Work Package
ZEV	Zero-Emission Vehicle
ZIP	Postal code area

1 Introduction

1.1 About CodeZERO

CodeZERO is a three-year Horizon Europe research project aiming to co-create sustainable and zero-emission last-mile delivery and return solutions for e-commerce that align with **consumers'** preferences while being sustainable for **retailers, logistics operators** and **local authorities**. Additionally, the project is focused on providing clear, consumer-friendly communication and developing tools for local authorities to promote eco-friendly behaviour.

CodeZERO is articulated in four phases:

- An **ANALYSIS** phase which provides (1) an analysis of existing delivery and return options and an understanding how they are shaped by the needs and constraints of all involved stakeholders; (2) an in-depth intersectional analysis of various groups of online consumers to understand what are the features of delivery and return options making them attractive, with the aim to identify mechanisms to incentivize behaviour changes; and (3) develops an assessment framework to measure the impacts in the environmental, economic and social domains of new solutions.
- A **DESIGN** phase, in which CodeZERO engages in a co-design process involving retailers, transport operators, consumers and local authorities in developing (1) guidelines for retailers to raise awareness among customers; (2) a set of zero-emission and sustainable delivery and return options for retailers and transport operators; and (3) a toolset for local authorities to accelerate the transition towards sustainable solutions in last mile consignments in e-commerce.
- A **TEST** phase running 4 pilots in 4 different European cities in Italy, Netherlands, Belgium, and Norway to test a set of sustainable solutions identified in the previous phase with the aim to prove their feasibility, to fine-tune their design and to assess their impacts from the perspective of all stakeholders.
- A **CONSOLIDATION** phase where (1) CodeZERO outcomes are fine-tuned based on the lessons learned from real life applications, (2) requirements for up-scaling of solutions at European level are discussed (3) recommendations are formulated and (4) directions for future research are outlined.

Engagement with consumers and retailers' associations, industry stakeholders, cities and researchers contributes to shaping project results.

Running from June 2024 to May 2027, CodeZERO is organized along eight WPs:

- WP1 Analysis of current delivery models
- WP2 Analysis of consumers' behaviour
- WP3 CodeZERO assessment framework
- WP4 Design of CodeZERO solutions
- WP5 Testing solutions: CodeZERO living labs
- WP6 Conclusions and recommendations
- WP7 Dissemination, communication, and exploitation
- WP8 Project management.

1.2 Aim of this deliverable

This deliverable assesses whether, and under which conditions, the CodeZERO solutions tested in the Living Labs of Milan, Oslo, Utrecht and Antwerp contributed to improving the attractiveness, operational feasibility and sustainability of zero-emission last-mile delivery and return options. It brings together the assessment of delivery options implementation and the assessment of communication measures and consumer behaviour, with the aim of identifying both measurable results and lessons learned across the four pilots.

The operational assessment builds on the Delivery Options Assessment Framework developed in WP3. The framework includes 63 KPIs covering demand-side, supply-side, spatial-context and impact dimensions. It applies a Multi-Criteria Analysis approach and uses stakeholder-specific weights derived through the Analytic Hierarchy Process (AHP), allowing each delivery option to be assessed from the perspectives of consumers, retailers, logistics operators and local authorities. In this deliverable, the framework is used to compare reference and pilot delivery options and to identify where the tested solutions produced measurable differences.

For each Living Lab, the full set of 63 KPIs is assessed in the Excel framework. In the written chapters, however, only the KPIs that show a variation between the assessed delivery options are reported and discussed. KPIs that do not change remain part of the calculation but are not described in detail, either because the pilot does not affect them, because they are not relevant to the specific delivery configuration, or because sufficiently reliable data are not available. This keeps the chapters focused on the actual effects of the tested interventions while maintaining consistency with the full assessment framework.

The KPI-based results are complemented, where relevant, by operational data, surveys, interviews, driver registrations, communication analytics and partner observations. This is necessary because the four Living Labs differ in scope and maturity: some compare vehicle configurations within an existing service, while others test alternative delivery models, mobile pick-up points, micro-hubs or PUDO networks. The stakeholder-weighted scores therefore provide a structured comparison, but their interpretation also requires contextual and operational judgement.

Living Lab-specific variations in the assessment approach

Minor variations in KPI selection and interpretation reflect the different nature of the four pilots:

Milan: the assessment focuses on the KPIs affected by the introduction of a cargo tricycle into an existing cargo-bike fleet and by the updated checkout communication; qualitative interviews are used to interpret and enrich operational results.

Oslo: KPI selection also depends on data comparability between home delivery and CCNY; route filtering, modelling and customer travel to pick-up points are used to support the comparison.

Utrecht: some KPIs are excluded because the pilot does not involve an active consumer choice between delivery options, and some operational impacts cannot be quantified with available data.

Antwerp: the assessment compares three delivery options — home delivery, PUDO and shop delivery — and integrates operational data with checkout tests, communication campaigns and consumer travel behaviour.

The stakeholder-weighted results presented in the Living Lab chapters were produced using the Excel-based CodeZERO Assessment Framework for Zero-Emission Delivery Options, developed in D3.1. Each Living Lab team applied the tool to quantify the full set of KPIs for the delivery options under comparison, using observed data and, where direct measurements were unavailable, informed estimates based on literature, operational experience or professional judgement.

Table 1: Example of a selection of Impact side KPIs applicable by the Living Labs

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Values for Delivery option A (base)*	*Values for Delivery option B (pilot)*
Service efficiency	Vehicles load factor	Share of vehicles used for delivery departing from warehouses with a load factor equal or above 75% of the carrying capacity	%	↑	80%	70%
Service efficiency	Distance travelled	Travelled distance to complete D deliveries (1000) in an area of X (30) square km Distance = ∑(i) DistVi where - DistVi: Distance travelled by vehicle type i to complete Di (200) deliveries in an area of X (30) square km and - D= ∑(i) Di	km	↓	2,1	2,2
Service efficiency	Shipments consolidation	Average deliveries per tour AvDel= ∑(i) AvDelVi where - AvDelVi: Average deliveries per tour per type i vehicle	Number / tour	↑	5,2	5,3
Service efficiency	Total delivery time	Time needed to complete D deliveries in an area of X square km by all types of vehicles. T = ∑(i) Ti where - Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km and - D= ∑(i) Di	Hours	↓	1,16	1,75
Transport impacts	Congestion	Index obtained as combination of: - the time needed for delivering products by each vehicle type - the road occupancy of each vehicle type. I = ∑(i) Ti*OccVi where: - Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km - OccVi: road occupancy of vehicle type i under the condition that - D= ∑(i) Di	hours *sqm	↓	10	25

Since the KPIs are expressed in different units, their original values are first converted into comparable, dimensionless scores using a scaling factor based on the expected magnitude of each indicator. The calculation also accounts for the KPI direction, so that the resulting score increases when performance improves, whether this requires a higher or a lower original KPI value. The normalised scores are then multiplied by stakeholder-specific weights derived from the AHP pairwise comparisons and aggregated by attribute type and assessment dimension.

Table 2: Illustrative normalisation and weighting of selected impact KPIs for Delivery Options A and B, by stakeholder perspective

Attribute	Magnitude[1]	Scaling factor[2]	Normalised score A (Direction Operators)[3]	Normalised score B (Direction Operators)[4]	Normalised score A (Direction Society)[5]	Normalised score B (Direction Society)[6]	Weights (CON)[7]	Weights (LO)[8]	Weights (RTL)[9]	Weights (PA)[10]
Vehicles load factor	75%	66,7	53,33	46,67	53,33	46,67		0,217	0,204	
Distance travelled	1	50,0	-5,00	-10,00	-5,00	-10,00		0,084	0,077	
Shipments consolidation	30	1,7	8,67	8,83	8,67	8,83		0,093	0,111	
Total delivery time	3	16,7	80,67	70,83	80,67	70,83		0,099	0,096	
Congestion	250	0,2	98,00	95,00	98,00	95,00	0,094	0,159	0,153	0,137

Therefore, the values reported in the final stakeholder-weighted tables (example reported in Table 3) are comparative composite scores, not percentages, physical measurements or absolute performance ratings. A higher value indicates a more favourable result for the specified stakeholder and assessment dimension, while identical values indicate that the compared options do not differ for the underlying KPIs. Scores should primarily be compared between delivery options within the same row and table. The cumulative value summarises the results across the attribute types included in that table. Further methodological details are provided in D3.1.

[1] **Magnitude:** Expected reference value representing the typical size of the KPI; it is used for normalisation and is not a statistical average.

[2] **Scaling factor:** Ratio between 50 and the KPI magnitude, used to convert values expressed in different units into comparable scores.

[3] **Normalised score A, Direction Operators:** Normalised KPI score for Delivery Option A, calculated according to whether operators prefer higher or lower values.

[4] **Normalised score B, Direction Operators:** Normalised KPI score for Delivery Option B, calculated according to whether operators prefer higher or lower values.

[5] **Normalised score A, Direction Society:** Normalised KPI score for Delivery Option A, calculated according to whether higher or lower values are preferable from a societal perspective.

[6] **Normalised score B, Direction Society:** Normalised KPI score for Delivery Option B, calculated according to whether higher or lower values are preferable from a societal perspective.

[7] **Weights (CON):** Relative importance assigned to the KPI by consumers with the AHP pairwise comparisons.

[8] **Weights (LO):** Relative importance assigned to the KPI by logistics operators with the AHP pairwise comparisons.

[9] **Weights (RTL):** Relative importance assigned to the KPI by retailers with the AHP pairwise comparisons.

[10] **Weights (PA):** Relative importance assigned to the KPI by public authorities with the AHP pairwise comparisons.

Table 3: Example of resulting scores - Demand side attributes – Consumers perspective - Milan[11]

Attribute type	Result Delivery Option A	Result Delivery Option B
Cost	3,16	3,16
Flexibility	6,85	6,85
Delivery time	14,33	14,33
Delivery method	8,99	8,99
Information	27,43	70,96
Reliability	13,27	13,27
Cumulative	74,03	117,56

The second component of the deliverable focuses on communication interventions and consumer behaviour. Each pilot implemented communication interventions, such as information campaigns, nudges and checkout changes, to apply in real-world conditions the communication guidelines developed in Deliverable 4.3 (Pernot et al. 2025) and presented in Appendix 1.

For each pilot, these communication interventions were evaluated, based on the assessment framework for consumers behaviour change developed in Deliverable 3.2 (Pernot and Phillips 2025). The framework is intended to assess the effects of the interventions on consumers' delivery choices, as well as their influence on predictors of choices, such as awareness, attitudes, intentions and the importance given to sustainability in relation to other goals.

To apply the framework, the interventions must first be described. Relevant KPIs are then selected from the 28 indicators included in the framework, depending on what each communication intervention is intended to achieve. Using an appropriate experimental design, KPI values are compared across groups, for example between consumers exposed to the intervention and those not exposed to it. The results are then discussed to assess the effectiveness of the intervention and to identify implications for the communication guidelines and their further refinement.

Because the communication interventions, their reach, and the available data varied across the Living Labs, the results do not always allow firm conclusions to be drawn about the effectiveness of the interventions. Nevertheless, they provide useful preliminary findings that can inform and guide further research.

[11] **Note**: Values are dimensionless composite scores calculated through the Excel-based CodeZERO Assessment Framework. Higher values indicate more favourable performance for the stakeholder and dimension concerned. Scores should be compared between delivery options within the same row and table. See D3.1 for the full methodology.

1.3 Structure of the document

Deliverable 5.2 is structured as follows:

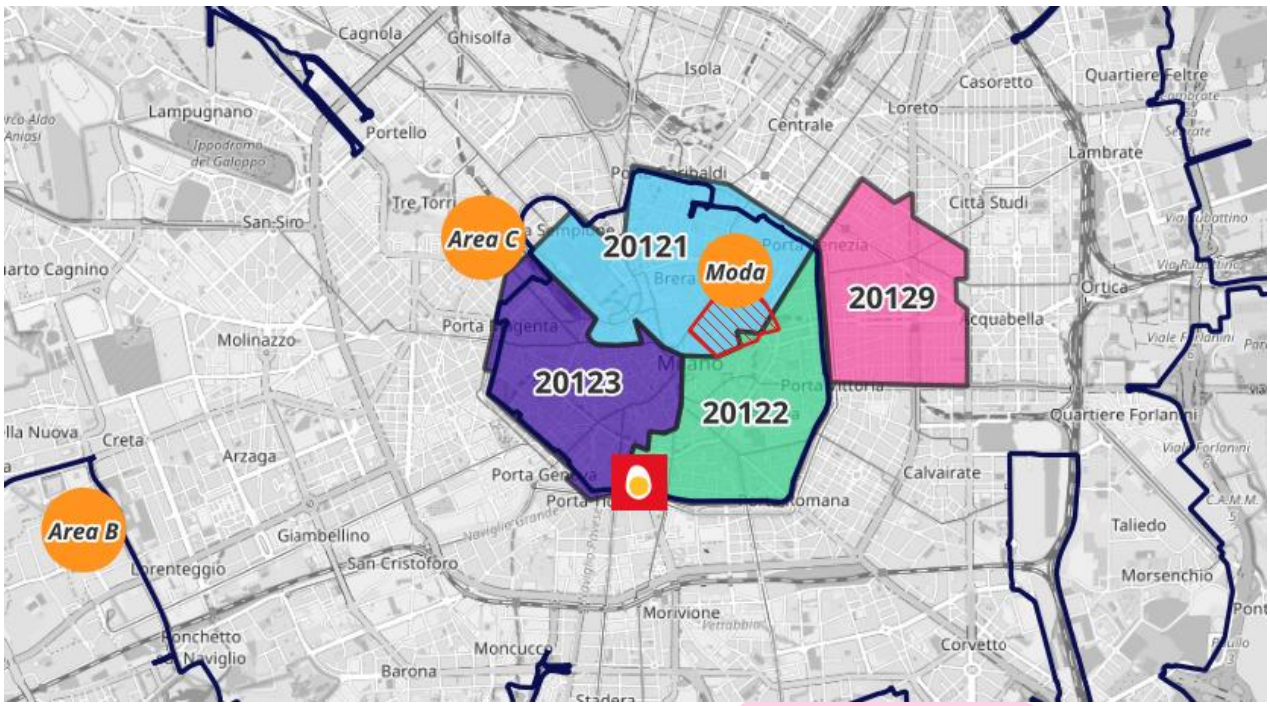
- **Chapter 1** provides an outline of the CodeZERO project, introduces the aim of the deliverable and presents the common assessment approach used across the four Living Labs.
- **Chapter 2** describes the Milan pilot, focusing on IKEA home delivery operations performed by So.De cargo bikes and on the integration of a tricycle into the existing delivery fleet.
- **Chapter 3** examines the Oslo pilot, involving Click & Collect Near You (CCNY), a mobile pick-up point service operated with electric vehicles as an alternative to home delivery.
- **Chapter 4** presents the Utrecht pilot, which tests a mobile micro-hub supported by light electric vehicles (LEVs) and an electric cargo trailer for grocery deliveries in restricted inner-city areas.
- **Chapter 5** covers the Antwerp pilot, focused on expanding and promoting out-of-home delivery options, including a denser PUDO network operated by Bpost and behavioural nudges on the TORFS retail website.
- **Chapter 6** draws cross-cutting conclusions on the main results, implementation challenges, enabling factors and lessons learned from the four Living Labs.

2 Living lab in Milan

2.1 Context, delivery and communication solutions synthesis

Milan represents a dense and complex urban logistics environment, characterised by high commercial activity, strong e-commerce demand, intense competition for curbside space and access regulations that directly influence last-mile delivery operations. The city centre and inner districts are subject to several regulatory frameworks, including Area C (congestion charge), Area B (low-emission zone) and additional Limited Traffic Zone rules in sensitive areas such as the Quadrilatero della Moda. Within this context, e-commerce accounts for a significant share of urban deliveries, while the limited availability and frequent misuse of loading/unloading bays create operational pressure for logistics operators.

Figure 1: ZIP codes invested by the pilot, So.De. hubs and access regulation perimeters



The Milan Living Lab focuses on IKEA home deliveries operated by So.De Social Delivery, comparing two cargo-cycle fleet configurations under comparable operating conditions: a standard fleet composed just by Long John type cargo bikes and a fleet composed by Long John cargo bikes and integrated with a higher-capacity boxed cargo tricycle. The pilot builds on the existing IKEA–So.De cooperation and tests whether the tricycle can improve general performances as load consolidation, reduce kilometres and working hours per delivered unit, and support more efficient use of cargo-bike capacity, including through co-loading with parcels from other So.De clients. The pilot is implemented in ZIP codes 20121, 20122, 20123 and 20129, using So.De's existing city hub in Via Calatafimi 10 and its adapted OVO management system to monitor route-level operational indicators such as travelled kilometres, parcels, stops, shipments, weight, route duration and IKEA co-loading share.

Table 4: Synthetic benchmark between two and three-wheels cargo bikes

Category	Long John (Bullitt)	Tricycle (Tricylift)
Type		
Public perception	Agile and widely used for goods transport	Bulkier and less agile, but closer to a van, making it easier for the public to picture logistics services
Weight & volume	100 kg payload, limited space, often volume constraints with bulky items	200 kg payload, 2 m³ box, optimized for bulky deliveries. Volume is usually saturated before weight
Protection	Open loading area, limited weather protection for goods and rider	Enclosed box and rider pedalling comfort (recumbent drive)
Stability & safety	2 wheels, less stable when heavily loaded	3 wheels, more balance and safety with heavy or voluminous loads
Brand visibility	Limited space for logos/visibility	Large box surface ideal for branding and visibility

The operational test is complemented by communication measures aimed at increasing the visibility and perceived value of IKEA's sustainable cargo-bike delivery option. The checkout message on IKEA's website was revised to move beyond a generic environmental claim and explicitly communicate both the lower ecological footprint of cargo-bike delivery and the dignified, protected working conditions ensured for couriers. Additional communication touchpoints include postcards delivered with parcels, QR-code access to a post-delivery survey, LinkedIn posts, So.De newsletters, landing pages and planned visibility measures linked to the branded tricycle box. These measures are designed to assess whether clearer and more credible information on environmental and social sustainability can improve consumer awareness, trust and willingness to choose or recommend the service, within the technical and corporate constraints of IKEA's online purchase journey.

2.2 Assessment of delivery options implementation

2.2.1 Delivery options assessed

The Milan Living Lab compares two operational scenarios for IKEA home deliveries operated by So.De in the same service area and under the same delivery model. The comparison is not between cargo bikes and vans, and not between two individual vehicles. It compares:

- Option A – Baseline scenario: deliveries operated only with two-wheel e-cargo bikes, including Bullitt by Larry vs Harry and Transporter by Riese & Müller.

- Option B – Pilot scenario: the same two-wheel cargo-bike fleet integrated with the boxed cargo tricycle TricyLift by FlexiModal.

The two options keep the same hub, service area, delivery eligibility criteria, customer-facing delivery conditions and co-loading approach. Co-loading is therefore not treated as a separate pilot measure, but as a common operational condition. The relevant difference is the fleet composition: Option B introduces a vehicle with higher load capacity but lower agility, potentially more suitable for heavier, bulkier or denser routes.

Interview results[12] - Operational rationale for introducing the TricyLift

The introduction of the TricyLift was mainly driven by the need to diversify So.De's fleet and increase the range of services that can be handled with cargo-cycle logistics. According to So.De, the main limitation of the two-wheel cargo bikes was not reliability or safety, but load capacity and, to a lesser extent, protection of the cargo. The TricyLift was selected because it offers higher capacity and a modular configuration: in the current pilot it is used with a closed box, but the same front structure could potentially support different boxes or modules.

The tricycle was not introduced as a replacement for Long John cargo bikes. The operational logic is to use the right vehicle for the right service. Two-wheel cargo bikes remain more suitable for lighter, faster and more agile deliveries, especially in dense central areas or routes with many small stops. The tricycle is more relevant where volume and load matter more, for example supermarket deliveries, food recovery, bulky items or routes where two or more standard cargo-bike rounds can be consolidated.

The pilot was monitored over approximately six months: Phase 1, from 19 January to 7 April, collected OVO data on standard two-wheel cargo-bike routes; Phase 2, from 8 April to 26 June, collected the same indicators after the introduction of the TricyLift, complemented by ex-post interviews with couriers.

The route-level monitoring focuses on three main dimensions: travel time, measured through actual route duration and compared with the planned schedule; transported volume, measured through

[12] On 3 July 2026, at the end of the pilot, TRT conducted four interviews at So.De's premises in Via Calatafimi to collect additional qualitative evidence on operational aspects not captured by predefined metrics. The interviews were carried out with two bicycle couriers, Louis and Muslim, the company dispatcher, Alberto, and the logistics director, Elia. The insights collected complement the quantitative assessment and support the interpretation of the results presented throughout the report.

parcels, stops, weight and distance; and load use / consolidation, measured through shipments, IKEA shipments and non-IKEA co-loading share.

The final monitoring dataset includes 320 operational routes, split into 162 routes in Scenario A and 158 routes in Scenario B. Overall, the database records approximately:

- 3,528 **km travelled**, equal to about 2.08 km per stop;
- 6,040 **kg transported**, equal to about 2.33 kg per parcel;
- 2,592 **parcels**, equal to about 1.54 parcels per shipment;
- 1,696 **stops**;
- 1,688 **shipments**;
- 1,331 **IKEA shipments**, equal to about 79% of total shipments;
- 21% non-IKEA shipments, representing the **co-loading** from other So.De clients.

On average, each observed route includes about 11.0 km, 18.9 kg, 8 parcels, 5 stops, 5.3 shipments and 4.2 IKEA shipments.

BAU vs pilot scenario: The first comparison looks at average fleet performance before and after the introduction of the TricyLift. At aggregate level, the differences between the two scenarios are limited. The mixed fleet shows almost the same average duration, a slightly higher distance, a slightly higher transported weight and stable values for parcels and stops. Non-IKEA co-loading increases marginally from 17% to 18%. This suggests that the tricycle did not significantly alter the overall fleet performance during the pilot period. The result is also affected by the short testing window, the presence of more public holidays in the second period, fewer assigned routes and limited control over demand volumes.

Table 5 Milan case: BAU vs Pilot scenario

Indicator	Option A – only long john	Option B - Mixed fleet
Duration	01:13:57	01:13:21
Length	11.07 km	11.21 km
Weight	19 kg	20 kg
Parcels	8	8
Stops	5	5
Non-IKEA co-loading	17%	18%
Routes	162	158

BAU vs specific tricycle-use case: The second comparison focuses on two specific weeks, from 13 to 26 April 2026, when the tricycle was used on higher-load routes and therefore more consistently with its capacity profile. This is useful because the mixed-fleet average does not fully capture the potential of the TricyLift: most routes in Option B were still operated with standard Long John cargo bikes, while the tricycle performs differently when assigned to routes that better match its capacity.

In this second reading, the tricycle performs differently. Route duration increases, from about 1h14 to 1h25, confirming that the three-wheel vehicle is slower and less agile than standard two-wheel cargo bikes. However, the additional time is associated with a much higher load: average weight increases from 19 kg to 34 kg, parcels from 8 to 14, and stops from 5 to 8, while distance remains almost unchanged. Non-IKEA co-loading also increases from 17% to 20%.

Table 6 Milan case: BAU vs specific tricycle-use case

Indicator	Option A – only long john	Option B - Mixed fleet in two "functional" weeks
Duration	01:13:57	01:25:17
Length	11.07 km	11.18 km
Weight	19 kg	**34 kg**
Parcels	8	**14**
Stops	5	**8**
Non-IKEA co-loading	17%	20%
Routes	162	158

The two tables show two different but complementary results. At fleet level, the introduction of one tricycle into an already optimised two-wheel cargo-bike operation produces only small changes. When the tricycle is isolated, in the period and routes where it was used more effectively, its value becomes clearer: it can carry more weight, more parcels and more stops with only a limited increase in distance, although with longer route duration. This indicates that the TricyLift should not be read as a replacement for the two-wheel fleet, but as an additional vehicle type to be assigned selectively to routes where higher capacity matters more than speed and agility.

Interview results - Interpretation of tricycle performance from the operational standpoint
The quantitative results show limited differences at fleet level, but stronger effects when the tricycle is isolated on suitable routes. This is consistent with the interviews. The dispatcher reported that the tricycle is slower and less agile than two-wheel cargo bikes, especially in the historical centre, on narrow streets, cobblestones, tram tracks and congested areas. For this reason, route planning with the tricycle requires more attention to density, load and urban context.

At the same time, both dispatcher and couriers confirm that the tricycle performs better when capacity is the main constraint. It can merge two routes, and in some cases even three, when sufficient compatible volume is available. Couriers also reported that the TricyLift makes load handling easier, especially for crates, supermarket shopping and food recovery, where the volume and weight transported are more relevant than high manoeuvrability.

2.2.2 Key KPIs driving the comparison

As presented in D3.1, the Delivery Options Assessment Framework includes 63 KPIs covering the demand, supply-context, and impact dimensions. For the Milan Living Lab, a total of 7 Attributes that differ between Delivery Option A and Delivery Option B were selected: 1 demand KPI, 1 supply-context KPI, and 5 impact KPIs. These KPIs are listed below and described in the following subsections.

The remaining KPIs do not produce variations because the pilot does not directly affect them: the service area, hub, delivery price, customer-facing service conditions, workforce arrangement, distribution network and general operating model remain unchanged. The tested change concerns the integration of a boxed cargo tricycle into the existing two-wheel cargo-bike fleet, together with the updated communication of the cargo-bike delivery option.

In addition to the quantitative assessment based on the Delivery Options Assessment Framework and OVO route-level data, the Milan pilot also includes qualitative evidence collected through semi-structured interviews with So.De's organisation manager, dispatcher and couriers. These interviews were used to interpret the KPI results, especially where numbers alone do not fully explain the operational effects of introducing the TricyLift. The qualitative input covers route planning, vehicle allocation, handling of load and volume, perceived comfort and safety, operational limits in different urban contexts, and potential conditions for scaling the mixed-fleet model.

2.2.2.1 Demand KPIs

On the demand side, only one KPI is considered directly affected by the Milan pilot. Customers do not choose between Long John bikes and the tricycle, and the delivery service conditions remain stable. The relevant change concerns the information provided to customers: before the pilot, the message mainly referred to the environmental benefit of cargo-bike deliveries; during the pilot, the communication was expanded to include the social dimension, explicitly mentioning protected and dignified working conditions for cycle couriers.

Table 7: Demand side KPIs applicable to the Milan Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*[13]	*Direction*[14]	*Delivery option A (base)*	*Delivery option B (pilot)*
Information	**Impact of purchase** [15]	**Impact information index:** **- No information: 0** **- Information on CO2 emissions: 1** **- Information on working conditions of drivers and warehouse workers: 2** **- Information on CO2 emissions AND working conditions of drivers and warehouse workers: 3**	**Ad.**	↑	1	3

[13] **Measurement unit***: Unit used to express the KPI value; "Adimensional" indicates an index or score without a physical unit.

[14] **Direction***: Indicates whether a higher value (↑ **Upwards**) or a lower value (↓ **Downwards**) represents better performance for the KPI within the assessment framework.

[15] Detail on social impacts of deliveries (e.g., emissions, working conditions of delivery personnel, etc.)

This KPI is therefore applicable because the pilot modifies the content of information made available to consumers, not the delivery choice architecture itself. The change is relevant from an assessment perspective because the Milan pilot combines both environmental performance with social sustainability, which is one of the specific features of the So.De delivery model, but before the pilot, this aspect was not mentioned in the IKEA check out message.

Obviously, the KPI and its results, should be interpreted cautiously. Over a three-month test period, it is not possible to robustly quantify whether a “more complete” message produces a measurable improvement in consumer behaviour. The KPI captures a real change in the information provided, but not necessarily a statistically demonstrable behavioural effect within the timeframe of the pilot.

2.2.2.2 Supply - context KPIs

On the supply-context side, the relevant KPI concerns the number of vehicles required to complete a given delivery volume in a defined urban area. In the Milan case, this KPI changes because the introduction of the TricyLift modifies the operational capacity of the fleet: the pilot does not add a separate service but integrates a higher-capacity vehicle into the existing cargo-bike operation. The assessment therefore focuses on whether the mixed fleet can complete comparable delivery volumes with fewer vehicle resources or with a more efficient allocation of routes.

Table 8: Supply - context KPIs applicable to the Milan Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Delivery option A (base)*	*Delivery option B (pilot)*
Size and composition of the vehicle fleet	**Delivery vehicles - Total vehicles**	**Number of vehicles required to complete N (e.g.10k) deliveries per week in an area of X (e.g.180) square km**	**N° of vehicles**	**↓**	**5,3**	**5,1**

In the baseline configuration, the service relies on the existing two-wheel e-cargo-bike fleet, composed mainly of Bullitt by Larry vs Harry and Transporter by Riese & Müller vehicles. This fleet includes around 12 cargo bikes, with typically 9–12 vehicles used in daily operations. In the pilot configuration, the fleet is integrated with one boxed cargo tricycle, the TricyLift by FlexiModal.

The KPI is considered improved because the tricycle increases the carrying capacity available within the fleet and can reduce the number of vehicles needed to complete a comparable number of deliveries in the target area. This does not mean that the tricycle replaces the whole fleet, but that it allows the operator to assign some higher-load routes to a vehicle better suited to them.

2.2.2.3 Impacts KPIs

The impact KPIs are the core of the Milan comparison, since they capture the operational effects of moving from a two-wheel cargo-bike fleet to a mixed fleet including the TricyLift. The selected indicators focus on load utilisation, distance travelled, consolidation, delivery time and congestion. These KPIs are assessed using the operational logic of the framework and the route-level information collected through OVO, complemented where needed by literature-based assumptions for road occupancy.

Table 9: Impact side KPIs applicable to the Milan Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Values for Delivery option A (base)*	*Values for Delivery option B (pilot)*
Service efficiency	Vehicles load factor	Share of vehicles used for delivery departing from warehouses with a load factor equal or above 75% of the carrying capacity	%	↑	80%	70%
Service efficiency	Distance travelled	Travelled distance to complete D deliveries (1000) in an area of X (30) square km Distance = ∑(i) DistVi where - DistVi: Distance travelled by vehicle type i to complete Di (200) deliveries in an area of X (30) square km and - D= ∑(i) Di	km	↓	2,1	2,2
Service efficiency	Shipments consolidation	Average deliveries per tour AvDel= ∑(i) AvDelVi where - AvDelVi: Average deliveries per tour per type i vehicle	Number / tour	↑	5,2	5,3
Service efficiency	Total delivery time	Time needed to complete D deliveries in an area of X square km by all types of vehicles. T = ∑(i) Ti where - Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km and - D= ∑(i) Di	Hours	↓	1,16	1,75
Transport impacts	Congestion	Index obtained as combination of: - the time needed for delivering products by each vehicle type - the road occupancy of each vehicle type. I = ∑(i) Ti*OccVi where: - Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km - OccVi: road occupancy of vehicle type i under the condition that - D= ∑(i) Di	hours *sqm	↓	10	25

The vehicles load factor is defined as the share of vehicles used for delivery departing from warehouses with a load factor equal to or above 75% of carrying capacity. In the Milan pilot, this indicator is relatively weaker in the mixed-fleet scenario because the tricycle has higher capacity and is therefore harder to saturate consistently. This is not necessarily a negative operational result in absolute terms, but it indicates that the benefits of the tricycle depend strongly on route assignment and on the availability of sufficient consolidated volume.

Distance travelled is measured as the total kilometres needed to complete a given delivery volume within the target area, using real route data from OVO. This KPI captures whether the mixed fleet allows the same delivery demand to be served with fewer or more kilometres. It is therefore central to understanding whether the higher-capacity vehicle contributes to route rationalisation.
Shipments consolidation is measured as the average number of deliveries per tour. In the Milan pilot, this indicator improves with the introduction of the tricycle, since the vehicle allows more deliveries to be grouped within the same tour when used on suitable routes. This is one of the clearest operational advantages of the mixed-fleet configuration.

Total delivery time is defined as the total time needed to complete a given delivery volume in the target area. This indicator worsens in the pilot scenario because the tricycle is slower than the two-wheel cargo bikes. The result is consistent with the vehicle characteristics: the tricycle offers higher capacity and better consolidation potential, but at the cost of lower speed and longer route duration.

Finally, congestion is assessed through an index combining delivery time and road occupancy by vehicle type. For Milan, this indicator is interpreted using literature-based road occupancy parameters applied to the local context. Even when the tricycle increases delivery time, both two-wheel cargo bikes and the mixed cargo-bike fleet remain much less space-consuming than vans: considering the full congestion formula, cargo-bike solutions are estimated to be around ten times less impacting than van-based delivery in terms of road occupancy and contribution to urban congestion.

2.2.3 Stakeholder-weighted assessment results

2.2.3.1 Consumers perspective

From the consumers' perspective, the main change between Delivery Option A and Delivery Option B is concentrated in the Information attribute, which increases from 27.43 to 70.96. This reflects the update of the IKEA checkout message: while the baseline communication mainly referred to the environmental benefit of cargo-bike delivery, the pilot message also introduced the social dimension of the service, referring to protected and dignified working conditions for cycle couriers. All other demand-side attributes remain unchanged, as the pilot did not modify the delivery price, the delivery promise, the visible delivery method, the level of flexibility offered to customers or the expected reliability of the service. As a result, the cumulative demand-side score increases substantially, from 74.03 to 117.56, and the improvement is almost entirely driven by the information component. This quantitative enhancement in communication is further supported by the results of the second assessment: specifically, the stronger information strategy positively reflected on consumer awareness and engagement, as demonstrated by KPI 1 (% consumers who recall the message) that represent the high recognition of the cargo-bike service visibility, KPI 8 (% consumers with a favourable attitude towards cargo bike delivery), that is referred to favourable attitudes supported by willingness to accept trade-offs, KPI 13 (% consumers who intend to choose cargo bike delivery for a future purchase despite trade-offs, and KPI 15 (average ranking of sustainability as a goal influencing delivery choice) where environmental and social sustainability emerged among the core drivers for recommending the service.

However, this result should be interpreted as a clear improvement in the way the delivery option is presented to consumers, rather than as direct evidence of a measured behavioural change in actual purchasing acts. In the Milan pilot, customers do not choose between two-wheel cargo bikes and the tricycle, nor are they exposed to different operational configurations. They are exposed to a more complete explanation of what the sustainable delivery option represents. The potential improvement could be even larger if the checkout environment allowed a more complete

explanation of the IKEA–So.De model. However, due to constraints linked to IKEA's purchase journey, the message could not move too far from the final purchasing step or tell the full story of the service. At equal delivery cost, especially for non-essential purchases such as IKEA products, a better-informed customer would often only face the "cost" of potentially waiting one or two additional days. The pilot therefore improves the information layer but also shows that there is still room to make the value proposition clearer.

Public impacts for consumers remain substantially stable. Environmental impacts are unchanged at 42.2 in both options because both scenarios are based on electric cargo-bike operations and do not introduce a different direct emission profile. Labour impacts also remain unchanged at 21.8, since the pilot does not modify So.De's employment model or contractual conditions. The only variation concerns Transport impacts, which slightly decrease from 9.2 to 9.0, producing a small reduction in the cumulative public impact score from 64.53 to 64.24. This is linked to the fact that the tricycle is larger and slower than two-wheel cargo bikes, slightly worsening the transport-impact index. The magnitude of the change is limited and should be read within the cargo-bike family of solutions, which remains far less space-consuming than van-based delivery.

Table 10: Demand side attributes – Milan

Attribute type	Result Delivery Option A	Result Delivery Option B
Cost	3,16[16]	3,16
Flexibility	6,85	6,85
Delivery time	14,33	14,33
Delivery method	8,99	8,99
Information	27,43	70,96
Reliability	13,27	13,27
Cumulative	74,03	117,56

Table 11: Public Impacts for Consumers - Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	42,2	42,2
Transport impacts	9,2	9,0
Labour impacts	21,8	21,8
Cumulative	64,53	64,24

[16] **Note**: All tables' values are dimensionless composite scores calculated through the Excel-based CodeZERO Assessment Framework. Higher values indicate more favourable performance for the stakeholder and dimension concerned. Scores should be compared between delivery options within the same row and table. See D3.1 for the full methodology.

2.2.3.2 Retailers perspective

From the retailers' perspective, the supply-side attributes are almost unchanged, with a marginal improvement in Size and composition of the vehicle fleet, from 4.68 to 4.82. This is consistent with the nature of the pilot: Option B does not redesign the service organisation, the monitoring system, the workforce arrangement or the distribution network, but adds one higher-capacity vehicle to the existing cargo-bike fleet. The cumulative supply-side score therefore increases only slightly, from 96.5 to 96.6. The result confirms that, for the retailer, the pilot does not represent a structural change in the delivery service offered to customers, but a targeted operational refinement of the fleet used by the logistics partner.

The Spatial arrangement attribute remains unchanged at 15.49, as the pilot does not modify the geographical area served, the hub location, the access conditions or the urban context in which deliveries take place. This stability is important for the assessment because it confirms that the variation between Option A and Option B can be attributed to the change in fleet composition, rather than to differences in service area, regulation or distribution network.

Table 12: Supply side attributes – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Service organisation	33,7	33,7
Impact monitoring system	8,66	8,66
Size and composition of the vehicle fleet	4,68	4,82
Workforce arrangement	13,52	13,52
Distribution network	35,92	35,92
Cumulative	96,5	96,6

Table 13: Context attributes – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Spatial arrangement	15,49	15,49

Private impacts for e-tailers show a slight decrease in Service efficiency, from 53.6 to 50.9. This result reflects the operational trade-off introduced by the TricyLift: the vehicle increases load capacity and creates opportunities for better consolidation, but it is less agile and generally slower than two-wheel cargo bikes. The decrease should not be interpreted as the failure of the tricycle as a vehicle type. The baseline operation is the result of more than five years of progressive optimisation around Long John cargo bikes, while the tricycle was introduced and tested over a much shorter period. The result therefore indicates that the mixed-fleet model was not yet able to fully exploit the potential of the new vehicle within the available testing period.

Public impacts for e-tailers remain almost unchanged. Environmental impacts stay at 38.8 and labour impacts at 12.0, since both options rely on the same low-emission delivery model and the same So.De labour framework. Transport impacts decrease slightly from 15.0 to 14.5, bringing cumulative public impacts from 65.8 to 65.3. This small reduction reflects the same trade-off

observed in the operational indicators: the tricycle can carry more, but its lower agility and higher road occupancy slightly affect the transport component. The variation remains limited and must be understood in the context of an assessment tool designed to compare a broad range of delivery options, including conventional van-based models, lockers, PUDO networks and other distribution formats. Within that wider comparison space, both Milan options remain low-impact cargo-cycle solutions.

Table 14: Private Impacts for e-tailers – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Service efficiency	**53,6**	**50,9**

Table 15: Public Impacts for e-tailers – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**38,8**	**38,8**
Transport impacts	**15,0**	**14,5**
Labour impacts	**12,0**	**12,0**
Cumulate public impacts	**65,8**	**65,3**

2.2.3.3 Transport operators perspective

From the transport operators' perspective, the supply-side results follow the same pattern observed for retailers. The only attribute that changes in size and composition of the vehicle fleet, increasing from 3.25 to 3.35, while service organisation, monitoring system, workforce arrangement and distribution network remain stable. The cumulative supply-side score increases marginally from 95.4 to 95.5. This small improvement reflects the fact that the TricyLift expands the range of vehicle configurations available to So.De and creates an additional option for assigning routes according to load, volume and delivery density.

The context attribute Spatial arrangement remains unchanged at 10.91, as the pilot does not alter the operating geography, the urban constraints or the access conditions faced by the operator. This confirms that the comparison is not affected by changes in the city context, but by the introduction of a different vehicle type within the same operational environment.

Table 16: Supply side attributes – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Service organisation	28,9	28,9
Impact monitoring system	8,87	8,87
Size and composition of the vehicle fleet	3,25	3,35
Workforce arrangement	14,83	14,83
Distribution network	39,50	39,50
Cumulative	95,4	95,5

Table 17: Context attributes – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Spatial arrangement	10,91	10,91

Private impacts for logistics operators show a decrease in Service efficiency, from 55.5 to 52.6. This is the most relevant result for the operator perspective. Option B introduces a clear trade-off: the tricycle offers higher load capacity and stronger consolidation opportunities, but also lower agility, longer route duration and more difficult capacity saturation when demand is not sufficient or routes are not specifically designed around the vehicle. The result does not invalidate the mixed-fleet approach; rather, it suggests that the tricycle delivers its value only when assigned to suitable routes. In other So.De services outside the IKEA collaboration and therefore outside the CodeZERO assessment perimeter, the same type of vehicle has performed particularly well for food deliveries, supermarket shopping and bulky-item collection, where one tricycle can replace multiple standard Long John operations.

