



D6.3: Adoption Feasibility Studies by Follower Cities



This project has received funding from the European Union's Horizon Europe research and innovation programme under grant agreement No. 101069782



Project & Document Information

Grant Agreement No	101069782	Acronym	URBANE
Project Full Title	UPSCALING INNOVATIVE GREEN URBAN LOGISTICS SOLUTIONS THROUGH MULTI-ACTOR COLLABORATION AND PI-INSPIRED LAST MILE DELIVERIES		
Call	HORIZON-CL5-2021-D6-01		
Topic	HORIZON-CL5-2021-D6-01-08	Type of action	IA
Coordinator	INLECOM INNOVATION		
Start Date	01/09/2022	Duration	42 months
Deliverable	D6.3	Work Package	WP 6
Document Type	Report	Dissemination Level	PU
Lead beneficiary	POLIS		
Responsible author	Alonso Davila Graf		
Contractual due date	31/12/2025	Actual submission date	31/12/2025



Disclaimer and Acknowledgements



Funded by the European Union

This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No 101069782

Disclaimer

Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

While the information contained in the document is believed to be accurate, the authors or any other participant in the URBANE consortium make no warranty of any kind regarding this material including, but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Neither the URBANE Consortium nor any of its members, their officers, employees, or agents shall be responsible or liable in negligence or otherwise howsoever in respect of any inaccuracy or omission herein.

Without derogating from the generality of the foregoing neither the URBANE Consortium nor any of its members, their officers, employees, or agents shall be liable for any direct or indirect or consequential loss or damage caused by or arising from any information advice or inaccuracy or omission herein.

Copyright message

©URBANE Consortium. This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation, or both. Reproduction is authorised provided the source is acknowledged.

Authoring, Revision & QA Information

Deliverable Contributors	
Contributor Name	Organisation (Acronym)
Alonso Davila Graf	POLIS
Claudia Ribeiro	POLIS
Raffaele Vergnani	POLIS
Marina Martin Vilches	POLIS
Giorgia Rambaldi	RAV
Corrado Guerrini	RAV
David Robin	CDA
Nathalie Debord	CDA
Anton Renard	ANTW
Josef Strach	PRAHA
Simon Torp Agersnap	AAKS
Lowette Roos	MECH
Alice Benini	ITL
Fahad Anwar	ITL
Bart Vannieuwenhuys	TRV
Blanca Yáñez Serrano	EIT
John Limaxis	INLE
Zisis Maleas	CERTH

0				
Version	Date	%	Changes	Author
0.1	18-09-2024	5%	Table of Content	Alonso Davila Graf
0.4	07-04-2025	15	Feasibility Studies Methodology and Template	Alonso Davila Graf (POLIS), Fahad Anwar (ITL), Bart Vannieuwenhuys (TRV), Blanca Yáñez Serrano (EIT)
0.8	28-09-2025	50	First Draft of Wave 3 Feasibility Studies	Giorgia Rambaldi (RAV), David Robin (CDA), Nathalie Debord (CDA) Anton Renard (ANTW), Josef Strach (PRAHA), Simon Torp Agersnap (AAKS), Lowette Roos (MECH)
0.9	19-12-2025	90	Feedback and Refinements	Raffaele Vergnani (POLIS), Giorgia Rambaldi (RAV), David Robin (CDA), Nathalie Debord (CDA) Anton Renard (ANTW), Josef Strach (PRAHA), Simon Torp Agersnap (AAKS), Lowette Roos (MECH)
1.0	30-12-2025	100	Final Edits	John Limaxis (INLE)

Quality Control (includes peer & quality reviewing)			
Date	Version	Name (Organisation)	Role & Scope
19/12/2025	0.9	Stathis Zavvos (VLTN)	Peer review

Executive summary

Under Task 6.3, the six follower cities, Aarhus, Antwerp, Prague, Mechelen, Ravenna and La Rochelle, engaged in a structured process to assess the feasibility of adopting innovations tested in URBANE's Living Labs (Helsinki, Bologna, Thessaloniki and Valladolid). Building on lessons from Wave 1 and using the URBANE Innovation Transferability Platform, each city reviewed its current plans, priorities, and logistics vision to understand how solutions such as shared lockers, micro-hubs, collaborative delivery models, automated vehicles, and smart contracts could fit its local context. Through interactive and collaborative sessions, the follower cities mapped their priorities, examined Living Lab outcomes and identified potential adoption pathways shaped by their local operational, governance, and policy priorities.

All six cities conducted SWOT analyses and developed roadmaps and plans for identifying infrastructure requirements, data and digital tool needs, regulatory considerations, governance models, costs, and funding opportunities. Nonetheless, despite differing contexts, the studies confirm that URBANE innovations are transferable with tailored adaptation. Finally, each city present a set of possible recommendations, covering aspects from clarifying LTZ rules and piloting collaborative micro-hubs to standardising access policies and improving governance for shared infrastructure, all aim to follow URBANE's goal to reduce emissions, enhance delivery reliability and support the transition to sustainable mobility. More specifically:

Antwerp's study focused on integrating autonomous delivery vehicles and exploring micro-hub and locker-based models. The city sees high potential in digital tools and recognises that improved data exchange between operators and authorities is fundamental to future interventions. Through its feasibility study, Antwerp aims to finalise its Sustainable Urban Logistics Plan (SULP) and push for clear regulatory frameworks for new delivery modes.

Prague 6 concentrated on shared parcel lockers and peripheral micro-hubs to alleviate congestion in dense residential districts. The district's analysis underscores the value of coordinated planning with private operators, locker optimisation tools, and transparent data-sharing frameworks. The feasibility study highlights the need for better and denser parcel infrastructure and to improve the sustainability of the last mile in line with national and local climate strategies.

Aarhus evaluated the establishment of a centrally located micro-hub operated through cargo bikes, embedded in the city's SULP, under development. The city seeks to demonstrate the viability of low-emission delivery in a context marked by high freight intensity linked to Denmark's largest container terminal. With the feasibility study, Aarhus hopes to position the micro-hub as a future building block of a potential Zero-Emission Zone and an instrument to reduce delivery-related congestion in the historic city centre.

Mechelen's feasibility study focused on transforming its extensive public-domain locker network into an open, multi-operator system. As an early pioneer of zero-emission logistics and parcel lockers, the city demonstrated strong environmental gains from previous pilots but faces significant governance and market challenges in persuading major couriers to share infrastructure. The study highlighted the need for a stronger regulatory framework, regional alignment and clearer incentives to unlock the Physical Internet model and ensure equitable access to public space.

Ravenna's work centred on the potential introduction of cargo-bike delivery supported by micro-hubs at the edge of its historic centre Limited Traffic Zone (LTZ). Ravenna identified clear inefficiencies in current delivery patterns, with high levels of illegal curbside use and strong suitability for light zero-emission operations. The study underscored that while technology and new operational models are viable, progress depends on improved access regulations, enhanced LTZ enforcement and sustained cooperation and collaboration with couriers and business associations.

La Rochelle's study examined opportunities to expand lockers and micro-hubs within a broader decarbonisation strategy. The analysis showed high potential for integrating lockers at transport hubs and tourist nodes, offering flexible delivery solutions while reducing city-centre congestion.

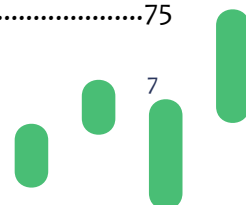


Table of Contents

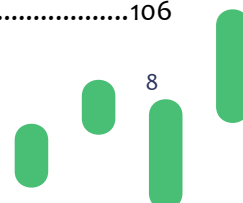
- 1 Introduction..... 14
 - 1.1 Objectives of the task..... 14
 - 1.1.1. URBANE Outputs Mapping to GA Commitments 14
 - 1.1.2. Deliverable Overview and Report Structure 15
- 2 Overall Approach and Conceptual Framework..... 17
 - 2.1 Preliminary analysis of Urban Logistics Plans and Priorities 17
 - 2.2 Interactive sessions: mapping URBANE’s innovations and matchmaking..... 18
 - 2.3 Design and methodology of the SWOT analysis..... 19
 - 2.4 Template for the feasibility studies 20
 - 2.5 Links with other WPs and Living Labs 20
- 3 Feasibility Study: Antwerp 22
 - 3.1 Background of urban logistics in Antwerp..... 22
 - 3.1.1 Local plans and linked key initiatives – city’s logistics vision 25
 - 3.1.2 Existing projects and trends..... 25
 - 3.2 Replicability and lessons learned from URBANE’s Living Labs 28
 - 3.2.1 Use of the Transferability Platform and Digital Tools..... 30
 - 3.3 Innovation/use case – Operational Feasibility (SWOT analysis) 32
 - 3.3.1 Vision and objectives 32
 - 3.3.2 Strengths and weaknesses, opportunities and threats: SWOT Analysis 33
 - 3.3.3 Identification of opportunities..... 33
 - 3.3.4 Analysis of threats 34
 - 3.3.5 Risk mitigation 35
 - 3.3.6 Required digital and physical infrastructure 36
 - 3.3.7 Integration with the existing system..... 37
 - 3.3.8 Regulatory and legal frameworks: required permits, compliance, GDPR, etc..... 37
 - 3.3.9 Financial Feasibility Estimations: Budget, Costs, Revenue, and Funding Opportunities 38
 - 3.4 Stakeholders and Governance..... 41
 - 3.4.1 Stakeholders analysis and expertise needed 41
 - 3.4.2 Governance Structure 41
 - 3.4.3 Potential future steps for public acceptance and perception, outreach and engagement .. 42



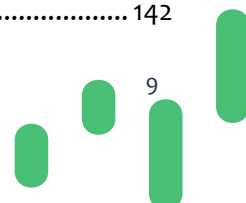
- 3.5 Conclusion and recommendations towards public authorities42
- 4 Feasibility Study: Aarhus 45
 - 4.1 Background of urban logistics in Aarhus..... 45
 - 4.1.1 Logistics plan and vision in Aarhus 47
 - 4.1.2 Existing Regulations and Projects..... 49
 - 4.2 Replicability and lessons learned from URBANE’s Living Labs53
 - 4.3 Innovation/use case – Operational Feasibility (SWOT analysis) 54
 - 4.3.1 Vision and objectives - description and benefits..... 54
 - 4.3.2 Identification of opportunities..... 54
 - 4.3.3 Identification of threats55
 - 4.3.4 Risk Mitigation55
 - 4.3.5 Action Plan Brainstorm..... 56
 - 4.3.6 Required digital and physical infrastructure 56
 - 4.3.7 Integration with the existing system..... 56
 - 4.3.8 Regulatory and legal frameworks: required permits, compliance, GDPR, etc..... 56
 - 4.3.9 Financial Feasibility Estimations: Budget, Costs, Revenue, and Funding Opportunities.....57
 - 4.3.10 Timeline and Milestones57
 - 4.3.11 Evaluation and Impact Assessment.....57
 - 4.4 Stakeholders and Governance..... 58
 - 4.4.1 Governance structure..... 58
 - 4.5 Conclusion and recommendations towards public authorities 60
- 5 Feasibility study in La Rochelle 61
 - 5.1 Background of urban logistics in La Rochelle 61
 - 5.1.1 Local plans and linked key initiatives - city's logistics vision 61
 - 5.1.2 Existing projects and trends..... 61
 - 5.2 Replicability and lessons learned from URBANE's Living Labs 62
 - 5.2.1 Lessons learned and what can be adapted to local context (adopting options) 62
 - 5.3 Innovation/use case – Operational Feasibility (SWOT analysis) 66
 - 5.3.1 Strengths and Weaknesses – current status..... 67
 - 5.3.2 Opportunities and Threats 70
 - 5.3.3 Analysis of challenges..... 71
 - 5.3.4 Risk mitigation72
 - 5.3.5 Action Plan Brainstorm..... 74
 - 5.3.6 Required digital and physical infrastructure75



5.3.7	Regulatory, legal frameworks & financial feasibility	75
5.3.8	Timeline and Milestones.....	76
5.3.9	Evaluation and Impact Assessment.....	77
5.4	Stakeholders and governance	78
5.4.1	Identification and classification of stakeholders	78
5.4.2	Governance	79
5.5	Conclusions and recommendations.....	80
6	Mechelen’s feasibility study.....	82
6.1	Background of urban logistics in Mechelen.....	83
6.1.1	Existing projects and trends.....	84
6.1.2	Lockers as part of the solution	85
6.1.3	From pilot to citywide locker network.....	87
6.1.4	Towards an open locker network.....	88
6.1.5	Current status	88
6.2	Replicability and lessons learned from URBANE’s Living Labs	89
6.3	Innovation/use case – Operational Feasibility (SWOT analysis)	91
6.3.1	Vision and objectives - description and benefits.....	91
6.3.2	Identification of opportunities.....	92
6.3.3	Challenges and barriers	93
6.3.4	Risk mitigation	94
6.3.5	Action plan brainstorm.....	95
6.3.6	Regulatory and legal frameworks: required permits, compliance, GDPR, etc.....	96
6.3.7	Financial feasibility estimations: budget, costs, revenue, and funding opportunities.	97
6.3.8	Timeline and milestones.....	97
6.3.9	Evaluation and impact Assessment	98
6.4	Stakeholders and Governance	99
6.4.1	Stakeholder analysis and expertise needed.....	99
6.4.2	Governance structure.....	100
6.4.3	Potential future steps for public acceptance and perception, outreach and engagement.	101
6.5	Conclusion and recommendations towards public authorities	101
7	Feasibility Study: Prague	105
7.1	5.1 Background of urban logistics in Prague.....	105
7.1.1	Local plans and linked key initiatives – city’s logistics vision	105
7.1.2	Key Aspects and Challenges.....	106



- 7.1.3 Regulations in Logistics and Transportation..... 107
- 7.1.4 Existing projects and trends.....109
- 7.2 Replicability and lessons learned from URBANE’s Living Labs109
 - 7.2.1 Lessons learned and what can be adapted to Prague’s local context (adopting options).109
 - 7.2.2 Use of the Transferability Platform and Digital Tools..... 111
- 7.3 Innovation/use case – Operational Feasibility (SWOT analysis)112
 - 7.3.1 Vision and objectives - description and benefits.....112
 - 7.3.2 Strengths and Weaknesses – current status.....113
 - 7.3.3 Opportunities and Threats113
 - 7.3.4 Identification of opportunities.....114
 - 7.3.5 Analysis of challenges.....114
 - 7.3.6 Risk mitigation114
 - 7.3.7 Action Plan Brainstorm.....115
 - 7.3.8 Regulatory and legal frameworks: required permits, compliance, GDPR, etc..... 116
 - 7.3.9 Financial Feasibility Estimations: Budget, Costs, Revenue, and Funding Opportunities..... 116
 - 7.3.10 Timeline and Milestones..... 116
- 7.4 Stakeholders and Governance117
 - 7.4.1 Stakeholder analysis and expertise needed.....117
 - 7.4.2 Governance structure..... 118
 - 7.4.3 Potential future steps for public acceptance and perception, outreach and engagement 118
- 7.5 Conclusion and recommendations towards public authorities119
- 8 Feasibility study: Ravenna.....121
 - 8.1 Background of urban logistics in Ravenna.....121
 - 8.1.1 Local plans and linked key initiatives – city’s logistics vision121
 - 8.1.2 Existing projects and trends.....124
 - 8.2 Replicability and lessons learned from URBANE’s Living Labs 127
 - 8.2.1 Lessons learned and what can be adopted to local context (adopting options)..... 127
 - 8.2.2 Use of Transferability Platform and Digital Tools 132
 - 8.3 Innovation/use case – Operational Feasibility (SWOT analysis) 137
 - 8.3.1 Vision and objectives 137
 - 8.3.2 Strengths and weaknesses, opportunities and threats: SWOT Analysis 138
 - 8.3.3 Identification of opportunities.....139
 - 8.3.4 Analysis of challenges (and “Risk mitigation”?)......140
 - 8.3.5 Action plan 142