Public impacts for logistics operators also remain largely stable. Environmental impacts are unchanged at 44.4, and labour impacts remain at 10.9. Transport impacts decrease slightly from 15.6 to 15.1, reducing cumulative public impacts from 71.0 to 70.5. The slight worsening is linked to the tricycle's lower speed and higher road occupancy compared with two-wheel cargo bikes. However, the effect remains marginal compared with the externalities usually associated with van-based last-mile delivery. The operational conclusion is therefore not that Option B is systematically better than Option A, but that it introduces additional capacity and flexibility that require further route adaptation to be fully exploited.

Interview results - Labour and usability aspects not fully captured by the current KPIs

The assessment framework keeps labour impacts unchanged because the pilot does not modify So.De's employment model, contracts or formal workforce arrangement. However, the interviews show that vehicle design may still influence working conditions in ways that are not fully captured by the current KPI structure. Couriers highlighted the tricycle's stability, especially in rain and when crossing tram tracks, and appreciated the recumbent riding position. These aspects may be relevant for future, more detailed labour-related indicators.

The interviews also point to possible improvements: weather protection, better mirrors, a horn, and possibly suspension, since the vehicle can be rigid on uneven roads. These elements do not change the current labour-impact score, but they matter for operational acceptance and future scale-up.

Table 18: Private impacts for logistics operators – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Service efficiency	**55,5**	**52,6**

Table 19: Public impacts for logistics operators – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**44,4**	**44,4**
Transport impacts	**15,6**	**15,1**
Labour impacts	**10,9**	**10,9**
Cumulate public impacts	**71,0**	**70,5**

2.2.3.4 Local authorities perspective

From the local authorities' perspective, the assessment focuses on public impacts. Environmental impacts remain unchanged at 44.8, since both options are based on electric cargo-bike delivery and do not alter the direct emission profile of the service. Labour impacts also remain unchanged at 17.2, as the pilot does not modify So.De's employment conditions or organisational arrangements. As a non-measured element, however, the introduction of a recumbent cargo tricycle could be relevant for future labour-related KPIs: a more stable and ergonomic vehicle may improve working conditions, especially for less experienced couriers, and future configurations could include covers or weather protection. This would also be consistent with the direction taken by larger logistics players, increasingly interested in tricycles, quadricycles and other professional light-electric delivery vehicles.

The only variation concerns Transport impacts, which decrease from 13.4 to 13.0, bringing cumulative public impacts from 75.5 to 75.1. This slight worsening reflects the larger footprint and lower speed of the tricycle compared with two-wheel cargo bikes. From a city perspective, however, the scale of this effect is very limited. The comparison takes place within the cargo-bike segment, not between cargo bikes and vans. Even the mixed fleet remains far less space-consuming and less intrusive than conventional van-based delivery, with a substantially lower contribution to congestion and curbside pressure.

For local authorities, the main result is therefore one of continuity rather than disruption. Option B does not reduce the environmental or social value of the Milan cargo-bike delivery model. It introduces a small transport-efficiency trade-off, but within a vehicle category that remains compatible with dense urban areas, access-restricted zones and policies aimed at reducing the negative externalities of last-mile logistics. The pilot suggests that three-wheel cargo cycles can be part of the urban logistics toolkit, provided that their use is targeted to routes and services where higher load capacity outweighs lower agility, such as dense residential areas in peripheral and

semi-central districts, grocery deliveries, food recovery operations, and routes involving bulky goods. Conversely, they appear less suited to narrow and highly congested central streets, areas with intense pedestrian activity, or routes requiring frequent manoeuvring and rapid stop-and-go operations.

Table 20: Public Impacts public authorities – Milan

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**44,8**	**44,8**
Transport impacts	**13,4**	**13,0**
Labour impacts	**17,2**	**17,2**
Cumulate public impacts	**75,5**	**75,1**

2.2.4 Overall performance and level of success

Overall, Option B shows a moderately positive performance, mainly as a complementary solution to the existing two-wheel cargo-bike fleet. The pilot does not change the service model, hub, pricing, workforce arrangement or delivery conditions; it only introduces the TricyLift into the fleet and improves the information provided to customers through the revised checkout message.

The clearest improvement concerns the consumer perspective, where the demand-side cumulative score increases from 74.03 to 117.56, driven by the Information attribute. This reflects the updated IKEA checkout message, which adds the social value of the service — protected and dignified working conditions for couriers — to the previous environmental message.

Operationally, the results are more mixed. At fleet level, the introduction of the tricycle produces limited changes: average duration, distance, parcels and stops remain close to the baseline. However, when the tricycle is observed in the two weeks where it was assigned to higher-load routes, its role is clearer: it carries more weight, more parcels and more stops, with only a limited increase in distance and a longer route duration. This confirms that the TricyLift is not a general substitute for Long John bikes, but a vehicle to be used selectively when capacity and consolidation matter more than speed and agility.

Public impacts remain broadly stable. Environmental and labour scores do not change because both options rely on the same electric cargo-bike operation and the same So.De employment model. Transport impacts slightly worsen due to the tricycle's lower agility and larger footprint compared with two-wheel cargo bikes, but the scale of this effect remains limited within a cargo-bike-based system.

The level of success is therefore positive but conditional. The tricycle adds useful operational flexibility, especially for heavier or denser routes, but requires appropriate route assignment, sufficient volumes and operational learning. The quantitative results provide useful evidence, but they should be read together with the qualitative feedback from So.De: operational decisions depend on actual service needs, vehicle characteristics, route density, urban context and the balance between demand, supply and impacts.

2.3 Impact on consumer behaviour and attractiveness of zero-emission delivery and return options

2.3.1 Description of the communication interventions

During the pilot, several communication initiatives were implemented to increase the visibility of the cargo bike delivery service and strengthen customer awareness of its value proposition.

Two LinkedIn posts were published, by IKEA's official company profile, as part of the communication campaign. The first, released on 19 January, announced the launch of the pilot project and highlighted the partnership between IKEA, So.De and AMAT. The second, published on 26 April, focused on the introduction of the cargo tricycle as an additional delivery solution within the pilot.

In parallel, the message displayed during the IKEA online checkout process was revised. The updated wording not only emphasised the environmental benefits of cargo bike deliveries but also highlighted the social value of the initiative, underlining the dignified and protected working conditions provided to couriers involved in the service.

A further communication measure consisted of the distribution of redesigned postcards included with customer orders. The postcards featured a dedicated call to action on the reverse side, inviting customers to complete a survey aimed at assessing service visibility, awareness and perceptions. The survey findings are presented in greater detail in Section 2.3.1.3.

Several of these measures, including the revision of the checkout message and the redesign and redistribution of the postcards, originated from the insights and recommendations generated during the stakeholder workshop held at So.De's hub in Milan on 9 April 2025. Other suggestions collected from consumers, such as the inclusion of a cargo bike visual within the checkout interface, or the choice of the cargo bike delivery option as the pre-selected/default option were assessed but ultimately not implemented due to compliance requirements with IKEA's global communication guidelines, corporate policies and general availability of such delivery option in other locations beyond Milan.

2.3.1.1 Strategy and resources

The communication strategy developed for the pilot was underpinned by three pillars, in line with the principles set out in the Communication Guidelines presented in D4.3. Each pillar addressed a specific objective while contributing to the overall visibility and assessment of the pilot:

- Promotion of the pilot through LinkedIn, aimed at raising awareness among both internal and external stakeholders about the initiative and the broader sustainability agenda behind it. This aligns with G1 "Be open, clear and specific in your messaging", by communicating the partnership and the promotion transparently, G3 "Make verifiable claims" through factual reporting of the collaborative project milestones, in line with the goal of ensuring clear and credible communication; and G16 "Align communication across channels and consumer journey / supply chain" by keeping corporate channels consistent and supporting sustainability messaging.
- Modification of the checkout message, with the objective of increasing customer awareness regarding their delivery method selection and encouraging more informed purchasing decisions at the point of sale without altering the sales funnel. This directly applies G7 "Encourage reflection on delivery choice", to prompt mindful decision-making at checkout,

G2 “Explain new cues simply and clearly” to ensure the new service details are easily grasped, and G12 “Cover all dimensions of sustainability” by giving equal weight to both environment impacts and social aspects involved.

- Distribution of postcards and data collection through a customer survey, intended to gather attitudinal and behavioral insights from consumers, providing valuable feedback on the perception and effectiveness of the pilot. The call-to-action message printed on the postcards supports G4 “Layer sustainability information” and G11 “Show the real-world impact of choices” by detailing the tangible social and environmental benefits delivered by So.De with message that matters, while providing a rewarding and engaging touchpoint in line with G18 “Give consumers positive sustainable choice experience”.

Figure 2: Postcards improved with call-to-action “100% Sustainable and Supportive” and related message.



The call-to-action, on the postcards distributed, reports the following message:

> *“The IKEA parcel you received was delivered by So.De – Social Delivery, the first ethical and sustainable delivery service in the city of Milan. A home delivery system that guarantees dignified and protected working conditions for its bicycle couriers and that, thanks to the exclusive use of bikes and cargo bikes, minimises environmental impact. So.De and IKEA Italy are participating in CodeZERO, a project promoted by the European Commission to explore and develop innovative, sustainable, zero emission solutions for last mile delivery in online shopping. Would you like to contribute to our research? Scan the QR code and complete the survey. You’ll help us make a difference in building zero impact deliveries!”*

As it is often the case in large and complex organisations, one of the key challenges of the project was successfully implementing the initiative while fully complying with internal policies, governance processes, and corporate guidelines. For this reason, the project required close collaboration among a broad range of stakeholders, each contributing their expertise and playing a critical role in the execution process.

Among the primary stakeholders involved, for what regard the final approval of the proposed measures, there were the IKEA Italy Responsible Sourcing Leader, acting as the business partner

and service contractor, Service Fulfilment Operations, responsible for implementing the operational changes required to support the pilot, and Service Experience, which oversees all customer-facing communications and ensures consistency throughout the customer journey. In addition, the Web Editors were engaged to implement the required modifications across the website and digital touchpoints.

To support the communication and engagement activities, colleagues from Communication Operations were involved in defining the call-to-action strategy as well as developing the LinkedIn communication plan. At the same time, the creative team was responsible for the design and production of the postcards distributed to customers. Their contribution was essential in ensuring that all communication materials reflected the company's established tone of voice, a key element of the brand's identity and a fundamental aspect of maintaining consistency across all channels.

Throughout the entire project, the Legal Department played a pivotal oversight role, reviewing and validating the various stages of the initiative to ensure compliance with regulatory requirements and internal standards. From customer communications to survey implementation and data collection activities, legal guidance was instrumental in mitigating risks and enabling a smooth rollout.

Ultimately, the pilot represented a highly cross-functional effort, demonstrating that the successful implementation of innovative initiatives within a large organisation depends not only on the strength of the concept itself, but also on the ability to effectively align stakeholders, navigate governance processes, and coordinate diverse capabilities toward a common objective.

2.3.1.2 Activities, efficacy of execution and outputs

In Section 2.3 of Deliverable D5.1, the social media communication activities launched on 19 January have already been described in detail. To avoid repetition, this section focuses on the communication actions implemented during the subsequent phases of the pilot.

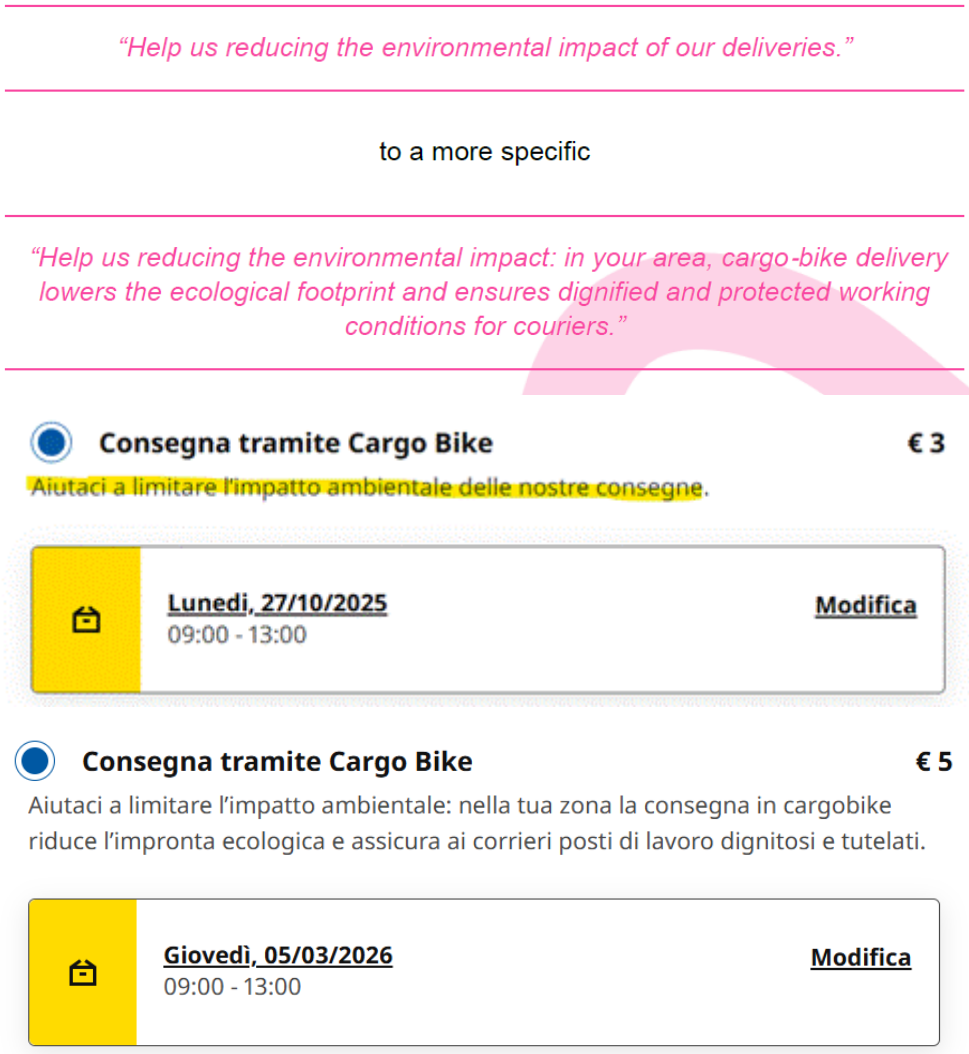
First, regarding social media communication, as shown in the LinkedIn post published in April 2025, communication efforts shifted towards highlighting the acquisition and operational deployment of the new cargo tricycle, showcasing the evolution and scaling of the delivery service throughout the pilot period. The posts aimed to increase visibility of the initiative and raise awareness among stakeholders and the wider public regarding the environmental and operational benefits of cargo bike deliveries.

Figure 3 Example of LinkedIn post



In parallel with these social media activities, regarding the customer purchasing journey, the revision of the checkout message did not alter the purchasing process itself, in order to avoid changes in the sales funnel. The customer experience remained unchanged, with no additional steps required to select or complete the delivery service. Furthermore, there was no price differentiation between delivery options within the target parcel category (below 10 kg), meaning that cost was not a decision factor for customers. The main objective of this intervention was therefore to increase consumer awareness and encourage more informed delivery choices by highlighting the environmental and social benefits associated with the service.

Figure 4 Screenshot of the revised IKEA check out message



Finally, the postcard distribution and survey campaign complemented the previous communication activities by actively seeking customer feedback. Unlike the LinkedIn posts and the revised checkout message, this intervention generated tangible and measurable outputs. The number of postcards produced was based on IKEA's mid-term delivery forecast, which is updated four times per year and includes both annual and monthly delivery projections by service type. Based on these estimates, and applying a prudent upward rounding, a total of 5,000 postcards were produced.

During the target period, 4,361 cargo bike deliveries were completed. A postcard was included with every order delivered during this period. Nevertheless, drivers frequently reported difficulties in handing the postcard directly to customers and encouraging survey participation. As the pilot area was primarily located in central Milan, deliveries were often completed through building concierges rather than directly with end customers, significantly reducing opportunities for personal interaction and direct engagement.

The final results showed 44 QR code accesses and 28 completed surveys. This indicates that slightly more than 1% of customers interacted with the survey link, while approximately 64% of those who accessed the QR code subsequently completed the survey.

While the survey completion rate among respondents can be considered positive, the overall participation rate highlights some limitations of postcard-based data collection methods, particularly when direct customer interaction is limited. The results suggest that the effectiveness of this approach is strongly influenced by the presence of a human touchpoint capable of explaining the initiative and motivating participation. In contexts where such interaction is lacking, customer engagement and contribution rates may be significantly reduced despite the relevance of the initiative itself.

2.3.2 Experimental design

The monitoring and evaluation approach for the checkout communication intervention relied on a post-delivery survey (see Appendix 2) aimed at assessing: (i) the overall visibility of the cargo bike delivery option; (ii) customers' trust in the information provided; and (iii) the importance attributed to the environmental and social benefits associated with this delivery solution.

As described in detail in Section 2.3.2 *Approach to Monitoring and Evaluation* of Deliverable D5.1, the communication material distributed with deliveries emphasized two key value propositions: the reduced environmental impact resulting from the exclusive use of bicycles and cargo bikes for last-mile deliveries, and the provision of fair and protected working conditions for bicycle couriers. Visual elements, including bicycle iconography and the IKEA and CodeZERO logos, were intended to enhance credibility, recognition, and message recall. A concise call-to-action (“Scan the QR code and complete the survey”) directed customers to an online questionnaire, while the QR code enabled the tracking of participation generated by this offline communication channel.

As mentioned, the survey was sent to all customers who received an IKEA delivery by cargo bike in Milan. The questionnaire included questions on awareness of the service, perceptions of its environmental and social benefits, willingness to recommend it, and preferences regarding delivery cost and waiting times.

A key segmentation variable was provided by the first survey question, which asked respondents whether they had previously used IKEA’s cargo bike delivery service. This segmentation was selected because previous experience with the service was expected to be a major factor influencing awareness, perceptions, acceptance and willingness to choose cargo bike delivery. By comparing repeat users with first-time users, it was possible to assess whether direct exposure to the service is associated with more favourable attitudes and greater acceptance.

Based on this answer, respondents were divided into two groups:

- **A:** consumers who had previously used IKEA's cargo bike delivery service (40%);
- **B:** consumers who had never used the service before (60%).

As already mentioned, the pilot generated a relatively limited number of survey responses. Out of more than 4,000 information cards distributed with cargo bike deliveries, 44 customers accessed the survey through the QR code and 28 completed the questionnaire, corresponding to a completion rate of 64% among those who opened the survey and an overall response rate below 1% of the total number of cards distributed. Given the small sample size, results should be considered exploratory and indicative rather than statistically representative. In addition, the survey relied on voluntary participation and therefore may be affected by self-selection bias, as customers with a stronger interest in sustainability-related topics may have been more inclined to participate. Consequently, the findings should be interpreted as indicative of consumer perceptions rather than representative of the entire population of cargo bike delivery users.

Despite the limited sample, the survey provides useful insights into customer perceptions. Awareness of the service appears reasonably high, with 40% of respondents reporting prior use of cargo bike delivery and 60% considering the visibility of the option on the IKEA website to be adequate. More than half of respondents (55%) indicated that they had first learned about the service through the IKEA e-commerce website. These findings suggest that the visibility of the service on the IKEA website is generally perceived as satisfactory by respondents. While the small sample size prevents drawing firm conclusions, the results do not provide strong evidence that lack of visibility constitutes a major barrier to the adoption of cargo bike delivery.

Environmental sustainability emerged as the primary reason for recommending the service (44%), followed by social sustainability (37%). Economic convenience (15%) and convenience or comfort (4%) were mentioned less frequently. The relatively low importance attributed to the economic aspect is certainly linked to the fact that cargo bike deliveries have the same cost as traditional deliveries. Therefore, there is no real economic advantage. This result should rather be interpreted as indicating that the benefit of this option lies in the fact that it is not economically disadvantageous, while offering greater environmental and social sustainability.

To explore potential strategies for increasing the visibility of the cargo bike delivery option, respondents were asked which measures they considered most effective. Responses were relatively evenly distributed among the use of bicycle, environmental, and social responsibility icons. Conversely, no clear preference emerged for either setting cargo bike delivery as the default option or explicitly presenting it as “Suggested by IKEA”.

To better understand consumers’ willingness to choose cargo bike delivery, a set of conditional questions was included in the survey. The results provide further insights into the behavioural trade-offs consumers are willing to make between delivery cost and waiting time. More specifically, these questions were designed to assess how respondents balance delivery cost and delivery speed against the environmental and social benefits associated with cargo bike logistics.

. When cargo bike delivery was offered at the same price as conventional delivery, only 7% of respondents were unwilling to accept any additional waiting time. Most respondents indicated a willingness to wait between one and five additional days, with preferences concentrated around one to three days. When cargo bike delivery was presented as a lower-cost option, willingness to accept longer waiting times increased further, with 64% of respondents indicating acceptance of delays between three and five days. Conversely, when delivery times were equal, 52% of respondents stated that they would not pay a premium for cargo bike delivery, while 40% would accept a surcharge of up to 20% and 7% a surcharge of up to 50%. Finally, when cargo bike delivery was more expensive than conventional delivery, 37% of respondents were unwilling to accept any additional waiting time, whereas 26% would accept one extra day, 26% two extra days, and 11% three extra days.

Overall, although the low response rate limits the statistical robustness of the findings, the survey provides preliminary evidence that customers recognize and value the environmental and social benefits of cargo bike deliveries and may be willing to accept moderate trade-offs in delivery time and cost to support more sustainable last-mile logistics solutions.

2.3.3 KPIs

The distribution of postcards and the collection of data through a customer survey were intended to gather attitudinal and behavioral insights from consumers, providing valuable feedback on the perception and effectiveness of the pilot. Particular attention was given to the differences between customers who had previously used IKEA's cargo bike delivery service and therefore consciously chose it again, and those who were experiencing this delivery option for the first time. The comparison between users and non-users was included to assess whether familiarity with the service influences awareness, perceptions, and behavioural intentions. Since one of the objectives of the communication measures was to increase awareness and acceptance of cargo bike delivery, differences between the two groups can provide indications of the extent to which greater exposure to the service is associated with more favourable attitudes and adoption intentions.

The same survey responses were subsequently used to calculate a set of Key Performance Indicators (KPIs) defined within the evaluation framework developed in Deliverable D3.2. These indicators were selected to measure message recall, attitudes towards cargo bike delivery, future behavioural intentions, and the relative importance of sustainability considerations in delivery choices.

Specifically:

- **KPI 1 (% consumers who recall the message)** was measured based on respondents' recognition of the visibility of the cargo bike delivery service on the IKEA e-commerce platform.
- **KPI 8 (% consumers with a favourable attitude towards cargo bike delivery)** was calculated by identifying respondents who expressed willingness to accept at least one trade-off in support of the service, either a higher delivery cost at equal delivery time or a longer delivery time at equal delivery cost.
- **KPI 13 (% consumers who intend to choose cargo bike delivery for a future purchase)** was derived using a more stringent criterion than a simple intention-to-reuse measure. Rather than capturing only respondents' willingness to use the service again, it reflects their willingness to choose cargo bike delivery even when faced with potential trade-offs, such as higher delivery costs and longer delivery times compared with conventional delivery alternatives.
- **KPI 15 (average ranking of sustainability as a goal influencing delivery choice)** was derived from respondents' answers regarding the main reasons for which they would recommend cargo bike delivery to a friend, distinguishing between environmental sustainability, social sustainability, cost, and convenience considerations.

Table 21: KPIs list with associated data

KPI number	KPI	Data source	KPI values for consumers A[17]	KPI values for consumers B[18]	Dimension addressed
1	% consumers who recall the message	Self-reported	Yes 72% No 28%	Yes 50% No 50%	Retention of message
8	% consumers with favourable attitude towards cargo bike	Self-reported	Yes 91% No 9%	Yes 94% No 6%	Attitude to target delivery/return option
13	% consumers who intend to choose cargo bike for next purchase	Self-reported	Yes 64% No 36%	Yes 64% No 36%	Intention to choose target delivery option next time
15	Average ranking of sustainability as goal influencing choice of delivery option, relative to cost, convenience, speed and safety	Self-reported	Environment 54,5% Social 27,3% Cost 9,1% Convenience 9,1%	Environment 37,5% Social 43,8% Cost 18,8% Convenience 0%	Ranking of sustainability among other goals

The KPI results show a coherent pattern across all dimensions analysed, with high levels of message retention, positive attitudes, and consumer willingness. The consistency of these findings across both respondent groups strengthens the overall indication of consumer acceptance of cargo bike delivery solutions.

2.3.4 Assessment summary

The survey results highlight some interesting differences between customers who had previously used IKEA's cargo bike delivery service (Consumers A) and those experiencing it for the first time (Consumers B).

Message recall was higher among returning users, with 72% of Consumers A remembering the communication message compared to 50% of Consumers B. This suggests that previous exposure to the service may increase attention to and retention of promotional information.

Attitudes towards cargo bike delivery were highly positive in both groups. Consumers were considered to have a favourable attitude towards cargo bike delivery if they were willing either to pay a premium for a sustainable delivery service at equal delivery times or to accept a longer delivery time at equal delivery costs. Based on this definition, favourable attitudes were reported

[17] Consumers A: customers who had previously used IKEA's cargo bike delivery service.

[18] Consumers B: customers experiencing it for the first time.

by 91% of Consumers A and 94% of Consumers B, indicating broad appreciation of the service regardless of prior experience.

The willingness to choose cargo bike delivery for a future purchase was assessed using a more demanding criterion. Consumers were considered likely to choose the service again if they were willing to accept both a higher delivery cost and a longer waiting time compared with conventional van delivery. According to this definition, 64% of respondents in both groups expressed an intention to select cargo bike delivery in the future, demonstrating a substantial level of commitment to the sustainable delivery option.

Differences emerge when examining the motivations behind delivery choices. Among customers with prior experience (Consumers A), environmental sustainability was the dominant factor influencing delivery preferences (54.5%), followed by social sustainability (27.3%). In contrast, first-time users (Consumers B) assigned slightly greater importance to social sustainability (43.8%) than to environmental sustainability (37.5%). Cost considerations remained secondary in both groups, while convenience played only a marginal role and was not selected by any respondent in Consumers B.

Overall, the results suggest that cargo bike delivery is positively perceived by both experienced and first-time users. The findings also provide several practical lessons for future deployment. First, communication appears to be most effective when integrated directly into the customer journey, as the IKEA website was identified as the primary source of awareness for most respondents. Second, environmental and social sustainability messages appear to reinforce one another, with both dimensions emerging as key drivers of positive perceptions. Finally, the low response rate obtained through postcard distribution suggests that offline communication tools are significantly more effective when supported by direct interaction with end customers.

While previous users appear more receptive to communication messages and place stronger emphasis on environmental benefits, new users show a particularly strong appreciation for the social value of the service. Most importantly, the very high share of consumers expressing a favourable attitude (over 90% in both groups) and the substantial share willing to choose the service even under less favourable conditions (64%) indicate strong acceptance of cargo bike delivery across both customer segments. Nevertheless, it should be acknowledged that respondents may be disproportionately concerned with sustainability-related issues, which could have contributed to the particularly positive attitudes observed towards cargo bike delivery.

The various channels served complementary purposes:

- LinkedIn communication successfully supported stakeholder awareness and institutional visibility but was not designed to influence consumer decisions directly.
- Checkout communication represented the most strategically relevant consumer-facing channel because it reached customers at the point of decision-making, directly aligning with CodeZERO's objective of influencing consumer behaviour at the final stage of the purchase journey. At the same time, this touchpoint is particularly commercially sensitive for IKEA, as the checkout phase constitutes a critical part of its sales funnel and revenue generation process. Consequently, any modification required careful compliance with IKEA's internal governance and communication guidelines, making its implementation especially challenging.

- Postcards and QR-code surveys generated valuable feedback but achieved limited engagement, with less than 1% of recipients completing the survey. The low response rate highlights a key limitation of offline communication tools when there is no direct interaction with customers. The delivery context in central Milan often involved building concierges rather than end users, reducing exposure to the communication materials.

Overall, communication objectives can be considered to be achieved. Awareness of the service was supported through both digital and physical communication channels, attitudes towards cargo bike delivery were overwhelmingly positive across respondent groups, and the survey generated useful qualitative and quantitative feedback. The only objective that was achieved to a limited extent was customer engagement through the postcard campaign, as participation rates remained lower than expected despite the broad distribution of communication materials.

As a conclusion, the communication interventions were successful in increasing awareness, generating favourable attitudes, and fostering willingness to choose zero-emission delivery options. Although the pilot does not provide direct evidence of actual behavioural change, the high level of acceptance observed among respondents, including their willingness to accept trade-offs in delivery time and cost, suggests a strong potential for future adoption of cargo bike delivery services. The strongest impact was therefore observed in attitude formation and behavioural intention rather than in directly measurable behaviour change.

The pilot also demonstrates that combining environmental and social sustainability messages can enhance the attractiveness of cargo bike delivery.

Future communication guidelines should build on these strengths while incorporating stronger visual elements, behavioural nudges, consumer segmentation, and more effective post-purchase engagement mechanisms to further support the adoption of zero-emission delivery solutions. Additional studies based on larger samples and different urban contexts would help assess the extent to which communication interventions can translate positive attitudes and intentions into actual delivery choices.

3 Living lab in Oslo

3.1 Context, delivery and communication solutions synthesis

The Click and Collect Near You (CCNY) service offered by IKEA is the main focus of the Oslo Living Lab. The service is envisioned as an alternative to home delivery or traveling to one of IKEA's store or warehouse locations. When shopping online, CCNY customers can choose to collect their goods from a mobile pick-up point in Oslo during specific time windows. The pick-up points are active for 1-hour fixed time slots one or two times a week during which an electric van will park at a designated location and wait for customers to collect their goods. The locations are intended to be easily accessible by walking, biking and public transport.

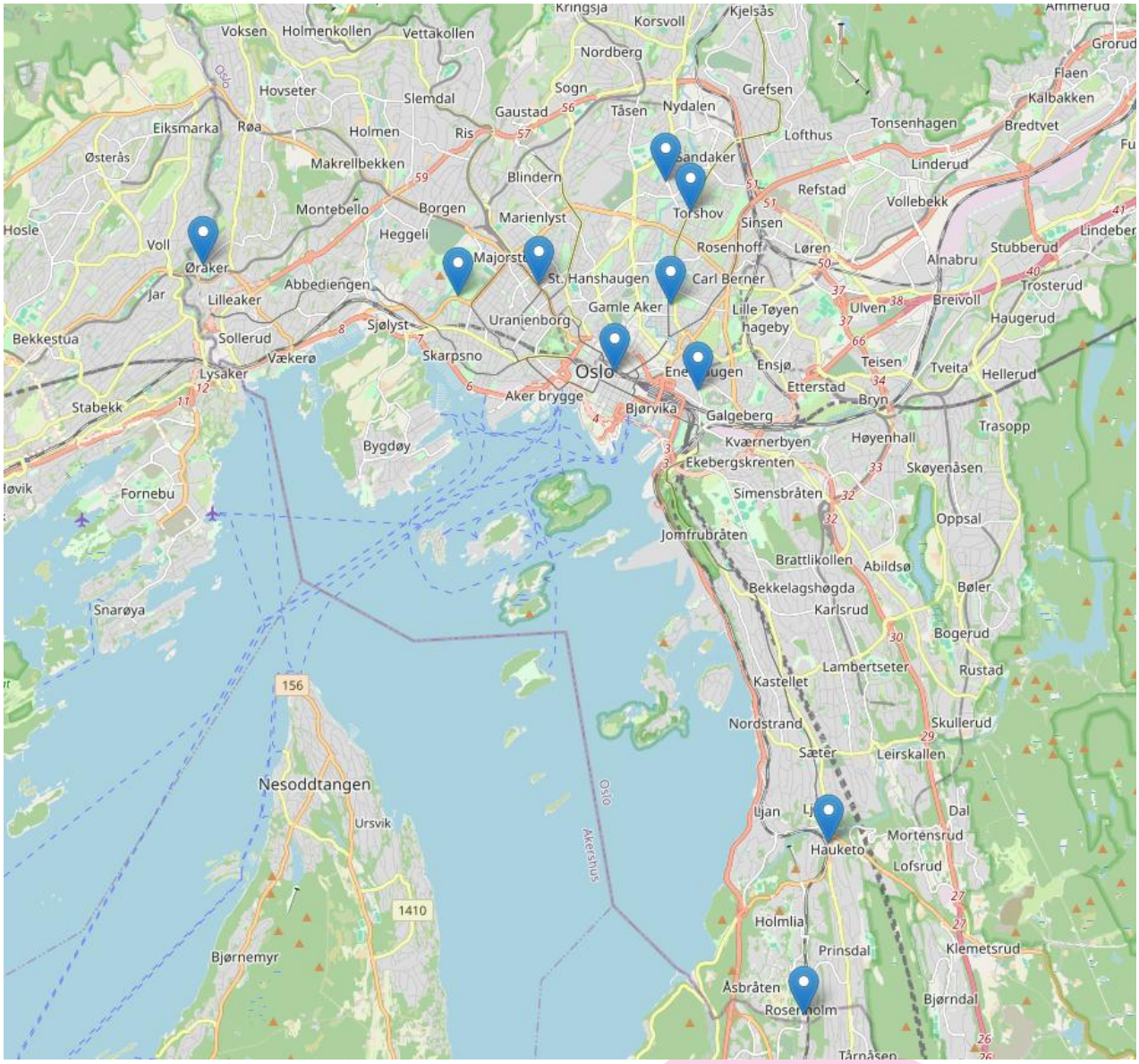
Figure 5: One of IKEAs CCNY pick-up points in the neighbourhood of Grünerløkka, Oslo



The goal of the service is to reduce overall driven kilometres while simultaneously offering an attractive, convenient service to customers that is less expensive for both the customer and the transporter. The service began with 10 pick-up points around Oslo. During the pilot three of the pick-up points were terminated due to limited use by the customers (Figure 6). These points were located outside the city centre in more sub-urban areas. Therefore, the impact assessment (section 3.2) is restricted to the remaining seven pickup points. More details about the pilot's conception and development are available in Deliverable 5.1.

The deployment of the pilot was accompanied by communication measures intended to increase the use of CCNY. Different communication strategies were used to increase the awareness about the sustainability of CCNY and the visibility of the delivery option. The second part of this assessment (section 3.3) focuses on evaluating the effect of these communication measures on consumer choice and intention to choose CCNY.

Figure 6 The original 10 Pick-up point locations in Oslo



3.2 Assessment of delivery options implementation

3.2.1 Delivery options assessed

For the assessment, home delivery (Option A) is compared against CCNY (Option B). The pilot started on October 13th, 2025, and the evaluation is based upon data collected from the start until the end of April 2026. Posten/Bring is the transport operator that IKEA uses for both delivery options and they use electric vehicles for both services.

To assess the pilot, the following data were used:

1) Route data from Posten/Bring's database for both home delivery and CCNY. The dataset contains multiple variables related to deliveries and vehicle movements, such as number of deliveries, delivery weight and kilometres driven.

2) CCNY delivery driver registrations of customer travel mode (walk, bike, car) to the pick-up points.

3) An online survey distributed to customers who had used the CCNY service. The survey is described in detail in section 3.3. For the purposes of impact assessment, the survey provided information on travel mode and travel time to the pick-up points.

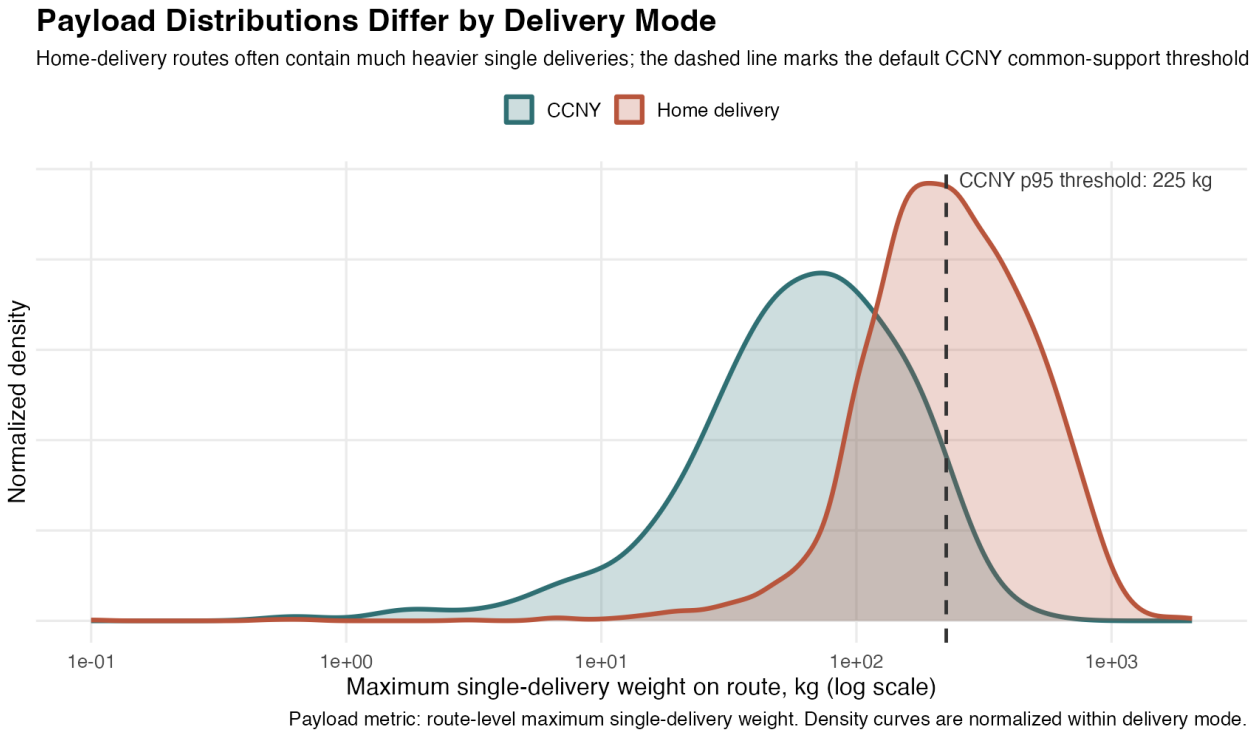
Home delivery from IKEA encompasses multiple types of delivery services. Customers can receive their goods at the curb, at the door, or have goods carried into their home. In the original data the weight distribution of deliveries was shifted towards heavier weights for the home delivery and included delivery routes in more suburban areas of Oslo. To conduct a more comparable analysis we removed all deliveries with weight above the 95th percentile (225kg) of the CCNY deliveries (Figure 7). The same was done for the size of the goods delivered, with the 95th percentile used to exclude individual deliveries larger than 1.23 m^3. Finally, only home delivery routes in which all deliveries occurred within 3 kilometres of the seven most central CCNY locations were used. By applying payload and geographical restrictions to the route data we avoid comparing deliveries which were unable or unlikely to go through the CCNY service. Table 22 describes the dataset used for analysis after routes not meeting the above criteria were excluded.

Table 22: Descriptive statistics of the two delivery datasets from Posten/Bring used for the analysis

Delivery Mode	Routes	Deliveries	Total km	Median km	Km per delivery (mean)	Deliveries per route (mean)	Delivery weight (median)	Total route weight kg (median)
Home Delivery	48	347	2605	53	7.5	6	76	938
CCNY	204	2025	7775	39	3.8	9.9	14	228

Generally, we see that the home delivery service travels farther to make the same number of deliveries but also delivers heavier goods. However, there is overlap between the two services (Figure 7 Payload distribution for the different services), which shows that a share of goods that go through home delivery are potentially suited for CCNY and vice versa.

Figure 7 Payload distribution for the different services



3.2.2 Key KPIs driving the comparison

Deliverable 3.1 provides an exhaustive list of 63 KPIs that may be used to evaluate delivery solutions. Of these, 13 KPIs were selected to compare the two solutions, comprising five demand KPIs, two supply KPIs, and six impact KPIs. These are discussed in greater detail in the following sections.

However, it is important to note that using the framework to enact a direct comparison of the two services was challenging and at times eliminated important nuance. The main issue stems from the fact that the framework did not always account for answering from the perspective of the CCNY service. We note specific instances in which this occurs in the following sections and discuss the assessment of the service more holistically in section 3.2.4. CCNY is still in a pilot phase so comparing a new service against a fully integrated and established service (home delivery) may not always lead to a fair comparison, nor should CCNY and home delivery be seen purely as alternatives; the services are in many respects complementary and allow the retailer and transporter to deploy their delivery services more efficiently.

Since CCNY and home delivery differed in typical parcel weight and volume, we included these as covariates to avoid confounding the mode comparison with payload differences. Because the pilot ran over 22 weeks, during which operating conditions could vary, we additionally included calendar-week fixed effects. To estimate a delivery-weighted average km-per-delivery rate for each mode, we fit a Gamma generalized linear model (log link), with the number of deliveries per route entered as an offset and routes weighted by their number of deliveries:

$$\log(k_i) = \log(N_i) + \beta_0 + \beta_1 C_i + \beta_2 \log(1 + \overline{w}_i) + \beta_3 \log(1 + \overline{v}_i) + \gamma_{t(i)},$$

where k_i is km driven on route i, N_i is the number of completed deliveries, $C_i$distinguishes CCNY from home delivery, $\overline{w}_i$ and $\overline{v}_i$ are mean delivery weight and volume, and $\gamma_{t(i)}$ denotes the calendar-week fixed effects, where $t(i)$ denotes the week in which route i occurred. Routes are weighted by N_i so that the fitted rate reflects a delivery-weighted, rather than route-weighted, average. The Gamma distribution accommodates the strictly positive, right-skewed nature of route distances. The log link together with the offset means the model estimates a rate (km/delivery) rather than total route distance. With this specification, estimated km per delivery was 4.0 for CCNY and 5.9 for home delivery, respectively (ratio 0.68, 95% CI 0.5-0.9)

3.2.2.1 Demand KPIs

For the demand KPIs, the most relevant attributes for assessing the differences between the two services relate to price, flexibility and delivery time (Table 23). For price, CCNY is much less expensive, costing €9 for customers, whereas home delivery costs about €45 (varying depending on level of service chosen). CCNY offers a very different customer experience when compared to home delivery as the customer must carry out the final journey themselves. This allows the transporter to offer the service at a lower price.

However, the restrictions on when and where goods can be picked up also impacts the KPIs related to flexibility for customers. A home delivery customer can choose a two-hour time slot during the day in which to receive their goods at home, whereas CCNY customers must pick up their goods during a specific 1-hour time window for a given pick-up point. They can only change their delivery date or time window by choosing a different pick-up point.

Table 23: Demand side KPIs applicable to the Oslo Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Values for Delivery option A (base)*	*Values for Delivery option B (pilot)*
Cost	Delivery price	Average price per delivery	€/delivery	↓	45	9
Flexibility	Choice of delivery date	Delivery date choice index: - The delivery date can be chosen and can be even the same day: 4 - The delivery date can be chosen and can be any day since the day after the purchase: 3 - The delivery date can be chosen and can be any day since three days after the purchase: 2 - The delivery date can be chosen and can be any day since seven days after the purchase: 1 - The delivery date cannot be chosen: 0	Adimensional	↑	2	0
Flexibility	Choice of delivery time slot	Delivery time slot choice index: - One out 1 hour delivery time slots can be chosen: 4 - One out 2 hours delivery time slots can be chosen: 3 - One out 3 hours delivery time slots can be chosen: 2 - One out 4 hours delivery time slots can be chosen: 1 - The delivery time slot cannot be chosen: 0	Adimensional	↑	3	0
Flexibility	Choice of point of delivery	Delivery point choice index: - The point of delivery can be chosen (delivery to private address, lockers, pick-up point, van pick-up point) and can be even at floor (for delivery to private address): 2 - The point of delivery can be chosen (delivery to private address, lockers, pick-up point, van pick-up point): 1 - The point of delivery cannot be chosen (delivery to private address): 0	Adimensional	↑	1	0
Delivery time	Delivery time slot	Delivery time slot length	hours	↓	2	1

Within the assessment framework, the available options did not always match the service perfectly. For example, for the KPI “choice of delivery time slot”, the following options are provided within the assessment framework (Table 23):

Delivery time slot choice index:

- **One out 1 hour delivery time slots can be chosen: 4**
- **One out 2 hours delivery time slots can be chosen: 3**
- **One out 3 hours delivery time slots can be chosen: 2**
- **One out 4 hours delivery time slots can be chosen: 1**
- **The delivery time slot cannot be chosen: 0**

A CCNY customer has a one our time slot, but it can only be chosen by changing delivery points so we chose the more conservative answer with a lower score (that CCNY users cannot choose a delivery date). There was a similar issue with the choice of delivery date KPI since the day is fixed, the length of a time a customer must wait depends on when they order their goods. In such instances, we chose the more conservative answer, resulting in a lower score for the CCNY than if we had chosen a more generous interpretation. This clearly impacts the overall scores for flexibility from the consumer perspective as seen in section 3.2.3.1.

Customers may also perceive flexibility differently, valuing aspects differently than what is assigned by the framework. For example, with CCNY customers are able to pick up their goods whenever

they would like during the 1-hour window whereas for home delivery, customers are restricted to waiting at home for a 2-hour delivery window (or until their goods arrive).

3.2.2.2 Supply - context KPIs

There were just two KPIs related to supply that showed a difference for the Oslo pilot as the home delivery and CCNY services shared much in common outside of the operational process of delivering. Goods for both services originate from the same warehouses from workers operating under the same conditions with identical systems for plucking, sorting and optimizing delivery routes. As a result, the only two KPIs that were selected for this section were those related to fleet composition and number of drivers required. To determine the number of drivers needed, the route analysis model used for the impact KPIs (section 3.2.2.3) was applied to determine how many drivers would be needed to perform 100 home deliveries within a three-kilometre radius of the pick-up points versus how many would be needed to perform the same number of deliveries through the pick-up points. Based on the data, 17.6 drivers were needed to perform home delivery whereas only 2.9 drivers were needed for the CCNY service.

Bring has a large vehicle fleet that is applied dynamically. This means that different vehicles were used throughout the pilot process leading to a higher number of vehicles and drivers than required based on the average delivery productivity of the fleet. On the other hand, CCNY had two dedicated vehicles and drivers, reducing the number of vehicles used. IKEA and Bring made the choice to use dedicated drivers in order to avoid introducing multiple drivers to how the service works and ensuring a more consistent customer experience. If the CCNY service were to be upscaled and more tightly integrated, we would expect a more dynamic approach that included a larger number of vehicles and drivers. From a route planning perspective CCNY potentially offers advantages in its predictability; the vehicle will always be in the same location for the same amount of time each day.

Table 24: Supply - context KPIs applicable to the Oslo Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Values for Delivery option A (baseline)*	*Values for Delivery option B (pilot)*
Size and composition of the vehicle fleet	Delivery vehicles - Total vehicles	Number of vehicles required to complete 100 deliveries per week in an area of 66 square km	N° of vehicles	↓	18.3	3.5
Workforce arrangement	Number of drivers - Total	Number of driver units required to complete 100 deliveries per week in an area of 66 square km	N° of drivers	↓	17.6	2.9

3.2.2.3 Impacts KPIs

The Impact KPIs showed the most significant differences between CCNY and home delivery service. While both services used electric vehicles, the number of kilometres driven per delivery was substantially lower for CCNY than home delivery. This has implications for the environmental impact, service efficiency and transport impact of the two services. KPIs related to load factor, distance, number of deliveries and time were determined to be the most relevant for the assessment.

For load factor, just 4.1% of CCNY vehicles departed the warehouse with a load factor of over 75% whereas for home delivery this number was 68.8%. This is based on IKEAs use of a Ford E-Transit with a box body and a reported payload capacity of 950kg.

For home delivery, only routes where all deliveries occurred within a three kilometres radius of the seven pickup points were selected. This was done to create a more similar comparison to the CCNY service. For CCNY, route distance is modelled at the route-pattern level using OpenStreetMap routing. We use this modelled distance rather than the delivery van's observed total driving distance because the observed van movement often included operational activity (e.g. additional deliveries) outside the CCNY routes of interest to this study. The fewer number of kilometres driven for CCNY also meant that PM emissions were lower per delivery.

The reported results are from the delivery company driving route data, thus excluding the customer travel mode and distance. To assess the impact of driving by the customer to the pickup points we conducted a customer survey and collected delivery driver registrations of customer behaviour from the pickup points. Taken together, the results suggest that approximately 30% of customers drove a car to the pick-up points to collect their goods. Accounting for customer travel resulted in an increase in vehicle km per delivery from 3.84 to 4.39 for the CCNY service. For comparison, home delivery requires 7.5 km per delivery in the city centre.

For Transport impacts, the CCNY vehicles use less time to make the same number of deliveries, meaning that their contribution to congestion is lower as they use less space over time in traffic which positively impacts the assessment's score in favour of CCNY for all stakeholders as seen in section 3.2.3.

Table 25: Impact side KPIs applicable to the Oslo Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Values for Delivery option A (baseline)*	*Values for Delivery option B (pilot)*
Service efficiency	Vehicles load factor	Share of vehicles used for delivery departing from warehouses with a load factor equal or above 75% of the carrying capacity	%	↑	68.8%	4.1 %
Service efficiency	Distance travelled	Travelled distance to complete D deliveries (1) in an area of X (66) square km Distance = ∑(i) DistVi where - DistVi: Distance travelled by vehicle type i to complete Di (1) deliveries in an area of X (66) square km and - D= ∑(i) Di	km	↓	7.5	3.8
Service efficiency	Shipments consolidation	Average deliveries per tour AvDel= ∑(i) AvDelVi where AvDelVi: Average deliveries per tour per type i vehicle	Number / tour	↑	7.2	9,9
Service efficiency	Total delivery time	Time needed to complete 1 deliveries in an area of 66 square km by all types of vehicles. T = ∑(i) Ti where Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km and D= ∑(i) Di	Hours	↓	0.68	0.43
Environmental impacts	Pollutant emissions – PM	Average quantity of PM emissions per delivery	g/delivery	↓	0.57	0.1
Transport impacts	Congestion	Index obtained as combination of: - the time needed for delivering products by each vehicle type - the road occupancy of each vehicle type. I = ∑(i) Ti*OccVi where: - Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km - OccVi: road occupancy of vehicle type i under the condition that - D= ∑(i) Di	hours* sqm	↓	14.8	5.5

3.2.3 Stakeholder-weighted assessment results

3.2.3.1 Consumers perspective

Cost was clearly a driving factor between the comparison of the two different services, with CCNY priced at about €9 whereas home delivery costs €45. However, home delivery scores better in terms of flexibility within the framework as customers able to more freely choose their delivery date and time slot which tipped the overall score in favour of home delivery (Table 26). CCNY offers a slightly different type of flexibility that may be preferable under some circumstances. The delivery window is tighter, meaning customers know exactly when their goods will be at the specific location and they also have the flexibility to meet up at any point during that time window. Home delivery offers a wider range of choice for delivery, but the customer must be at home during a two-hour window at the precise moment when the delivery arrives.

As discussed in 3.2.2.1, more conservative values were used for the KPIs related to flexibility which resulted in a lower score for CCNY. If the service were to become more popular, the flexibility for CCNY could potentially be increased. A larger throughput of goods could justify an increase in the number of days or length of time the CCNY service visits a pick-up point each week which would provide more options for customers. However, at this stage the existing home delivery service is evaluated as more attractive than CCNY when considering the demand side attributes.

Table 26: Demand side attributes – Oslo

Attribute type	Result Delivery Option A	Result Delivery Option B
Cost	**2.76**	**5,60**
Flexibility	**11,65**	**0,00**
Delivery time	**15.51**	**17.28**
Delivery method	**6.82**	**6.82**
Information	**6.44**	**6.44**
Reliability	**18.07**	**18.07**
Cumulative	**61.27**	**53.23**

From the consumer perspective, the public impacts favour the CCNY service (Table 27), as fewer vehicles are required per delivery and fewer kilometres are driven resulting in lower PM emissions. Congestion is also reduced as CCNY vehicles are on the road for shorter periods of time and when they are parked they do so in designated locations that do not block traffic.

Table 27: Public impacts for consumers – Oslo

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	29.7	33.9
Transport impacts	3.7	5.8
Labour impacts	17.4	17.4
Cumulative	50.78	57.09

3.2.3.2 Retailers perspective

From the retailer perspective, the supply side attributes favour the CCNY service due to fewer vehicles and drivers needed to perform the same number of deliveries. However, the higher productivity numbers are also contingent on pick-up points being implemented in popular locations. As discussed in section 3.1, three pick-up points were closed due to low goods volumes, so the CCNY service cannot necessarily be introduced effectively in all areas where home delivery occurs. The straightforward nature of the service is part of its advantage in this situation. It is relatively easy to trial a new pick-up point without any major investments, just a van driving to a specific location and waiting. If it proves to be successful it can be continued.

Table 28: Supply Side Attributes

Attribute type	Results Delivery Option A	Results Delivery Option B
Service organisation	36.0	36.0
Impact monitoring system	0.87	0.87
Size and composition of the vehicle fleet	2.97	8.59
Workforce arrangement	4.69	9.93
Distribution network	24.19	24.19
Cumulative	68.7	79.6

Service efficiency comes out more positively for home delivery, driven primarily by a much higher share of vehicles (68.8) leaving warehouses with a load factor above 75%. While the share of vehicles with a load factor above 75% was lower for CCNY (4.1%), it had better performance in terms of kilometres driven, number of deliveries per tour and time needed to deliver a given number of parcels.

Table 29: Private Impacts for e-tailers

Attribute type	Results Delivery Option A	Results Delivery Option B
Service efficiency	59.8	53.1

The CCNY service provides more positive public impacts when compared against home delivery. As discussed previously, this is primarily related to fewer kilometres driven and the resulting environmental and transport benefits of fewer PM emissions and less congestion.

Table 30: Public Impacts for e-tailers

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**25.7**	**29.5**
Transport impacts	**6.0**	**9.3**
Labour impacts	**16.1**	**16.1**
Cumulate public impacts	**47.7**	**54.9**

3.2.3.3 Transport operators perspective

Generally, the CCNY solution scored higher than home delivery for most of the measured attributes (Table 31: Supply Side Attributes). This is unsurprising as fewer kilometres driven with more parcels delivered per hour is an attractive proposition for transport operators.

Table 31: Supply Side Attributes

Attribute type	Results Delivery Option A	Results Delivery Option B
Service organisation	**31.1**	**31.1**
Impact monitoring system	**0.89**	**0.89**
Size and composition of the vehicle fleet	**3.71**	**7.56**
Workforce arrangement	**4.59**	**11.52**
Distribution network	**26.62**	**26.62**
Cumulative	**66.9**	**77.7**

However, CCNY was not superior in all respects; as discussed above in section 3.2.3.2, home delivery was the better solution in terms of vehicle load factor. This can partially be attributed to the novelty of the CCNY service as, especially early on, some days saw relatively few deliveries to a specific pick-up point meaning that the van had extra capacity. This negatively impacts the service efficiency score.

There is also less flexibility in what can be loaded into a CCNY vehicle. A normal home delivery route can be adjusted, and additional parcels can be loaded to increase the number of stops and ensure better use of the vehicle's capacity. CCNY on the other hand, can only take the parcels that are designated for a specific pick-up point. If there are 30 orders, they can deliver 30 orders in a single hour at a specific point, but the opposite is also true. If there are just a few orders in the vehicle they still need to travel to the pick-up point and wait until all customers have picked up their goods.

Table 32: Private Impacts for Logistics Operators

Attribute type	Results Delivery Option A	Results Delivery Option B
Service efficiency	**61.5**	**53.9**

As CCNY becomes more fully integrated into a transport provider's operations, it would be possible to make better use of the vehicle capacity. In the pilot phase, the service has had dedicated drivers taking dedicated trips to ensure the implementation of a new service runs smoothly. However, available capacity could be used to augment existing home delivery services, i.e. if the CCNY service does not fill the vehicle, the driver could take additional home delivery orders to ensure higher fill rates and better service efficiency.

Table 33: Public Impacts for logistics operators

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**32.2**	**35.6**
Transport impacts	**6.2**	**9.7**
Labour impacts	**14.7**	**14.7**
Cumulate public impacts	**53.1**	**60.0**

Drivers involved in the CCNY service also reported to IKEA that they were happy with the service as it was less physically strenuous for them to deliver parcels out to customers at the truck as opposed to parking and carrying goods to customers. Instances in which they would carry goods up to higher floors in apartment buildings were mentioned as especially tiring.

3.2.3.4 Local authorities perspective

For local authorities, the CCNY service can be seen as beneficial when looking at the operational side, especially in regard to environmental and transport impacts. As previously mentioned, reducing kilometres driven also reduces PM emissions and congestion, providing positive effects for city residents. The CCNY vehicles also spend less time driving in neighbourhoods as they are not delivering directly to a home address. While impacts from vans driven for the service are reduced, local authorities will still need to consider and potentially monitor the impacts of customer travel to the pick-up points.

The main concern for local authorities is the potential generation of private vehicle trips to the pick-up points. As discussed in 3.2.2.3, the evaluation and scoring here is based only on a direct comparison between kilometres driven by the LSP for the two different services. However, even after including kilometres driven by customers, the results favour CCNY.

While the overall kilometres driven for CCNY may be lower, there is a potential for conflict if a higher proportion of customers drive to the pick-up points and arrive at similar times. Some of the pick-up points have limited on-street parking so the arrival of multiple customers in cars simultaneously could generate traffic related issues until the customers receive their deliveries and leave the area. Such conflicts were not observed or reported during the pilot phase, but suggest an avenue for future monitoring and research.

Table 34: Public Impacts for public authorities

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	31.0	35.4
Transport impacts	5.3	8.4
Labour impacts	13.7	13.7
Cumulative public impacts	50.1	57.5

3.2.4 Overall performance and level of success

When compared with home delivery, CCNY comes out ahead in almost all categories assessed. It offers environmental benefits, reduces vehicle movements, and delivers parcels more efficiently. However, it falls short of home delivery in some areas. According to the framework, CCNY is less flexible than home delivery, being more restrictive on when and where delivery occurs. We also see that load factor is quite low for the CCNY service. Only 4.1% of the CCNY routes analysed have a load factor of over 75% when leaving the warehouse compared to 68.8% for home delivery. Scaling up the service could address some of these issues. Increasing the number of pick-up points or the number of days per week in which they are active would give customers greater flexibility and choice. If the service continues to grow in popularity or the dedicated CCNY vehicles used some of their capacity for home delivery, the load factor would also continue to rise.

It is also important to note that CCNY cannot replace home delivery in every instance. Many of the goods moving through the home delivery service are too bulky, heavy or inconvenient to be collected at a pick-up point. CCNY should instead be seen as a service that is synergistic with home delivery, and its introduction can make the overall logistic system more efficient. By shifting some goods to CCNY that would otherwise have gone through home delivery, capacity is made available in those vehicles, both in terms of weight but also the time needed for drivers to carry out deliveries. If they are able to shift some goods over to the CCNY service, more time is available to deliver those goods which are best suited for home delivery.

From the customers' perspective, the CCNY service complements home delivery by providing a cheaper option for receiving goods that are relatively easy for them to transport a short distance home. The companies are therefore able to push some of the transport work onto the customer in exchange for a lower price than home delivery. The impact of consumer travel is not formally captured by the assessment framework but involves real consequences that should be considered. The extent of the impacts related to customer travel are tightly bound to travel mode choice. Walking, biking or using public transport are more sustainable options that have lower impacts and may even offer benefits (for example societal health benefits of more active travel). If a large proportion of customers choose to travel by car, the positive impacts of CCNY would be reduced. Based on collected data during the pilot, about 30% of customers drove to the pick-up points, which would increase the kilometres per delivery for CCNY from 3.84 to 4.39. Home delivery requires 7.5km per delivery in the city centre, which suggests that CCNY is effective at reducing the overall number of kilometres driven.

Future research should look more closely at the customer journey to a pick-up point in order to better understand why customers choose specific travel modes, what they would have done if the service were not available and what sorts of interventions can encourage the use of sustainable transport modes.

3.3 Impact on consumer behaviour and attractiveness of zero-emission delivery and return options

3.3.1 Description of the communication interventions

This section presents the different communication measures as part of an overall strategy organised around three objectives.

3.3.1.1 Strategy and resources

The different communication interventions can be summarised around three main objectives:

Objective 1: Increase awareness about the sustainability of the option through a message that was added in the confirmation e-mail from the start of the pilot in order to improve consumers attitude towards CCNY.

Objective 2: Compare the effect of a sustainability message with a convenience message, through an A/B test conducted in the IKEA Family newsletter published between November 27th to December 2nd.

Objective 3: Increase awareness and visibility about the new service: different measures happened all along the pilot, from the modification of the check-out to communication around the pilot launch and including advertisement in social medias and the IKEA Family Newsletter. The most active intervention has been an important marketing campaign conducted in two steps:

a. between December 2025, 25th and January 2026, 4th, targeting Oslo
b. between January 12th and 18th, at the national level.

Objectives 1 and 2 were discussed and decided during a few meetings between TOI researchers and IKEA Marketing department before the start of the pilot. The focus in these discussions was about testing sustainable communication along the consumer journey. It became quickly clear that it was not possible for IKEA to integrate any new elements at the check-out (for example cues or labels) and the website was generally a more challenging channel to use, as the website should be aligned with the brand standards. So the only change that would happen on the website was to add the new option at the check-out, together with some additional information about the CCNY locations.

As a result, we explored other communication channels for sustainability communication, along the customer journey. And IKEA Marketing team suggested both the confirmation e-mail and the IKEA Family newsletter.

To decide the content of the sustainability messages in the confirmation e-mail and in the IKEA Family Newsletter, the communication guidelines (G1 to G18, see Appendix 1) (Pernot et al. 2025) were discussed. The messages were supposed to be open, clear and specific (G1), and show a real-world impact (G11). The Marketing team at IKEA was also careful about making sustainability claims before the pilot and the impact assessment. Claims had to be verifiable and true no matter what the final assessment would be to avoid greenwashing (G3).

In that perspective it was decided to use messages highlighting the fact that IKEA was driving fewer kilometres, something that was verifiable at that stage of the pilot. The sustainability message in the newsletter also adds some information to explain that CCNY allows delivery to the customer at the same time as their neighbour, thus driving fewer kilometres, offering lower price and more sustainability, as well as a green leaf which is now a widespread cue for sustainable delivery options (G2).

With these two messages, there was an attempt to align communication across channels and consumer journey (G16).

Objective 3 was also discussed during the meetings between TOI researchers and IKEA. IKEA already had experience with CCNY outside of urban areas and wanted to replicate the same type of communication. So, the following measures were first conducted:

- add the delivery solution at the check-out.
- as all delivery options appear in a similar way at IKEA check-out, solutions to make the option stand out were discussed (G6). Delivery options are ranked by price, so as it was already decided that CCNY would be considerably cheaper than home delivery, CCNY appeared second in the list, just after pick-up at the warehouse (G9).
- provide information about how CCNY works to give consumers actionable plans for out-of-home collection (G17) with a sentence explaining the principle of CCNY, the list of pick-up locations and possible time-windows, a map showing the different location, advices to bring a friend to help carrying the parcels.

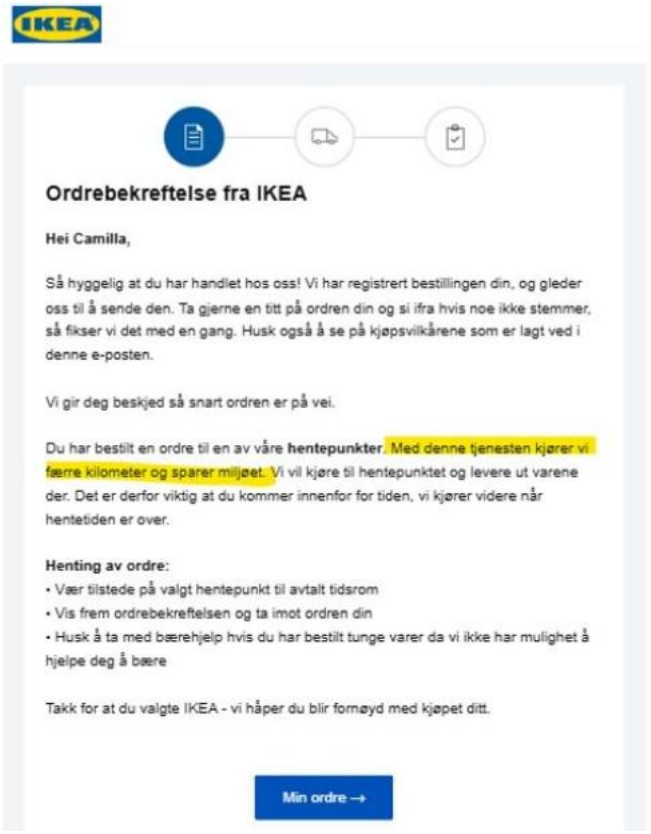
Then during the pilot period, it became clear that the CCNY option was lacking visibility and that Oslo customers did not know about the service. The focus of communication measures then shifted to increasing the visibility of the service through marketing campaigns across several channels (social media, IKEA Family Newsletter - G16) focusing more on the convenience and proximity of the service rather than on sustainability.

The resources used to develop and implement this strategy involved both TOI and IKEA. At TOI, three researchers were involved, bringing expertise in consumer behaviour and choice mechanisms. At IKEA, the pilot lead held several internal discussions with the Marketing Team to convince them of the need to communicate the new delivery option. He also organised four meetings between TOI and the Marketing Team to discuss the possibilities for, and content of, the communication measures. In addition, a survey was jointly developed by TOI and IKEA to assess the effects of the communication measures, as well as consumers' travel behaviour to and from the pick-up point for the impact assessment. A fifth person from IKEA was involved in the survey. She was TOI's main contact for discussing the questionnaire and was responsible for implementing the survey in IKEA's system, as well as for distributing it and collecting the data.

3.3.1.2 Activities, efficacy of execution and outputs

For **objective 1**, the communication activity consisted in a new sentence added in the confirmation e-mails received by consumers ordering with CCNY emphasising the environmental benefits of the solution: "With this service, we drive fewer kilometres and help protect the environment." The sentence was added on October 2025, 17th, so from the very start of the pilot. Figure 8 shows how the updated order confirmation looks like. The e-mail already included information about what the customer must do to execute collection at the mobile pick-up point.

Figure 8: Confirmation e-mail for customers choosing CCNY, with message on environmental benefits highlighted



IKEA

Ordrebekreftelse fra IKEA

Hei Camilla,

Så hyggelig at du har handlet hos oss! Vi har registrert bestillingen din, og gleder oss til å sende den. Ta gjerne en titt på ordren din og si ifra hvis noe ikke stemmer, så fikser vi det med en gang. Husk også å se på kjøpsvilkårene som er lagt ved i denne e-posten.

Vi gir deg beskjed så snart ordren er på vei.

Du har bestilt en ordre til en av våre **hentepunkter**. Med denne tjenesten kjører vi færre kilometer og sparer miljøet. Vi vil kjøre til hentepunktet og levere ut varene der. Det er derfor viktig at du kommer innenfor for tiden, vi kjører videre når hentetiden er over.

Henting av ordre:
- Vær tilstede på valgt hentepunkt til avtalt tidsrom
- Vis frem ordrebekreftelsen og ta imot ordren din
- Husk å ta med bærehjelp hvis du har bestilt tunge varer da vi ikke har mulighet å hjelpe deg å bære

Takk for at du valgte IKEA - vi håper du blir fornøyd med kjøpet ditt.

Min ordre →

When discussing the content of the sustainability message with IKEA marketing team, the main challenge was to find a message that could not be accused of greenwashing, especially because the pilot impact had not been evaluated yet. This was addressed by focusing on the reduction of kilometres driven for IKEA, which remained valid regardless of the results of the impact assessment.

The main issue with this communication measure is its very early implementation that did not enable us to collect any baseline data, before its implementation. This issue is mitigated by one of the questions included in the survey asking about passive recall of the message.

For **objective 2**, the communication activities consisted of a module in the IKEA Family newsletter with two different messages to perform an A/B test. Message A was about sustainability and included a green leaf label, and message B focused on the convenience and proximity of the service (see Figure 9).

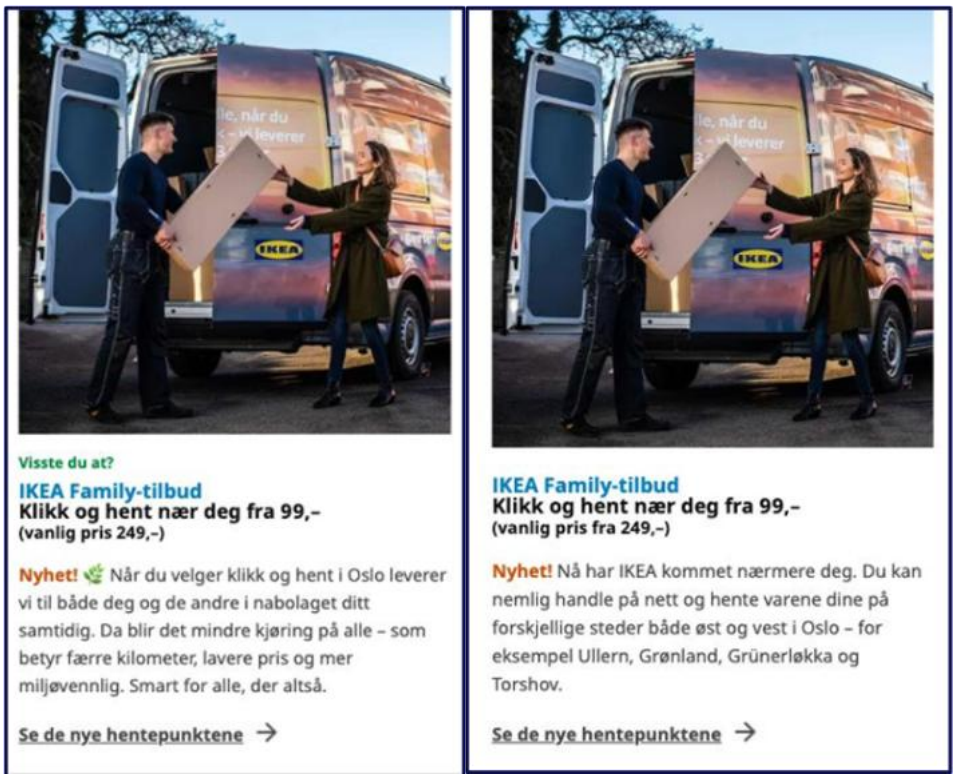
Message A: “When you choose click and collect in Oslo, your order is delivered together with others in your neighbourhood. This reduces the number of trips, meaning less kilometres, lower costs, and more environmentally friendly. Smart for everyone.”

Message B: “Now IKEA is closer to you. You can now shop online and collect your products at several locations both east and west of Oslo—for example Ullern, Grønland, Grünerløkka, and Torshov.”

During the week from November 27th to December 2nd 2025, half of the IKEA Family members living in Oslo received message A and the other half received message B.

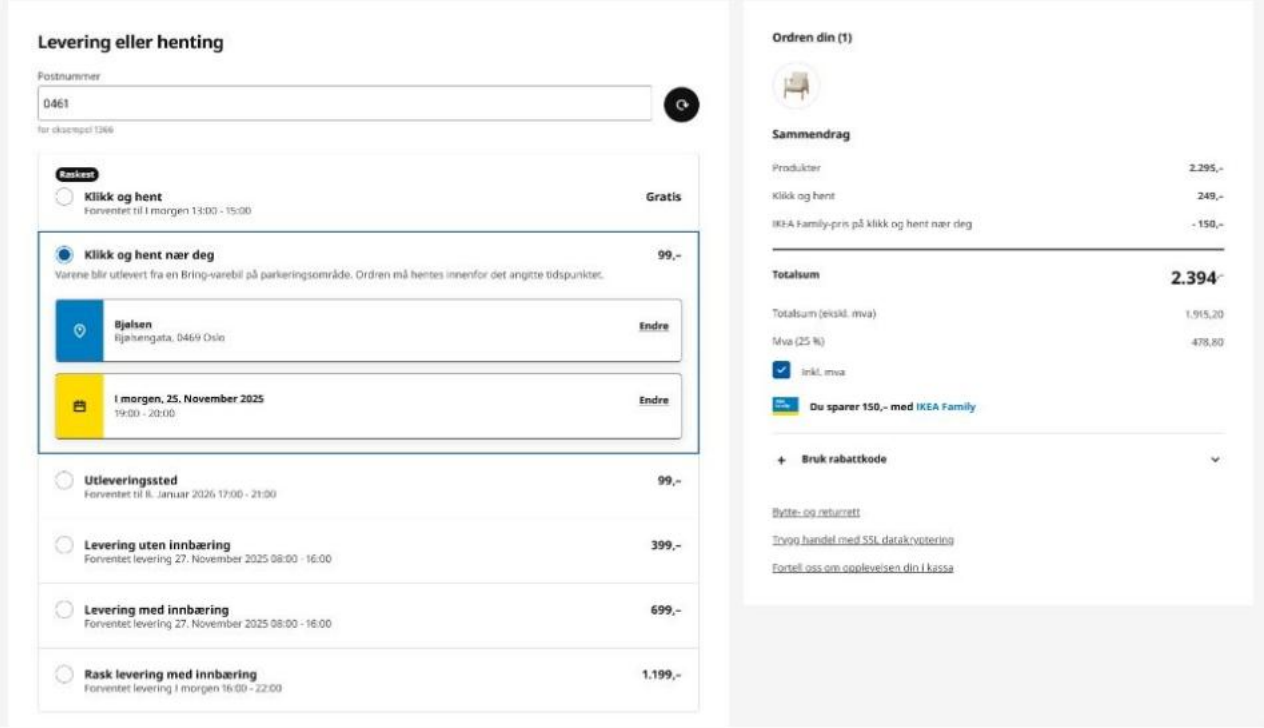
Unfortunately, the first results from IKEA click rates were quite low (1,5%), with no significant difference between A and B modules.

Figure 9: Module on CCNY from the IKEA Family newsletter used for A/B test
(On the left: sustainability message with a green leaf label; On the right: convenience message).



For **objective 3**, different communication measures were conducted. First of all, the CCNY option has been made available at the IKEA check-out for customers entering a postal code in Oslo. On Figure 10, it is shown that the option is called “Click and Collect Near You” and is explained by a sentence saying “The products will be delivered by a Bring van on a parking area. The orders must be collected during the given time window.” Below is the location suggested for a specific postal code, and the time-window available for this location. Both can be changed by clicking on “endre”.

Figure 10: Screenshot of the IKEA checkout page for a postal code in Oslo



Advertisement for the new delivery service was minimal at the start of the pilot, consisting of only a few newspaper articles as well as posts made by project partners on LinkedIn. Then, from the end of December 2025, communication was intensified through advertising campaigns on social media and a new module in the newsletter.

Table 35: Summary of advertisement measures (taken from Deliverable 2.1)

Date	Communication measure	Target group
13.10.2025	Article in the digital newspaper *Avisa Oslo*	Oslo residents
13.10.2025	Article in the digital newspaper *Handelswatch*	Oslo residents
14.10.2025	Press release from IKEA	Oslo residents
14.10.2025 & 22.10.2025	Multiple posts on LinkedIn from project partners	Oslo residents
25.12.2025 - 04.01.2026	Marketing campaign on social media	Oslo residents
29.12.2025	New module in the newsletter	IKEA Family members
January 2026	Add a module in some trigger newsletters	IKEA Family members
12.01.2026 - 18.01.2026	National marketing campaign on CCNY (social media, newsletter and push notification)	Norway residents

These measures are described in detail in Deliverable 5.1, section 3.3.2, together with extensive screenshots of the different publications. This current deliverable will only report the main communication measures for the evaluation and will focus on the most active intervention, which has been an important marketing campaign conducted in two steps.

1. ***Marketing campaign (IKEA Family newsletter and social media) between December 2025, 25th and January 2026, 4th, targeting Oslo:***

The two advertisements presented in Figure 11 and Figure 12 were presented on Facebook and Instagram.

Figure 11: Screenshots of the two visuals for the marketing campaign on Facebook

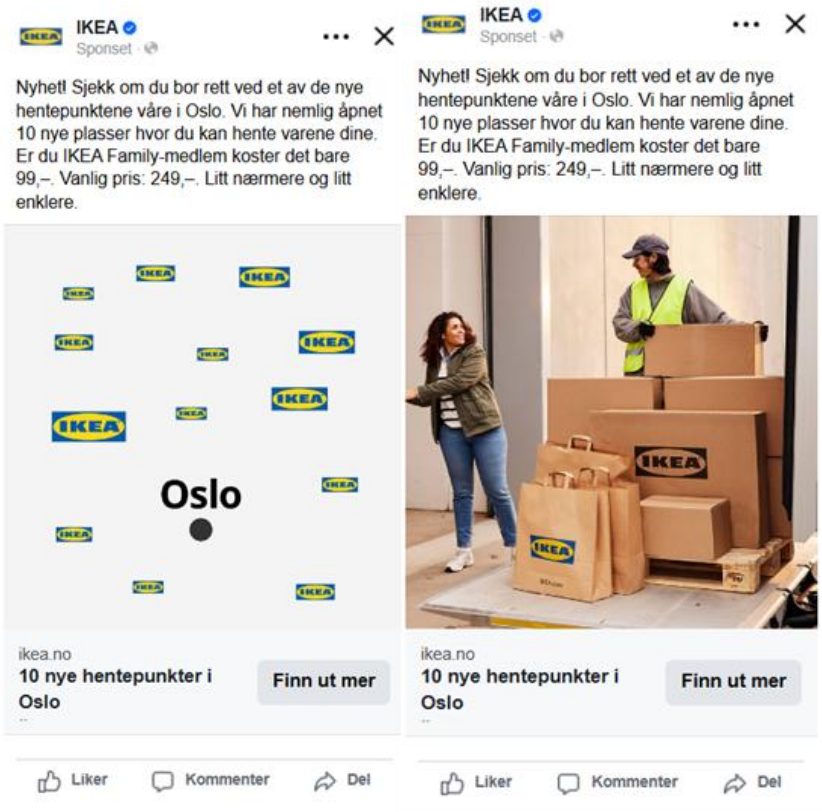
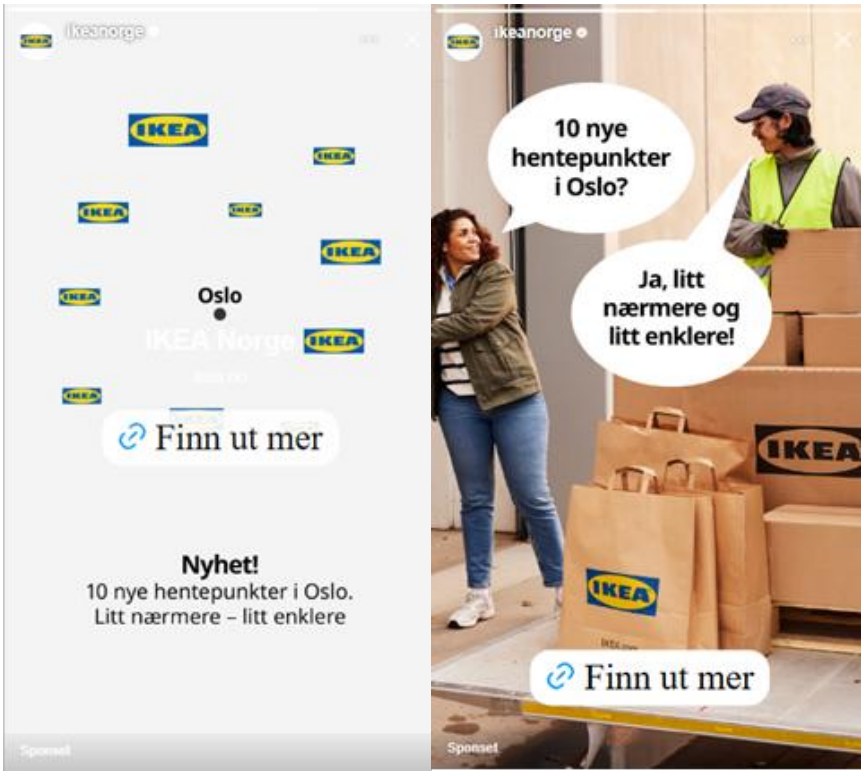


Figure 12: Screenshots of the two visuals for the marketing campaign on Instagram



In addition, a module on CCNY was included in the newsletter On December 2025, 29th, saying: "Ten new pickup locations in Oslo. Now IKEA has come closer to you! You can shop online and pick up your items at various locations both east and west in Oslo — for example Ullern, Grønland, Grünerløkka and Torshov. Click and collect near you from 99 NOK for IKEA Family members (regular price from 249 NOK)."

Figure 13: Module in IKEA Family newsletter



Ti nye utleveringssteder i Oslo

Nå har IKEA kommet nærmere deg! Du kan nemlig handle på nett og hente varene dine på forskjellige steder både øst og vest i Oslo – for eksempel Ullern, Grønland, Grünerløkka og Torshov. Klikk og hent nær deg fra **99,–** for **IKEA Family-medlemmer** (vanlig pris fra **249,–**).

Se alle hentepunktene →

2. ***Marketing campaign (IKEA Family newsletter, app and social media) between January 12th and 18th, at the national level.***

As CCNY also exists in non-urban areas in Norway, the idea of this campaign was to advertise all locations together. Three channels were used with the same picture and the same messaging "Shop first – pick up nearby", emphasizing the availability of multiple pick-up points all over the country:

- on social media (Facebook and Instagram story- see Figure 14)
- in the IKEA Family newsletter (see Figure 15)
- with a push notification in the App (see Figure 16).