8.3.6	Required digital and physical infrastructure (and 3h-Integration with the existing system)	142
8.3.7	Regulatory and legal frameworks.....	144
8.3.8	3l – Financial feasibility estimations: budget, costs, revenue and funding opportunities...	144
8.3.9	Timeline and milestone	146
8.3.10	Evaluation and Impact Assessment.....	147
8.4	Stakeholders and Governance.....	149
8.4.1	Stakeholders analysis and expertise needed	149
8.4.2	Governance structure.....	153
8.4.3	Potential future steps for public acceptance and perception, outreach and engagement	153
8.5	Conclusion and recommendations towards public authorities	153
9	Conclusions and Lessons Learned	156

List of figures

Figure 1	Miro Board screenshot from the matchmaking meeting.....	18
Figure 2	SWOT Analysis components	19
Figure 3	Impact against Feasibility map	20
Figure 4	Antwerp geographical location.....	22
Figure 5	Antwerp modal split.....	23
Figure 6	Share of city vehicle KMs per business category	24
Figure 7	citloore UI for Antwerp.....	31
Figure 8	Simulation Result Dashboard	32
Figure 9:	geographical location of the city of Aarhus.	45
Figure 10:	Modal share within transportation modes in The Municipality of Aarhus.....	46
Figure 11:	Modal share based on total vehicle km in The Municipality of Aarhus.	46
Figure 12:	Distinction between different planning zones in Aarhus.	49
Figure 13	Official list of requirements for diesel vehicles from “Miljoezoner.dk”	50
Figure 14	Low Emission Zone in Aarhus city centre within the inner ring road O1.	50
Figure 15:	Within the Low Emission Zone (bright red), a pedestrian zone (dark red) is established, facilitating a network of car-free walkable shopping streets.	51
Figure 16	Example of a designated offloading site for trucks in proximity to the pedestrian area in Aarhus.	52
Figure 17:	Designated offloading sites (in blue) in connection with the pedestrian streets in Aarhus (yellow).	52
Figure 18:	list of stakeholders	58
Figure 19:	next steps of the implementation of the microhub	60
figure 20:	map showing all delivery points in shops and lockers in la rochelle.....	66
figure 21:	example of a carrefour locker located in la rochelle (source: city of la rochelle).....	67

figure 22: map representing the size of the protected area in the city centre (source: city of la rochelle) 69

figure 23: location of delivery points in la rochelle (source: city of la rochelle).....72

Figure 24: location of lockers and relay points in la rochelle (source: city of la rochelle).....73

figure 25: location of shops with parcel drop-off and collection option in la rochelle (source: city of la rochelle).....73

figure 26: The key locations for deploying lockers and microhubs, red dots (source: city of la rochelle) 74

figure 27: all steps of public locker deployment (source: city of la rochelle).....77

Figure 28 The city map – the inner city and ring road clearly visible 82

Figure 29 streets in different colours, each with a specific access regulation at certain times..... 83

Figure 30 SUSTAINABILI GAINS IN THE MECHELEN ECOZONE, COMPARED WITH BUSINESS AS USUAL OPERATIONS(SOURCE: VUB, BPOST) 87

Figure 31 THE LOCATION OF SMART LOCKERS IN THE CITY CENTRE (SOURCE: CITY OF MECHELEN)..... 88

Figure 32 THE LOCATION OF PRAGUE 6 WITHIN THE CITY AGGLOMERATION 105

Figure 33 Ravenna LTZ (left) and access system for the historic centre (right) 121

Figure 34 Ravenna Simulation results using Impact Assessment Radar 134

Figure 35 CitIQore Simulation results 135

Figure 36 URBANE Innovation Transferability Platform and Mapping of tools and their use..... 136

Figure 37 . Location of proposed NDAs in Ravenna 138

Figure 38 Ravenna SWOT analysis..... 139

Figure 39 Micro-hub locker modules: dimensions, cell sizes, and configuration..... 142

Figure 40 Potential Locations for Smart Cameras installation 144

Figure 41 Preliminary Implementation timeline..... 147

Figure 42 matrix showing ratio of influence and level of stakeholder interest 149

List of tables

Table 1 Glossary of acronyms and terms. 13

Table 2 LL Lessons learned adapted for Antwerp 28

Table 3 Simulation parameters 31

Table 4 Antwerp SWOT analysis 33

Table 5 the three phases towards ADVs implementation 38

Table 6 TIMELINE AND MILESTONES for EXPLORING AUTONOMOUS DELIVERY ROBOTS IMPLEMENTATION 39

Table 7 List of Involved stakeholders and those planned to be engaged..... 41

Table 8 Lessons learned and what can be adapted to the local context 53

Table 9 SWOT analysis..... 54

Table 10 Risks and mitigation measures per category 55

Table 11 FOCUS ON LESSONS LEARNT, MEASURES TAKEN AND UNSOLVED ISSUES INSPIRED BY THE HELSINKI LL 63

Table 12 FOCUS ON LESSONS LEARNT, MEASURES TAKEN AND UNSOLVED ISSUES INSPIRED BY THE BOLOGNA LL..... 64

Table 13 SWOT analysis..... 67

Table 14 Stakeholder Role and Level of Involvement	79
Table 15 STREETS IN DIFFERENT COLOURS, EACH WITH A SPECIFIC ACCESS REGULATION AT CERTAIN TIMES	83
Table 16 streets in different colours, each with a specific access regulation at certain times.....	84
Table 17 LIST OF ONGOING PROJECTS	84
Table 18 FOCUS ON LESSONS LEARNT FROM BOLOGNA LL	89
Table 19 THE SWOT ANALYSIS.....	92
Table 20 FOCUS ON OPPORTUNITIES IDENTIFIED, SUBDIVIDED PER TOPIC	92
Table 21 The swot analysis	112
Table 22 stakeholder matrix – power vs. interest.....	118
Table 23 Planning and Policy instruments at regional and municipal level in Ravenna.....	122
Table 24 URBANE Innovation Transferability Platform Tools.....	128
Table 25 URBANE Innovation Transferability Platform Tools Adopting options.....	128
Table 26 Overview of digital enablers relevant for Ravenna UCs.....	130
Table 27 Ravenna Answers to Impact Assessment Radar Level 1 Questionnaire.....	133
Table 28 Simulation Parameters	134
Table 29 Opportunities Analysis within the Ravenna SWOT Framework.....	139
Table 30 Ravenna SWOT Threats and Risk Mitigation Actions	141
Table 31 evaluation and impact assessment matrix I.....	147
Table 32: evaluation and impact assessment matrix II	148
Table 33 stakeholders matrix.....	149

Glossary of Terms and Acronyms

TABLE 1 GLOSSARY OF ACRONYMS AND TERMS.

Acronym / Term	Description
ADVs	Autonomous Delivery Vehicles
AI	Artificial Intelligence
AMI	Appel à Manifestation d'Intérêt (Call for Expressions of Interest)
ANCI	National Association of Italian Municipalities
ANPR	Automatic Number Plate Recognition
AV	Autonomous Vehicle
BC	Blockchain
B2B	Business-to-Business
B2C	Business-to-Consumer
GDPR	General Data Protection Regulation
GIS	Geographic Information System
KPI	Key Performance Indicator
LEZ	Low Emission Zone
LL	Living Lab
LSP	Logistics Service Provider
LTZ	Limited Traffic Zone
NDA's	Nodal Delivery Areas
NO₂	Nitrogen Dioxide
PI	Physical Internet
RAV	City of Ravenna
ROI	Return on Investment
SME	Small and Medium-Sized Enterprise
SULP	Sustainable Urban Logistics Plan
SUMP	Sustainable Urban Mobility Plan
SWOT	Strengths, Weaknesses, Opportunities, Threats
TEN-T	Trans-European Transport Network
TRA	Transport Region Antwerp
VIL	Flanders Innovation & Logistics
WP	Work Package
ZEZ	Zero Emission Zone

1 Introduction

1.1 Objectives of the task

The aim of task 6.3 was to invite the six follower cities, Aarhus, Antwerp, Prague 6, Mechelen, Ravenna and La Rochelle, to explore how the innovations tested in URBANE’s Living Labs might fit within their own urban logistics landscapes. Without imposing the URBANE solutions to the cities, the task encouraged each city to reflect on its existing mobility strategies, operational realities and long-term priorities to analyse how solutions such as micro-hubs, shared lockers, collaborative delivery models, automated vehicles or smart contracts could respond to local needs. By basing the feasibility studies on the experience, pilots and lessons learned of the Wave 1 Living Labs, the task helped the cities situate the different innovations and tools developed under URBANE within their own contexts and challenges, whether it is congestion in historic centres, competition for public space, or the growing pressures of e-commerce.