Figure 14: National social media campaign on Facebook and Instagram

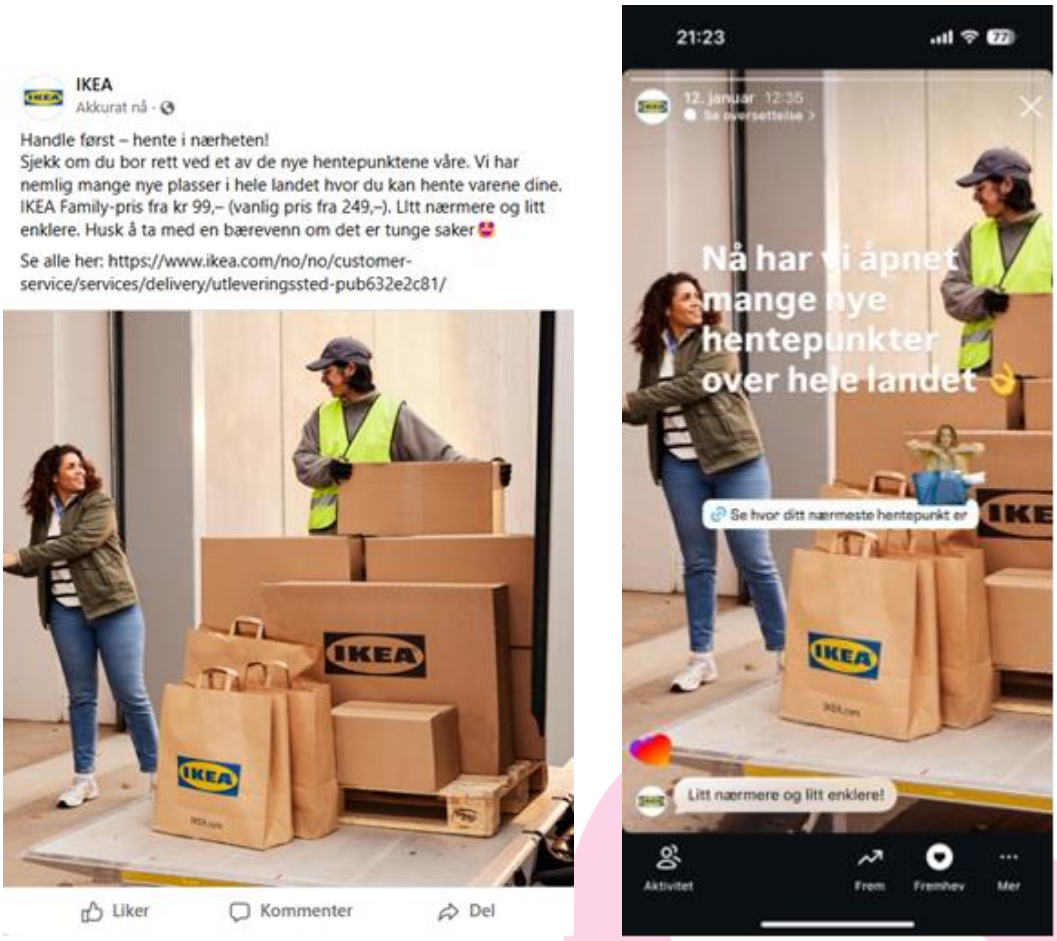


Figure 15: Module in the IKEA Family Newsletter - national campaign



Figure 16: Push notification in IKEA App - national campaign



3.3.2 Experimental design

3.3.2.1 Survey design, respondent recruitment and sample description

TOI researchers and IKEA quickly decided to run a survey. Different configurations of sampling were discussed to ensure data was collected both from the group exposed to the communication measures and data from a control group not exposed to the communication measures. The solution that was retained has been to collect data during the two first weeks of the pilot before any communication measure was implemented. This has been implemented this way: the survey was launched from the start of the pilot and the communication measures planned after two weeks (with the exception of the sustainability message in the confirmation e-mail). But unfortunately, several factors led to the survey receiving only a limited number of responses during the first two weeks. The evaluation approach was adjusted to a time-series experimental design to assess objective 3 (consumer choice and behaviour will be tracked over time and compared before and after

communication interventions), and an assessment based on passive recall for objective 1 and 2 (consumers who remember the communication measures are compared with those who don't).

The questionnaire (see Appendix 3) was designed jointly by TOI and IKEA and implemented in IKEA's survey system. To ensure proper data protection, IKEA sent out the survey directly, avoiding the need to share customers' personal data with TOI. This also made it possible to omit some questions about the order itself, such as the order date and weight, as IKEA could link the survey responses to its existing order data. Each week, an e-mail with the link to the survey was sent by IKEA to all customers who picked up an order in Oslo using CCNY. Several challenges emerged with the survey distribution process. The workflow relied heavily on manual work at IKEA and was dependent on one person, which made it vulnerable to absences and led to missed survey waves in some weeks. In addition, emails to clients with Microsoft/Outlook addresses bounced back, making it impossible to reach part of the target group. Internal bugs also affected the sending process, particularly during some weeks around Christmas. At the start, the click-through rate was very low; however, this was improved by changing the email subject line to "Answer and win", and gift cards were introduced from the start to encourage participation.

Figure 17: Survey structure and respondent flow

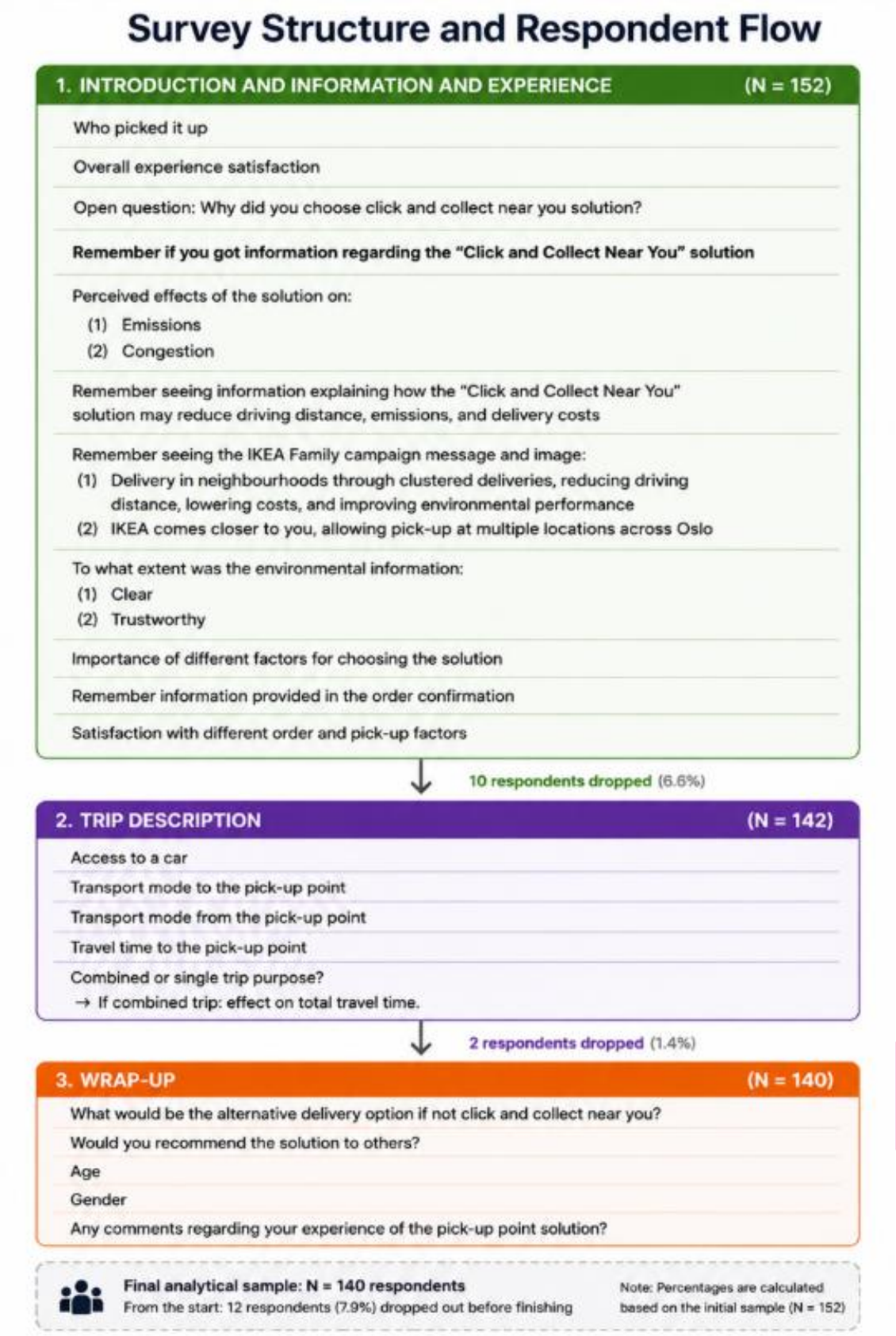


Figure 17 illustrates the survey structure and respondent flow. One can look at the survey in three sections: (1) the main section regarding how respondents received and experienced information regarding the pick-up solution, and the pick-up point itself. Section 2 asked respondents questions regarding the trip and trip choices, while the final section provides information on any alternatives to CCNY and some background information about the respondent.

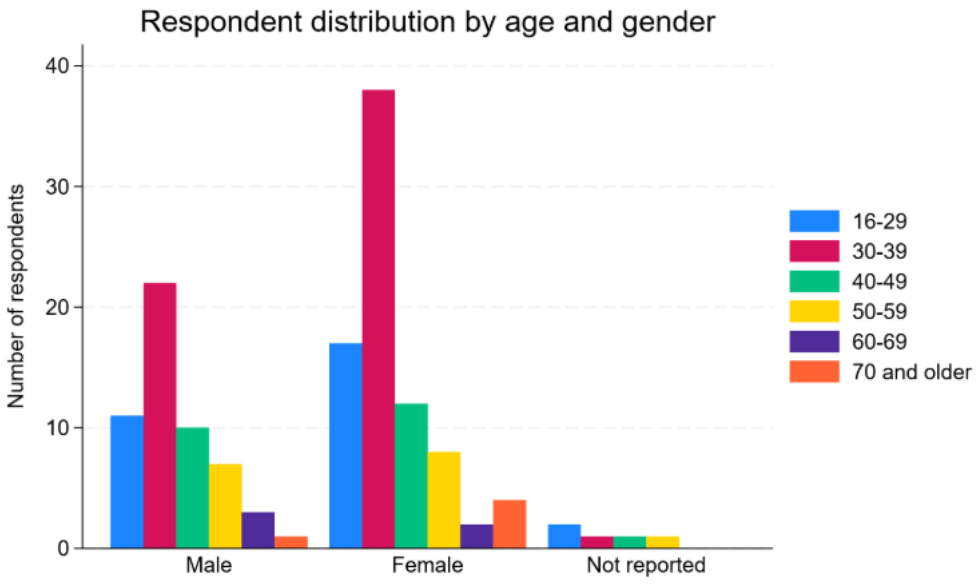
As reported in Figure 17, 152 respondents started at the introduction section. Note that the survey gathered a total of 157 respondents in the data, meaning five respondents dropped out before reaching the introduction. Furthermore, 10 respondents dropped out during the second section and continued through the third section regarding the trip description. In the end a total of 140 respondents completed the entire survey, with a drop rate of 7.9%.

All observations are kept for the analysis, not only fully complete responses. Note that this will yield different numbers of responses in the reported tables and figures.

3.3.2.2 Who are the respondents

The survey gathered a total of 152 respondents, with 140 completing all the questions. Figure 18 illustrates the age distribution of respondents by gender.

Figure 18: Age distribution for each gender category



The age distribution largely follows the same pattern across genders, with most respondents in the samples aged 30-39, followed by ages 16-29, 40-49, and 50-59. There are somewhat more females in the 70-and-older age range.

Furthermore, about 32 % report having access to a car whether through shared or private ownership. Including the possibility of borrowing or using a car-sharing service, about 45 percent of the sample have, in some sense, access to a car. About 21 % report not having a driver's license; together with the age distribution, this indicates that our sample reflects the characteristics of the urban population.

3.3.2.3 Segmentation of consumers to perform the KPI comparison

3.3.2.3.1 For objective 1: increase awareness of the option's sustainability

Objective 1 is about increasing consumers' awareness about the sustainability of CCNY and increase attitude towards CCNY through a message that was added in the confirmation e-mail. As this measure was implemented from the start of the pilot, it is not possible to compare KPIs between consumers who ordered before and after the measure. As an alternative, it is decided to use passive recall of the message to segment consumers in two groups.

Table 36 reports the number and shares of respondents who did or did not see information regarding the new solution before placing an order.

Table 36: Number and share of respondents who report remembering having read the information in the order confirmation

	Freq.	Percent
Yes	23	16.08
No	102	71.33
Don't know	18	12.59
Total	143	100

3.3.2.3.2 For objective 2: A/B test

Objective 2 is about comparing the effect of a sustainability message with a convenience message, through an A/B test conducted in IKEA Family Newsletter. The segmentation of the two consumer groups is based on the passive recall of whether consumers remember the IKEA advertisement with different conveyances, i.e., an environmental message and a convenience message. If they state 'yes ', they are sorted as treated, meaning a stated treatment status, and 'no' or 'don't know' in the control group. Furthermore, since respondents should have received either the environmental (A) or convenience (B) version, we cross-check whether any respondents report receiving both; if so, the response is unreliable. Table 37 reports the number of respondents distributed between stated treatment-control across the A and B-test.

Table 37: Number of respondents in the treatment and control groups in the A and B groups

A/B	Control	Treatment	Total
Control	120	2	122
Treatment	7	28	35
Total	127	30	157

As the table shows, most respondents state that they are not treated, i.e., do not remember having seen the intervention message (which is in line with the low click rate reported by IKEA). Of those

who remember seeing the intervention message, most state that they have seen both (A and B), which is not possible. In total, this means that for A, only 7 respondents report being treated, which is credible, and the number for B is 2. Unfortunately, this means that the sample size is insufficient to make a reasonable comparison.

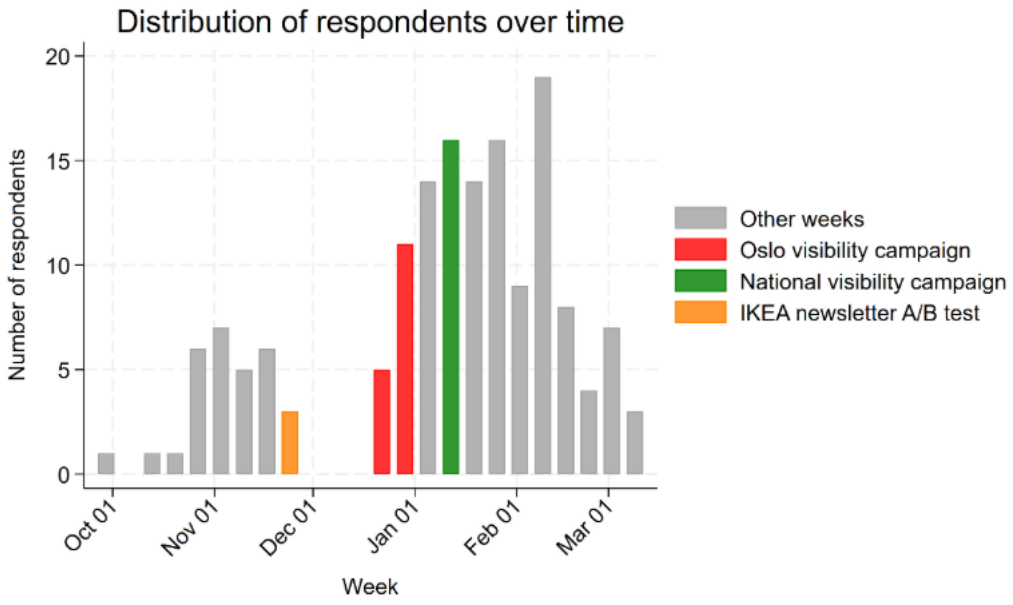
3.3.2.3.3 For objective 3: increase visibility during the pilot

Objective 3 consists in increasing the visibility of the CCNY service through different measures that happened all along the pilot. The KPI comparison will focus on evaluating the effect of the marketing campaign that happened in two steps:

a. between December 2025, 25th and January 2026, 4th, targeting Oslo
b. between January 12th and 18th, at the national level.

Figure 19 shows the distribution of respondents over time, per date of order, together with the different marketing/visibility campaigns.

Figure 19: Distribution of respondents over the week, where the intervention timing is highlighted in different colors.



Based on the intervention's dates reported above and the distribution of orders, three periods of interest should be compared: (1) Before 25 Dec, (2) 25. Dec – 18. Jan and (3) After 18. Jan. The table below reports the number of respondents for each period in our sample.

Period	Freq.	Percent
Before 25 Dec	32	20.38
25 Dec – 18 Jan	44	28.41
After 18 Jan	81	51.59
Total	157	100

3.3.3 KPIs

The KPI selection was done for objective 1 and 3, and not for objective 2 as the sample size does not allow a KPI comparison. The KPIs to assess the communication measures are selected from the framework developed in Deliverable 3.2 (Pernot et Phillips, 2025) according to the communication objectives and the chosen communication paths.

3.3.3.1 For objective 1: increase awareness of the option's sustainability

As the objective of this communication measure is to increase awareness of the option's sustainability, the expected communication pathway is first that consumers trust the content of the message (KPI 5). The aim is then for this increased awareness of the sustainable option (KPI 7) to influence consumers' attitudes and intentions to use CCNY for their next purchase (KPI 13).

To achieve this, the communication should help make sustainability a more prominent consideration among the different goals consumers have when choosing a delivery option (KPI 15). At the same time, it should not negatively affect the customer satisfaction with online check-out (KPI 4), overall experience (KPI 17) or the clarity of information on how to collect the order (KPI 18). Finally, the intended outcome is an increase in the share of orders using CCNY (KPI 23).

Table 38 reports the selected KPI numbers and their corresponding descriptions, also associated with the relevant question in the survey, and how the results from the survey have been chosen to be operationalized to match the KPI.

Table 38: KPI related to objective 1, KPI description, survey question used, and how it's operationalized.

KPI number	KPI description	Data source	How operationalized
4	Satisfaction with online check-out	Survey: question 12 – two alternatives	Percent reporting Somewhat satisfied and very satisfied info pick-up point/info possible pick-up time
5	Trust in message	Survey: question 9 – second alternative	Percent of respondents reporting from a fairly large to very large extent
7	Awareness of sustainable delivery choice	Survey: question 5 – two alternatives	Percent of respondents stating 'yes'
13	Intention to choose target delivery option next time	Survey: question 20	Mean value of the scale 0 - not likely; 10 – very likely
15	Ranking of sustainability among other goals	Survey: question 10	Mean-ranked (1-5) factors between price, delivery time, convenience, time of pickup, and environment. AND share of respondents stating that environment is important.
17	Experienced satisfaction	Survey: question 2	Percent of respondents stating that total satisfaction: somewhat and very
18	Know-how to collect	Survey: question 12 – two alternatives	Percent of respondents reporting somewhat or very satisfied with information during delivery travel AND how easy it was to find

3.3.3.2 For objective 3: increase visibility during the pilot

As the objective of this communication measure is to increase the visibility of CCNY, the expected communication pathway is first that the message is noticed, remembered and retained by consumers (KPI 1). The aim is then for this increased visibility to strengthen consumers' intention to choose CCNY for their next purchase (KPI 13).

To achieve this, the communication should seek to reinforce, or at a minimum preserve, the importance of sustainability in consumers' decision-making (KPI 15). At the same time, it should not negatively affect satisfaction with the checkout (KPI 4), the overall customer experience (KPI 17), or the clarity of information on how to collect the order (KPI 18). Finally, the intended outcome is an increase in orders using CCNY (KPI 23).

Table 39: KPI related to objective 1, KPI description, survey question used, and how it's operationalized.

KPI number	KPI description	Data source	How operationalized
1	Retention of message	Survey: no update of the survey to include a question on recall of this new measure. But we can use question 4.	Percent who remember having seen information before ordering
4	Satisfaction with online check-out	Survey: question 12 – two alternatives	Percent reporting Somewhat satisfied and very satisfied info pick-up point/info possible pick-up time
13	Intention to choose target delivery option next time	Survey: question 20	Mean value of the scale 0 - not likely; 10 – very likely
15	Ranking of sustainability among other goals	Survey: question 10	Mean-ranked (1-5) factors between price, delivery time, convenience, time of pickup, and environment. AND share of respondents stating that environment is important.
17	Experienced satisfaction	Survey: question 2	Percent of respondents stating that total satisfaction: somewhat and very
18	Know-how to collect	Survey: question 12 – two alternatives	Percent of respondents reporting somewhat or very satisfied with information during delivery travel AND how easy it was to find

3.3.4 Assessment summary

3.3.4.1 Customer experience - the 'click and collect near you' solution and its information/advertisement

Table 40 presents respondents' satisfaction with the pickup experience. The scales are aggregated to capture positive (important) and negative (unimportant) responses, yielding a full distribution of the six-point scale (in addition to the Don't know alternative); see Appendix 4. Percentages are calculated within each attribute, and the total number of observations is given in the last column, N.

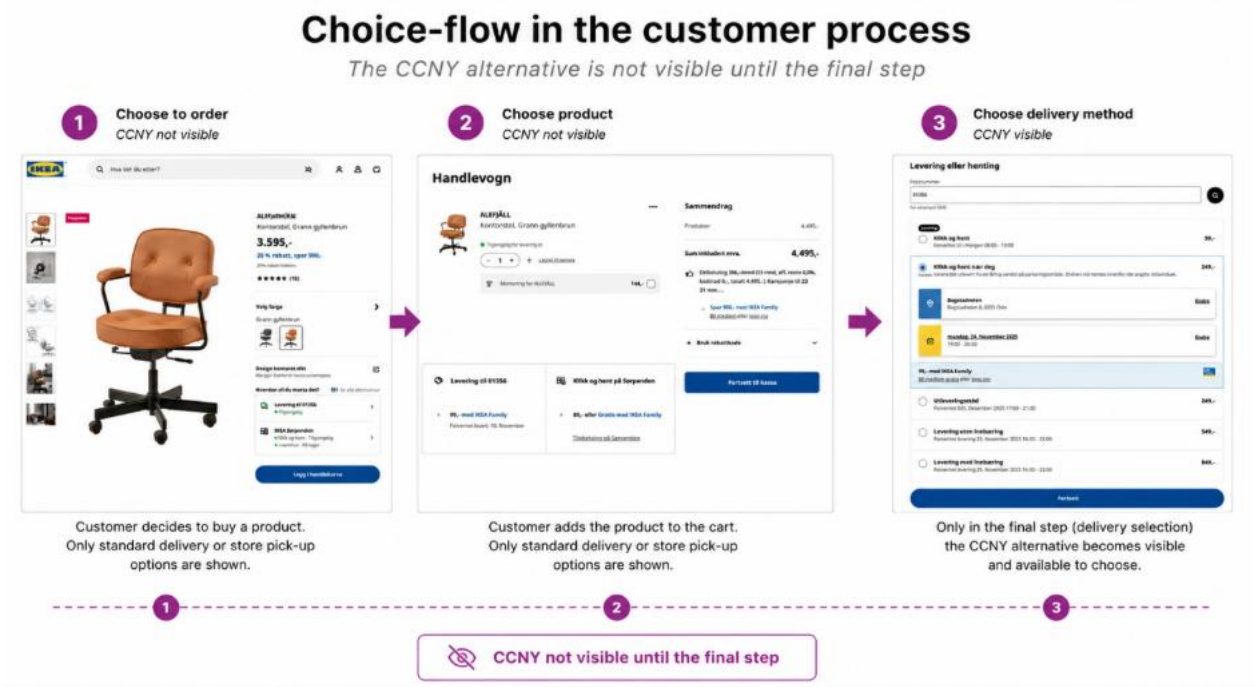
Overall, respondents reported high levels of satisfaction with the pickup experience. The highest satisfaction levels were observed for information provided during delivery (79%), followed by ease of finding the pickup point (76%) and information about the possible pickup time (75%). Satisfaction was somewhat lower for information about the pickup point itself, although two-thirds of respondents (66%) still reported being satisfied. Results suggest that customers were generally satisfied with the CCNY experience, particularly with communication during delivery and the practical aspects of order pickup.

Table 40: Satisfaction with pickup experience

Factor	Satisfied	Not satisfied	Neutral	Don't know	N
Information during delivery	78.7 %	10.6 %	8.5 %	2.1 %	141
Easy to find pickup point	76.4 %	14.3 %	6.4 %	2.9 %	140
Pickup time information before ordering	74.6 %	9.9 %	13.4 %	2.1 %	142
Pickup point location information before ordering	66.2 5%	16.2 %	14.8 %	2.8 %	142

The share of dissatisfied respondents ranged from 10% to 16%, with the highest level of dissatisfaction related to information about the pickup point. We suspect this also reflects a lack of information about CCNY, as only 10% of respondents remembered seeing information about it before ordering. Which is in line with the fact that CCNY is presented only on the last page of checkout for the final selection of the delivery option. To give an impression of the information provided on the IKEA homepage, a step-by-step overview of the ordering process is presented in Figure 20.

Figure 20: Choice-flow at the IKEA homepage. From picking products to finalizing the order.



First, when a customer is browsing the IKEA website and viewing different products, two delivery options are advertised on each product page: home delivery and pickup at the warehouse.

Furthermore, when selecting the products and proceeding to the shopping cart, the same (two) delivery options are advertised, step 2 in Figure 20. Only when in the final step before payment, step 3, is CCNY presented as one of five options.

3.3.4.2 Choice of delivery option and environmental aspects

Table 41 presents respondents' assessments of the importance of pick-up attributes. The scales are aggregated to capture positive (important) and negative (unimportant) responses, yielding a full distribution of the six-point scale (in addition to the Don't know alternative); see Appendix 4. Percentages are calculated within each attribute, and the total number of observations is given in the last column, N.

Table 41: Importance of pick-up attributes

Factor	Important	Neutral	Unimportant	Don't know	N
Convenient pick-up location	92.4 %	2.8 %	2.8 %	2.1 %	145
Price	89.7 %	5.5 %	3.4 %	1.4 %	146
Pick-up time	82.2 %	7.5 %	8.9 %	1.4 %	146
Order-to-delivery time	78.8 %	11.0 %	8.9 %	1.4 %	146
Environmental impact	39.0 %	26.7 %	29.5 %	4.8 %	146

The results indicate that convenient pick-up location, price, pick-up time, and order-to-delivery time were the most important factors when choosing CCNY. Convenient pick-up location was rated as important by more than nine in ten respondents (92%), followed by price (90%), pickup time (82%), and order-to-delivery time (79%). In contrast, environmental impact was considered important by a substantially smaller share of respondents (39%), while nearly one-third (30%) regarded it as unimportant. These results are broadly in line with the literature (Buldeo Rai et al. 2018; Nguyen et al. 2019) and with the results of the CodeZERO survey, which shows that only a fourth of consumers are sustainability-driven, while the rest are either price-sensitive or convenience-oriented (Cauwelier et al. 2025).

From an economic perspective, it's interesting that almost 40% say environmental impact is important, suggesting that, on the margin, environmental factors could affect a large proportion of customers. And that about 1 in 4 is neutral could indicate that this proportion would choose the environmentally friendly delivery, all else equal. Overall, this suggests there may be ways to influence IKEA customers' delivery selection by emphasising the environmental impact of delivery. However, the findings suggest that practical considerations related to convenience, cost, and timing were the primary drivers of CCNY use, whereas environmental considerations played a less prominent role in respondents' decision-making.

Table 42 reports the perceived effects of choosing CCNY instead of home delivery on emissions and congestion as increased, reduced, or I don’t know.

Table 42: Perceived effects of choosing CCNY instead of home delivery

Factor	Increased	No change	Reduced	Don't know	N
Emissions	8.6 %	15.1 %	62.2 %	13.2 %	152
Congestion	3.9 %	18.4 %	61.8 %	15.8 %	152

The majority of respondents expect reduced emissions and congestion for the CCNY compared to home delivery, while a small proportion of the sample believe it would increase or remain unchanged. Unfortunately, the data storage process had challenges regarding these two questions and the raw data received collapses the alternatives: No change and Reduction. The split of those in Table 42 is based on direct reports from the IKEA system. As we do not have access to this in the raw data, further analysis of the perceived effects on emissions and congestion is based on the following alternatives: Don’t know, Increased, and No change + Reduced collapsed together.

Table 43 and Table 44 show whether customers who consider environmental impact as important or unimportant have a higher tendency to believe that the solution will also reduce (or give no change) emissions (Table 43) and congestion (Table 44).

Table 43: Environmental importance by perceived effect on emissions

Effect on emission	Environmental impact is considered			N
	Important	Unimportant	Don't know	
Don't know	11.8 %	41.2 %	47.1 %	17
Increased	46.2 %	15.4 %	38.5 %	13
No change or reduced	42.2 %	29.3 %	28.4 %	116

Table 44: Environmental importance by perceived effect on congestion

Effect on congestion	Environmental impact is considered			N
	Important	Unimportant	Don't know	
Don't know	18.2 %	40.9 %	40.9 %	22
Increased	50.0 %	0.0 %	50.0 %	6
No change or reduction	42.4 %	28.8 %	28.8 %	118

Findings should be interpreted with caution as the distribution of responses was highly unbalanced. The vast majority of respondents believed that CCNY reduces emissions and congestion, while only a small number believed it increases them. Consequently, the estimates for the latter group are based on very few observations and are therefore subject to considerable uncertainty. That said, Table 43 and Table 44 suggest that CCNY customers who value the environment more tend to believe CCNY increases emissions and congestion. A hypothesis to explain this correlation could be that customers who value the environment are more pessimistic about the environmental impact of new delivery solutions.

Table 45 presents the share of respondents who perceived information about the environmental benefits of CCNY as clear and trustworthy, measured as the percentage responding, where "to a fairly large extent" or "to a very large extent" and “to a very small extent” and “to a fairly small extent”, “Don’t know” & “Neither” are collapsed. The last column shows the total number of observations.

Table 45: Perceptions of environmental information

Factor	Large extent	Small extent	Neutral & don’t know	N
Clear environmental message	42.7 %	26.0 %	31.3 %	150
Trustworthy environmental message	67.3 %	10.7 %	22.0 %	150

The results indicate that respondents generally perceived the environmental information positively, particularly regarding its trustworthiness. About seven in ten respondents (67.3%) reported finding the environmental message trustworthy to a fairly large or very large extent. In contrast, fewer than half (42.7%) reported that the message was clear to the same extent. This suggests that while respondents tended to trust the environmental information provided, there may be room to communicate the message more clearly and effectively.

Do people who perceive the environmental message as clear and trustworthy place greater importance on environmental considerations and believe that CCNY has environmental benefits?

Table 46 reports how important the environment is (%), by giving the share who rated environmental impact as important, neither and don't know, or unimportant when choosing CCNY. N denotes the number of respondents in each trust category. As such, it examines the relationship between trust in the environmental information provided about CCNY and the importance attached to environmental considerations

Table 46: Trust in environmental information over how important respondents report environmental factors are.

	Environmental impact is considered			N
	Important	Neither and don't know	Unimportant	
Low trust	18.75 %	18.75 %	62.50 %	16
Neutral trust	25.0 %	43.75 %	31.25 %	32
High trust	46.9 %	29.60 %	23.50 %	98

From Table 46, we see that respondents reporting high trust in the environmental information were substantially more likely to consider environmental impact important. Similarly, low trust in the message is associated with a higher likelihood of considering environmental aspects unimportant. As such, the results indicate a clear association between trust and environmental perceptions. However, one should not interpret it as evidence of a causal relationship, but rather as an indication of some mechanism.

Moreover, when looking at trust and the expected effect of a CCNY solution (Table 47), this indication is further strengthened.

Table 47: Trust level over the effect of CCNY on emission and congestion.

	Emission		Congestion	
	Increased	**Decreased or neutral**	**Increased**	**Decreased or neutral**
Low trust	15.38 %	8.47 %	16.67 %	8.26 %
Neutral trust	23.08 %	18.64 %	33.33 %	19.83 %
High trust	61.54 %	72.88 %	50.00 %	71.90 %
N	13	118	6	121

When respondents believe that CCNY has a decrease or neutral effect on emissions, they have somewhat higher trust in the environmental message provided. The same patterns are even more prominent when looking at the effect on congestion. This indicates that awareness of the consequences of delivery choice is associated with higher trust in sustainability information. Note, however, the skewness of the sample, as most respondents believe it will decrease or be neutral for both emission (118) and congestion (121). Results should be interpreted with caution.

Looking at the same aspect regarding the perceived clarity of the environmental message, Table 48 reports the relationship between clear perception and the importance of environmental factors.

Table 48: Clarity level by how important the environmental aspect is.

	Environmental impact is considered			N
	Important	Neither and don't know	Unimportant	
Low clarity	38.46 %	30.77 %	30.77 %	39
Neutral clarity	23.91 %	34.78 %	41.30 %	46
High clarity	50.82 %	29.51 %	19.67 %	61

As with trust level, those who report that the environmental aspect is important also perceive the environmental message more clearly. Taken together, this could indicate that those who are more concerned with the environmental aspect pay closer attention and perceive related messages as clearer and more trustworthy. Notes that when considering the message at a neutral level, most also report that environmental aspects are unimportant (41,3 percent). While those who report low clarity are quite divided on how important the environmental aspect is. This contrasts with low trust, which indicates that the environmental aspect is unimportant. As such, it might imply that trust is more strongly correlated with a pro-environmental focus, regardless of message clarity.

To further investigate clarity, Table 49 reports the distribution of clarity levels by the expected effect on emissions and congestion, respectively.

Table 49: Distribution of clarity levels by expected effect on emissions and congestion.

	Emission		Congestion	
	Increased	**Decreased or neutral**	**Increased**	**Decreased or neutral**
Low clarity	15.38 %	27.12 %	16.67 %	25.62 %
Neutral clarity	46.15 %	27.12 %	33.33 %	30.58 %
High clarity	38.46 %	45.76 %	50.00 %	43.80 %
N	13	118	6	121

There is a slightly higher level of high clarity when respondents also report expecting and neutral or decreased emission – while the reverse is true when looking at congestion. This might be because a few respondents report that they think the solution would increase congestion (6).

Looking at those who report a decreased or neutral effect, the distribution of clarity levels seems similar for both emission and congestion. Indicating that the effects on emissions and congestion are connected, and that those expectations also might affect how clearly the message is perceived.

3.3.4.3 Effect of communication interventions

3.3.4.3.1 For objective 1: Increase awareness of the option's sustainability

Table 50 reports the KPI measures by customer category: (1) customers who remember the sustainability message in the confirmation e-mail and (2) customers who don't remember the message. Details about each KPI are given in Table 38.

Table 50: KPI values for customers who do and do not remember the sustainability message in the confirmation e-mail.

KPI number	KPI description	Customers who remember the message in the confirmation e-mail	Customers who DON'T remember the message in the confirmation e-mail
KPI 4	Satisfaction with online check-out	77.3 %[19]	63.9 %
		86.4 %[20]	72.3 %
KPI 5	Trust in the message	69.9 %	66.7 %
KPI 7	Awareness of sustainable delivery choice	91 %[21]	97 %
		91 %[22]	91 %
KPI 13	Intention to choose CCNY next time	7.95	8
KPI 15	Ranking of sustainability among other goals	4 (shared last: equal with possible pickup time)	4 (marginally above possible pickup time)
KPI 17	Experienced satisfaction with delivery option chosen	91 %	86 %
KPI 18	Know-how to collect	77.3 %[23]	78.8 %
		77.3 %[24]	76.3 %

[19] Satisfaction with information found about the location of the pickup point before the order is placed.

[20] Satisfaction with information received about possible pickup times before the order is placed.

[21] Awareness that CCNY may reduce congestion, or at least have no negative effect on it.

[22] Awareness that CCNY may reduce emissions, or at least have no negative effect on it.

[23] Percent of respondents reporting somewhat or very satisfied with information during delivery travel

[24] Percent of respondents reporting somewhat or very satisfied with how easy it was to find

KPI 4 shows higher values among consumers who recall the message in the confirmation email, indicating that the intervention does not appear to negatively affect the customer experience at checkout. This result is unsurprising, as the intervention does not take place during checkout and this was not the primary reason for selecting the KPI. Nevertheless, it is interesting to note that customers who recall the message also evaluate the checkout experience more positively. This may suggest that these consumers pay greater attention to information presented on the website and in emails. They also appear to be more positive towards CCNY overall, as reflected in the slightly higher value for KPI 17.

KPIs 5, 7, 13, 15, and 18 do not show significant differences between the two groups. In particular, KPI 7 indicates that awareness is high among both groups which does not highlight any effect of the message communicated. KPIs 13 and 15 suggest that the communication measure does not affect either the intended choice of delivery option or on the relative importance of environmental factors compared to other goals like price or convenience. The intention of choosing CCNY for a future purchase is relatively high in both groups, indicating that other factors other may play an important role. One possible explanation is that this intention is already relatively high among all consumers who used the service, leaving limited possibilities for an awareness intervention to raise it further. It would be interesting to extend the study to consumers who did not use the service during the pilot in order to better understand the potential barriers and study the effects of communication campaigns among them.

3.3.4.3.2 For objective 3: Increase visibility during the pilot

Table 51 reports the KPI measured for customers who ordered during three different periods marked by different communication interventions. Details about each KPI are given in Table 39.

Table 51: KPI measures for three periods during the pilot

KPI	KPI description	Customers who ordered before December 25th	Customers who ordered between December 25th and January 18th	Customers who ordered after January 18th
KPI 1	Retention of message	21.8 %	15.91 %	2.56 %
KPI 4	Satisfaction with online check-out	75.86 %[25]	64.10 %	63.51 %
		82.76 %[26]	74.36 %	71.16 %
KPI 13	Intention to choose CCNY next time	8.24	7.18	8.34
KPI 15		4	4	4

[25] Satisfaction with information found about the location of the pickup point before the order is placed.

[26] Satisfaction with information received about possible pickup times before the order is placed.

	Ranking of sustainability among other goals	46.7%[27]	43.9%	33.8%
KPI 17	Experienced satisfaction with the delivery option chosen	81.25 %	75.0 %	89.47 %
KPI 18	Know-how to collect	86.20 %[28]	76.32 %	77.03 %
		78.57 %[29]	73.68 %	77.02 %

KPI 1 measures the proportion of customers who recall seeing information about CCNY before placing their order. Although this proportion is generally low, it decreases significantly over the course of the pilot despite the visibility campaign conducted through social media and the newsletter. This suggests that the survey does not capture a measurable effect of the marketing campaign. The higher values observed at the beginning of the pilot may partly reflect the presence of early adopters, who are likely to be more attentive to information about new services. The sample from the final period may therefore be more representative of the broader customer population. The absence of an observable campaign effect suggests that IKEA should consider additional ways of increasing the visibility of CCNY beyond social media and newsletter campaigns.

The share of respondents stating that environmental considerations are important (KPI 15) also decreases over the pilot period. This may be partly related to the increase and diversification of the sample over time. It may also reflect an early-adopter effect, as early adopters may differ from the wider customer population and place greater importance on environmental issues.

Intention to use CCNY, measured by KPI 13, remains relatively stable over time. This is positive in the sense that the intention does not decline and was already relatively high at the beginning of the pilot. However, the stability of the indicator also suggests that the communication interventions did not produce a measurable increase in customers' intention to choose CCNY.

Satisfaction with the checkout experience, measured by KPI 4, and customers' understanding of how to collect their orders, measured by KPI 18, both decrease over time. IKEA should therefore consider whether the communication provided during the customer journey could be improved, particularly regarding the collection process.

Satisfaction with the CCNY option varies over time and reaches its highest level at the end of the pilot. Although this is a positive result, it is likely to be more closely related to the quality of the service itself than to the communication intervention.

[27] Share of respondents stating that the environment is important.

[28] Percent of respondents reporting somewhat or very satisfied with information during delivery travel

[29] Percent of respondents reporting somewhat or very satisfied with how easy it was to find

3.3.4.4 Conclusion

The assessment of objective 1 does not show a correlation between the communication intervention and awareness, which was the initial intention. Awareness is high in both groups (those who recall the message and those who do not), indicating that consumers who used the CCNY service are already quite aware of the impact of the solution. Intention is also quite high among all customers potentially due to satisfaction with the service. This indicates that the message included in the confirmation e-mail did not have a significant impact. One interpretation is that early adopters of an out-of-home delivery service might already be quite aware of its sustainability benefits. Sustainability communication should therefore be conducted through channels other than solely confirmation e-mails, as these only reach consumers who have already used the service and may already be aware of its sustainability implications.

In addition, sustainability communication was globally considered clear and trustworthy, particularly among those with high awareness. A perspective for future research would be to better understand the reasons why customers with lower awareness consider the message less clear and less trustworthy. Our results indicate that this could be considered when refining G1, G3 and G11. Communication clearness and trustworthiness also need to be assessed through the eyes of those who know less about environmental issues.

The assessment of objective 2 was unfortunately not possible, meaning that we cannot conclude on the effects of the two tested messages, as well as on the use of the green leaf (G2).