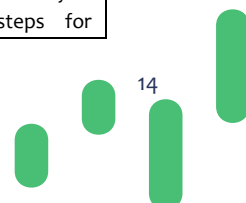
Another key ambition of Task 6.3 was to create a thinking process and structure to share experiences and learnings. Through constant interactive meetings and the collaboration and involvement of different project partners, cities were encouraged to build a clearer view of their logistics ecosystems: identify potential opportunities, be aware of potential key barriers they could face, and what kinds of partnerships or policy adjustments might support future experimentation. The process led each city to develop an initial picture of what already exists and can be built on, and a clearer vision of what the city aims to achieve and the next steps to move towards that goal. This was captured in SWOT analyses, governance analyses and stakeholder mapping. In this way, the feasibility studies served as an analytical process to bring ideas into potential actions, helping cities move to a more informed understanding of how the URBANE pilots and solutions could be implemented and have an impact within their own governance and urban contexts.

1.1.1. URBANE Outputs Mapping to GA Commitments

The table below summarises how the outputs and activities of Barcelona LL correspond to the commitments outlined in the GA. This ensures transparency regarding the alignment, status, and contribution of each deliverable and task.

Table 1. Outputs Mapping to GA Commitments

URBANE GA	URBANE GA Description	Document chapters	justification
D6.3 – Adoption Feasibility Studies by Follower Cities	Feasibility Studies report including a SWOT analysis and implementation plan for each Follower city with defined major steps towards adopting the URBANE innovations (infrastructure needs, data needs, collaborations, costs and potential funding sources, timeline) and consolidated recommendations of public authorities.	Chapters 2–7 (city-specific feasibility studies)	Chapters 2 to 7 present individual feasibility studies for each follower city (Antwerp, Aarhus, La Rochelle, Mechelen, Prague 6 and Ravenna). In addition, chapters 2 to 7 capture the outcomes of the structured engagement process carried out with the follower cities under Task 6.3. The content reflects a progressive workflow in which cities moved from understanding and selecting relevant URBANE innovations, to assessing local readiness and constraints, and finally to outlining concrete next steps for



			adoption. The chapters illustrate how Living Labs experience and project tools informed city-level reflections, stakeholder dialogue, and decision-making, resulting in tailored SWOT analyses, prioritised actions, and forward-looking recommendations. The demonstrates that Task 6.3 functioned as a capacity-building and co-creation process, translating to clear pathways towards the adoption of URBANE innovations in different local contexts.
Task			
Task 6.3 Adoption Feasibility Studies by Follower Cities	Follower cities stakeholder will be engaged early in the project and involved in dissemination and capacity building activities. On M25 they will play a more active role and get involved in a series of interactive sessions that will guide them to map out URBANE innovations, evaluate their readiness and plan adoption actions, drawing from Wave 1 LLs lessons learned and using the tools of URBANE Innovation Transferability Platform. Specifically they will a) participate in a workshop where the outcomes of the URBANE LLs and tools will be presented, b) conduct a preliminary analysis of their own plans for urban logistics, highlighting their own priorities, c) map URBANE results and innovative models to potential use cases that could be suitable to address the needs in their own cities and discuss with local stakeholders to reflect on the barriers and prerequisites of implementation, d) design a compact SWOT analysis and implementation plan by defining the major steps to adopt the innovations (infrastructure needs, data needs, collaborations that could be established, costs and potential funding sources, timeline etc.), e) consolidate their views in a report with their own recommendations and, f) communicate their conclusions and results of their feasibility analysis in a side-workshop during the final URBANE conference.		Chapters 2 to 7 demonstrate the implementation of Task 6.3. Each follower city feasibility study reflects the outcomes of the interactive process described in the GA, including: (a) analysis of Living Labs lessons and URBANE tools, (b) preliminary assessment of local urban logistics plans and priorities, (c) mapping of URBANE innovations to local use cases, supported by stakeholder considerations, (d) development of a SWOT analysis and implementation-oriented action plan addressing infrastructure and data needs, governance and collaborations, costs, funding opportunities and timelines, and (e) consolidation of city-specific conclusions and recommendations for public authorities. Together, these chapters document the active involvement of follower cities and the translation of capacity-building activities into concrete adoption pathways.

1.1.2. Deliverable Overview and Report Structure

This deliverable presents the feasibility studies carried out by the URBANE follower cities to assess the potential adoption of innovations developed within the project’s Living Labs. The report is structured to provide a clear and consistent overview of the methodology applied, followed by city-specific analyses and conclusions. In more detail the report is organised into the following chapters:

Chapter 2 introduces the objectives, rationale, and methodology of Task 6.3, describing the process followed by the follower cities and the links with other URBANE work packages and Living Labs.

Chapter 3 presents the feasibility study for Antwerp and the selected innovation of using ADVs for last mile deliveries, including the associated operational, regulatory, and governance considerations.



Chapter 4 outlines the feasibility study for Aarhus, assessing the introduction micro-hubs delivery solutions within the city’s emerging logistics strategy.

Chapter 5 details the feasibility study for La Rochelle, analysing opportunities for expanding lockers and micro-hubs as part of the city’s broader decarbonisation objectives.

Chapter 6 describes the feasibility study for Mechelen, with a particular focus on the development of an open, multi-operator parcel locker network and related governance challenges.

Chapter 7 presents the feasibility study for Prague 6, examining the potential deployment of shared parcel lockers and peripheral micro-hubs to improve last-mile delivery efficiency.

Chapter 8 covers the feasibility study for Ravenna, exploring the introduction of cargo-bike-supported deliveries and micro-hubs in relation to the city’s Limited Traffic Zone.

Chapter 9 presents the conclusion and recommendations.

2 Overall Approach and Conceptual Framework

Task 6.3 was designed as the main activity through which the six follower cities, Aarhus, Antwerp, Mechelen, La Rochelle, Prague 6 and Ravenna, assessed the feasibility of adopting the innovations and digital tools developed in the Wave 1 Living Labs of URBANE. Led by POLIS, the task combined capacity-building, peer learning and structured methodological guidance to ensure that cities not involved directly in piloting activities could still meaningfully benefit from the knowledge generated in the project. The main rationale was to translate Living Lab experience into transferable insights and actionable adoption pathways tailored to each follower city's unique context.

Although Task 6.3 formally began in Month 19, the engagement strategy deliberately started much earlier. POLIS organised the first follower cities workshop, held in June 2023, to create early familiarity with the Living Labs and initiated a first round of exchanges with the cities. It provided valuable input to POLIS and WP6 partners in shaping the feasibility study template and the methodological guidance provided over the following months.

From Month 25 onwards, POLIS guided a constant and structured process to progressively expose the follower cities to the details and specificities of each Living Lab as well as to the insights on the digital tools developed by the project: CitiQore, Smart Contracts and the Impact Assessment Radar. These digital tools are the main components of the URBANE Innovation Transferability Platform and, depending on the level of progress of each follower city, they could support their feasibility analyses by introducing them to their modelling, mapping and optimisation functions.

The series of activities reflected the logic of a feasibility study: the follower cities began by analysing their own local urban logistics realities, then explored relevant aspects and innovations from the Living Labs, and finally looked into the feasibility of adoption by producing a SWOT analysis, a stakeholder mapping and a first simple action plan. Throughout the process, POLIS facilitated collaboration through regular group meetings, bilateral exchanges and targeted deep-dive sessions, enabling cities to progress in parallel while retaining the flexibility to explore innovations most relevant to their needs.

2.1 Preliminary analysis of Urban Logistics Plans and Priorities

The first step of Task 6.3 was for each follower city to conduct a structured preliminary analysis of its own urban logistics context. This involved identifying existing strategies, infrastructure, policy gaps and priorities. The aim was to establish a realistic starting point from which to explore the feasibility of adopting URBANE innovations.

From the first discussions and workshop as well as the subsequent exchanges showed the expected diversity among the six cities. Mechelen and La Rochelle entered the process with relatively mature logistics strategies and prior experience deploying infrastructure such as shared lockers or micro-hubs. Others, such as Aarhus, acknowledged that they had no formal logistics plan and were mainly in a reactive position while preparing to develop their first Sustainable Urban Logistics Plan (SULP) as a complement to their newly adopted SUMP. Prague 6 presented a very different context, where district-level logistics challenges intersect with city-wide governance structures, resulting in fragmented deployment and limited oversight. Antwerp and Ravenna brought forward complex spatial and regulatory environments



shaped by historic areas, vibrant commercial zones, and the competing needs of pedestrians, retailers and delivery operators.

Across all six cities, the preliminary analysis identified key priorities such as reducing congestion, improving public-space management, strengthening collaboration with private operators, enabling zero-emission logistics and enhancing safety in pedestrian zones. This preliminary phase demonstrated that while the follower cities were at different levels of readiness, all were positioned to explore potential adoption actions. Their preliminary analyses provided the task group with valuable insight to tailor support and shape the subsequent deep dives and group discussions.

2.2 Interactive sessions: mapping URBANE’s innovations and matchmaking

To support the follower cities in understanding how URBANE’s innovations could be applied to their specific context, T6.3 organised a series of interactive sessions. These sessions were essential for monitoring purposes and for translating the Living Labs lessons into knowledge that follower cities could analyse and potentially apply.

The process began with a “matchmaking meeting”, during which the follower cities were introduced to the Wave 1 Living Labs, Helsinki, Bologna, Thessaloniki and Valladolid. Using collaborative tools such as Miro boards, cities explored each Living Lab, identified initial areas of interest and started mapping innovations referencing their local needs. This exercise also helped form two thematic working groups, allowing cities with similar interests to progress in parallel and learn from one another.



FIGURE 1 MIRO BOARD SCREENSHOT FROM THE MATCHMAKING MEETING

Following the matchmaking phase, the task coordinated a series of “deep-dive meetings” among Living Labs and corresponding follower cities that expressed interest in their solutions. These sessions provided more in-depth information about pilot operations, governance models, data requirements, digital tools and lessons learned. Follower cities were able to ask detailed questions and explore practical issues such as site selection, regulatory conditions, stakeholder involvement and technical requirements.

In parallel, POLIS established two working groups, each composed of a subset of follower cities interested in similar solutions. The two working groups met regularly every two weeks to discuss progress, share challenges, compare approaches and collectively reflect on how URBANE innovations

could be applied to their local contexts. These discussions helped follower cities refine their ideas, validate assumptions and prepare for the SWOT analysis.

2.3 Design and methodology of the SWOT analysis.

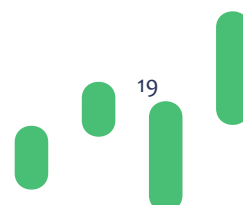
The SWOT analysis represented a key stage in each feasibility study, marking the transition from the initial assessment to the future vision. To guide this process, the task prepared a common methodology and organised a dedicated meeting to offer guidance to the cities. The guidance outlined theoretical principles, practical examples and a standardised structure to ensure comparability across follower cities.



FIGURE 2 SWOT ANALYSIS COMPONENTS

Cities were encouraged to develop their SWOT using a mix of internal consultation (with municipal departments, planners and logistics experts) and external engagement with private operators, retailers and logistics stakeholders. This helped ensure a balanced and realistic assessment of internal strengths and weaknesses, such as existing infrastructure, governance capacity, available data and political support, as well as external opportunities and threats linked to technological developments, regulatory changes or market behaviour.

The SWOT analysis was then connected to a follow-up phase where cities translated their observations into a theoretical action plans. This included identifying key steps required to adopt innovations, regulatory adjustments, governance mechanisms, infrastructure needs, data requirements, stakeholder engagement strategies and funding considerations. This methodological approach ensured that SWOT outcomes were not simply descriptive but constructive, leading naturally into the action-oriented next steps.



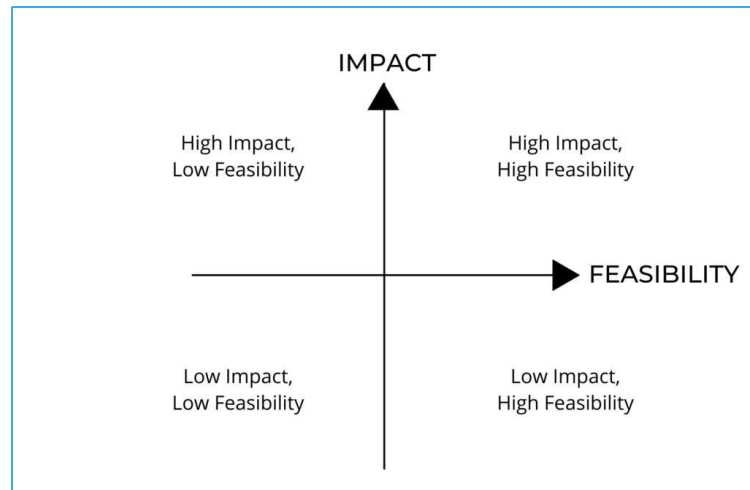


FIGURE 3 IMPACT AGAINST FEASIBILITY MAP

2.4 Template for the feasibility studies

To ensure consistency across the six follower cities, POLIS developed a dedicated feasibility study template. Its purpose was to guide cities through the required analytical steps while preserving the flexibility needed to reflect local particularities.

The template was structured around five main components, each corresponding to a key step in the feasibility process:

1. A detailed description of each city’s urban logistics context, enabling each follower city to document its existing frameworks, infrastructure, regulatory environment and operational challenges.
2. An exploration of the replicability of URBANE’s Living Lab innovations, asking the cities to identify which URBANE Living Lab solutions were relevant and why. This stage encouraged cities to map innovations against local needs, priorities and constraints.
3. A full SWOT analysis of the selected innovation, presented in a unified format so that strengths, weaknesses, opportunities and threats could be captured systematically and compared across cities.
4. A stakeholder and governance mapping helping the wave 3 cities identify the actors involved in logistics decision-making, their interests and potential roles in future adoption actions.
5. Conclusions and recommendations aimed at public authorities, prompting the follower cities to reflect on the essential conditions, enablers and actions needed to advance towards adoption.

The structure helped cities focus their analyses and enabled POLIS to track progress systematically. It also ensured that, despite each city’s unique starting point, the final feasibility studies would be comparable, coherent and aligned with the URBANE project goals.

2.5 Links with other WPs and Living Labs

Task 6.3 relied heavily on cross-WP collaboration and continuous support from the Wave 1 Living Labs. WP3 provided access to the digital tools and transferability methodologies embedded in the URBANE Innovation Transferability Platform. During the General Assembly in Karlsruhe, Follower Cities had the chance to test and explore these tools directly, gaining an understanding of how modelling, mapping and optimisation instruments could support their feasibility analyses.



The Wave 1 Living Labs played a central role throughout the task. Their teams participated in technical “deep-dive“ meetings, bilateral calls and in-person sessions, offering insights into their pilot experiences and answering technical and city-specific questions. These exchanges helped follower cities understand operational realities, such as governance arrangements, maintenance requirements, stakeholder dynamics and data flows, that are often not captured in high-level presentations.

WP5 contributed insights on logistics business plans and stakeholder engagement and co-creation, reinforcing the importance of involving local logistics operators. This interdisciplinary support ensured that the follower cities benefitted from the full breadth of URBANE expertise and could integrate technical, policy and organisational considerations into their feasibility assessments.

3 Feasibility Study: Antwerp

3.1 Background of urban logistics in Antwerp

Antwerp is a historic city in Flanders, the northern region of Belgium. Its 565,700 inhabitants - with more than 166 different nationalities - make Antwerp the largest city in the Flemish region and it is characterised by having Europe’s second largest port.



FIGURE 4 ANTWERP GEOGRAPHICAL LOCATION.