Regarding objective 3, the assessment shows that it has not been achieved as the visibility of the service decreases over time despite the communication interventions.

Some channels were used at different points of the customer journey (SoMe, Newsletter) but very little was done on IKEA's website at the actual moment of choice for consumers. The option was only visible at check-out, indicating that G6 (make the option stand out) should not only focus on making the option stand out at check-out but also at other moments in the consumer journey, especially when implementing a brand-new delivery option that consumers don't know about. The new option should stand out early in the consumer journey and different communication channels should be explored to target these early steps (G16).

Only consumers who used CCNY were surveyed making it difficult to know whether other customers noticed the option at the check-out and thus to assess how well the option stood out (G6) and whether the ranking by price was effective (G9). The evaluation of KPIs related to know-how also shows a potential for improvement on providing consumers actionable plans for out-of-home collection (G17). It would be interesting to know if customers who did not choose CCNY understood how the option works and knew what they were supposed to do if they had chosen it.

4 Living lab in Utrecht

4.1 Context, delivery and communication solutions synthesis

The Municipality of Utrecht aims to protect its historic inner city, and in particular its ageing quay walls. Due to the fragility of these quays, a weight restriction applies to vehicles entering the affected streets. In addition, a zero-emission zone is enforced to improve liveability for residents. The combination of these two measures means that parts of the city centre are inaccessible even to conventional electric vans. Within this context, logistics service providers and e-commerce retailers are investigating how orders can still be delivered to these streets without adversely affecting the city.

The Utrecht Living Lab of CodeZERO focused on Jumbo home deliveries, which the retailer carries out with its own fleet. Jumbo is one of the largest Dutch grocery chains, with physical stores throughout the Netherlands and a strong online presence. Grocery home deliveries are characterised by large order volumes and a requirement for cooled conditions, which makes them traditionally difficult to be performed efficiently with small electric vehicles. Distribution centres of grocery chains are typically located at a considerable distance from the recipient, which further complicates the use of small vehicles, due to their limited range in comparison to standard delivery vans.

The pilot is distinctive in its use of a mobile micro-hub from which last-mile deliveries are executed by a light electric vehicle (LEV) or a bicycle cargo trailer (see an impression picture of the transport equipment deployed at the micro-hub location: LEV, and the bicycle cargo trailer).

Figure 21 LEV and bicycle cargo trailer deployed in pilot in Utrecht





The mobile micro-hub, a large electric van, drives to a central location in the city centre. From there, the LEV or bicycle cargo trailer delivers groceries to customers' homes and returns to the micro-hub to reload. When the van is empty, it returns to the depot to be restocked before driving back to the central location for further deliveries. Through this fulfilment model, Jumbo can serve customers in the historic city centre with minimal impact on the surrounding urban environment and reach customers in addresses that were previously inaccessible.

Communication played a supporting rather than a steering role in the Utrecht Living Lab. As Jumbo's grocery delivery model does not offer customers a choice between delivery vehicles, the vehicle used is determined by the delivery address and the operational planning, not by the consumer, there was no decision moment at check-out that communication could influence. The communication effort was therefore designed to build awareness and acceptance of the pilot among residents and customers in the pilot area, rather than to shift delivery choices. This makes the Utrecht case a useful contrast to pilots where a consumer-facing choice architecture is available: it shows what communication can and cannot do when the sustainable option is implemented "behind the scenes".

4.2 Assessment of delivery options implementation

4.2.1 Delivery options assessed

The pilot started in mid-January and ran for four months. The assessment compares conventional van-based home delivery (Option A) with delivery via the mobile micro-hub (Option B). A third option was also investigated during the pilot, which involved direct delivery from the fulfilment centre to consumers using the LEV, but this option is not evaluated here, as only Options A and B follow directly from the results of the CodeZERO co-creation workshops.

Two data sources underpin the assessment: Jumbo itself tracks orders and vehicles using the handheld terminals used by their delivery personnel. This provides insight into delivery time, stop time, distance driven, but also vehicle loading capacity was during the trip.

Jumbo distributes an online survey to new customers to assess their experience of online grocery shopping. Option B requires the mobile micro-hub to drive to the city centre and cross-dock products to the LEV or bicycle cargo trailer. When comparing the LEV with the bicycle cargo trailer, the time required for the micro-hub to reach the city centre and for cross-docking is excluded, as it is identical for both and was not tracked by Jumbo.

Table 52 Overview of orders delivered during the pilot with the LEV and bicycle cargo trailer

	LEV	Bicycle cargo trailer
Number of orders	200.0	65.0
Orders on time (%)	89.5%	93.8%
Volume capacity (%)	78.5%	78.6%
Weight capacity (%)	49.2%	84.4%
Orders not planned (%)	10.3%	6.2%
Number of routes	43.0	29.0
Number of shifts	18.0	8.0
Orders per route	4.26	2.10
Routes per shift	2.39	3.63
Orders per hour	2.93	2.59
Planned time per route	3.47	2.94
Realised distance per order	1.62	2.52
Realised stopping time per order	7.74	7.44

As the results show, the bicycle cargo trailer delivered substantially fewer orders than the LEV over the pilot period. This is primarily explained by its lower capacity: the trailer carried 2.10 orders per route on average, while the LEV carried more than double that at 4.26. The trailer therefore reaches its limit on both weight (84.4% utilisation) and volume (78.6%), whereas for the LEV weight is not a binding constraint (49.2%) and volume is the limiting factor (78.5%). This reflects the nature of online grocery orders, which are typically high in volume but low in weight.

The bicycle cargo trailer achieved shorter stopping times per order (7.44 minutes versus 7.74) and higher punctuality (93.8% of orders on time versus 89.5%), most plausibly because of its greater manoeuvrability in the narrow streets of the inner city and the resulting predictability of its travel times. However, its limited capacity means it completes fewer orders per hour (2.59 versus 2.93) and must return to the micro-hub more frequently, which increases total operational time and cost per order. The realised distance per order is also markedly higher for the trailer (2.52 km versus 1.62 km), reflecting the additional return trips to the hub.

A further observation concerns planning reliability. The share of orders that could not be planned was higher for the LEV (10.3%) than for the trailer (6.2%), which suggests that capacity constraints translate into planning failures somewhat differently for the two vehicles: the trailer's constraints are known and absorbed in advance, while the LEV was used for a broader and more variable set of orders.

4.2.2 Key KPIs driving the comparison

Deliverable 3.1 developed a KPI framework, which is used here to assess the performance of the Utrecht Living Lab. In particular, six different demand-side KPIs, four supply-side KPIs, and four impact KPIs have been used for the assesment. An important note is that, as mentioned earlier, for the comparison the time needed for cross-docking and driving towards the micro hub is not included in the analysis because of limited data availability. This exclusion favours Option B for those KPIs that relate to time and distance, and the results below should be read with that caveat in mind.

4.2.2.1 Demand KPIs

On the demand side the KPIs are mostly focused on ensuring that the delivery of the goods is aligned with the needs and expectations of the customers. As the delivery process differs between the pilot and normal scenario, there demand KPIs are most important as they indicate if the customer experience better or worse performance due to the pilot.

The delivery time attribute is particularly important for grocery deliveries, as customers must be at home to receive their goods. Punctuality is therefore essential to ensure that customers are available during the communicated delivery time slot. Additionally, it is important that the customer receives all the goods they ordered. Due to weight and capacity constraints of the delivery method this might not always be feasible.

Table 53: Demand side KPIs applicable to the Utrecht Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*[30]	*Delivery option A (base)*	*Delivery option B (pilot)*
Delivery time	Delivery time slot punctuality	Share of deliveries made in the announced/chosen time slot	%	↑	92%[31]	90%
Delivery time	Products consolidation	Share of deliveries including all ordered products as requested	%	↑	85%[32]	89%
Delivery method	Point of delivery	Delivery point index: - Any place: 3 - Any place in non-low emission zones: 2 - Any place in non-vehicle restricted areas: 1	Adimensional	↑	2	3
Delivery method	Vehicle type	Vehicle type index: - Conventional ICE vehicle: 1 - Zero emission motorised vehicle: 2 - Bike/Cargo bike: 3 - Driverless vehicle (bot, drone): 4	Adimensional	↑	2	3
Reliability	Products safety	Share of deliveries without damaged products	%	↑	99%[33]	99%
Reliability	Actual delivery	Number of reported unfounded communications per 100 deliveries	%	↓	0%[34]	1%

4.2.2.2 Supply - context KPIs

For the supply context the related KPIs are related to the focus of the pilot, which is minimising the impact on the historical city center due to the use of a micro-hub and alternative delivery vehicles. Therefore, the supply KPIs related to these are of relevance for this analysis. As the alternative delivery methods influence the needed number of vehicles and thus drivers this attribute is also of relevance. The use of a micro-hub influences the spatial urban area and is therefore important to include in the analysis.

[30] **Direction***: Indicates whether a higher value (↑ **Upwards**) or a lower value (↓ **Downwards**) represents better performance for the KPI within the assessment framework.

[31] Confidential information

[32] Confidential information

[33] Confidential information

[34] Confidential information

Table 54: Supply - context KPIs applicable to the Utrecht Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Delivery option A (base)*	*Delivery option B (pilot)*
Size and composition of the vehicle fleet	Delivery vehicles - Total vehicles	Number of vehicles required to complete N (e.g.10k) deliveries per week in an area of X (e.g.180) square km	N° of vehicles	↓	0.064[35]	0.243
Size and composition of the vehicle fleet	Delivery vehicles by type and technology	I = 0.5*ICE_Share + 1*EV_Share + 2*B/C_Share + 3*AUT_Share where: -ICE_Share: Share of internal combustion engine vehicles (trucks and vans) on total vehicles used to complete N_{ICE} deliveries per week in an area of X square km -EV_Share: Share of electric vehicles (trucks and vans) on total vehicles used to complete N_{EV} deliveries per week in an area of X square km -B/C_Share: Share of non motorised vehicles (bikes and cargobikes) on total vehicles used to complete $N_{B/C}$ deliveries per week in an area of X square km -AUT_Share: Share of driverless vehicles (drones, bot) on total vehicles used to complete N_{AUT} deliveries per week in an area of X square km	Adimensional	↑	0.7[36]	1.5
Workforce arrangement	Number of drivers - Total	Number of driver units required to complete N (e.g.10k) deliveries per week in an area of X (e.g.180) square km	N° of drivers	↓	0.064[37]	0.243
Spatial arrangement	Micro-hubs	Number of micro-hubs in urban area	Sites/km^2		0	1

4.2.2.3 *Impacts KPIs*

The impact KPIs reflect the operational efficiency of the pilot compared to the conventional delivery scenario. Therefore, all attribute types are classified as service efficiency attributes. While additional attributes, such as driver workload, driver retention and recruitment potential, and customer retention, would also provide valuable insights, these could not be included due to limitations in data availability. Nevertheless, the selected attributes provide important insights into the efficiency of the pilot compared to the normal situation. This is particularly relevant for retailers, as any future upscaling of the concept will need to be both operationally and economically viable.

[35] Confidential information

[36] Confidential information

[37] Confidential information

Table 55: Impact side KPIs applicable to the Utrecht Living Lab

Attribute type	*Attribute*	*Indicator*	*Unit*	*Direction*	*Delivery option A (base)*	*Delivery option B (pilot)*
Service efficiency	Vehicles load factor	Share of vehicles used for delivery departing from warehouses with a load factor equal or above 75% of the carrying capacity	%	↑	80%[38]	79%
Service efficiency	Shipments consolidation by type of vehicle	Average deliveries per tour per type i vehicle	Number/tour	↑	4.651[39]	4.287
Service efficiency	Total delivery time	Time needed to complete D deliveries in an area of X square km by all types of vehicles. T = ∑(i) Ti where Ti: Time needed by vehicle type i to complete Di deliveries in an area of X square km and D= ∑(i) Di	Hours	↓	3.11[40]	2.792

4.2.3 Stakeholder-weighted assessment results

4.2.3.1 Consumers perspective

From a consumer perspective, the two delivery options perform almost equivalently, with Option B scoring marginally higher on the cumulative demand-side assessment (65.86 versus 64.23). This near-parity is the central finding: the mobile micro-hub and small delivery vehicles do not materially degrade the service consumers receive. Option B performs better on delivery time and delivery method, reflecting punctuality gains and the suitability of smaller vehicles in the historic inner city, but these gains are largely offset by a lower cost score due to lower vehicle productivity and the additional handling step at the micro-hub. Flexibility and information remain unchanged, while reliability is marginally lower because larger grocery orders are harder to accommodate.

The key consumer trade-off is therefore between cost and delivery quality. As long as the additional cost is absorbed by the retailer, as it was during the pilot, consumers experience a marginally better service. If the cost difference were passed on, this advantage would likely disappear. The attractiveness of Option B could improve if vehicle capacity increases and especially if access restrictions become stricter.

Public impacts substantially strengthen the consumer-side case for Option B, which scores far higher than Option A (59.84 versus 34.93), mainly because of environmental benefits from shifting the final leg to small vehicles and, to a lesser extent, positive labour impacts reported by drivers. The main drawback is transport impact: replacing one larger vehicle with several smaller ones increases vehicle movements, a concern also raised by residents. Overall, Option B appears attractive from a consumer perspective when service levels and prices remain unchanged, but consumers suggested that convenience remains decisive and are unlikely to select a retailer solely on the basis of delivery sustainability.

[38] Confidential information

[39] Confidential information

[40] Confidential information

Table 56: Demand side attributes – Utrecht

Attribute type	Result Delivery Option A	Result Delivery Option B
Cost	3,69	2,63
Flexibility	23,13	23,13
Delivery time	14,12	15,92
Delivery method	4,93	5,95
Information	4,89	4,89
Reliability	13,47	13,35
Cumulative	64,23	65,86

Table 57: Public impacts for consumers – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	8,4	42,0
Transport impacts	5,6	3,8
Labour impacts	14,0	20,9
Cumulative	34,93	59,84

4.2.3.2 Retailers perspective

Supply-side attributes: From the retailer's perspective the assessment reverses: Option A scores higher on the cumulative supply-side attributes (65.4 versus 60.7). The mobile micro-hub option performs better on service organisation (32.8 versus 30.5) and distribution network (17.60 versus 16.96), reflecting the operational proximity that the micro-hub creates between the vehicle and the delivery area. These gains are outweighed by two significant penalties: size and composition of the vehicle fleet (4.19 versus 7.70) and workforce arrangement (5.18 versus 9.44). Option B requires the retailer to operate and maintain two smaller vehicle types instead of one larger, and thus to deploy more drivers to deliver the same number of orders.

Table 58: Supply side attributes – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Service organisation	30.5	32.8
Impact monitoring system	0.87	0.87
Size and composition of the vehicle fleet	7.70	4.19
Workforce arrangement	9.44	5.18
Distribution network	16.96	17.60
Cumulative	65.4	60.7

Context attributes: Option B scores markedly better on spatial arrangement (72.89 versus 38.77), which captures the use of a micro-hub infrastructure in the urban area. This is the attribute where the pilot most clearly demonstrates its value, and it is also the attribute most dependent on public action, since the availability of suitable transhipment locations is a planning decision rather than a retailer decision.

Table 59: Context attributes – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Spatial arrangement	**38.77**	**72.89**

Private impacts: Option B is assessed slightly lower than option A for private impacts for e-tailers (47.1 versus 53.3), this is due to the slight increase in costs of delivery option B. The use of LEV and bicycle trailers is a costly operation for the retailer, hurting the profitability of the delivery option.

Table 60: Private Impacts for e-tailers – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Service efficiency	**53.3**	**47.1**

Public impacts: Option B scores substantially higher on cumulative public impacts (58.1 versus 34.8), driven almost entirely by environmental impacts (38.6 versus 7.0). As in the consumer assessment, transport impacts (6.2 versus 9.1) and labour impacts (13.4 versus 18.8).

Table 61: Public Impacts for e-tailers – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**7.0**	**38.6**
Transport impacts	**9.1**	**6.2**
Labour impacts	**18.8**	**13.4**
Cumulate public impacts	**34.8**	**58.1**

4.2.3.3 Transport operators perspective

The transport operator assessment closely mirrors the retailer perspective, which is expected given that Jumbo operates its own fleet and therefore combines both roles in this pilot. Option A scores higher cumulatively (62.9 versus 59.9). Option B performs better on service organisation (28.7 versus 26.4) and distribution network (19.70 versus 18.37), while Option A performs better on fleet size and composition (6.44 versus 5.38) and, most markedly, workforce arrangement (10.87 versus 5.24). Workforce arrangement is the dominant differentiator: delivering a given volume of orders with small vehicles requires more driver hours, which is a material barrier in a labour market where driver availability is already constrained. At the same time, the operational experience was positive: drivers appreciated the electric vehicle for its comfort of unloading and loading. This finding is based on feedback and observations gathered during expert meetings and operational discussions with Jumbo drivers and support staff.

Table 62: Supply side attributes – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Service organisation	26.4	28.7
Impact monitoring system	0.89	0.89
Size and composition of the vehicle fleet	6.44	5.38
Workforce arrangement	10.87	5.24
Distribution network	18.37	19.70
Cumulative	62.9	59.9

Table 63: Context attributes – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Spatial arrangement	36.03	65.99

Private impacts: Option A scores slightly higher on service efficiency from the operator perspective (52.5 versus 48.2), in contrast to the retailer assessment. The difference reflects the operator's narrower focus on productivity per vehicle and per driver hour rather than on the ability to serve a constrained area. Consolidation is the mechanism at issue: with 4.26 orders per route for the LEV and 2.10 for the trailer, against the substantially higher consolidation achievable in a conventional van, Option B delivers less value per tour. The operational value of Option B therefore lies not in efficiency but in access.

Table 64: Private impacts for logistics operators – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Service efficiency	52.5	48.2

Public impacts: Cumulative public impacts strongly favour Option B (62.7 versus 37.8), driven by environmental impacts (44.2 versus 10.9). Transport impacts (6.5 versus 9.4) and labour impacts (12.0 versus 17.5) again favour Option A.

Table 65: Public impacts for logistics operators – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	10.9	44.2
Transport impacts	9.4	6.5
Labour impacts	17.5	12.0
Cumulate public impacts	37.8	62.7

4.2.3.4 Local authorities perspective

From the perspective of local authorities, only public impacts are assessed, and the result is the most decisive of any stakeholder group: Option B scores 66.6 against 28.1 for Option A. This is mainly driven by environmental impacts (44.6 versus 8.9), aligning directly with Utrecht's objectives to protect historic quays by reducing the local burden of freight traffic. The main caveat is transport impact, where Option A performs better (8.1 versus 5.6), because smaller vehicles reduce weight, emissions, noise and space use per movement, but increase the total number of movements.

The policy implications are therefore nuanced. The pilot supports the use of locations such as Paardenveld as potential micro-hub sites, but also shows that groceries are a poor fit for this model because shipments are large. The concept appears more promising for smaller parcels, hospitality supplies, or operators serving many customers in a compact area.

Table 66: Public Impacts public authorities – Utrecht

Attribute type	Results Delivery Option A	Results Delivery Option B
Environmental impacts	**8.9**	**44.6**
Transport impacts	**8.1**	**5.6**
Labour impacts	**11.1**	**16.4**
Cumulate public impacts	**28.1**	**66.6**

4.2.4 Overall performance and level of success

The Utrecht Living Lab shows a consistent pattern across stakeholder groups: Option B, delivery via a mobile micro-hub with a light electric vehicle or bicycle cargo trailer, clearly outperforms conventional van delivery on public impacts for consumers, retailers, transport operators and local authorities. It is also marginally preferred by consumers on demand-side attributes and scores far higher on spatial arrangement. However, it is less attractive to the retailer and transport operator on supply-side attributes and performs worse on transport impacts for every stakeholder group.

The main strength of Option B is that it enables grocery delivery in streets where conventional electric vans are excluded by weight restrictions, without degrading the consumer service. Punctuality was maintained or improved, driver experience was positive, and no complaints or service dissatisfaction were recorded during the pilot.

Overall, the pilot succeeded in demonstrating technical and operational feasibility and in generating the environmental and spatial benefits sought by the municipality, but it did not demonstrate economic viability at current productivity levels or a directly scalable model for grocery delivery. Future implementation should focus on using the largest vehicle that remains acceptable for the local street context, and matching micro-hubs to suitable goods flows. To stimulate further discussion, Jumbo initiated a broader debate on the standardisation of load carriers (cradles) to improve loading capacity and better align (electric) vehicle design with grocery supply chain requirements. While this topic extends beyond the scope of the project, it is expected to raise awareness of the role that standardisation can play in improving efficiency. At the same time, it highlights the challenge of achieving industry-wide standardisation within a highly competitive grocery market.

4.3 Impact on consumer behaviour and attractiveness of zero-emission delivery and return options

4.3.1 Description of the communication interventions

The purpose of the communication interventions in Utrecht was to make an otherwise invisible logistics innovation visible, and to build acceptance for it among the residents and customers affected. Because the LEV and bicycle-trailer deliveries were introduced operationally rather than chosen by the consumer, communication was not expected to produce a measurable modal shift in delivery choice. Instead, it was expected to raise awareness among customers in the pilot area that their groceries might arrive by a different vehicle, arrived later or in a different form than usual, and generate wider visibility for the concept among professional and municipal audiences.

Given this absence of a consumer-facing choice, the assessment relies primarily on qualitative evidence gathered in a workshop, complemented by Jumbo's earlier experience with message testing in its own channels.

4.3.1.1 Strategy and resources

The communication strategy pursued acceptance and awareness rather than behavioural change. The target "behaviour" was passive: continued use of the Jumbo home delivery service and tolerance of possible operational deviations during the pilot period, alongside a general increase in familiarity with small-vehicle urban delivery among residents of the pilot area. No delivery attributes (price, time slot, speed) were communicated differently from the standard offer, because none of these attributes changed.

Communication was not displayed on the check-out page, since the check-out menu offers no delivery-option choice on which such a message could act. An e-mail was sent to Jumbo customers living in the pilot area, informing them about the ongoing activities. The Municipality of Utrecht issued an announcement to residents in the area surrounding the micro-hub location, highlighting that the research aims to find alternative ways to deliver with minimal (spatial) impact. Several LinkedIn posts by the partners and involved organisations addressed a wider professional audience. Additional questions were included in the standard post-order survey for customers placing a first order with Jumbo and living in the pilot area.

These communication interventions were developed with reference to the communication guidelines set out in Deliverable 4.3. As the goal of the messaging was intended to familiarise the neighbourhood with the new operations and to build acceptance, it drew principally on the guidelines G1 (Be open, clear and specific in your messaging). Further, it engaged the guideline G11 (Show the real-world impact of choices) by addressing whether the currently unused space around the parking garage could be put to more alternative use, and in doing so contribute to a sustainable neighbourhood.

Resources were modest and largely absorbed within existing communication functions. Jumbo's customer communication team drafted and distributed the customer e-mail through its existing newsletter infrastructure; the municipality's communication department handled the resident announcement; project partners produced the LinkedIn content.

In previous internal research, Jumbo conducted A/B testing of sustainability-related messages in its own channels, which indicated that abstract sustainability framings ("sustainable", "lower emissions") performed poorly, whereas concrete operational framings such as "we are already in your neighbourhood" performed better. These earlier findings informed the general tone of the

Utrecht communication but were not re-tested within the pilot, since the pilot offered no controlled comparison point.

4.3.1.2 Activities and efficacy of execution

The communication activities were executed as planned but were limited in scope. The customer e-mail was distributed to Jumbo customers with delivery addresses in the pilot area at the start of the pilot period. The municipal announcement was issued to residents in the vicinity of the micro-hub location, primarily to explain the presence of the vehicle and the transfer activity in public space. LinkedIn posts were published by the partners at several moments during the pilot. Post-order survey questions ran continuously for first-time customers in the area.

4.3.1.3 Outputs

The tangible outputs of the communication activities were:

- The customer e-mail sent to Jumbo customers in the pilot area, announcing the pilot and explaining the delivery concept.
- A series of LinkedIn posts by the project partners documenting the pilot for a professional audience (Figure 22).
- The announcement issued by the Municipality of Utrecht to residents living near the micro-hub location (**Errore. L'origine riferimento non è stata trovata.**).
- The additional questions integrated into Jumbo's post-order survey for first-time customers. However, the response rate was too low to produce results that were considered sufficiently reliable, robust or representative for analysis. For this reason, Jumbo chose not to share the survey outcomes, and therefore no survey results are presented in this report.
- The micro-hub itself, which carried Jumbo branding and functioned as a visible, if passive, communication carrier in the streetscape.

No changes were made to the online consumer interface, so no screenshots of check-out modifications are available.

Figure 22 LinkedIn post about the pilot in Utrecht posted by Logistiek Platform Utrecht (left) and except from the message distributed to residents in the neighbourhood (right).





4.3.2 Experimental design

As both the consumer-side experience and the communication interventions changed only marginally during the pilot, no quantitative assessment of their impact was possible. The evaluation of the communication measures therefore relies on a qualitative design, centred on a workshop held in Utrecht on 25 June that brought together local residents, policymakers and operational staff from Jumbo. During the workshop, residents were asked whether they had noticed the pilot, how they experienced ordering from Jumbo, and how they assessed the logistics activity generated by grocery home delivery more broadly. This qualitative approach helped to explore the lived experience of residents in the pilot area and created space for direct exchange between the municipality and Jumbo. Furthermore, a survey directed at first-time consumers who are located in the pilot area during its execution was conduced. However, in practice these responses could not be isolated from the wider survey population and were therefore not included in the analysis.

4.3.3 KPIs

Since there was no direct quantitative assessment of the communication strategies, only a qualitative assessment could be completed. A limited set of KPIs could nevertheless be addressed qualitatively on the basis of the workshop. These are reported below as qualitative assessments rather than percentages.

Table 67: KPIs list with associated data

KPI number	KPI	Data source	Qualitative findings	Dimension addressed
1	% consumers who recall the message	Workshop	Not recalled. Participating residents did not recall seeing or experiencing the pilot or its communication.	Retention of message
7	% consumers aware of the impact of the sustainable delivery option vs. other options	Workshop	Low. Residents were aware of delivery nuisance in general but did not associate grocery delivery with a sustainability problem; they questioned whether smaller vehicles are in fact more sustainable if more of them are needed.	Awareness of sustainable delivery/return choice
8	% consumers with favourable attitude towards a micro-hub and small vehicle combination	Workshop	Favourable. Residents were positive about innovation in delivery vehicles, particularly bike-based delivery for smaller shipments.	Attitude to target delivery/return option
15	Average ranking of sustainability as goal influencing choice of delivery option, relative to cost, convenience, speed and safety	Workshop	Low ranking. Convenience was the decisive factor; sustainability was acceptable only if price and convenience were unaffected. Longer waiting times were acceptable to some; higher prices and inconvenient slots were not.	Ranking of sustainability among other goals
21	% of consumers who consider that attempts to influence consumers (marketing strategies, nudging) reduces the clarity of delivery choice	Workshop	Hidden costs. Participants noted that the true logistics costs and impacts of delivery are hidden from consumers, which makes frequent small orders easy and informed choice difficult.	Transparency of choice
22	% consumers who last time say they chose their routine option out of habit for specific retailer/ product category?	Workshop	High. Delivery choice was described as routine and convenience-driven, with no active reconsideration per order.	Degree to which choice is habit

4.3.4 Assessment summary

The communication interventions in Utrecht did not produce a measurable effect on consumer behaviour, and by design could not have done so. The pilot changed the vehicle used for the final leg of delivery without changing anything the consumer sees, chooses or pays. Communication therefore operated in an awareness-and-acceptance role, and its most concrete achievement is that the transition to light electric vehicles and bicycle trailers took place without generating complaints, confusion or dissatisfaction among customers. For a retailer considering such a change, this is a meaningful result, it suggests that the operational side of shift to smaller vehicles can be introduced without a communication burden, provided service levels are maintained.

From the workshop and KPI results, three observations follow, shaping the outcomes of the communication guideline analysis.

First, the effectiveness of a communication guideline is conditional on the presence of more choices on the consumer side. A larger share of the guidelines, such as G8 (Provide comparability between options), G6 (Make sustainable options stand out), G17 (Give consumers actionable plans for out-of-home collection or return), G18 (Give consumers positive sustainable choice experience), presuppose that the consumer faces a decision and is able to make a direct choice. However, in the case of Jumbo where the vehicle is assigned operationally and delivery slots are priced by routing efficiency rather than by environmental impact, these guidelines cannot be applied.

Second, sustainability communication alone may not change behaviour, but alternative messaging could prove useful. Residents were clear that they would not pay more or accept a less convenient time slot for a more sustainable delivery, and that they would not choose a retailer on the basis of its delivery sustainability. This aligns with Jumbo's earlier A/B testing, which showed that abstract sustainability messaging (such as a green leaf or reduction in emissions) was ineffective in shifting consumers to choose an alternative time slot. However, convenience oriented messages, such as "already in your neighbourhood", had stronger influence on consumer choice. This underlines the importance of communication addressing tangible, graspable terms, and links back to the communication guidelines G11 (Showing the real-world impact of choices) and G12 (Cover all dimensions of sustainability).

Third, transparency about the hidden logistics of ordering is an under-used lever and should be addressed in the future. Participants observed that consumers do not see the real costs, consolidation effects or spatial impacts of their delivery choices, which makes frequent small orders costless from the consumer's point of view. Making these consequences visible, through information about consolidation benefits, order-batching incentives, or the effect of delivery choices on the neighbourhood, is a communication path that acts on ordering behaviour rather than on delivery-mode choice, and is applicable even where no delivery-mode choice exists. This is a promising extension of the current guideline set.

The Utrecht case suggests that the attractiveness of smaller zero-emission delivery (such as LEVs) to consumers is, at present, not the most impactful factor to its adoption in the context of Jumbo, as consumers are not the decision-makers. Adoption is determined by the retailer's fleet, hub location and load carrier system, and by municipal access regulation. Communication's role is to prevent the transition from being experienced as a drastic change in service, and to build the general legitimacy that makes stricter access regulation politically feasible.

5 Living lab in Antwerp

5.1 Context, delivery and communication solutions synthesis

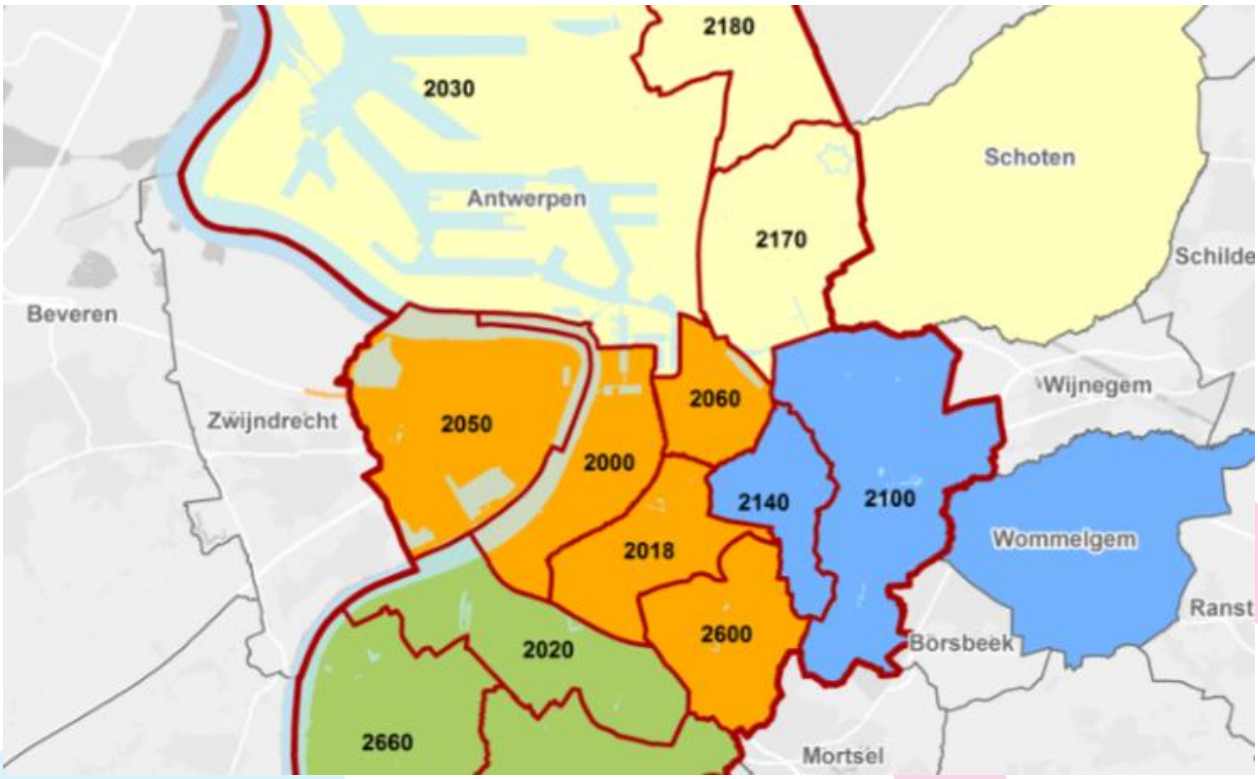
The Antwerp Living Lab brings together the City of Antwerp, Bpost (the Belgian postal operator), TORFS (a Belgian footwear retailer), and Mobilise (the VUB research group). The initiative aims to reduce the environmental footprint of e-commerce deliveries by promoting out-of-home delivery options, particularly deliveries to PUDO (Pick-Up and Drop-Off) points and delivery at the shop.

The pilot combines infrastructure development, behavioural incentives, and multi-stakeholder collaboration within a defined urban area covering the postal codes 2000, 2018, and 2060, shown in Figure 23. As a first step, the Bpost network of PUDO points was expanded to improve accessibility for consumers within the pilot area.

The pilot complemented this infrastructure deployment with targeted communication campaigns and incentive mechanisms designed to encourage consumers to reconsider their delivery choices and adopt alternatives to home delivery. Consumers were encouraged to use nearby pick-up points, combine parcel collection with existing daily trips, and rely on active and sustainable transport modes such as walking and cycling.

By shifting part of the last-mile journey from the transport operator to the consumer, the pilot creates a more direct link between delivery choices and their environmental consequences. In doing so, it seeks to improve the efficiency of last-mile logistics while encouraging more sustainable consumer behaviour.

Figure 23: Postcodes of Antwerp and around



Source: Stad Antwerpen, 2018

5.2 Assessment of delivery options implementation

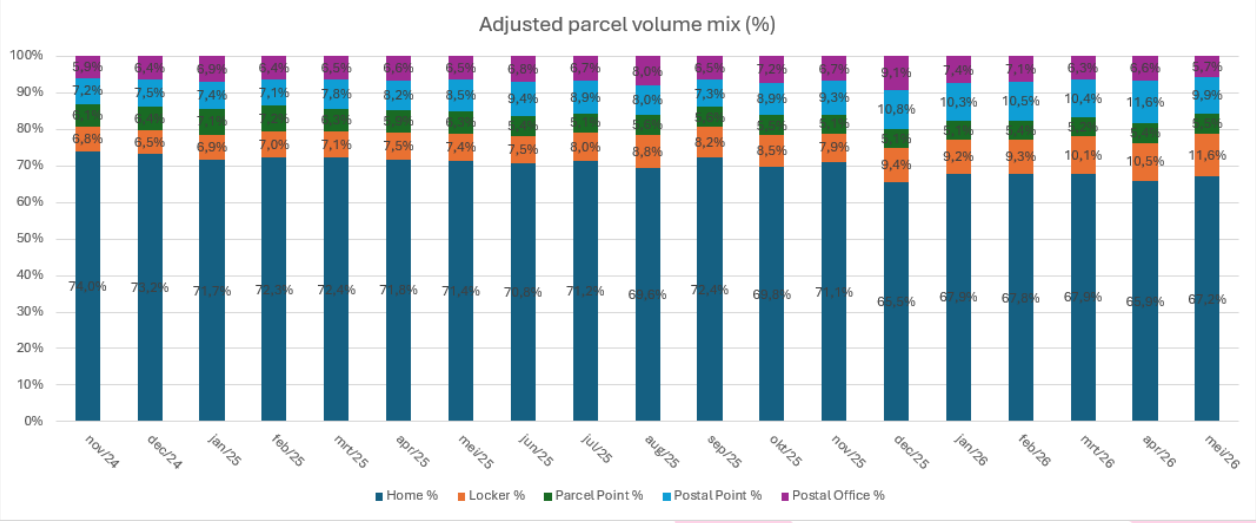
5.2.1 Delivery options assessed

Three delivery options were assessed during the pilot: home delivery (Scenario A), PUDO delivery (Scenario B), and delivery at the shop (Scenario C).

Home delivery serves as the baseline scenario, as it remains the most popular delivery option. As shown in Figure 24, approximately 60–65% of consumers in the three pilot postal codes selected home delivery in 2025. Operationally, orders are dispatched from the TORFS warehouse in Temse, located between Brussels and Antwerp. From there, Bpost transports the parcels in a consolidated truck to its national sorting hub, Antwerp X, located approximately 40 km from the TORFS warehouse.

At Antwerp X, TORFS parcels are sorted by destination together with shipments from other retailers. Parcels destined for Antwerp are then transported in a second consolidated truck to the regional Bpost depot, Antwerpen Centrum, located approximately 10 km from Antwerp X. From this depot, last-mile deliveries to the three pilot postal codes are organised through milk-round routes serving final consumers at their homes. In May 2026, these delivery rounds were operated using a fleet of 64 vehicles, of which 59% were electric. The delivery network also included 26 cargo-bike rounds and 15 walking rounds. For the purposes of the analysis presented below, the Bpost fleet is assumed to be fully electrified, as full electrification is expected to be achieved by October 2026.

Figure 24: Delivery mix of Bpost on the pilot zone.

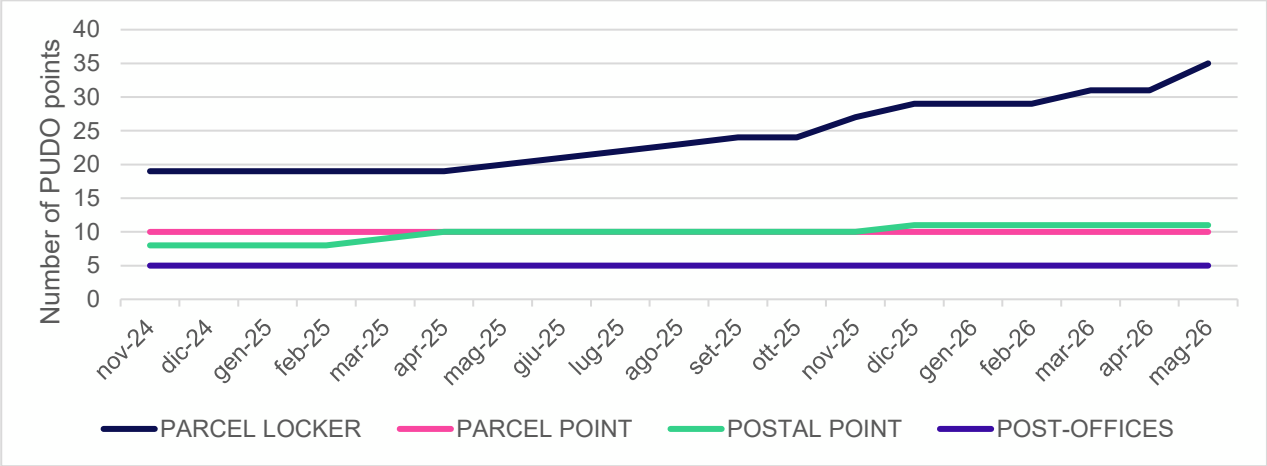


Delivery to PUDO points constitutes Scenario B and represents the main alternative to home delivery. As illustrated in Figure 24, the share of deliveries to PUDO points has been increasing, while the share of home deliveries has gradually declined. This trend is closely linked to the expansion of the PUDO network in Antwerp, illustrated in Figure 25.

From an operational perspective, deliveries to PUDO points follow a process similar to that of home deliveries. Parcels are consolidated with home-delivery flows from the TORFS warehouse through to the regional depot at Antwerpen Centrum. From there, dedicated milk-round routes serve the

PUDO network. Due to the higher delivery volumes associated with PUDO points, cargo-bike and walking routes are not used for these deliveries.