Its urban and port areas face a complex mobility situation and experience major infrastructural works. Situated on 3 TEN-T corridors (North Sea–Baltic, Rhine-Alpine, North Sea–Mediterranean) Antwerp has to reconcile major flows of commuters, citizens and visitors with freight and (urban) logistics transport. Antwerp’s primary mobility objective is to achieve a modal shift of 50/50 in the region to keep it accessible and liveable. Measures include improving transport infrastructure, reducing motorised road movements and promoting sustainable transport.

Governance

In Antwerp, the governance and decision-making structure for urban freight is multi-layered, involving municipal, regional, and national levels, but with a strong emphasis on local (municipal) decentralised leadership and stakeholder collaboration.

Municipal

The City of Antwerp plays a central role in shaping urban freight policy through initiatives like the drafting of a Strategic Urban Logistics Plan (SULP). This plan is developed in collaboration with stakeholders from the logistics sector and aims to make city logistics more efficient and sustainable. The city acts as both process supervisor and content expert, coordinating working sessions and pilot projects to test and refine policy measures.

Transport Region Antwerp (TRA)

Antwerp is part of the broader TRA, which includes 32 surrounding municipalities. Because the governance across this region is fragmented, with varying administrative capacities and technical



expertise a multimodal mobility plan ‘Routeplan 2030’ has been developed. It forms the development framework for the elaboration of projects and programmes at regional and local level.

National and EU

While the federal government and Flemish Region (Federal Public Service Mobility & Transport) set overarching transport and environmental regulations, the European Union also plays a role by promoting frameworks such as Sustainable Urban Mobility Plans (SUMPs) and CO₂-free city logistics by 2050. These frameworks encourage cities like Antwerp to engage stakeholders and integrate freight into broader mobility strategies.

PRESENT LOGISTICS STATUS

The modal split of freight transport in Antwerp is calculated on the basis of vehicle kilometres. Today, vans (N1) are used in a wide range of activities and therefore cover the most vehicle kilometres. Trucks up to 12 tons (N2) are the second largest category. In third place are heavy trucks type N3. To date, the share of bicycle logistics is very limited and is estimated at 1% of vehicle kilometres for urban delivery.

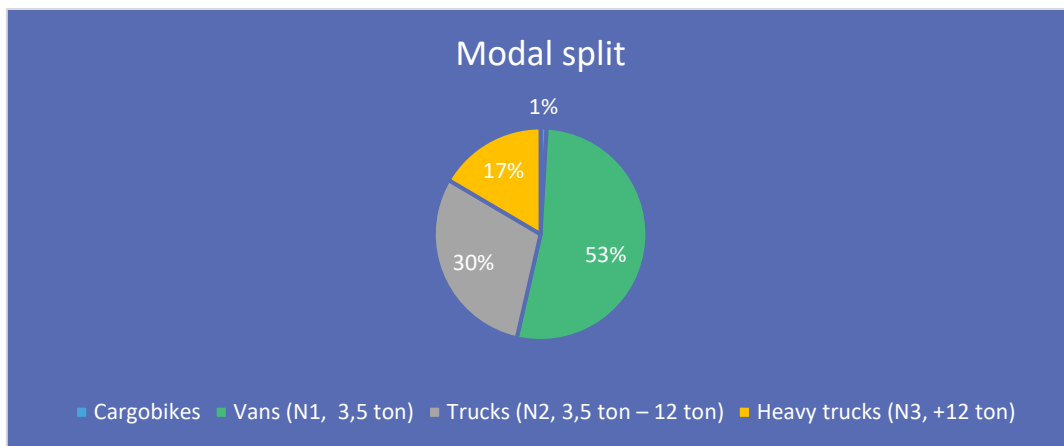


FIGURE 5 ANTWERP MODAL SPLIT.

Current logistics trends

There is enormous diversity in the logistics operations of these transports. Some transporters enter the city occasionally, while others are scheduled daily. For instance, there are journeys with one delivery point in the city, and others have a route with several delivery points spread all over the city. All these transports have their own characteristics and consequently result in different challenges. They include deliveries to companies, shops, restaurants, hospitals, facility services, construction sites and home deliveries, among others. In addition, there are also goods flows that make the opposite movement and leave the city again, such as waste flows and return shipments.

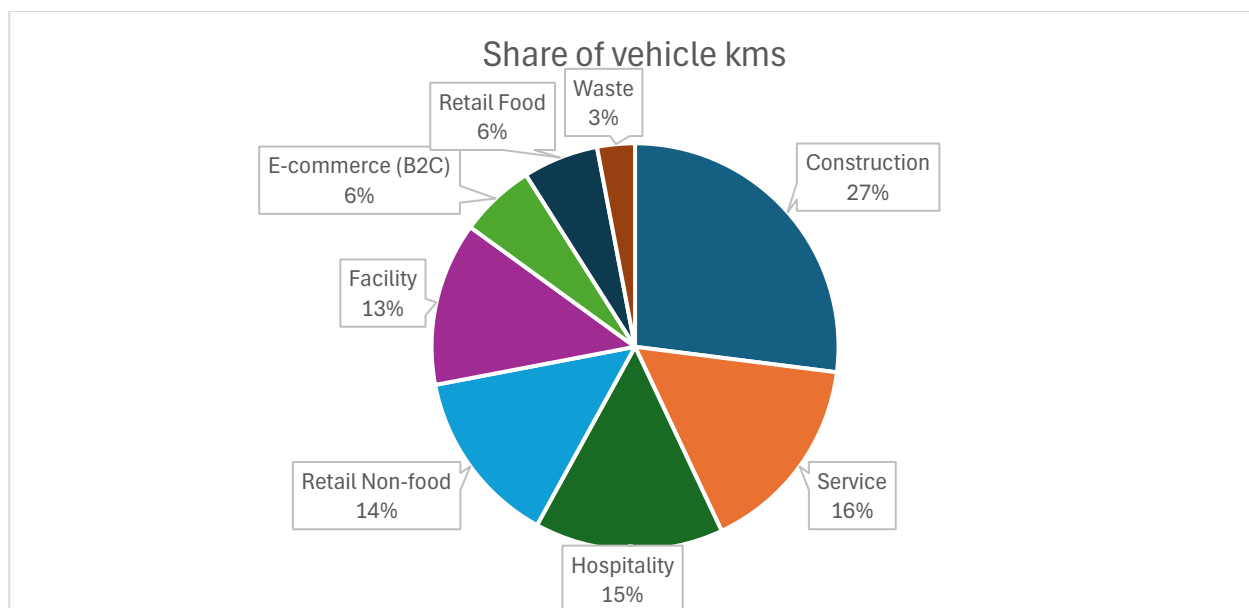


FIGURE 6 SHARE OF CITY VEHICLE KMS PER BUSINESS CATEGORY

With a 27% share, the construction sector travels the most vehicle kilometres, followed by the service (16%) and hospitality (15%) sectors. Noteworthy is the low share of vehicle kilometres travelled by e-commerce.

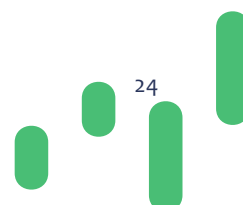
Construction-related goods flows are organized with heavy and sector-specific vehicles that cover a significant number of kilometres in the city. The challenge involved mainly includes the traffic-safe routing of these vehicles to their destination. Supermarket deliveries, on the other hand, are made via carefully planned and usually already known routes. But the final destination is often in residential areas, where traffic-safe handling with minimal inconvenience to the surrounding area is a major challenge. E-commerce deliveries comprise a relatively small share of vehicle kilometres travelled by urban freight. Nevertheless, they are highly visible in the streetscape and the destination varies with each round. Moreover, they usually have a significant impact on traffic flow in Antwerp's (residential) streets.

Impact on road safety

About 10% of motorized traffic in the city centre (within the ring road) is freight transport. However, the impact of freight transport on road safety is a major concern. For example, 20% of accidents on Antwerp territory (excluding the port area) involve freight transport. Accidents involving heavy freight tend to be serious, often resulting in fatalities. Over the past five years, there has been an average of 1.75 fatalities annually. The right-turn movement of a truck is by far the main cause of injury accidents in both light and heavy freight transport, 35% and 25% of accidents respectively.