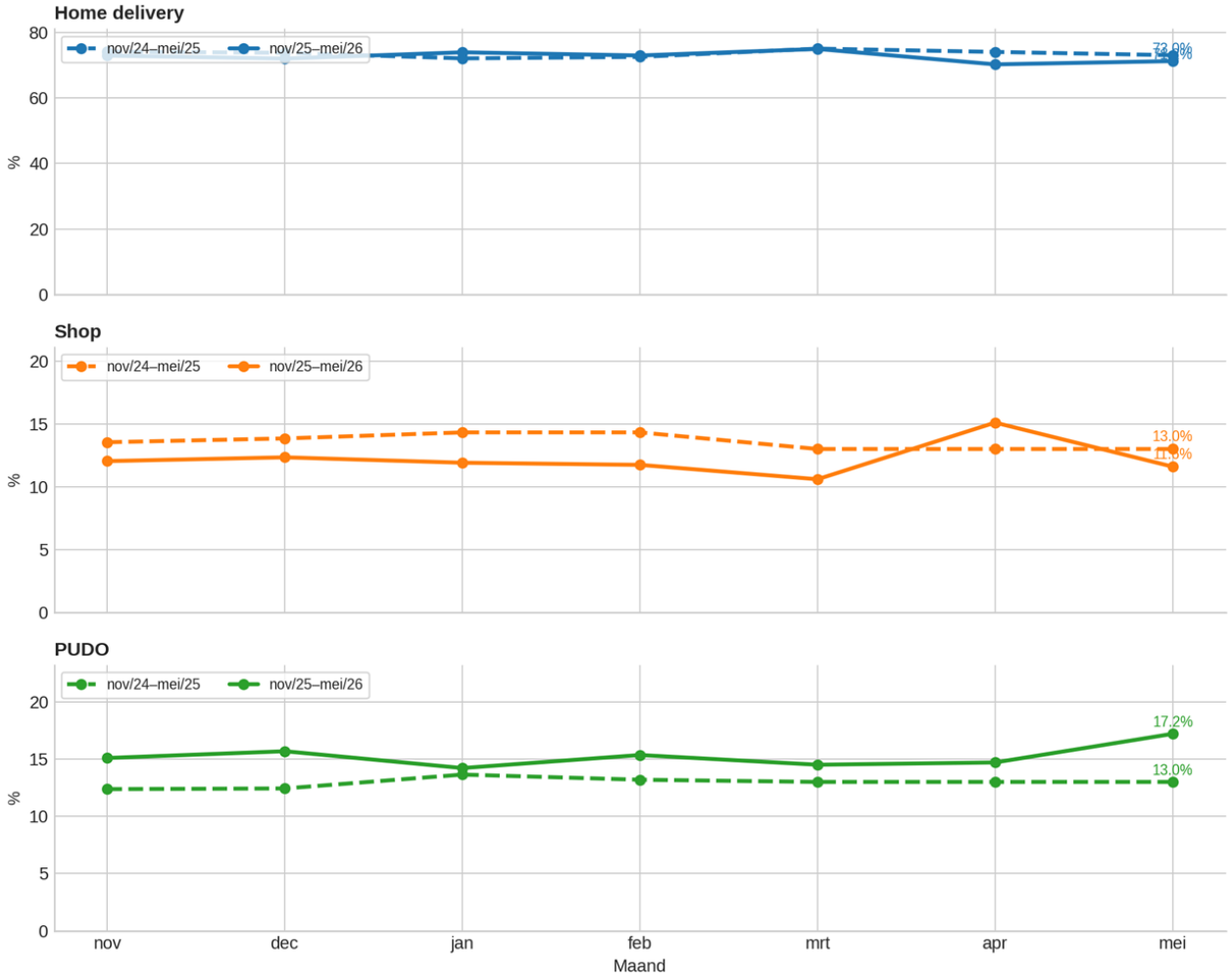
Figure 25: Evolution of PUDO points in the pilot zone



Finally, the Antwerp pilot also assessed a third delivery option: delivery to the shop. TORFS is not a purely online retailer and operates an extensive network of physical stores. Direct interaction with customers represents an important added value for the company, and encouraging consumers to visit a store can strengthen customer engagement. Moreover, deliveries to the shop are less costly because online orders can be consolidated with the regular replenishment of store inventory.

The option “delivery at the shop” typically involves a slightly longer delivery time, as stores are not supplied on a daily basis. Delivery times are therefore communicated as ranging from one to three days. In 2025, deliveries to the shop accounted for approximately 12% of TORFS online orders in Antwerp. However, as shown in Figure 26, the share of delivery at the shop has gradually been replaced by deliveries to PUDO points.

Figure 26: Delivery mix of TORFS during the pilot phase compared with the same period a year before



Volledige maanden uit de tabel, N/A buiten beschouwing gehouden.

5.2.2 Key KPIs driving the comparison

The KPI framework developed in Deliverable 3.1 was used to assess the performance of the three delivery options implemented in the Antwerp Living Lab. As anticipated in the introduction, a selection process was applied to identify the indicators most relevant for comparing home delivery, delivery to PUDO points, and delivery to the shop.

As a result, the assessment retained six Demand KPIs, six Supply KPIs, and nine Impact KPIs. These indicators are presented in the following sections.

5.2.2.1 Demand KPIs

Cost is generally a key factor influencing consumer delivery choices. However, because no significant differences in delivery pricing were observed across the three options, this KPI was excluded from the analysis. Table 68 therefore focuses exclusively on those demand-side KPIs that differentiate between the delivery alternatives.

The most significant difference relates to delivery flexibility. Home delivery offers consumers little control over the delivery time. Parcels are typically delivered during the next scheduled delivery round and consumers are informed of the expected delivery day. Consequently, the KPI Choice of delivery time slot receives its lowest score for home delivery as delivery time slot cannot be chosen.

By contrast, both PUDO delivery and delivery to the shop offer consumers complete flexibility in collecting their parcels. Collection can take place at any convenient moment after notification of arrival, eliminating the need to be present during a predefined delivery window. As a result, these two delivery options achieve the highest score for delivery-time flexibility and a perfect score for successful delivery.

The difference in successful delivery rates reflects the risk of failed home deliveries. For home delivery, approximately 8% of delivery attempts are unsuccessful because the consumer is not available to receive the parcel. In contrast, deliveries to PUDO points and retail stores are not affected by this issue and therefore achieve a 100% delivery success rate.

For the remaining demand-side KPIs, delivery to PUDO points closely resembles home delivery because both services are operated by Bpost. Delivery is generally completed within one day, although occasional delays result in an average delivery time of 1.2 days. Delivery to the shop takes slightly longer because online orders are consolidated with store replenishment shipments. As the Antwerp store is typically supplied three times per week, the average delivery time is estimated at two days.

Finally, delivery punctuality is in general very high. The simpler logistic process of the option delivery at the shop lowers though the risk of operational errors, resulting in slightly higher punctuality scores than those observed for home delivery and PUDO delivery.

Table 68: Demand side KPIs applicable to the Antwerp Living Lab

Attribute type	Attribute	Unit	Values for option A (home delivery)	Values for option B (PUDO)	Values for option C (delivery at the shop)
Delivery method	Point of delivery - Share of deliveries	%	92%	100%	100%
Delivery time	Delivery date punctuality	%	94%	94%	99%
	Delivery time slot punctuality	%	94%	94%	99%
	Delivery date	Days	1,2	1,2	2
	Delivery time slot	Hours	1	0	0
Flexibility	Choice of delivery time slot	Adimensional	1	4	4

5.2.2.2 Supply - context KPIs

The supply-side assessment focuses on operational differences between delivery options. Since order picking and preparation follow the same process regardless of the final delivery destination, activities within the TORFS warehouse were not considered in the comparison.

The main operational differences emerge once parcels leave the warehouse. Consequently, data collection focused primarily on the downstream logistics operations managed by Bpost. These differences are reflected in indicators such as the number of warehouses used, warehouse area, vehicle fleet characteristics, and workforce requirements as shown in Table 69.

Both home delivery and delivery to PUDO points rely on two additional logistics facilities—Antwerp X and Antwerpen Centrum—which require warehouse space (about 30.000m²) and warehouse staff (about 120 workers). They require also delivery vehicles (about 64 vehicles) and drivers (about 90 workers). While these resources generate additional costs, they are shared across very large delivery volumes, enabling Bpost to achieve important economies of scale.

Delivery to the shop follows a different approach. Online orders are consolidated with regular store replenishment flows and are transported directly by TORFS. This operation requires one truck, one driver and no extra warehouse space. This truck serves 6 stores, including the store in the city centre of Antwerp. However the truck used is a diesel-powered vehicle whereas the Bpost fleet is largely electrified. This difference explains a lower score of delivery to the shop for the KPI Delivery vehicles by type and technology.

Table 69: Supply - context KPIs applicable to the Antwerp Living Lab

Attribute type	Attribute	Unit	Values for option A (home delivery)	Values for option B (PUDO)	Values for option C (delivery at the shop)
Distribution network	Number or warehouses	N° of warehouses	2	2	0
	Size of warehouses	Squared meters	30.000	30.000	0
Size and composition of the vehicle fleet	Delivery vehicles - Total vehicles	N° of vehicles	64	64	1
	Delivery vehicles by type and technology	Adimensional	1,285	1	0,5
Workforce arrangement	Number of drivers - Total	N° of drivers	90	90	1
	Number of warehouses workers	N° of workers	120	120	0

5.2.2.3 Impacts KPIs

The last-mile services provided by Bpost generate additional vehicle kilometres for both home delivery and delivery to PUDO points. By contrast, delivery to the shop does not require a dedicated last-mile distribution service, as parcels are consolidated with the regular replenishment of TORFS stores. Consequently, Table 70 shows that no additional kilometres are driven in Scenario C, whereas Scenarios A and B both involve approximately 25 km of additional transport activity for the last mile operations.

These additional logistics services also generate additional costs. Home delivery is the most expensive option due to the large number of individual delivery stops involved. Delivery to PUDO points is more cost-efficient because multiple parcels can be delivered in a single stop, improving operational efficiency and reducing driver time. Delivery to the shop incurs much less additional distribution cost, as online orders are transported using the internal fleet supplying the stores. In relative terms, if a home delivery costs TORFS approximately €5, delivery to a PUDO point costs around €4 and a delivery to the shop cost 1€. These costs are approximations as sharing real data would be too sensitive for this report. The level of magnitude reflects however the retailer cost differences across delivery options.

The additional operations associated with home delivery also generate higher environmental impacts. Considering the entire logistics chain from the TORFS warehouse to the final delivery location, Table 70 indicates that home delivery performs worst across most environmental indicators. The environmental impact per parcel is especially increased due to the lower vehicle load factor in scenario A.

On the other hand, delivery to PUDO points performs better on all environmental criteria thanks to higher vehicle utilisation rates. The impact of transport operations is that scenario B distributed across a larger number of parcels, resulting in lower impacts per delivery. Delivery to the shop

achieves the best overall environmental performance though, as it improves the load factor of vehicles already supplying the stores. They avoid also the need for an additional distribution network.

One exception should, however, be noted. Greenhouse-gas emissions for delivery to the shop are slightly higher than for delivery to PUDO points. This is explained by the diesel vehicle currently used to supply TORFS stores, whereas the Bpost fleet operating in Antwerp is assumed to be fully electrified in the present analysis.

The apparent advantage of delivery to the shop should nevertheless be interpreted with caution, as the analysis above only considers logistics operations. The trips made by consumers to collect their parcels can influence the overall environmental performance of this delivery option. This aspect is examined in more detail in Section 5.2.4.

Table 70: Impact side KPIs applicable to the Antwerp Living Lab

Attribute type	*Attribute*	*Unit*	*Values for option A (home delivery)*	*Values for option B (PUDO)*	*Values for option C (delivery at the shop)*
Service efficiency	**Distance travelled**	***Kms***	***25***	***25***	***0***
	Total delivery time by vehicle type	***Hours***	***5***	***2***	***0***
	Delivery production cost	***€/delivery***	***5***	***4***	***1***
	Vehicles load factor	***%***	***75%***	***95%***	***87.5%***
Environmental impacts	**Pollutant emissions - PM**	***g/delivery***	***0,16***	***0,12***	***0,012***
	Pollutant emissions - NOx	***g/delivery***	***11,42***	***8,20***	***1,46***
	GHG emissions	***g/delivery***	***2,61***	***1,87***	***2,19***
	Noise	***External cost/delivery***	***0,07***	***0,05***	***0,004***
Transport impacts	**Congestion**	***External cost/delivery***	***0,19***	***0,14***	***0,06***

5.2.3 Stakeholder-weighted assessment results

5.2.3.1 Consumers perspective

According to the results presented in Table 71, delivery to PUDO points emerges as the preferred option from the consumer perspective. This finding contrasts with the current dominance of home delivery in Antwerp but may also highlight the untapped potential of out-of-home delivery solutions.

Compared with home delivery, PUDO points are particularly valued for the flexibility they offer. Consumers can collect their parcels at a time that suits them best, whereas home delivery provides limited control over the exact delivery moment. This flexibility also contributes to the strong performance of delivery to the shop. However, the latter is slightly disadvantaged by its longer delivery time, which explains the small preference for PUDO points over in-store collection.

Table 71: Demand side attributes – Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Cost	3,16	3,16	3,16
Flexibility	15,31	24,58	24,58
Delivery time	11,24	13,90	12,39
Delivery method	4,93	5,11	5,11
Information	5,40	5,40	5,40
Reliability	9,09	9,09	9,09
Cumulative	49,12	61,23	59,72

When public impacts are also considered, delivery to the shop becomes the preferred option, as illustrated in Table 72. By consolidating online orders with regular store replenishment flows, this option reduces environmental impacts and transport externalities. As a result, it achieves the highest overall score from the consumer perspective when public benefits are considered.

Table 72: Public impacts for consumers – Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Environmental impacts	22,5	28,7	36,7
Transport impacts	4,7	6,0	8,8
Labour impacts	17,4	17,4	17,4
Cumulative	44,63	52,09	62,98

5.2.3.2 Retailers perspective

From the retailer perspective, delivery to the shop is the most attractive option. The retailer costs per delivery are the lowest with that option. Home delivery and delivery to PUDO points are more costly given that the additional service provided with these options to the consumers are offered free of charge most of the time by the retailer.

As shown in Table 73, delivery to the shop minimises the number of vehicles, workforce requirements, and warehousing resources needed to fulfil online orders. Unlike home delivery and PUDO delivery, parcels do not need to pass through the additional distribution network operated by Bpost. This does not demonstrate however a higher logistics efficiency given that Bpost spread their vehicles, workforce and warehousing resources on high volumes, allowing them to benefit of economies of scale and consolidation benefits. Table 74 can be misleading in that regard as it demonstrates a higher service efficiency. It demonstrates especially that more resources are used with home and PUDO deliveries. The lowest performance of home and PUDO deliveries is therefore mostly explained by the additional costs involved in these options which are most of the time not paid by consumers.

Table 75 shows the retailers' assessments of public impacts. Their perspective is shared with the consumers perspective, showing that home delivery is performing the lowest and delivery to the shop the highest.

Table 73: Supply side for retailers - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Service organisation	**19,4**	**19,4**	**19,4**
Impact monitoring system	**0,43**	**0,43**	**0,43**
Size and composition of the vehicle fleet	**6,76**	**5,58**	**9,24**
Workforce arrangement	**7,31**	**7,31**	**14,58**
Distribution network	**16,11**	**16,11**	**23,30**
Cumulative	**50,0**	**48,8**	**66,9**

Table 74: Private impacts for retailers - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Service efficiency	**50,0**	**56,7**	**64,9**

Table 75: Public impact for retailers - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Environmental impacts	20,9	26,7	34,8
Transport impacts	7,6	9,6	8,7
Labour impacts	16,1	16,1	13,7
Cumulate public impacts	44,6	52,4	53,0

5.2.3.3 Transport operators perspective

The perspective of transport operators is largely aligned with that of retailers explained in previous section. Although transport operators do not directly manage deliveries to the shop, they recognise the operational benefits associated with this option. As a result, the interpretation of the results shown in Table 76, Table 77 and Table 78 is largely similar.

It remains however relevant to focus the comparison between home deliveries and PUDO deliveries when analysing the perspective of transport operators as they manage these flows. On the supply side, the main difference between the two options is reflected in the vehicle fleet. Home deliveries integrate cargo-bikes which improves the overall performance of this option. But the service efficiency of PUDO deliveries is more in favour of PUDO deliveries: the difference is explained by better loading rates in vehicles delivering PUDO points, a higher productivity per stop and as a result a lower cost per delivery. This efficiency is translated also in the public impact of the two delivery options. The lower distance per delivery with the PUDO option results in reduced environmental impacts.

Table 76: Supply side attributes for transport operators - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Service organisation	16,7	16,7	16,7
Impact monitoring system	0,44	0,44	0,43
Size and composition of the vehicle fleet	7,31	5,29	7,37
Workforce arrangement	8,06	8,06	16,06
Distribution network	17,44	17,44	25,11
Cumulative	50,0	48,0	65,7

Table 77: Private impacts for transport operators - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Service efficiency	**50,0**	**57,0**	**65,6**

Table 78: Public impact for transport operators - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Environmental impacts	**23,7**	**30,3**	**37,2**
Transport impacts	**8,0**	**10,1**	**14,9**
Labour impacts	**14,7**	**14,7**	**14,7**
Cumulate public impacts	**46,4**	**55,1**	**66,9**

5.2.3.4 Local authorities perspective

Local authorities focus primarily on the societal impacts of the different delivery options, including environmental and transport-related externalities.

From this perspective, delivery to the shop performs best due to the consolidation benefits it provides. By integrating online orders into existing store replenishment flows, it minimises additional vehicle movements and reduces environmental impacts. Home delivery performs least favourably because of the fragmented nature of the operations involved. The high number of delivery stops limits opportunities to optimise vehicle utilisation and loading rates in the last mile. These results are presented in Table 79.

Table 79: Public impact for public authorities - Antwerp

Attribute type	Result Delivery option A (home delivery)	Result Delivery option B (PUDO)	Result Delivery option C (delivery at the shop)
Environmental impacts	**24,0**	**30,6**	**39,3**
Transport impacts	**6,8**	**8,7**	**12,8**
Labour impacts	**13,7**	**13,7**	**13,7**
Cumulate public impacts	**44,6**	**53,0**	**65,8**

5.2.4 The role of consumers

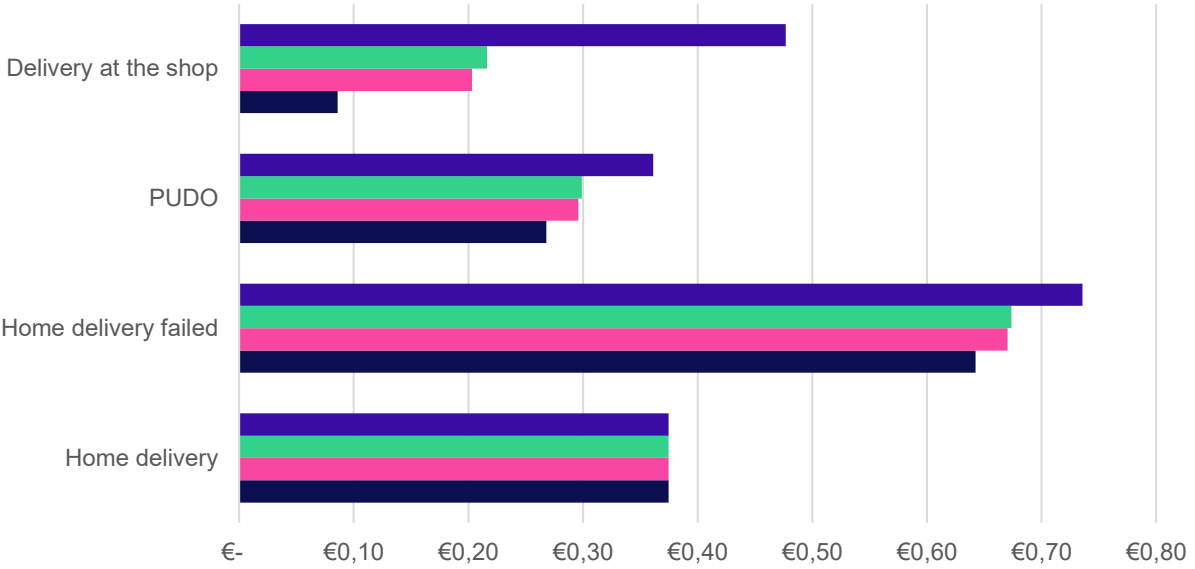
The results presented above should be interpreted with caution, as they only consider the logistics processes operated by TORFS and Bpost. Consumer behaviour can significantly influence the overall environmental performance of each delivery option.

Several behavioural factors may affect the results:

1. **Consumer mobility**: In urban environments, consumers can more easily access PUDO points and stores by walking or cycling. Dense urban areas generally provide better conditions for active mobility and public transport use than less urbanised areas. By contrast, dedicated car trips for parcel collection can significantly increase environmental impacts, particularly when these trips are not integrated into existing travel chains.
2. **Failed home delivery**: Consumers may select home delivery but subsequently be unavailable to receive their parcel. In such cases, the parcel is returned to the depot and delivered to a nearby PUDO point on the following day. These additional logistics movements, together with the consumer's trip to collect the parcel, should be considered in the impact assessment.
3. **Returns**: Product returns generate additional transport activity and therefore increase the overall impacts associated with e-commerce deliveries. Their contribution should be considered when evaluating the sustainability of alternative delivery solutions.

To better understand the importance of these behavioural factors, additional scenarios were developed combining the different delivery options with alternative consumer travel modes. The results are presented in Figure 27.

Figure 27: Impact of e-commerce deliveries according to delivery options and consumer's behaviour.



	Home delivery	Home delivery failed	PUDO	Delivery at the shop
Car (dedicated trip)	€0,37	€0,74	€0,36	€0,48
Car (trip chaining)	€0,37	€0,67	€0,30	€0,22
Public transport	€0,37	€0,67	€0,30	€0,20
By bike/foot	€0,37	€0,64	€0,27	€0,09

Home delivery is only marginally affected by consumer mobility because parcels are delivered directly to the consumer's residence. Consumer travel behaviour primarily affects out-of-home delivery options, especially delivery to the shop.

When consumers walk or cycle to the shop, the impact of their trip is negligible. Under these conditions, delivery to the shop becomes the most sustainable option, benefiting from the consolidation advantages discussed in Section 5.2.2.3. Conversely, travelling by car to collect a parcel significantly increases environmental impacts, almost tripling the total impact of this delivery option. In such a case, home delivery may become the preferable option because the delivery vehicle serves multiple households through consolidated delivery rounds. However, if consumers integrate parcel collection into an existing trip chain, delivery to the shop remains more environmentally friendly than home delivery. The use of public transport further reduces the impact associated with parcel collection.

A similar pattern can be observed for deliveries to PUDO points. However, consumer travel behaviour has a smaller influence because PUDO points are typically located closer to consumers than retail stores. The denser PUDO network reduces collection distances and therefore limits the impact of collection trips. Consequently, consumers who use public transport or private cars generally generate lower impacts when collecting parcels from PUDO points than from retail stores.

Nevertheless, walking and cycling remain the most sustainable collection modes and generate the lowest impact with PUDO points.

Finally, while consumer mobility has limited influence on successful home deliveries, failed home deliveries have a substantial impact on overall sustainability performance. In such cases, the parcel is effectively delivered twice: first unsuccessfully to the consumer's home and then to a nearby PUDO point. The resulting impacts are therefore approximately equivalent to the combined impacts of home delivery and PUDO delivery. Figure 27 clearly illustrates the significant external costs associated with failed deliveries. These findings suggest that consumers who frequently miss home deliveries should be encouraged to choose PUDO delivery instead.

5.2.5 Overall performance and level of success

The Antwerp pilot assessed two alternatives to conventional home delivery: delivery to PUDO points and delivery to the shop.

The stakeholder analysis reveals a broad consensus in favour of moving away from the current dominant delivery model, namely home delivery. The fragmented nature of home delivery operations increases both the private costs borne by retailers and the public impacts experienced by society as a whole.

Delivery to PUDO points improves the efficiency of last-mile logistics by consolidating larger parcel volumes at fewer delivery locations. This results in higher vehicle load factors, lower environmental impacts per parcel, and reduced delivery costs. Consequently, PUDO points represent a more sustainable and efficient alternative to home delivery from both an operational and environmental perspective.

However, delivery to the shop consistently outperforms PUDO delivery across most stakeholder assessments. By integrating online orders into existing store replenishment flows, this option allows retailers to use more efficiently their logistics resources. The retailer can rely on its existing logistics operations, reducing further both private and public impacts per delivery.

The main disadvantage of delivery to the shop is the longer delivery time experienced by consumers. As stores are replenished only three times per week, customers typically receive their parcels around one day later than with home delivery or delivery to a PUDO point. Nevertheless, this disadvantage appears to have only a limited influence on consumer preferences. Consumers place greater value on the flexibility of collecting their parcels at a time that suits them, which largely compensates for the slightly longer delivery lead time.

The environmental benefits of delivery to the shop should, however, be interpreted in light of consumer travel behaviour. As demonstrated in Section 5.2.4, the sustainability performance of this delivery option depends heavily on how consumers travel to collect their parcels. Its advantages are fully realised when consumers use active modes of transport, such as walking or cycling. Conversely, if consumers make dedicated car trips for parcel collection, the environmental impacts increase substantially, potentially making home delivery the more sustainable option, provided the delivery is successful on the first attempt.

Therefore, delivery to the shop should be primarily promoted among consumers who are likely to collect their parcels using active modes of transport. When information on consumer travel behaviour is unavailable, promoting delivery to PUDO points may represent a more robust and lower-risk strategy. PUDO points deliver significant operational and environmental benefits while being less sensitive to variations in consumer mobility patterns due to their dense network and shorter collection distances.

5.3 Impact on consumer behaviour and attractiveness of zero-emission delivery and return options

5.3.1 Description of the communication interventions

The co-design workshops conducted with TORFS, consumers, Bpost, and the City of Antwerp stressed the importance of expanding the PUDO network to provide alternatives to home deliveries in e-commerce. But consumers must also be willing to change behaviour and adopt these alternatives.

To address this challenge, the pilot combined infrastructure deployment with targeted communication interventions designed to encourage consumers to choose out-of-home delivery options. The following section describes these interventions and assesses their effectiveness in supporting more sustainable delivery choices.

5.3.1.1 Strategy and resources

The primary objective of the communication interventions was to improve the sustainability of e-commerce deliveries by increasing the share of consumers in Antwerp choosing out-of-home delivery options.

As this objective was shared by Bpost, TORFS, the City of Antwerp, and Mobilise, the four partners collaborated on a joint communication campaign across their respective social media channels. The campaign was organised into three communication waves, each built around a specific behavioural-change guideline.

G17: Give consumers actionable plans for out-of-home collection or return.

The first communication wave aimed to increase consumers' awareness of the infrastructure supporting out-of-home delivery options. The campaign highlighted the expansion of the PUDO network in Antwerp and included maps showing the locations of available PUDO points. The communication emphasised convenience as the main benefit of choosing these delivery options, focusing on their proximity and accessibility.

G14: Appeal to emotion, not just rationality.

The second communication wave focused on sustainability and the contribution of out-of-home deliveries to the liveability of the city. The key message was supported by a short video encouraging consumers to use active modes of transport, such as walking and cycling, when collecting parcels from PUDO points. Besides increasing the visibility of the campaign on social media, the video enabled consumers to visualise how sustainable parcel collection could be integrated into their daily routines. By combining practical examples with appealing visuals, the campaign sought to complement rational sustainability arguments with emotional engagement.

G10: Reward sustainable delivery choices.

The third communication wave combined sustainability messages with a direct financial incentive. Three golden tickets, each worth €250, were awarded to online shoppers: one to a consumer who selected delivery to the shop, one to a consumer who selected delivery to a PUDO point, and one to a consumer who completed the survey. The objective was to explore whether rewarding sustainable delivery choices could further encourage consumers to adopt out-of-home delivery options.

In parallel with the social media campaign, TORFS carried out a series of checkout experiments to assess the extent to which consumers could be nudged towards more sustainable delivery options during the online purchase process. These experiments addressed an additional communication guideline:

G6: Make sustainable options stand out.

The checkout interventions tested several design elements, including the order in which delivery options were presented, the use of visual cues and logos, and the provision of information highlighting the sustainability benefits of different delivery options. The results of these experiments are presented in the following section.

5.3.1.2 Activities, outputs and efficacy of execution (checkout)

TORFS conducted three checkout experiments to assess the potential of nudging both returning and new customers towards more sustainable delivery choices. In addition to delivery preferences, the experiments also monitored conversion rates in order to evaluate whether the proposed checkout modifications affected overall sales performance.

The first experiment focused on increasing the visibility of the sustainability benefits associated with out-of-home delivery options during the checkout process. The test was conducted as an A/B experiment between 15 September and 6 October 2025. Consumers were randomly assigned to either the standard checkout page (left-hand side of Figure 28) or a modified version (right-hand side of Figure 28).

The modified checkout page displayed a green leaf icon next to the out-of-home delivery options. When users hovered over the icon, additional information was shown explaining the sustainability advantages of these delivery modes. The objective was to determine whether highlighting environmental benefits at the point of purchase could encourage consumers to select more sustainable delivery options.

Figure 28: Print screen of the adaptations brought in the check-out of TORFS (test 1)



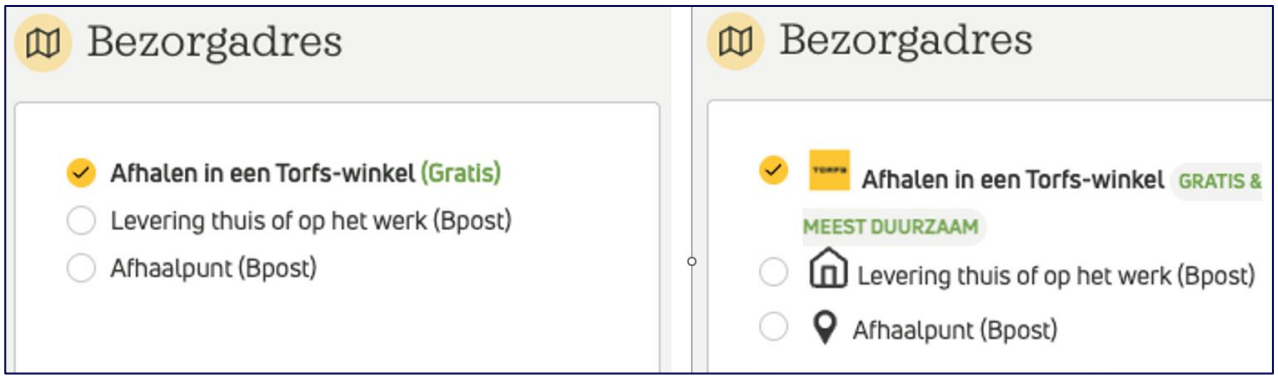
The first test generated data from 1,365 desktop orders and 3,277 mobile orders. The results presented in Table 80 show a positive impact on the uptake of out-of-home delivery options. However, no statistically significant effect on the overall conversion rate was observed. The intervention therefore influenced delivery choices but did not affect consumers' purchasing behaviour.

Table 80: Results of the A/B test 1 in the checkout of TORFS

	Returning	New
Mobile	+10% (shop delivery)	+60% (PUDO delivery)
Computer		+53% (shop delivery)

The second test was conducted between 19 January and 2 February 2026, alongside the first communication wave of the social media campaign. The default checkout page continued to serve as the control condition (left-hand side of Figure 29), while the test version (right-hand side of Figure 29) introduced additional visual cues, including logos and information specifically promoting delivery to the shop. The intervention aimed to increase the visibility of this delivery option and evaluate its influence on consumers' delivery choices during checkout.

Figure 29: Print screen of the adaptations brought in the checkout of TORFS (test 2)



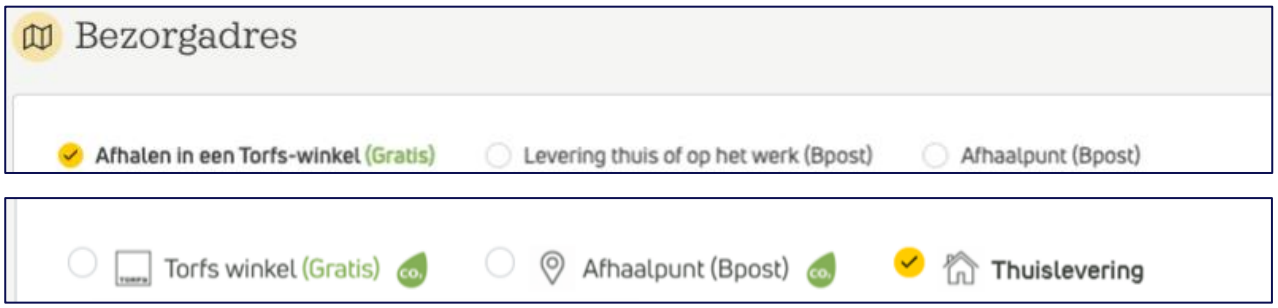
The second test generated data from 2,337 desktop orders and 5,671 mobile orders. The results presented in Table 81 once again show a positive impact on the uptake of out-of-home delivery options. However, no statistically significant effect on the overall conversion rate was observed.

Table 81: Results of the A/B test 2 in the check-out of TORFS

	Returning	New
Mobile		+23% (shop delivery) -6% (home delivery)
Computer	+15% (PUDO delivery) +11% (shop delivery)	-9% (home delivery)

The third test was conducted between 16 February and 2 March 2026, shortly after the completion of the second test. The default checkout page continued to serve as the control condition (top of Figure 30), while the test version (bottom of Figure 30) combined the interventions introduced in the first two experiments, including additional visual cues, logos, and messages promoting the sustainability benefits of out-of-home delivery options.

Figure 30: Print screen of the adaptations brought in the checkout of TORFS (test 3)



The third test generated data from 1,836 desktop orders and 5,292 mobile orders. The results presented in Table 82 confirm the positive effect of checkout nudges on the uptake of out-of-home delivery options, particularly PUDO deliveries. Importantly, this was the only test that also produced a statistically significant increase in conversion rates, demonstrating that promoting more sustainable delivery options can be achieved without negatively affecting online sales.

As a result, the revised checkout configuration was deployed across the TORFS website from 15 May 2026 onwards, replacing the previous default version for all users. Its impact on consumer delivery choices is discussed in the following section.

Table 82: Results of the A/B test 3 in the checkout of TORFS

	Returning	New
Mobile		+23% (shop delivery) -6% (home delivery)
Computer	+15% (PUDO delivery) +11% (shop delivery)	-9% (home delivery)

5.3.1.3 Activities, outputs and efficacy of execution (campaign)

The first communication wave was launched during the week of 19 January 2026. Figure 31 presents an example of a LinkedIn post shared by VUB as part of this campaign. Table 83 summarises the number of views generated by the posts published by the different project partners. In addition to these individual posts, a joint post was developed and shared by TORFS, the City of Antwerp, and Bpost. Overall, the first wave reached 14,349 views across all platforms.

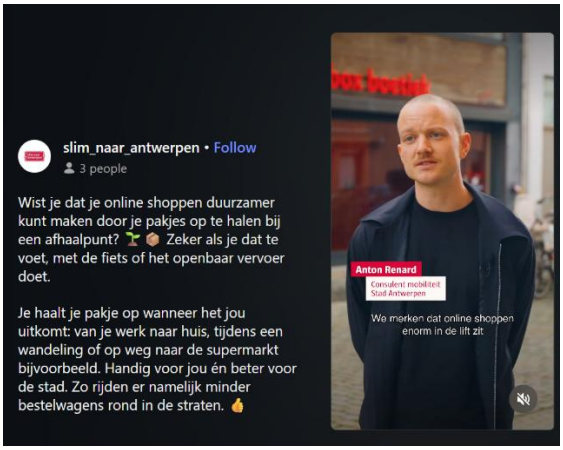
Figure 31: Example of a LinkedIn post shared during the first wave



Table 83: Reach of the first wave of posts

Views	TORFS	Antwerp	Bpost	VUB
Instagram	7021			/
Facebook	2,219	1,323	/	/
Linkedin	1,758	986	733	309

Figure 32: Example of an Instagram post shared during the first wave



The second communication wave was launched during the week of 23 March 2026. Figure 32 presents an example of an Instagram post shared by the City of Antwerp as part of this campaign. Table 84 summarises the number of views generated by the posts published by the different partners. In total, the second wave reached 10,584 views across all platforms. Despite the use of video content to support the campaign message, the second wave generated a lower reach than the first wave.

Table 84: Reach of the second wave of posts

Views	TORFS	Antwerp	Bpost	VUB
Instagram	3.676	/		
Facebook	Shared	1982	/	/
Linkedin	852	1023	2110	941

The third communication wave was launched during the week of 18 May 2026. Figure 33 presents an example of a Facebook post shared by TORFS as part of this campaign.minutes to complete. The relatively low number of responses compared with the overall reach of the campaign illustrates the difficulty of converting passive engagement into active participation.

Table 85 summarises the reach achieved by the different project partners across their social media channels. With a total of 24,989 views, the third wave generated the highest reach of all three communication waves.

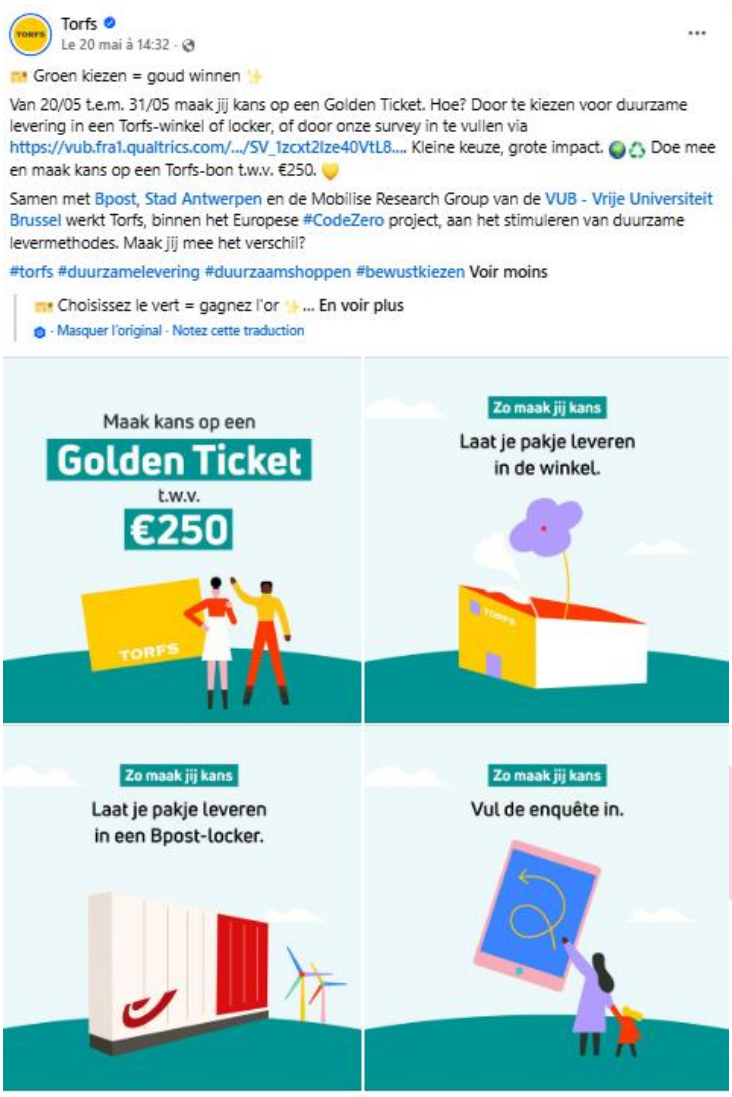
This strong performance may be partly explained by the introduction of the golden ticket incentive, which rewarded consumers for choosing out-of-home delivery options or participating in the survey. The campaign therefore combined awareness-raising with a direct call to action, potentially increasing both visibility and user engagement.

Following each communication wave, a debriefing session was organised with all project partners to identify successes, lessons learned, and opportunities for improvement. One of the main challenges highlighted during these discussions was the nature of social media itself. Posts must compete continuously with a large volume of content for users' attention and therefore tend to disappear rapidly from users' feeds. As a result, their visibility and impact are often short-lived.

To address this limitation, a dedicated webpage was developed and hosted on the websites of the project partners. The webpage provides an overview of the pilot and consolidates the key messages communicated throughout the three campaign waves, thereby extending their visibility beyond the lifespan of individual social media posts.

Another challenge identified by the partners was the difficulty of directing users from social media platforms to external websites. At the end of each post, viewers were invited to complete a short survey requiring no more than two to three

Figure 33: Example of a Facebook post shared by TORFS during the first wave



minutes to complete. The relatively low number of responses compared with the overall reach of the campaign illustrates the difficulty of converting passive engagement into active participation.

Table 85: Reach of the third wave of posts

Views	TORFS	Antwerp	Bpost	VUB
Instagram	15.018	/		
Facebook	6.961	891	Repost TORFS	/
Linkedin	1.307	Repost VUB	/	812

Nevertheless, generating survey responses was not the primary objective of the communication campaign. The principal aim was to raise awareness of out-of-home delivery options and their sustainability benefits. Consequently, the survey should be viewed primarily as an evaluation tool rather than as a measure of the overall success of the communication interventions.

The primary objective of the posts was to increase awareness of consumers and possibly influence their behaviour. When analysing the TORFS delivery mix presented in Figure 26, the first two communication waves do not appear to have significantly reduced the share of home deliveries. Between January and March, the delivery mix remained relatively stable and closely resembled that observed during the same period the previous year, with home deliveries accounting for approximately 73% of all orders.

A marked decline in the share of home deliveries can be observed from April onwards. This change is likely linked to a major strike at Bpost, which also explains the temporary increase in deliveries at the shop. The lower share of home deliveries persisted into May. One possible explanation is the success of the third communication wave, where the golden ticket incentive was included.

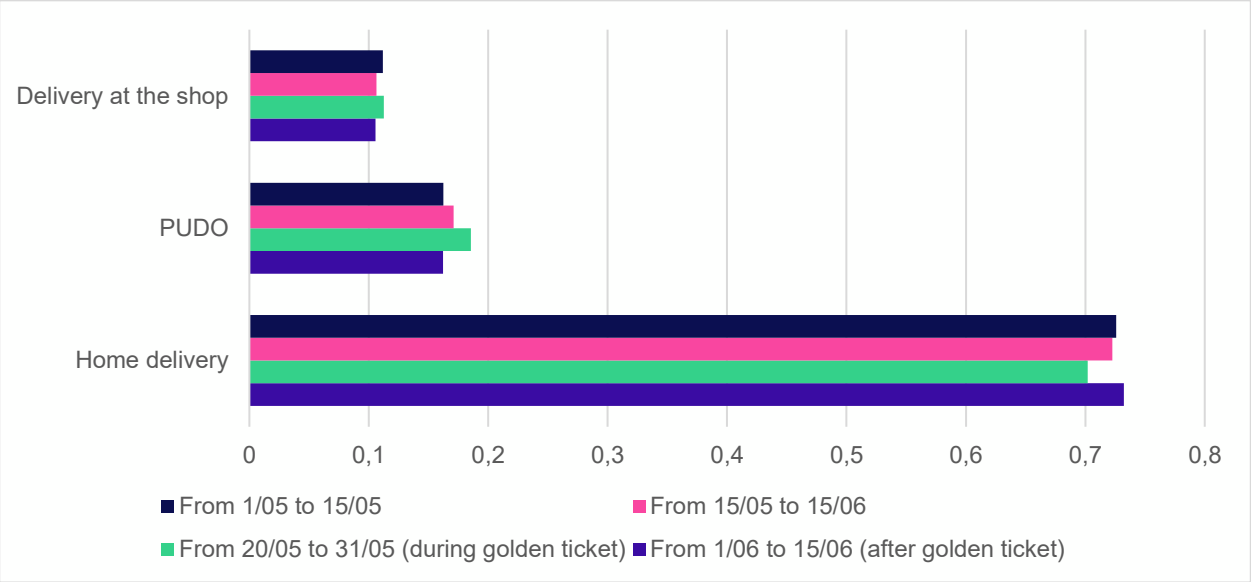
Figure 34 provides a more detailed analysis of the period between 1 May and 15 June. During the first two weeks of May, the share of home deliveries returned to levels comparable to those observed before the strike, averaging 72.57%. On 15 May, the third checkout configuration described in the previous section was implemented on the TORFS website. Between 15 May and 15 June, the average share of home deliveries decreased slightly to 72.25%.

However, this period also included the golden ticket campaign, which ran from 20 May to 31 May and therefore influenced the observed results. During the campaign period, the share of home deliveries fell more substantially, reaching 70.19%. This result highlights the potential of financial incentives to encourage consumers to choose out-of-home delivery options. At the same time, it makes it difficult to isolate the effect of the checkout modifications alone.

When considering only the period after the golden ticket campaign, the share of home deliveries increased again to 73.22%, returning to levels similar to those observed before the intervention. These findings suggest that the direct impact of the checkout modifications was limited or, at least, cannot be clearly distinguished from the effect of the financial incentive. Monitoring delivery choices

over a longer period would be necessary to determine whether the revised checkout design has a lasting influence on consumer behaviour.

Figure 34: Delivery mix at TORFS during the last weeks of the pilot



5.3.2 Experimental design

The objective of the communication interventions was to encourage consumers to choose out-of-home delivery options. The previous sections have shown how these interventions influenced the delivery mix during the pilot.

While encouraging the consumers to adapt their behaviour, the communications gave the possibility to the consumers to evaluate the communication interventions themselves. At the end of each social media post, viewers were invited to complete a short survey designed to evaluate whether the campaign influenced their intentions to select alternative delivery options. The survey also assessed how the communicated information was understood, trusted, and retained by consumers. No incentives were offered during the first two communication waves. During the third wave, however, a €250 golden ticket was introduced to encourage participation.

Deliverable 3.2 proposed a comprehensive set of KPIs to evaluate communication interventions. Given the typically low response rates associated with social media surveys, the questionnaire was designed to capture as many KPIs as possible through a limited number of questions with predefined response options. Respondents were also given the opportunity to provide additional feedback through open-text responses whenever the proposed answers did not adequately reflect their views.

The survey included the following questions:

1. **“When do you use pickup points for your online purchases?”** - This question explored respondents' delivery habits and preferences regarding out-of-home delivery options. It provided information related to KPI 13 (intention to choose an out-of-home delivery option for a future purchase), KPI 14 (intention to choose an out-of-home delivery option online), and KPIs 16 and 25 (preferences and actual choices among delivery options). Response options were: each time I can, When the checkout page informs me about the sustainability

of the option, When it is the cheapest option, When there are no other options, I do not order if pickup point is the only option.

2. **“How much extra distance do you travel to reach your pickup point?” and “How do you travel to your pickup point?”** - These questions investigated consumer travel behaviour when collecting parcels and provided information for KPIs 26, 27, and 28 related to collection parameters. Response options were: None, it is on my way most of the time, Up to 75m, Between 75m and 400m, Between 400m and 1km, Between 1km and 2km, Between 2km and 5km, More than 5km, I am not sure where a pick up point is located close to me.
3. **“Did you know that pickup points are generally more sustainable than home deliveries in urban areas?”** - This question assessed respondents' awareness of the sustainability benefits associated with out-of-home delivery options and contributed to KPI 7 (awareness of sustainable delivery choices) and KPI 9 (attitude towards out-of-home delivery options). Response options were: Yes, I am well aware, Yes, I can guess it is, No, I did not know, No, I am not so concerned anyway, Not sure, not very important to know.
4. **“Do you understand the idea that, in urban areas, pickup points are generally more sustainable than home deliveries?”** - This question evaluated respondents' understanding of the communicated message and supported KPI 2 (message comprehension). Response options were: Yes, completely, Yes, to some extent, No, not at all, Not sure, not so much attention brought to it.
5. **“Would you share with friends the idea that pickup points are generally more sustainable than home deliveries in urban areas?”** - This question assessed trust in the communicated message and provided data for KPI 5 (trust in the message). Response options were same than question 4.
6. **“Do the sustainability benefits encourage you to choose pickup points for future online purchases?”** - This question explored the extent to which sustainability considerations influence future delivery choices and contributed to KPI 14 (intention to choose an out-of-home delivery option online). Response options were: Yes, I’ll use more often pick-up points, Yes, I’ll keep collecting my parcels at a pick up point, No, I’ll keep asking for home deliveries, Not sure, I might try out collecting my parcels at a pick up point.
7. **“What is the main reason you do not use pickup points?” and “What is the main reason you use pickup points?”** - These questions explored the barriers and enablers associated with out-of-home delivery options. Through their predefined answer categories, they provided information on multiple KPIs, including KPI 12 (perceived difficulty of implementation), KPI 15 (ranking of sustainability among competing objectives), KPI 17 (satisfaction with the delivery experience), KPI 18 (knowledge of how to choose and collect parcels), and KPI 20 (visibility of delivery options). Response options for the reasons not to use were: I don’t know it existed, Pickup points are not located conveniently (e.g., too far or not on my route), The pickup process feels too complicated, Bad past experience with a locker (locker does not work, opening hours change,...), I don’t trust the locker technology, I’m concerned about safety, None of the above, I use them, Others. Response options for the reasons to use were: More convenient overall, More flexible pickup time, No missed deliveries, More secure than home delivery, Easier and faster pickup process, It is the more sustainable delivery option, None of the above, I don’t use them, Others.
8. **“What is your postcode?”** - This question collected geographical information to support additional analysis of respondents' behaviour. No other sociodemographic information was collected.

In addition to the survey data, TORFS provided operational data on delivery choices, enabling the measurement of KPI 23 and KPI 24. Overall, the questionnaire and retailer data together covered 18 of the 28 KPIs proposed in Deliverable 3.2.

In parallel with the social media survey, several questions relating to out-of-home delivery options were included in the annual mobility survey conducted by the City of Antwerp. However, the results of this survey will only become available in September 2026, after the submission deadline for this deliverable. Consequently, the analysis presented in this section is based exclusively on the responses collected through the social media campaign survey.

5.3.3 KPIs

The survey collected responses between 19 January and 15 June 2026. A total of 380 responses were received. Following data cleaning, which involved removing incomplete questionnaires and responses completed in less than 60 seconds, the final sample used for the analysis consisted of 259 valid responses. As the survey was spread on social media, respondents are followers of TORFS, Antwerp, Mobilise and Bpost. They are however not always living in the three postcodes of the pilot. Only seven respondents lived within the three postal codes covered by the pilot. A more narrow analysis takes into account the geographical spread of the respondents when analysing KPIs related to modal choice of consumers (KPI 26-27-28)

Figure 35: Collection of responses to the survey during the pilot in Antwerp

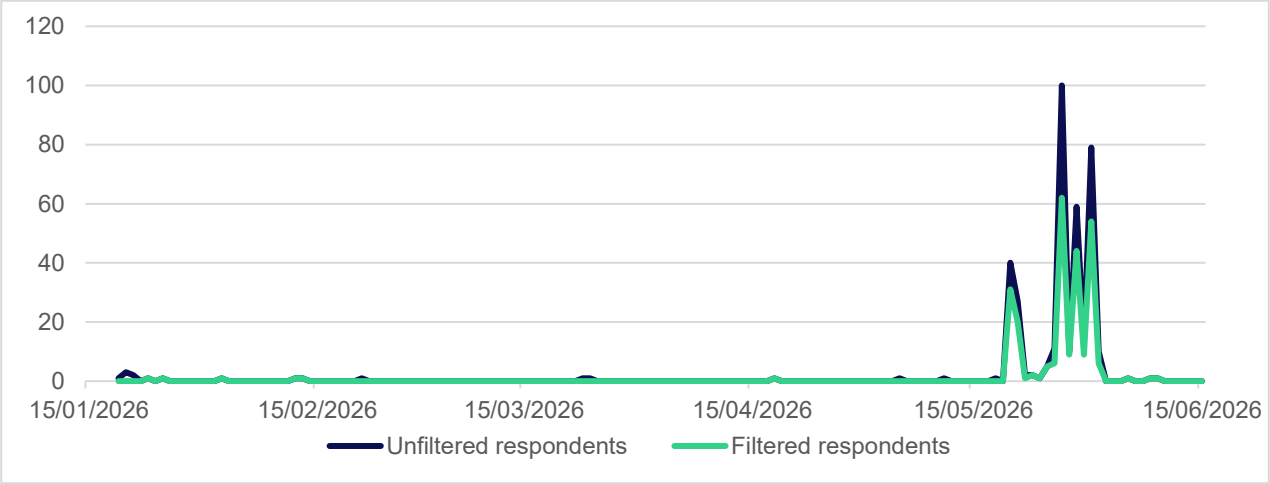


Figure 35 illustrates the evolution of survey participation over time. The first two communication waves generated very limited engagement with the survey: only five valid responses were collected following the January campaign, and just one valid response was received after the March-April campaign. These figures confirm the low response rates typically associated with social media surveys, particularly when compared with the reach of the corresponding campaigns, which generated 14,349 and 10,584 views, respectively.

As noted above, however, the primary objective of the social media campaign was not to maximise survey participation but to raise awareness of out-of-home delivery options. Consequently, the low number of responses does not necessarily indicate limited communication effectiveness.

Most survey responses were collected during the third communication wave. The substantially higher reach achieved during this period (24,989 views) likely contributed to the increase in

participation. Nevertheless, the €250 golden ticket incentive almost certainly played a decisive role in encouraging respondents to complete the survey.

The main KPI results derived from the survey are presented in Table 86 (self reported). They reflect mostly the opinions of respondents who reacted to the golden ticket campaign. They do not include the opinions of consumers who were involved in the check-out tests. But a more detailed analysis of these findings together with these KPIs is provided in the following section. The analysis integrates also the retailers data found in the table below. They are in line with the figures presented in Figure 26.

Table 86: KPIs list with associated data

KPI number	KPI	Data source	KPI values	Dimension addressed
2	% consumers who understand the message	Self-reported	94.20%	Comprehension of message
5	% consumers trusting the message	Self-reported	79.15%	Trust in message
7	% consumers aware of the impact of the sustainable delivery option vs. other options	Self-reported	83.78%	Awareness of sustainable delivery/return choice
9	% consumers who believe choosing the new delivery option will have an impact	Self-reported	83.78%	
12	% consumers thinking it would be difficult to implement the out-of-home delivery option	Self-reported	6.95%	Perceived difficulty of implementation of the delivery option
13	% consumers who intend to choose out-of-home delivery option for next purchase	Self-reported	77.61%	Intention to choose out-of-home delivery option next time
14	% consumers who say an online message made them want to choose the out-of-home delivery option	Self-reported	5.79%	Intention to choose out-of-home delivery option online
15	Average ranking of sustainability as goal influencing choice of delivery option, relative to cost, convenience, speed and safety	Self-reported	3rd most important criteria	Ranking of sustainability among other goals
16	% consumers preferring out-of-home delivery option last time	Self-reported	77.61%	
17	% consumers satisfied with delivery-collection experience (post-order)	Self-reported	76.06%	Experienced satisfaction with delivery option chose
18	% consumers who knew how to collect using the out-of-home delivery option?	Self-reported	89.96%	Know-how to choose and collect
23	Total number of deliveries (month of May)	Retailer data	47.108	
24	% deliveries for out-of-home delivery option	Retailer data	27%	

25	% consumers who chose the out-of-home delivery option for the last order	Self-reported	77.61%	
26	Average number of kilometres travelled by consumers	Self-reported	1.44km	Collection parameters
27	% consumers using private car (by fuel type) for collecting their parcel	Self-reported	10.42% (electric) 41.70% (conventional)	
28	% of consumers trip-chaining for parcel pickup	Self-reported	28.14%	

5.3.4 Assessment summary

The communication interventions implemented through the social media campaign reached a substantial audience. Across the three communication waves, the campaign generated a total reach of 49,922 views. Assessing the significance of this reach remains challenging, as no direct benchmark exists for comparison. However, the scale of the campaign can be contextualised by the activity on the TORFS webshop, which recorded 47,108 transactions in May alone.

While campaign reach is an important indicator of visibility, its influence on delivery choice remains the most relevant measure of success. Encouraging consumers to adopt out-of-home delivery options was the primary objective of the pilot. In this regard, the most notable results were observed during the third communication wave. As shown in Figure 34, the share of home deliveries decreased from 73% to 70% during the campaign period. This reduction was accompanied by an increase in out-of-home delivery options, particularly deliveries to PUDO points and, to a lesser extent, deliveries to the shop. The financial incentive introduced during the third wave likely played a key role in driving this behavioural change.

The same incentive also had a clear impact on participation in the survey used to evaluate the communication interventions. One of the most notable findings presented in Table 86 is that only 5.79% of respondents indicated that sustainability information displayed during the checkout process would directly influence their choice of an out-of-home delivery option. This suggests that providing sustainability-related information at checkout, on its own, has a relatively limited effect on delivery choices.

This finding does not imply, however, that communication about the sustainability benefits of out-of-home delivery is ineffective. On the contrary, 39% of respondents indicated that information on sustainability benefits would encourage them to choose out-of-home delivery options more frequently in the future, while a further 10% stated that it would motivate them to try these options for the first time. In addition, 30% reported that such information would reinforce their existing preference for out-of-home delivery options.

Overall, the communication messages were well received. The survey showed that 94% of respondents either fully or partly understood the sustainability benefits associated with out-of-home delivery. This result can be partially explained by an already high level of awareness among respondents: 47% indicated that they were already aware of these benefits, while a further 37%

reported a general awareness that out-of-home delivery options generate positive environmental impacts. Only 13% stated that they were previously unaware of these benefits. This awareness is reflected in the high level of trust in the communicated message, with 79% of respondents indicating that they would share the information with friends or relatives. Promoting the sustainability benefits of out-of-home delivery therefore appears to be a message that resonates with consumers and can support behavioural change.

Out-of-home delivery options are however not always the most sustainable choice. As discussed in Section 5.2.4, the environmental performance of these delivery options depends strongly on how consumers travel to collect their parcels. The survey therefore explored respondents' travel behaviour when collecting parcels from PUDO points or retail stores.

Car use was relatively common among respondents, with 42% reporting the use of a conventional car and 10% an electric vehicle. By comparison, 23% travelled by bicycle, 12% on foot, and 5% by public transport. These figures should be interpreted with caution, as the survey was not limited to residents of the pilot area. Only seven respondents lived within the three postal codes covered by the pilot. Expanding the analysis to include respondents from the dense suburban areas surrounding Antwerp increased the sample to 17 respondents (postcodes 2020, 2050, 2100, 2140, 2150, 2170, 2600, 2620, 2630, 2640, 2660). Within this subgroup, bicycle use increased to 41%, while conventional and electric car use declined to 18% and 6%, respectively. Among car users, it is worth noted that trip chaining was common. Approximately half indicated that the pick-up point was located along a route they were already planning to take. Among those making a dedicated trip, the additional distance travelled was generally limited: 25% reported an additional distance of around 75 metres, while another 25% reported travelling between 400 metres and 1 kilometre. Although the sample size is too small to draw firm conclusions, these findings support the assumption that reliance on private cars for parcel collection is lower in dense urban environments. Additional insights are expected from the annual mobility survey conducted by the City of Antwerp.

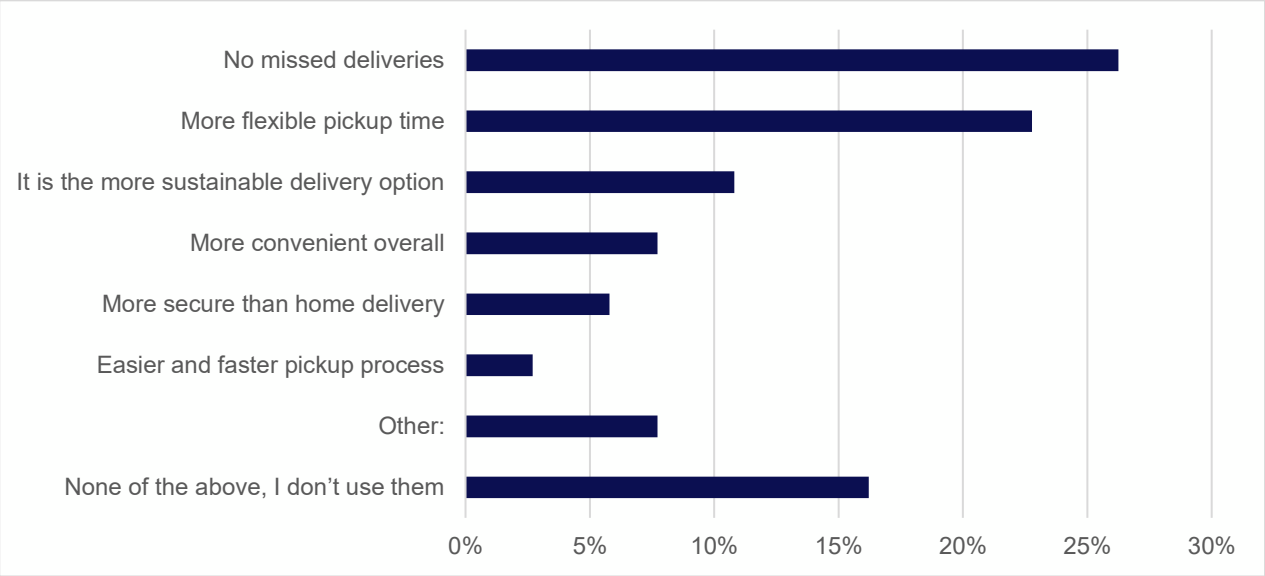
Sustainability is however not the primary motivation for choosing out-of-home delivery options. Figure 36 shows that the most frequently cited reasons for using pick-up points were avoiding missed deliveries and benefiting from greater collection flexibility. While sustainability is ranked only third among the reported motivations, convenience can be positioned as the first reason to use out-of-home deliveries.

This finding is reinforced by the responses to the complementary question on barriers to using pick-up points. The most frequently reported barrier was again convenience, with 9% of respondents indicating that available pick-up points were not conveniently located. As discussed in Section 5.2.1, the expansion of the Bpost PUDO network strongly coincided with the growth of out-of-home deliveries in Antwerp. At TORFS, this growth primarily benefited deliveries to PUDO points. However, rather than replacing home delivery, it appears to have come largely at the expense of delivery to the shop. The greater proximity and accessibility of PUDO points may explain this trend.

Several additional barriers were identified that could be addressed to further increase the attractiveness of PUDO points. These include perceptions that the collection process is too complex (7%), safety concerns (7%), negative past experiences such as malfunctioning lockers or inconsistent opening hours (5%), a lack of trust in the technology (3%), and limited awareness of

the available options (2%). Despite these barriers, almost half of respondents (46%) reported experiencing no significant obstacles and were already making regular use of PUDO points.

Figure 36: Responses to the question "What is the main reason you choose to use pick up point"



Although the results indicate that convenience is the primary motivation for choosing out-of-home delivery options, the role of price should not be underestimated. While Figure 36 does not explicitly identify price as a key driver, this factor was frequently mentioned by respondents under the category "Other". Furthermore, the impact of the golden ticket campaign during the third communication wave suggests that financial incentives can be a powerful lever for encouraging behavioural change towards out-of-home delivery options. Figure 37 further confirms the importance of pricing, with respondents indicating that cost-related incentives would strongly influence their delivery choices.

Nevertheless, adjusting pricing strategies remains a sensitive issue for retailers. Consumers increasingly expect free delivery, particularly when their purchase exceeds a minimum order value. At TORFS, this threshold is set at €30, meaning that, in practice, most orders qualify for free delivery regardless of the selected delivery option.

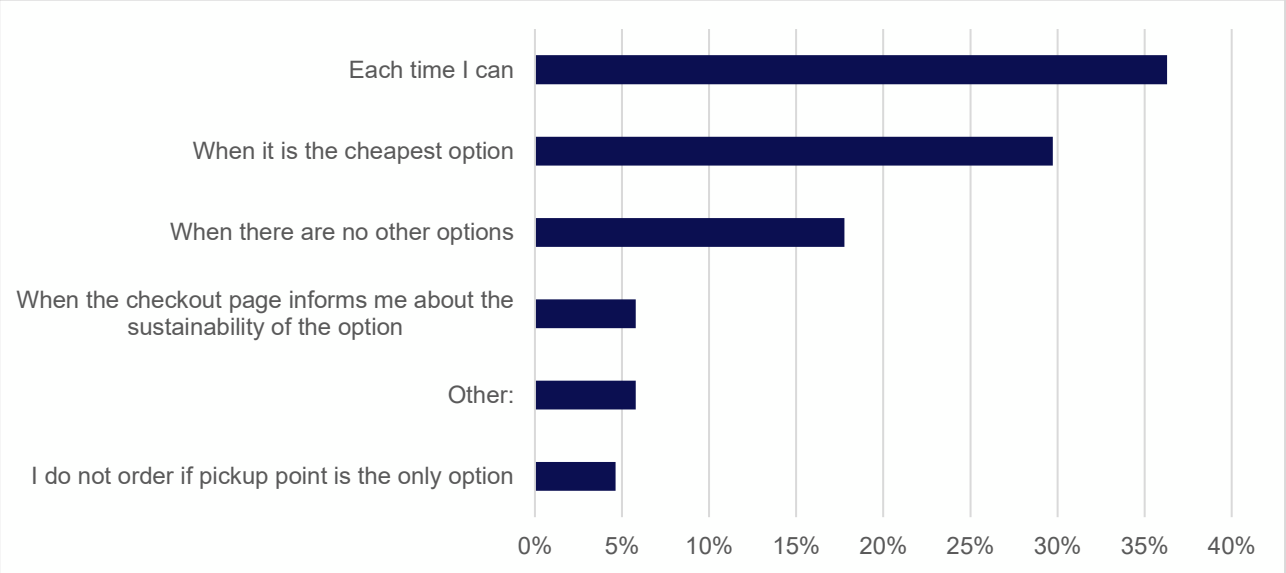
Within this context, two approaches can be considered to encourage the uptake of out-of-home delivery options. The first involves introducing a fee for home delivery while maintaining free delivery to PUDO points and retail stores. However, such a strategy carries commercial risks, as home delivery remains the preferred option for most consumers. Additional charges could therefore encourage some customers to switch to competing retailers.

The second approach consists of rewarding consumers who choose out-of-home delivery options. Since these options are already offered free of charge, incentives can take various forms, including discounts, loyalty points, vouchers, or prize draws. The golden ticket campaign implemented during the pilot provides a practical example of this approach. Building on these results, TORFS is also

exploring the development of a loyalty programme that would reward consumers for selecting more sustainable delivery options.

Overall, the findings suggest that positive incentives may represent a more promising strategy than penalising home delivery, as they encourage behavioural change while avoiding potential negative impacts on customer satisfaction and retailer competitiveness.

Figure 37: Responses to the question "When are you using pickup points for your online purchases?""



In conclusion, out-of-home delivery options have the potential to become the dominant delivery mode if supported by an appropriate mix of incentives. According to Figure 37, up to 77.61% of respondents would use out-of-home delivery options when considering all response categories except those who would only use a pick-up point in the absence of alternative delivery options and those who would not place an order under such conditions. This figure might be overestimated though. When comparing the 36% of respondents declaring that they use it each time they can with the 27% of orders shipped to a PUDO point or a shop in the delivery mix of TORFS, there might be an overrepresentation of users of parcel lockers in the survey.

Financial incentives appear in any case to be particularly effective in encouraging a behavioural shift towards out-of-home deliveries. The Antwerp pilot confirms that insight from the survey. The third wave of social media posts showed also that rewarding sustainable delivery choices was an effective communication intervention. The effect was more limited than what Figure 37 claims. But the incentive was limited to three golden tickets. There was not as such a price differentiation in the checkout.

Adapting the checkout by highlighting sustainable delivery options is another nudge that showed promising results during the A/B testing and was subsequently implemented on the TORFS website. However, its long-term impact on the delivery mix remains uncertain and would require further monitoring.

The communication interventions focused on appealing to emotions and providing consumers with actionable plans for out-of-home parcel collection did not generate a clear and immediate effect on the TORFS delivery mix as well. Unlike the third wave, the first two waves did not include a direct

call to action. Nevertheless, they may have influenced consumers' perceptions and intentions, the effects of which may only become visible over a longer time horizon than that covered by the pilot.

Indeed, the survey results suggest that communicating the sustainability benefits of out-of-home delivery can positively influence behavioural intentions: 10% of respondents indicated that such information would encourage them to try out-of-home delivery options, while 39% stated that it would motivate them to use these options more frequently. A further 30% reported that it would reinforce their existing preference for out-of-home delivery. These findings indicate that sustainability messages are generally well received and can support the adoption of more sustainable delivery practices.

However, communication activities should be accompanied by messages promoting active and sustainable modes of transport for parcel collection. As demonstrated in Section 5.2.4, the environmental benefits of out-of-home delivery depend strongly on how consumers travel to collect their parcels. Encouraging consumers who rely on private cars to access pick-up points may reduce, or even offset, the expected sustainability gains associated with these delivery options.

6 Conclusions

The final assessment provides an integrated overview of the implementation results and lessons learned from the four CodeZERO Living Labs in Milan, Oslo, Utrecht and Antwerp. Building on the mid-term assessment, it confirms that all pilots were successfully implemented in real-world commercial and regulatory environments, while also showing that the performance of each solution depends strongly on the local context, the delivery profile, the operational set-up and the degree of maturity reached during the pilot. Each Living Lab tested a distinct innovation.

- **In Milan**, the pilot compared an existing two-wheel cargo-bike fleet with a mixed fleet integrating a cargo tricycle. Although average fleet performance remained broadly stable, during the two weeks in which the tricycle was assigned to suitable higher-load routes, average transported weight increased from 19 kg to 34 kg, parcels from 8 to 14 and stops from 5 to 8, while distance remained almost unchanged at approximately 11 km; route duration increased from about 1h14 to 1h25. The pilot also improved the consumer-side assessment through the revised checkout message, with the score of the KPI “Information” increasing from 27.43 to 70.96. Postcards were distributed across 4,361 cargo-bike deliveries, but only 40 consumers accessed the survey and 28 completed it, corresponding to a 70% completion rate among those who accessed it but less than 1% of all recipients. Among respondents, more than 90% reported favourable attitudes towards cargo-bike delivery and 64% were willing to accept both higher costs and longer waiting times. This willingness to accept compromises suggests some resilience in consumer demand for sustainable last-mile logistics solutions. Digital nudging at checkout, which promotes mindful, informed decision-making can support mindful and informed decision-making without disrupting the sales funnel. Finally, the approach adopted around both social and environmental sustainability, strengthen the credibility and acceptance of zero-emission last-mile deliveries. These findings should be treated as exploratory because of the small, potentially self-selected sample, while the low participation rate also highlights that consumers are not only passive recipients of sustainable delivery solutions: their active participation in surveys, feedback activities and delivery choices is necessary to understand preferences, improve services and support more informed decisions by retailers, operators and public authorities.
- **In Oslo**, the Click & Collect Near You service by IKEA was evaluated positively when compared with home delivery across a range of KPIs, reducing kilometres driven and environmental impacts while also improving delivery efficiency and providing customers with a less expensive alternative. During the pilot period, the CCNY service averaged 3.84km per delivery, nearly half that of home delivery, which needed 7.5km. When accounting for customer travel to the pick-up points this figure rises slightly, to 4.39km per delivery, but remains an improvement. However, flexibility and load factor were two areas in which CCNY was not evaluated as highly as home delivery. CCNY customers have fewer options regarding time and place of delivery as the pick-up points are active during a specific time periods on specific days. Additionally, CCNY vehicles were not able to use their capacity as well as the home delivery vehicles, as they carried an average weight of 228kg, whereas home delivery vehicles averaged 938kg. If the service continues to grow in popularity, it is expected that CCNY will vehicles will utilise more of their capacity.

Among users of the service, satisfaction with the information provided was high: 79% were satisfied with the information received during delivery and 76% found the pickup point easy to locate. As reflected in the literature, price and convenience were the main factors influencing delivery choice, while environmental impact was important to 39% of respondents. This suggests that sustainability communication may not appeal to all IKEA consumers, but still to a substantial share. Different communication measures were tested during the pilot. The sustainability message included in the confirmation e-mail was not recalled by most consumers and had no significant effect on awareness or intention, highlighting the importance of choosing appropriate communication channels. In addition, the Oslo pilot showed the importance of making new delivery options visible to consumers, since only 10% of surveyed users recalled seeing information about CCNY before ordering, which probably contributed to the low initial uptake. To address this challenge, the pilot led to closer collaboration between logistics and marketing teams so that delivery options could be better integrated into retailers' communication. Based on their experience with the pilot, IKEA has chosen to continue the service and is considering additional pick-up points in Oslo as well as implementation in other Norwegian cities.

- **In Utrecht**, the pilot tested a mobile micro-hub concept for grocery deliveries, combining a temporary urban consolidation point with light electric vehicles (LEVs) and a bicycle cargo trailer for the last mile. The most distinctive innovation was not the deployment of zero-emission vehicles alone, but the creation of a new distribution architecture in which goods were transferred from a mobile hub located close to customers to smaller vehicles capable of operating in highly constrained urban environments. This approach was specifically designed for Utrecht's inner city, where access restrictions, limited road space, and vulnerable quay infrastructure challenge conventional delivery operations. The pilot demonstrated that grocery deliveries can be performed through a hub-and-spoke model using LEVs without compromising service quality. The LEV completed 200 orders across 43 routes, achieving 89.5% on-time deliveries, while the bicycle cargo trailer completed 65 orders across 29 routes with an on-time performance of 93.8%. The trailer proved particularly effective in narrow streets and highly constrained locations, although its lower payload resulted in lower productivity compared with the LEV. An important outcome was that the concept generated clear environmental and spatial benefits by reducing the need for larger delivery vehicles in the city centre. The assessment by local authorities strongly favoured the micro-hub solution, with the pilot scenario scoring 66.6 compared with 28.1 for the conventional delivery scenario. Consumer acceptance remained positive, with the pilot solution achieving a comparable assessment score (65.86) to conventional home delivery (64.23). Summarising, the Utrecht pilot focused on vehicle optimisation through the addition of a cargo tricycle and behavioural communication measures; by this Utrecht demonstrated a system innovation: the integration of a mobile micro-hub, cross-docking operations, and zero-emission light vehicles into a new grocery distribution model. The pilot showed that sustainable urban grocery logistics can be enabled through organisational redesign and urban consolidation rather than vehicle substitution alone. At the same time, it highlighted the importance of sufficient delivery density, efficient route planning, and integration with existing retail logistics processes for future scaling.

- **In Antwerp**, the expansion and promotion of out-of-home delivery options were explored through multiple interventions. Consumers seem to be influenced mostly by the conveniency of the options. In that regard, the development of the PUDO network by Bpost in Antwerp has been supporting the growth of that option among Bpost users: home deliveries have been reduced from 71% in May 2025 to 67% in May 2026. Sustainable benefits could also influence consumers but the results of A/B tests on the check-out still need to be confirmed in the next months. At least, 39% of respondents who saw the campaigns on social media confirmed that sustainable benefits would encourage them to choose out-of-home deliveries. Pricing seems to remain however another impactful trigger. Home deliveries were reduced from 73% to 70% during the campaign with the golden ticket. But pricing differentiation is difficult to implement as consumers expect already free deliveries. Moreover, knowing that sustainability of out-of-home deliveries depend also on how customers travel to collect parcels, pricing should not encourage careless consumers to adopt out-of-home deliveries and use their car to collect parcels.

Across the four pilots, the results confirm **the importance of strong multi-stakeholder cooperation between cities, retailers, logistics operators and research partners**. This cooperation was essential to ensure operational feasibility, data access, regulatory clarity and adaptation to local constraints. Pre-existing partnerships, municipal support, operational knowledge and the availability of monitoring systems were key enabling factors in all Living Labs.

The assessment also confirms that **no solution performs better on all dimensions. Each option produces specific gains and trade-offs**. Consumers tend to value price, convenience, reliability and flexibility; retailers and logistics operators focus on efficiency, resource use and scalability; local authorities prioritise environmental, transport and spatial impacts. The stakeholder-weighted assessment framework helps make these trade-offs explicit, but the results should not be read as a simple ranking. They indicate where the tested solutions perform well, where they create tensions, and where further adaptation is needed.

A common lesson is that **sustainable delivery options work best when they are not treated as direct replacements for conventional delivery, but as part of a more differentiated delivery system**. Cargo bikes, tricycles, mobile pick-up points, micro-hubs, PUDO networks and shop delivery each respond to specific operational needs. Their value increases when they are matched with the right goods, delivery densities, urban areas and customer profiles.

Communication activities were implemented in all pilots, using checkout messages, confirmation emails, newsletters, social media, app notifications, postcards, campaigns and incentives. These actions helped increase visibility and awareness of the tested options. However, partners often had limited ability to modify the online purchase journey or set sustainable options as defaults, due to corporate rules, technical constraints or anti-greenwashing safeguards. As a result, several interventions relied on lighter cues, such as labels, icons, short messages or supporting campaign material.

The communication results show that consumers respond better to clear, concrete and actionable information than to abstract sustainability claims. Messages placed close to the delivery decision, such as checkout nudges or delivery-choice information, were generally more relevant than broader awareness campaigns. At the same time, convenience, price, delivery time and habit remained strong drivers of behaviour. Sustainability helped reinforce positive attitudes and intentions, but rarely acted as the only reason for changing delivery choice.

Survey results should be interpreted with caution. Low response rates, self-selection bias and limited ability to link communication exposure with actual behaviour reduced the statistical

robustness of the consumer behaviour assessment. Nevertheless, the pilots generated useful exploratory evidence: consumers generally understand and value sustainable delivery options when the message is clear, credible and connected to practical benefits.

Overall, the CodeZERO Living Labs show that zero-emission and sustainable last-mile delivery solutions are feasible, but their success is conditional. They require suitable operational contexts, sufficient demand density, stakeholder alignment, consumer visibility and time for integration into existing logistics processes. **The main lesson is not that one model should replace all others, but that sustainable e-commerce logistics requires a more flexible delivery ecosystem, where different delivery options are combined according to context, demand, service requirements and expected impacts**.

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Appendix

Appendix 1: CodeZERO Communication guidelines V1 – heuristic form (Pernot et al. 2025)

Communicate clearly and credibly

1. Be open, clear and specific in your messaging
2. Explain new cues simply and clearly
3. Make verifiable claims
4. Layer sustainability information
5. Standardize sustainability information

Use messages that matter

11. Show the real-world impact of choices
12. Cover all dimensions of sustainability
13. Leverage social norms to influence choices
14. Appeal to emotion, not just rationality
15. Target life transitions for greater impact

Shape choice environments

6. Make sustainable options stand out
7. Encourage reflection on delivery choice
8. Provide comparability between options
9. Influence both habitual and conscious choices
10. Reward sustainable delivery choices

Align and support sustainability messaging

16. Align communication across channels and consumer journey / supply chain
17. Give consumers actionable plans for out-of-home collection or return
18. Give consumers positive sustainable choice experience

Appendix 2: Survey questionnaire to customers in Milan pilot



Survey on cargo bike deliveries – CodeZERO Project

Survey on the sustainable cargo bike delivery service offered by IKEA Italia in collaboration with SoDe Social Delivery

Welcome

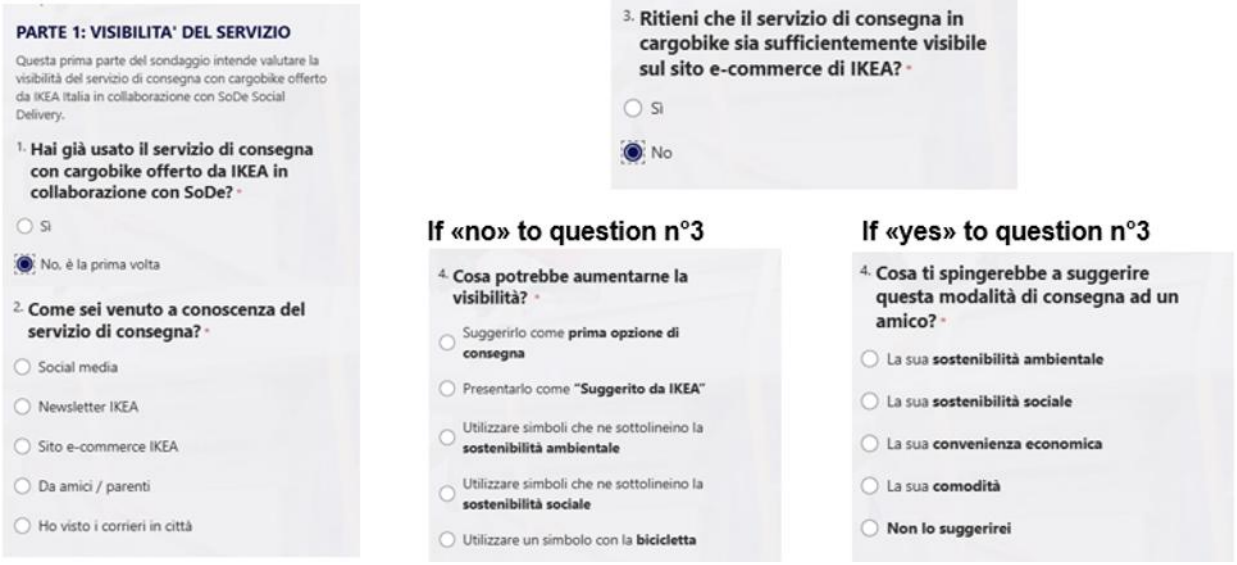
This survey is being conducted by **TRT Trasporti Territorio** (www.trt.it) as part of CodeZERO (www.codezero-project.eu), a research project **co-funded by the European Union** under the **HORIZON EUROPE** programme.

The aim of the survey is to gather information on the sustainable cargo bike delivery service offered by IKEA Italy (www.ikea.com) in collaboration with SoDe Social Delivery (www.so-de.it)

The survey takes just **2 minutes** to complete and the **data is collected anonymously**.

PART 1: VISIBILITY OF THE SERVICE

This first part of the survey aims to assess the visibility of the cargo bike delivery service offered by IKEA Italia in collaboration with SoDe Social Delivery.