Impact on traffic flow

Freight traffic is prominent in the city centre during rush hours. The peak of arrivals is between 6 am and 10 am. The hour of departures peaks at 4.30 pm. Moreover, most freight traffic can be observed on Fridays, in line with Antwerp's general traffic pattern. This has a significant impact on the liveability of the city. For example, it appears that most traffic accidents involving heavy freight occur in the morning rush hour and most involving light freight in the evening rush hour. The loading and unloading of goods also have an impact on traffic flow in the city. An analysis of citizen reports shows that it affects not only the flow and safety of passenger cars, but also public transport and cyclists.



Investing in sustainable logistics

The City of Antwerp translates sustainable urban logistics into traffic-safe and smart delivery by focusing on traffic-safe routing, connecting goods and stakeholders, avoiding mileage, shifting mileage (to other modes or at other times of the day, as much as possible outside peak hours) and changing the fleet (more environmentally friendly vehicles).

Solutions tailored to the different city districts

Antwerp's urban morphology is quite diverse, with different functions and different needs. This also manifests itself in terms of delivery and logistics. What works in one neighbourhood will not always work in another. An area-oriented approach makes it possible to develop objectives and measures that take into account the characteristics of different types of neighbourhoods in Antwerp.

3.1.1 Local plans and linked key initiatives – city's logistics vision

Zero emissions framework agreement (Flandres)

Flanders has set up a uniform set of regulations supported by the sector and applicable to all Flemish cities. The agreement consists of clearly formulated objectives, a coherent vision of how the Flemish government wants to achieve these objectives, and the flanking policies needed.

Green deal Sustainable urban logistics (Flandres)

Several organisations such as The Shift, VUB Mobilise, VVSG, King Baudouin Foundation, VIL and Bond Beter Leefmilieu put their heads together and, along with the Flemish government, launched the Flemish “Green Deal Sustainable Urban Logistics” in 2019. 49 companies, organisations and cities participated. The final conference took place in December 2023. As a city, we still participate in a learning network where officials (of several Belgian cities) can share experiences and experts can provide solutions.

Routeplan 2030 (Transport region Antwerp)

The plan fulfils the Flemish government's policy ambition to increase the share of sustainable (combi-)transport modes (walking, cycling, train, tram and/or bus and car passengers) for the entire Antwerp Transport Region to at least 50%, or to reduce the car share to below 50%. The 50/50 ambition is one for passenger transport, but logistics themes are also addressed in the Route Plan where relevant at this scale level. Modal shift by improving alternatives by water, pipeline, rail, and bundling logistics flows at multimodal accessible locations, alternatives to road transport will have more opportunities.

SULP (Antwerp)

The city of Antwerp is still finalizing its SULP. Therefore, the City of Antwerp plays a multifaceted role in addressing urban logistics challenges. The focus here is on one central question: how do we ensure a smooth supply of Antwerp residents and businesses, without jeopardizing the liveability of the city? To achieve this goal, Antwerp bases itself on a set of guiding principles (including cooperation, area-specific policy, diversified role as government) laid down by the municipal executive. These principles form the foundation for sustainable, efficient and future-oriented urban logistics solutions.

3.1.2 Existing projects and trends

Access policy

- LEZ (2017-...): A low-emission zone (LEZ) is a defined area where certain vehicles are not allowed to enter, or only under certain conditions, because they emit too many pollutants. If you enter an



LEZ with an unauthorised vehicle, or without any other form of permission, you will be fined. To improve air quality, Antwerp city centre and Left Bank are a low-emission zone (LEZ). The most polluting vehicles are no longer allowed to enter the city. Foreign vehicles must also comply with local rules.

- *Time windows/pedestrian areas*: A car-free zone or pedestrian zone focuses on pedestrians, cyclists and other active road users. Motorised traffic is not allowed in unless to load or unload and within certain hours. There are no on-street parking spaces, and the zones are marked with a specific traffic sign. Antwerp already has more than 150 pedestrian and car-free zones.

Modal shift

- *Sustainable city logistics in tenders*: Many European cities are developing their urban logistics strategies at the moment. Innovations, pilots and measures are introduced, all aiming towards making deliveries more efficiently and more sustainably. However, these innovations and measures focus mostly on logistics generated by private companies. Urban freight generated by/for public administrations are an underrepresented topic. To the extent known, no other Flemish cities have presented such a comprehensive approach for sustainable urban logistics in procurement. The clause in the tenders is awaiting approval.
- [Smart ways to Antwerp project calls](#) (2023-...): In early 2023, Smart ways to Antwerp launched another project call for projects that contribute to smooth, efficient and sustainable passenger and freight traffic. As such, the city wants to give innovative ideas and service providers a boost, with the aim of creating lasting services.

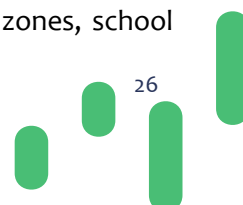
Fourteen project proposals were received from which a professional jury selected six. Factors considered for the assessment included the project's impact, the quality of the project proposal and the requested support from the city of Antwerp. Selected projects receive financial and/or communication support and professional expertise from the city.

Bundling

- [CodeZERO](#) (2024-2027): transformative three-year initiative to create sustainable, zero-emission last-mile delivery and return solutions for e-commerce. The mission is to make these solutions attractive and viable for retailers, logistics service providers and consumers. CodeZERO is innovating, testing and sharing solutions to influence consumer behaviour to choose more sustainable delivery options in four pilot sites: Antwerp, Milan, Oslo, and Utrecht. Antwerp is forming a consortium with Bpost (logistics service provider) and Torfs (retailer).
- [EU Mission 'Linkeroever \(Left Bank\) Climate-Neutral 2030'](#) (*European mission for 100 climate-neutral and smart cities*) (2021-2030): To reduce dependence on fossil fuels, the Left Bank will tackle everything that causes greenhouse gas emissions. Because of their great local impact, the city is focusing on three priority themes: reducing the energy consumption of buildings, producing renewable energy locally and focusing on sustainable transport for both people and goods.

Smart city logistics

- *Freight route planner* ([Scale-up](#)) (2021-2025): During the project the city of Antwerp developed (together with the project partners) a safe freight planner. It is a GIS-application that calculates the safest/least unsafe last mile for freight transport companies. In this way, freight transport can be guided to the destination while keeping in mind six parameters (pedestrian zones, school



zones, school street, tunnels & bridges, road categories, turnings circles). This is an advantage because contrary to a fixed freight route network, the parameters work on each segment of the route, up until the last one. The route planner will be integrated on the [website of smart-ways-to-antwerp](#).

- *Smart public transport initiatives for climate-neutral cities in Europe (SPINE) (2023-2026)*: accelerate progress towards climate neutrality by integrating public transport systems with new mobility services, sharing schemes, active transport modes, and micromobility.
- [Construction charter](#) (2023): This charter covers all construction industry freight traffic (+3.5 tonnes) to and from construction sites located in Antwerp territory. It was signed by the city and Embuild Antwerp (Belgian construction association), the member association of the construction industry. It is a mutual commitment between the city and contractors, including their subcontractors and suppliers. By signing the charter, the construction industry commits to organising both transport to and from the site, as well as vehicles and materials, in the safest and most sustainable way possible, minimising disruption.
- *Supermarket chain charter (2025)*: Based on the same principles as the construction charter, we have drafted a charter for supermarket chains. This charter is still being finalised.
- *ANPR-monitoring of (un)loading areas (2024-...)*: In Antwerp, we have a high proportion of misuse of loading and unloading zones. A pilot study has been conducted to monitor several areas. ANPR-cameras are combined with AI-software to monitor the (un)loading zones.
- [CityTraQ](#) (2022-2026): City of Antwerp is working with the Flemish Environment Agency to improve the air quality maps on which the city bases its air quality policy. The city focuses primarily on measuring flows of logistics and heavy traffic. In this way, the impact of various measures on air quality, such as the introduction of smart routes for trucks, can be better estimated.