1. Have you already used the cargo bike delivery service offered by IKEA in partnership with SoDe?

- Yes
- No. This is my first time

2. How did you find out about the delivery service?

- Social media
- IKEA newsletter
- IKEA e-commerce website
- From friends/relatives
- I've seen the couriers in town

3. Do you think the cargo bike delivery service is sufficiently visible on the IKEA e-commerce site?

- Yes
- No

If <<no>>> to question 3

4. What could increase its visibility?

- Suggest it as the first delivery option
- Present it as 'Recommended by IKEA'
- Use symbols that highlight its environmental sustainability
- Use symbols that highlight its social sustainability

- Use a symbol featuring a bicycle

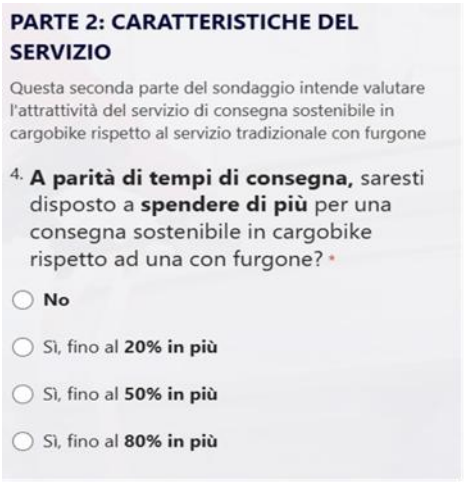
If <<yes>> to question 3

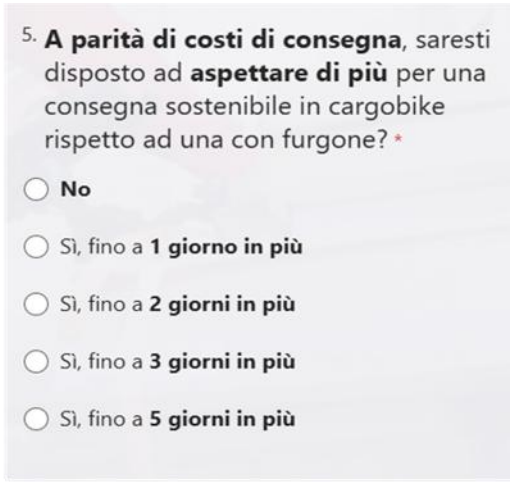
4.What would encourage you to recommend this delivery method to a friend?

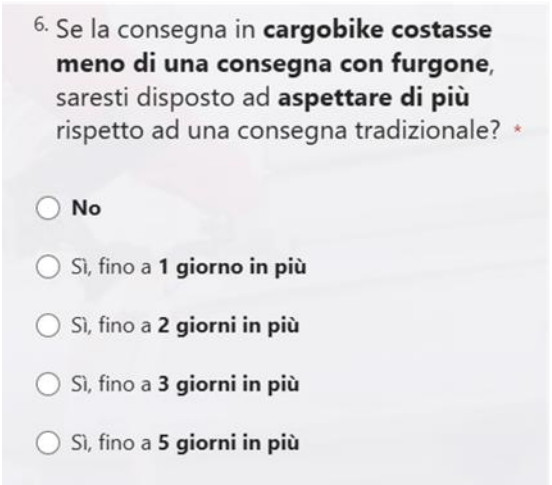
- Its environmental sustainability
- Its social sustainability
- Its affordability
- Its convenience
- I wouldn't recommend it

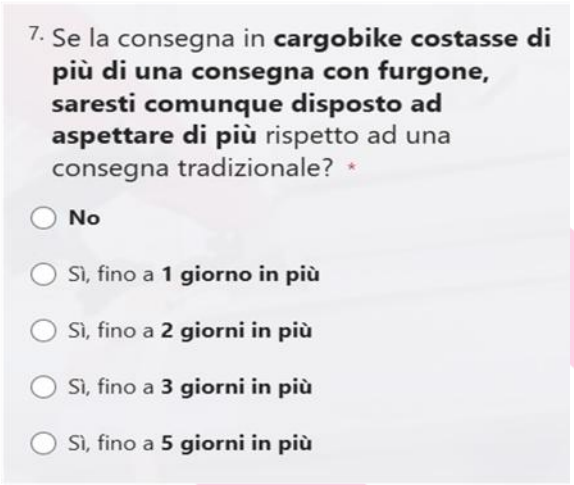
PART 2: SERVICE CHARACTERISTICS

This second part of the survey aims to assess the attractiveness of a sustainable delivery service using cargo bikes compared to a traditional van-based service.









4.**If delivery times were the same**, would you be willing to **pay more** for a sustainable delivery by cargo bike than for one by van?

- No
- Yes, up to 20% more

- Yes, up to 50% more
- Yes, up to 80% more

5.**If delivery costs were the same**, would you be willing to **wait longer** for a sustainable delivery by cargo bike than for one by van?

- No
- Yes, up to 1 day longer
- Yes, up to 2 days longer
- Yes, up to 3 days longer
- Yes, up to 5 days longer

6.**If a delivery by cargo bike cost less than one by van**, would you be willing to **wait longer** than you would for a traditional delivery?

- No
- Yes, up to 1 day longer
- Yes, up to 2 days longer
- Yes, up to 3 day longer
- Yes, up to 5 days longer

7.If delivery by cargo bike cost more than delivery by van, would you still be willing to wait longer than you would for a traditional delivery?

- No
- Yes, up to 1 day longer
- Yes, up to 2 days longer
- Yes, up to 3 days longer
- Yes, up to 3 days longer
- Yes, up to 5 days longer

Appendix 3: Survey questionnaire sent by IKEA to customers ordering with CCNY in Oslo pilot

Survey questionnaire sent by IKEA to customers ordering with CCNY



Hello!

Thank you for taking the time to help us evaluate our service.

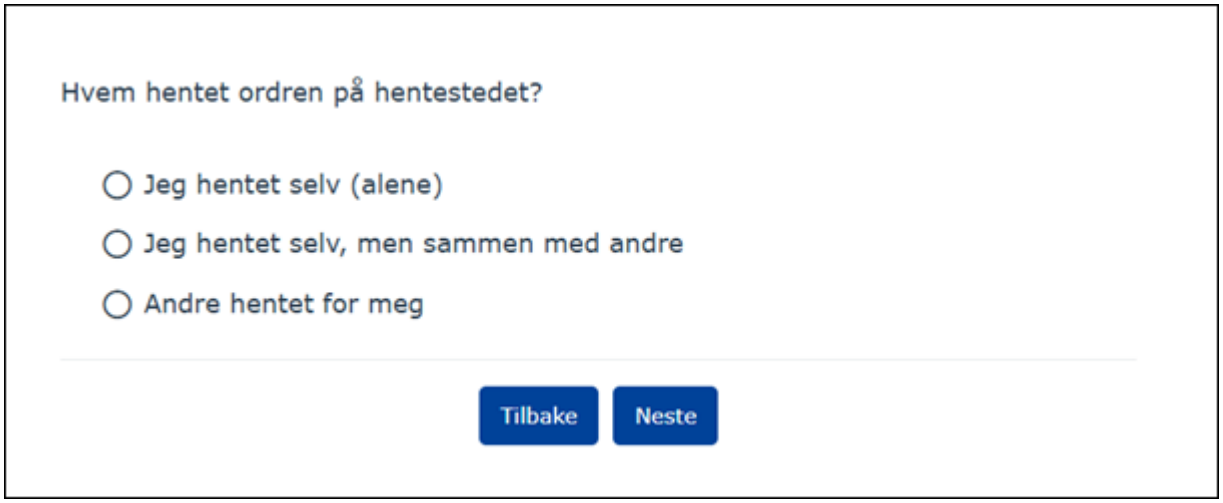
We are giving away 20 IKEA gift cards worth 500 kr each to everyone who responds.

Your chances of winning are high, as there are a limited number of deliveries per week.

Enter your email address in the last question to be included in the draw.

We look forward to hearing what you think!

Best regards, the IKEA customer service team



1. Who picked up the order at the pickup location?

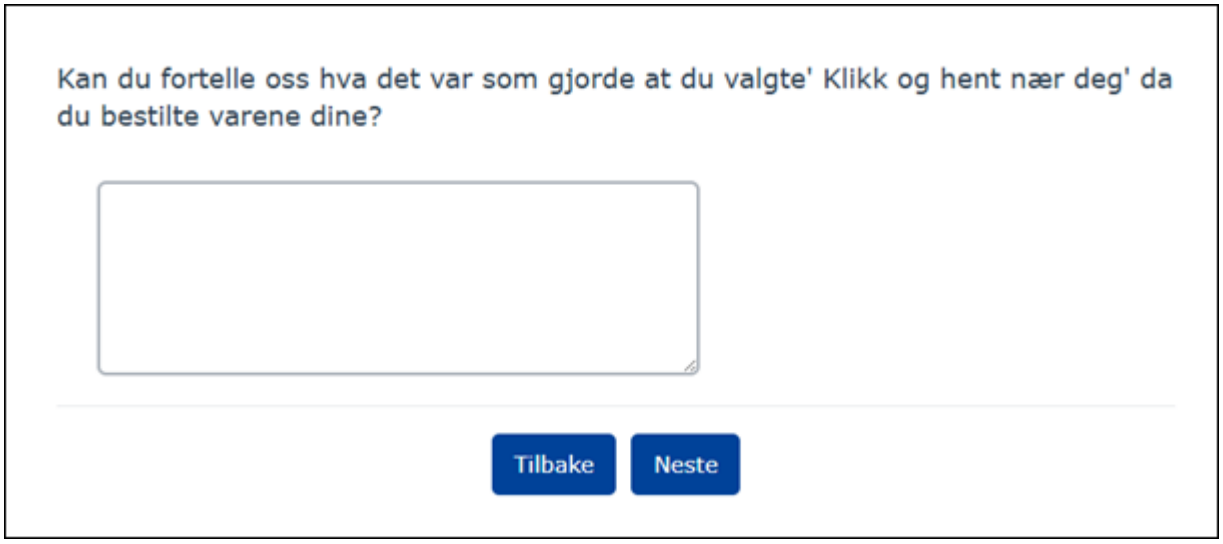
- I picked it up myself (alone)
- I picked it up myself, but with others
- Others picked it up for me



2. Overall, how satisfied were you with your experience of the “Click and Collect near you” service?

- Very dissatisfied
- Quite dissatisfied
- Neither satisfied nor dissatisfied
- Quite satisfied
- Very satisfied

- Don't know



3. Can you tell us what made you choose ‘Click and Collect’ when you ordered your items?



4. Kan du huske å ha sett eller fått informasjon om «Klikk og hent nær deg», enten fra IKEA eller i media før du bestilte denne nye leveringsordningen?

- Ja, skriv inn hva informasjonen handlet om - og hvor du så dette
- Nei
- Husker ikke



5. What do you think is the effect of choosing “Click and collect near you” over home delivery in relation to...

- emissions that affect the environment
- traffic congestion

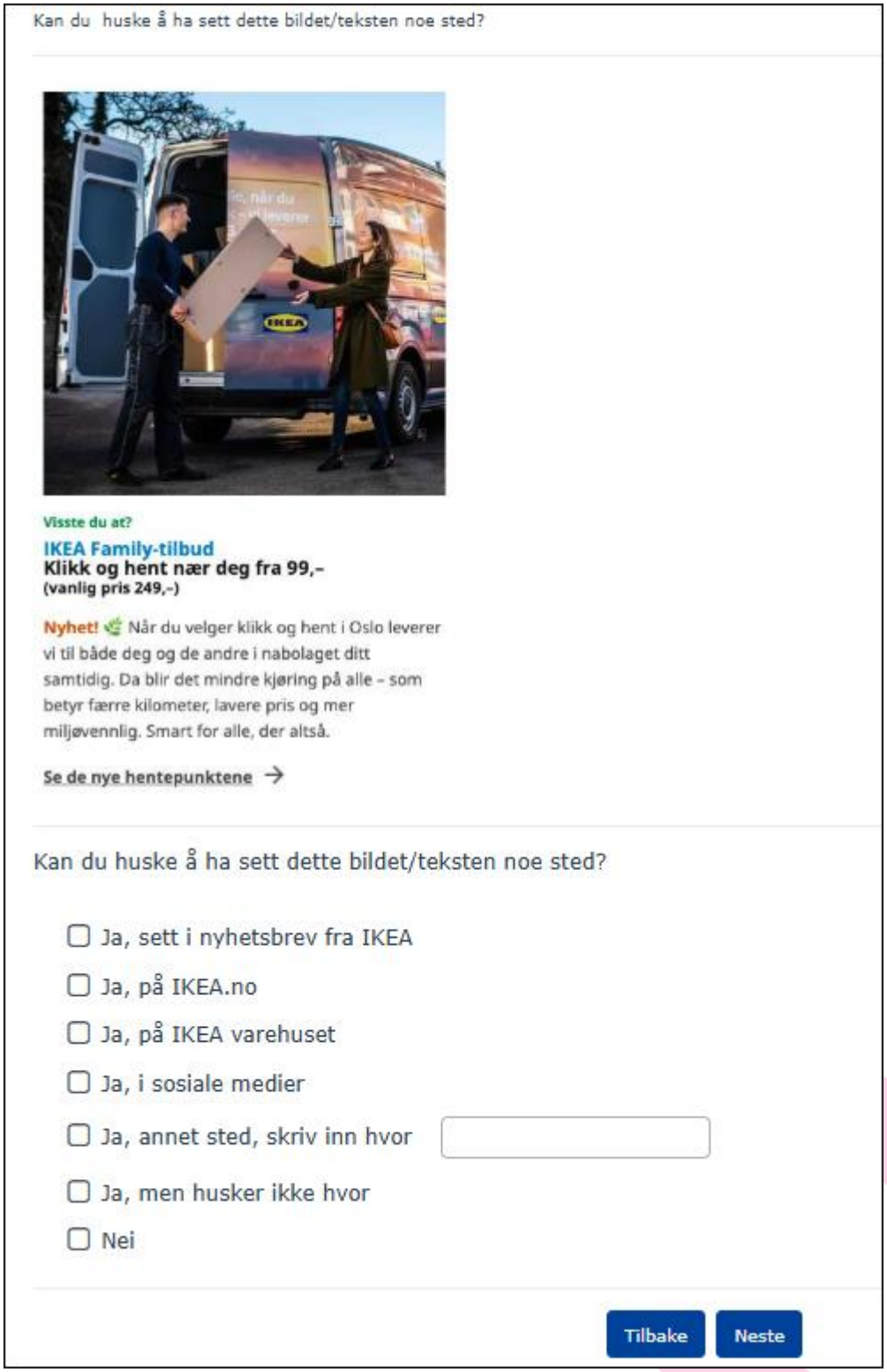
(Increased, No difference, Reduced, Don't know)



6. Do you remember reading this message:

“When you choose click and collect in Oslo, we deliver to you and others in your neighborhood at the same time. This means less driving for everyone – which means fewer kilometers, lower prices, and a more environmentally friendly service.”

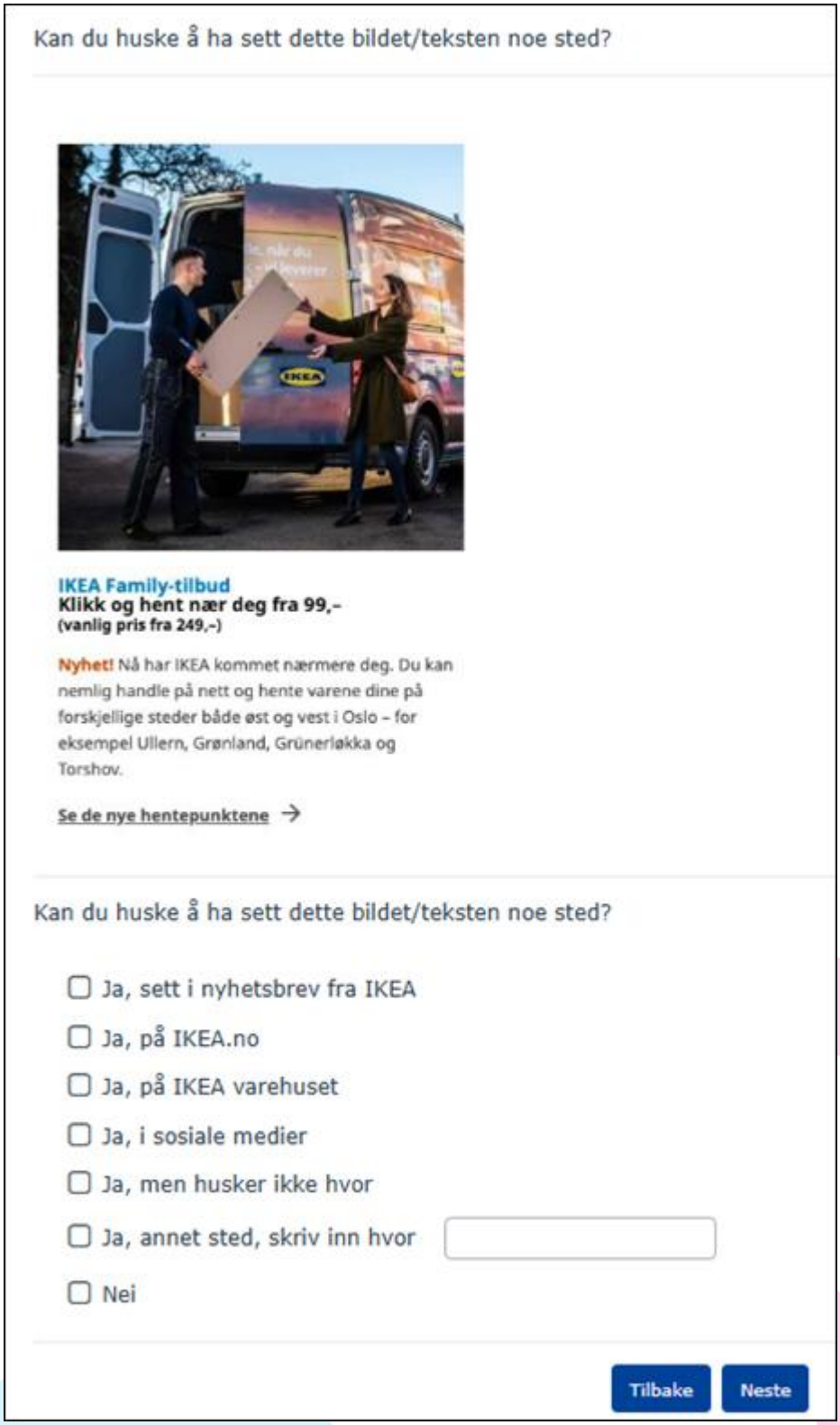
- Yes, before I placed my order
- Yes, after I placed my order
- No
- Don't know



7. Do you remember seeing this image/text somewhere?

- Yes, in a newsletter from IKEA
- Yes, on IKEA.com
- Yes, at the IKEA store
- Yes, on social media

- Yes, somewhere else, please specify where:
- Yes, but I don't remember where
- No



8. Do you remember seeing this image/text somewhere?

- Yes, in a newsletter from IKEA
- Yes, on IKEA.com
- Yes, at the IKEA store
- Yes, on social media
- Yes, somewhere else, please specify where
- Yes, but I don't remember where
- No



9. To what extent

- do you think the message about more environmentally friendly delivery is clear?
- do you trust the content of the message about more environmentally friendly delivery?

(To a very small extent, To a fairly small extent, Neither, To a fairly large extent, To a very large extent, Don't know)



10. To what extent were the following factors important to you when you chose “Click and collect near you”?

- Convenient pickup location
- Environmentally friendly delivery method
- Delivery time (the time from when you placed your order to when you could pick up the item)

- Price
- Time of pickup

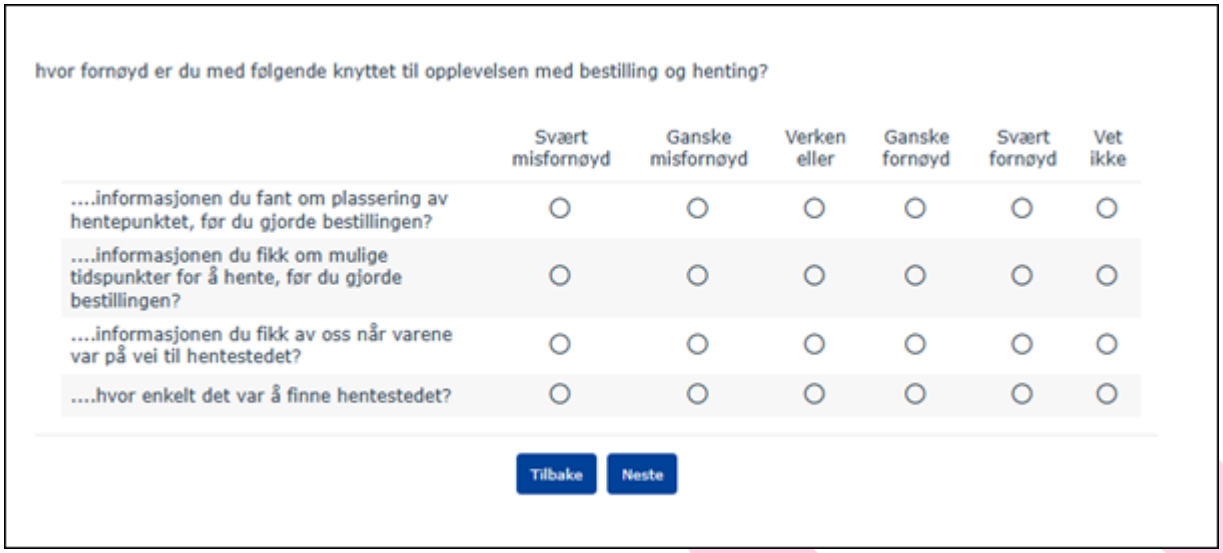
(Not very important, Somewhat unimportant, Neither important nor unimportant, Quite important, Very important, Don't know)



11. Do you remember reading this message in the order confirmation you received after your purchase?

“With this service, we drive fewer miles and save the environment.”

- Yes
- No
- Don't know



12. How satisfied are you with the following aspects of your ordering and pickup experience?

- the information you found about the location of the pickup point before you placed your order?
- the information you received about possible pickup times before you placed your order?
- the information you received from us when the goods were on their way to the pickup location?

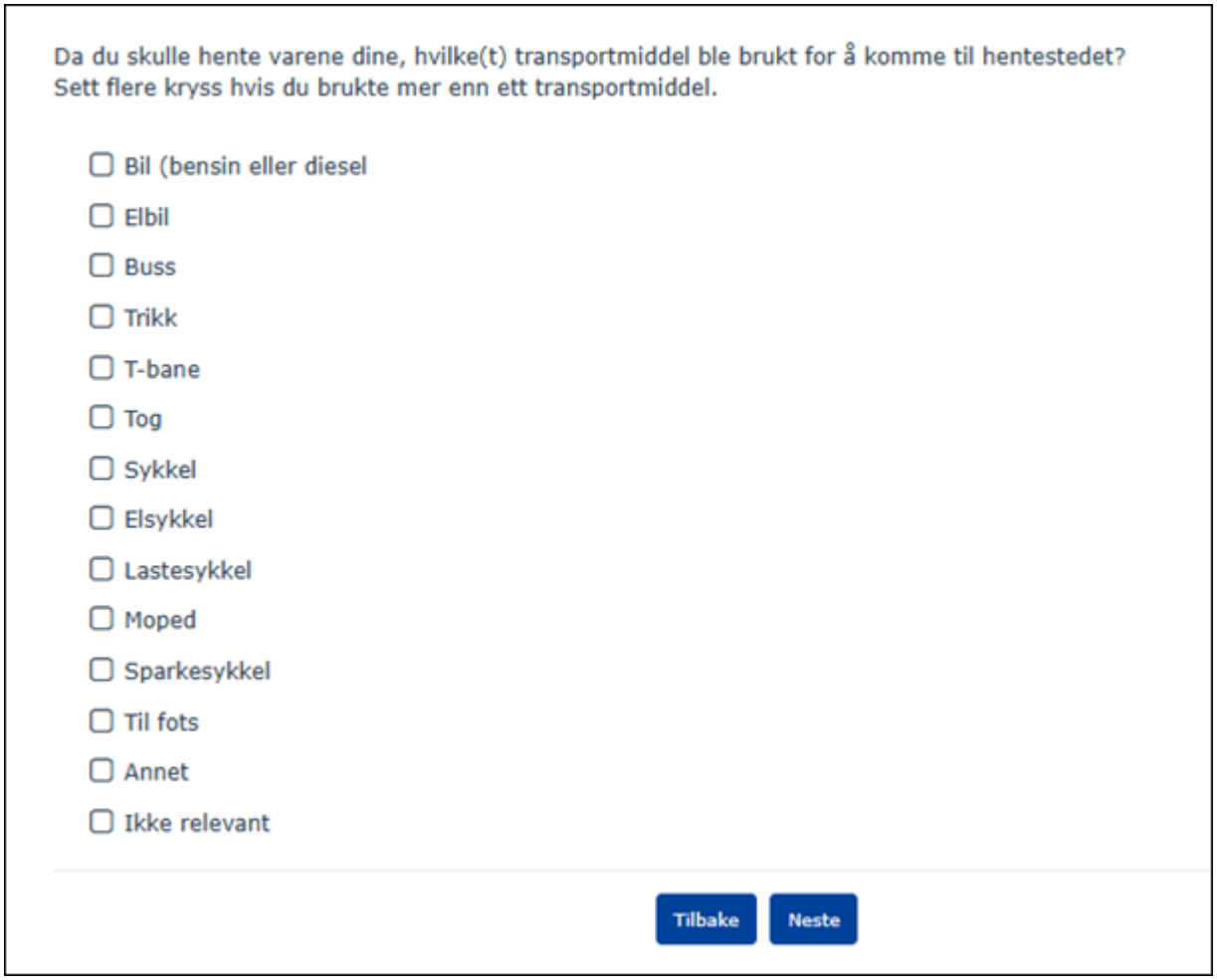
- how easy it was to find the pickup location?

(Very dissatisfied, Somewhat dissatisfied, Neither satisfied nor dissatisfied, Somewhat satisfied, Very satisfied, Don't know)



13. Do you have access to a car?

- Yes, I have my own car
- Yes, I share a car with others
- Yes, I can borrow a car when needed
- Yes, I use a car sharing service
- No, I don't have a driver's license
- No, but I have a driver's license

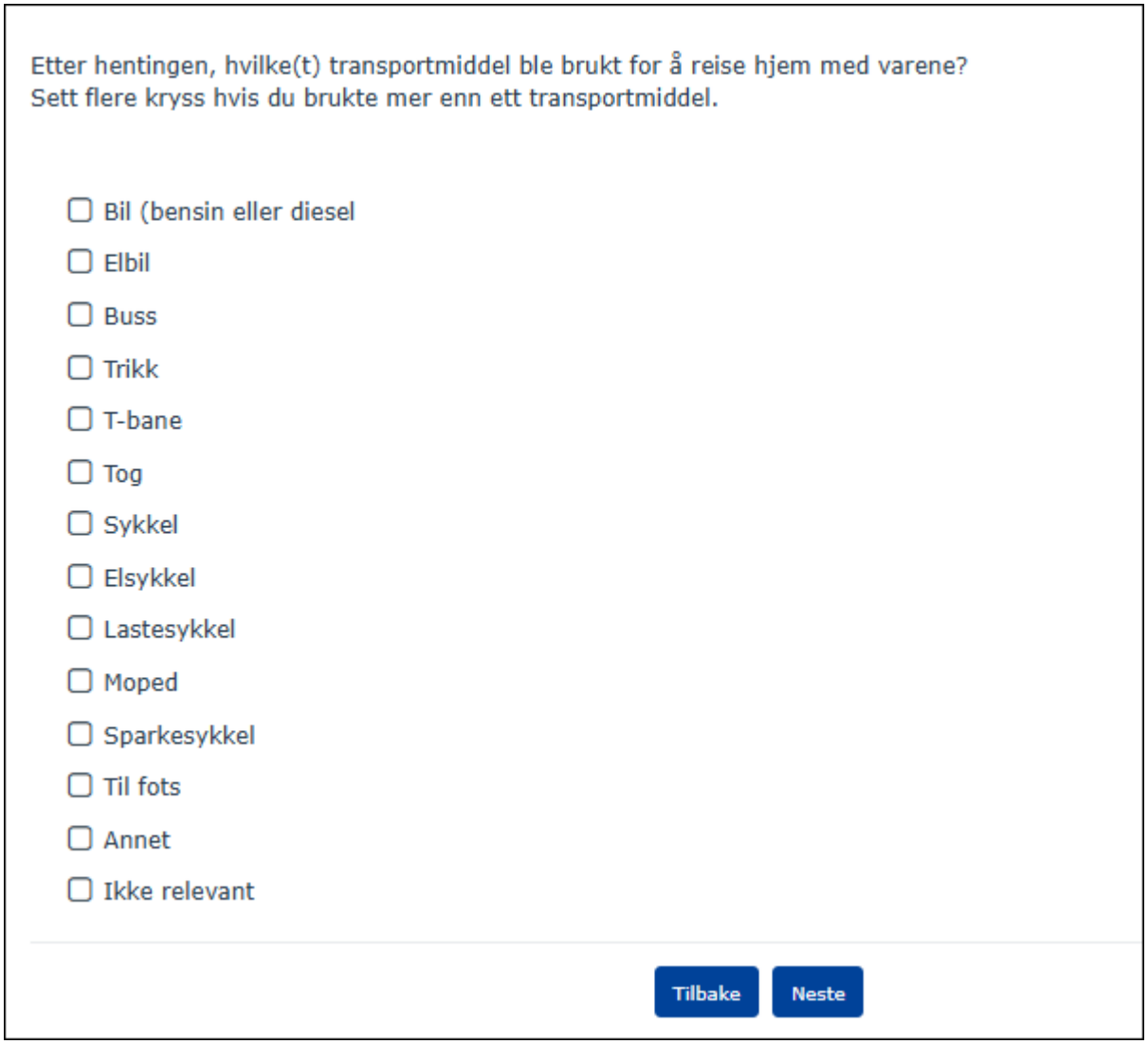


14. When you went to pick up your goods, what means of transport did you use to get to the pick-up point?

Tick more than one box if you used more than one means of transport.

- Car (gasoline or diesel)
- Electric car
- Bus
- Tram
- Subway
- Train
- Bicycle
- Electric bicycle
- Cargo bicycle
- Moped
- Scooter
- On foot
- Other

- Not applicable



15. After collection, which means of transport did you use to travel home with the goods? Tick more than one box if you used more than one means of transport.

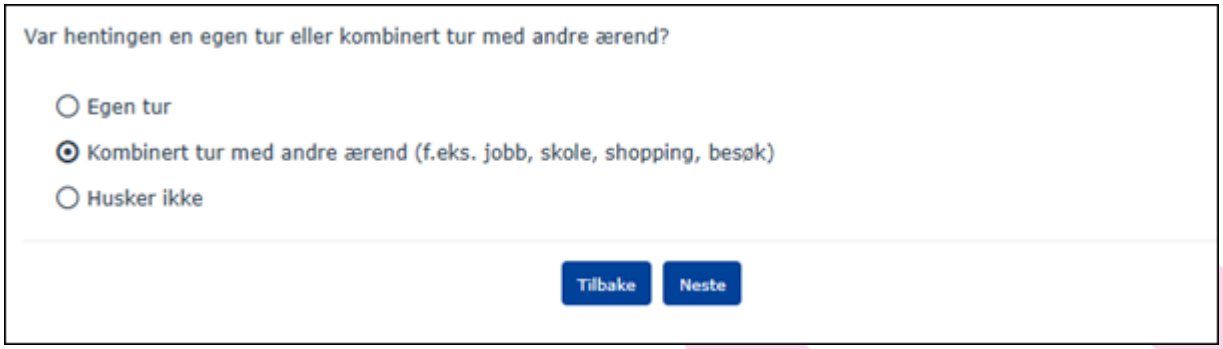
- Car (gasoline or diesel)
- Electric car
- Bus
- Tram
- Subway
- Train
- Bicycle
- Electric bicycle
- Cargo bicycle
- Moped

- Scooter
- On foot
- Other
- Not applicable



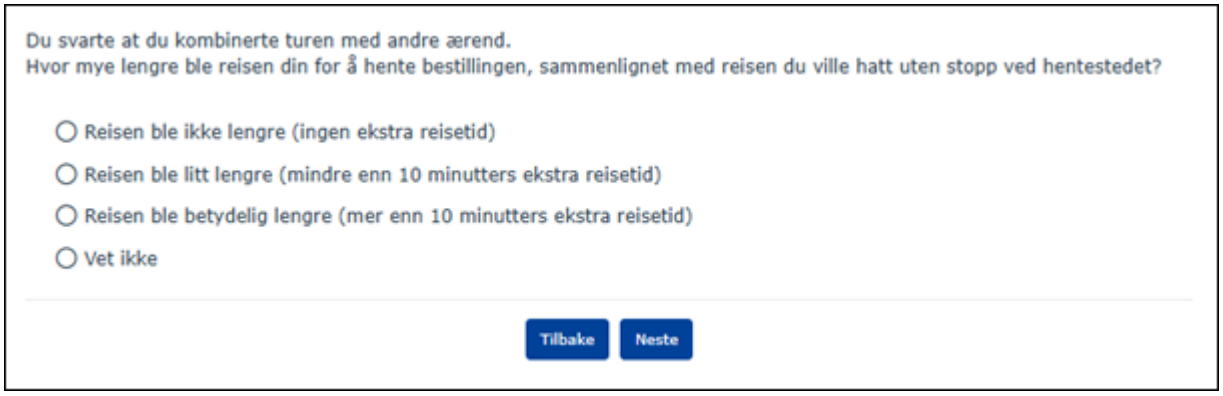
16. Can you estimate the approximate travel time to the pick-up location?

- Less than 5 minutes
- 6-10 minutes
- 11-20 minutes
- 21-30 minutes
- 31-40 minutes
- 41-60 minutes
- More than 60 minutes



17. Was the pickup a separate trip or combined with other errands?

- Separate trip
- Combined trip with other errands (e.g., work, school, shopping, visits)
- Don't remember



18. You replied that you combined the trip with other errands.
How much longer was your trip to pick up the order compared to the trip you would have had without stopping at the pick-up point?

- The trip was not longer (no extra travel time)
- The trip was slightly longer (less than 10 minutes extra travel time)
- The trip was significantly longer (more than 10 minutes extra travel time)
- Don't know



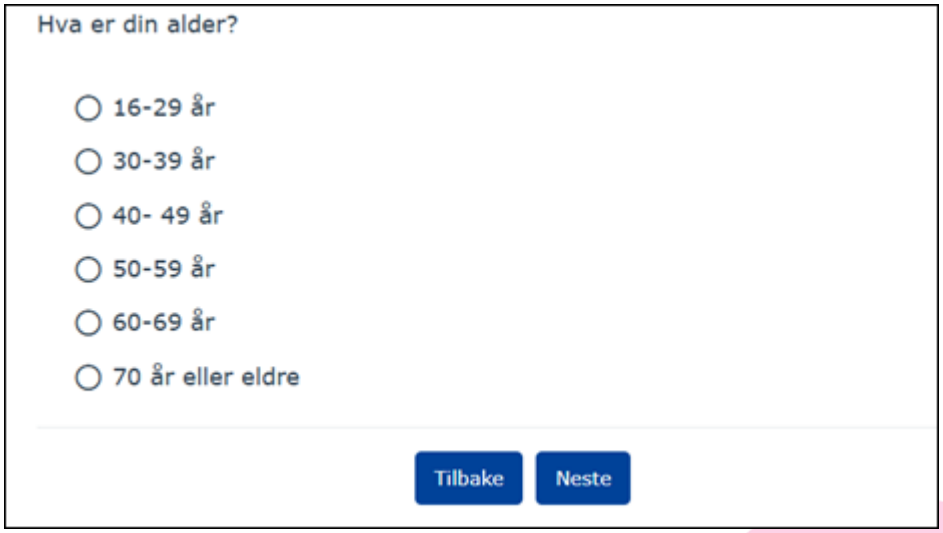
19. If “Click and collect near you” wasn't an option, how else would you have gotten the product(s)?

- I would have gone to an IKEA store to shop there
- I would have chosen home delivery
- I would have shopped with postal delivery to the post office/post office in store/post office pickup locker
- I would not have purchased the product(s) from IKEA
- Other option, please specify:



20. How likely are you to recommend 'Click and Collect' to a friend, family member, or colleague?

Very unlikely / Very likely

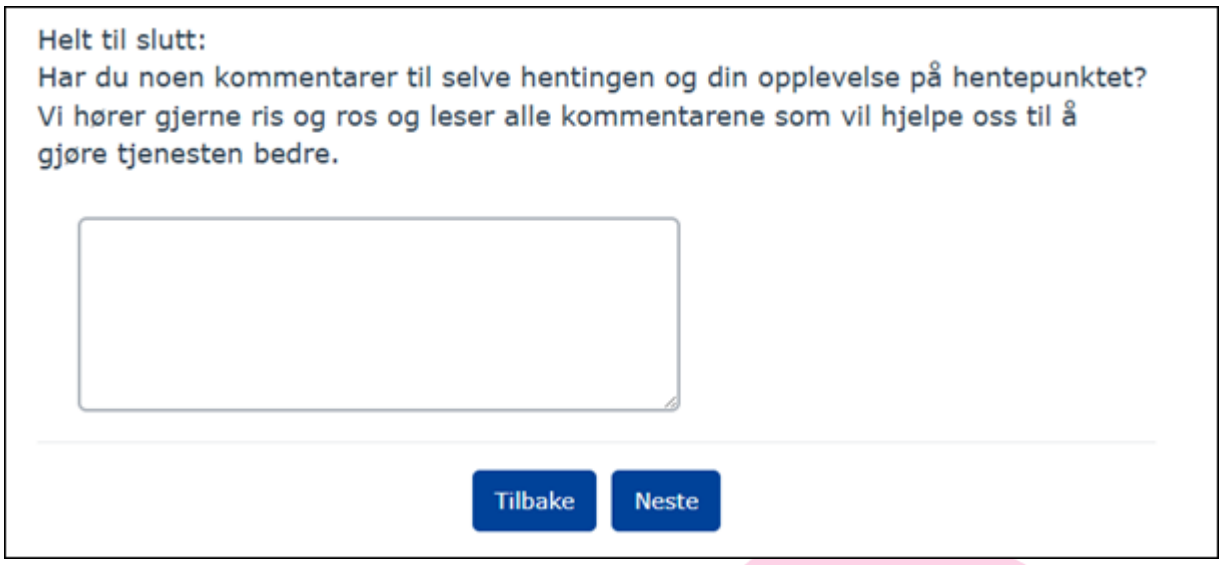


21. What is your age?

- 16-29
- 30-39
- 40-49
- 50-59
- 60-69
- 70 or older



22. Are you...
- Male
- Female
- Don't want to say



23. Finally:

Do you have any comments about the pickup itself and your experience at the pickup point? We welcome both praise and criticism and read all comments that will help us improve our service.



If you would like to enter the draw for a 500 kr IKEA gift card, enter your email address here.

All questions must be answered to qualify for the gift card.

Your email address will only be used to contact you if you win.

Appendix 4: Detailed figures for Oslo pilot

Table 87 presents respondents' assessments of the importance of different attributes when choosing CCNY, with the full distribution of responses across the six-point scale ranging from "Not very important" to "Very important", including the "Don't know" category.

Table 87: Importance of pick-up attributes

	Don't know	*Unimportant*	*Neutral*	*Important*	*Total*
Delivery time					
Frequency	2	13	16	115	146
Percent	1.4	8.9	11.0	78.8	100.0
Price					
Frequency	2	5	8	131	146
Percent	1.4	3.4	5.5	89.7	100.0
Environmental impact					
Frequency	7	43	39	57	146
Percent	4.8	29.5	26.7	39.0	100.0
Pickup time					
Frequency	2	13	11	120	146
Percent	1.4	8.9	7.5	82.2	100.0
Convenience					
Frequency	3	4	4	134	145
Percent	2.1	2.8	2.8	92.4	100.0
Total					
Frequency	16	78	78	557	729
Percent	2.2	10.7	10.7	76.4	100.0

Table 88 presents respondents' satisfaction with different aspects of the CCNY experience. The original response categories have been collapsed into three groups: dissatisfied, neutral, and satisfied, while "Don't know" is reported separately. Examining these dimensions helps identify

which aspects of the pickup process work well and where there may be room for improvement from the customer's perspective.

Table 88: Satisfaction with different aspects of the pickup experience - collapsed categories

	Don't know	Dissatisfied	Neutral	Satisfied	Total
Information about pickup point					
Frequency	4	23	21	94	142
Percent	2.8	16.2	14.8	66.2	100.0
Information about possible pickup time					
Frequency	3	14	19	106	142
Percent	2.1	9.9	13.4	74.6	100.0
Information during delivery					
Frequency	3	15	12	111	141
Percent	2.1	10.6	8.5	78.7	100.0
Easy to find pickup point					
Frequency	4	20	9	107	140
Percent	2.9	14.3	6.4	76.4	100.0
Total					
Frequency	14	72	61	418	565
Percent	2.5	12.7	10.8	74.0	100.0