Stakeholder involvement

- *Logistic partner network (2020-...)*: The City of Antwerp cannot possibly realise their logistics ambitions alone. It requires cooperation with various public and private stakeholders. In the coming years, stakeholder cooperation will therefore be intensified to achieve the stated ambitions for future-proof urban logistics. Opportunities will be created for cooperation between various players in the logistics chain so that goods flows are organised more intelligently. Monitoring and measuring evolutions in practice is an important part of this. Engagement is fostered through thematic meetings (supermarket charter, construction charter, Sulp) annual logistics event organised by the city (academic, private and public sector) and bilateral discussions. We are in close contact with Flemish cities (Ghent, Leuven, Hasselt and Mechelen), academic sector (University of Antwerp and VUB) and private companies (Droppr, PostNL, Colruyt, Shipit, Bpost, DHL, SME's, etc).

Similar innovations deployed in a city or region in Belgium

- [DISCO](#) (Ghent) (2023-2026): The DISCO project focuses on interconnected urban freight organisation and city planning, through data sharing and digitalization, based on a Physical Internet (PI) approach.
- *Smart city distribution* (Hasselt, Leuven) (2020-2025): setting up a digital platform implementing all access restrictions of the city area. This way, logistics service providers can get a clear overview



of what applies in the city. Through incentives (time slots, extra loading and unloading times, access, etc.), the city is able to monitor logistics flows and gain insights into the data.

3.2 Replicability and lessons learned from URBANE’s Living Labs

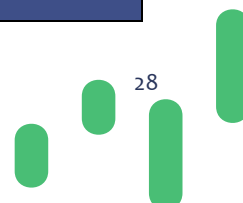
The following overview captures key lessons learned from the Living Lab Cities (Helsinki, Bologna, Thessaloniki, and Valladolid) regarding urban logistics innovations and their potential adaptation to the local context of Antwerp. Each city offers unique insights into marketing strategies, infrastructure compatibility, microhub viability, and cultural shifts in urban logistics.

In line with these broader urban logistics innovations, Antwerp will start exploring the integration of autonomous delivery robots for short-distance meal transport. Rather than treating this solely as a technological pilot, the city is leveraging it as a learning opportunity to better understand how emerging mobility solutions interact with public infrastructure, regulatory frameworks, and urban planning goals. Key areas under review include spatial design, legal compliance, and stakeholder coordination—critical factors for ensuring that such innovations can be safely and effectively scaled within Antwerp’s unique urban context.

Lessons learned and what can be adapted to local context (adopting options)

TABLE 2 LL LESSONS LEARNED ADAPTED FOR ANTWERP

Lessons Learned	Adopted to local level	Questions & Remarks
HELSINKI		
<p>Marketing the solutions effectively has a huge impact.</p> <p>Narrative = key, end-user = key</p>	<p>Including the urban logistics narrative into the “Smart Ways To Antwerp”-campaign</p>	<p>What is ADVs' solution for food deliveries? Good communication will be key.</p>
<p>Usage of new transport modes (ADV) in urban area is possible, even in areas with challenging weather conditions.</p>	<p>Apart from electric bicycles and vans we so far did not introduce or supported new transport modes.</p> <p>Antwerp is currently investigating small (food delivery) robots and drones.</p>	<p>Does Antwerp have supportive regulations directing the usage of land / usage of ADV’s in favour of sustainable initiatives?</p> <p>Only solutions for small volumes?</p> <p>Space claim of the pavement</p>
<p>The role of the city as land provider for a microhub.</p>	<p>In our project EU Mission 'Linkeroever (Left Bank) Climate-Neutral 2030 we are looking for opportunities for bundling logistic flows for construction sector using a transshipment hub (microhub).</p>	<p>E-commerce is only a small part of the urban logistic chain. The majority of logistic flow in the city of Antwerp are construction flows.</p> <p>How can we as a city intervene in this logistics chain?</p>
BOLOGNA		



<p>The selection and implementation of NDAs require careful assessment to ensure compatibility with surrounding infrastructure.</p>	<p>The city of Antwerp does not allow parcel lockers on public domain.</p> <p>Bpost (National Logistic service provider) has announced that they will expand their parcel network. Some of the new lockers will be placed in residential care centres. Bpost will also launch their first 'lockershop' in the southern part of Antwerp.</p> <p>An additional solution can be a mobile parcel locker (location flexibility, fast implementation, seasonal and temporary applications, sustainable/efficient)</p>	<p>Is equidistance from the city centre a good indicator?</p> <p>How to involve larger couriers? Or do we focus on the smaller ones?</p>
<p>A microhub needs to add some added value to the final product/service of the LSPs.</p>	<p>We have some successful companies (City Depot) in Antwerp that specialises in value-added deliveries and collections.</p>	<p>The pressure (race to the bottom) in the logistics sector to offer a service as cheaply as possible ('at no cost to the consumer') leads to cut-throat competition. Each additional chain entails additional costs (time or money).</p> <p>After the subsidy ends, most microhubs lose their viability. Added value is key.</p>
<p>SULP as a catalyst together with the commitment of the city</p>	<p>Currently, Antwerp is making ad hoc decisions on urban logistics. The finalisation of the SULP can provide a blueprint of the ambitions. We are currently rewriting the SULP to reach an approval.</p>	<p>We have difficulties in setting exact KPI's in our SULP. How do other cities set KPI's and ambitions?</p>
<p>THESSALONIKI</p>		
<p>Providing the necessary political backing and facilitating the implementation of actions required for the project's success</p>	<p>See above "SULP as a catalyst"</p>	<p>See above "SULP as a catalyst"</p>
<p>VALLADOLID</p>		
<p>Cities need to change the culture of urban goods distributions</p>	<p>Finalisation of the SULP will be the next big step for the city of Antwerp in changing the culture.</p>	<p>How can we accelerate the process of more sustainable logistics in neighbourhoods that are not facing the</p>



		externalities (traffic jams, scarce public space)?
New and big P&Rs are ideal for in-trunk deliveries	The city of Antwerp has installed 3 new park & rides with a total of 4,000 parking spaces over the past 4 years.	What is the modal shift we can realize with in-trunk delivery model?
Insights in L/U zones can support decision making	Antwerp is experimenting with AI cameras at unloading and loading zones. This way we will be able to investigate if the zones are properly used and have an oversight of the real demand.	The purchase of cameras is expensive and causes resistance from the inhabitants. The goal and purposes of every new camera on public domain has to be very well underpinned.

3.2.1 Use of the Transferability Platform and Digital Tools

Impact Assessment Radar

- **Strategic level:** Assesses the city's overall capacity and readiness for implementing new logistics solutions.
 - ➔ This would have been an excellent starting point at the outset of the project, as the city of Antwerp had already conducted research on logistic flows, organized stakeholder workshops, and collected data for the Sulp.
- **Tactical level:** Uses data from demand and last-mile delivery providers to simulate scenarios, estimate needs like the optimal number of lockers, and inform decisions on placement and initial assumptions.
 - ➔ Gaining insights into last-mile delivery data collection would have been highly valuable for the city, given the current scarcity of data. The tool could serve as an effective means to establish common ground with stakeholders and develop solutions for last-mile delivery challenges.
- **Operational level:** Monitors key performance indicators (KPIs) to measure and track the impact of current logistics operations, supporting the continuous optimization of performance.
 - ➔ As a city, we believe that at the operational level (particularly for SMEs) this tool can deliver substantial benefits. Larger companies likely already have systems in place to measure and manage their performance.

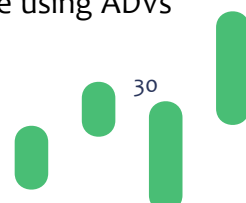
Blockchain Technology

Currently, the city has limited experience with blockchain technology. In future projects blockchain could serve as a reliable framework for establishing partnerships and securely sharing data.

CitiQore tool (Digital Twin for last-mile delivery)

The city has not conducted research on locker networks yet. However, this tool could serve as a starting point to improve coverage and efficiency.

To test the CityQore tool, we applied it to a simulation involving. We created a real-world scenario based on a restaurant in Antwerp that aims to operate its delivery service using ADVs



within a 500-meter radius. For the warehouse location, we selected the [Kielsbroek](#) area, where food warehouses are concentrated and typically supply restaurants in the city center.

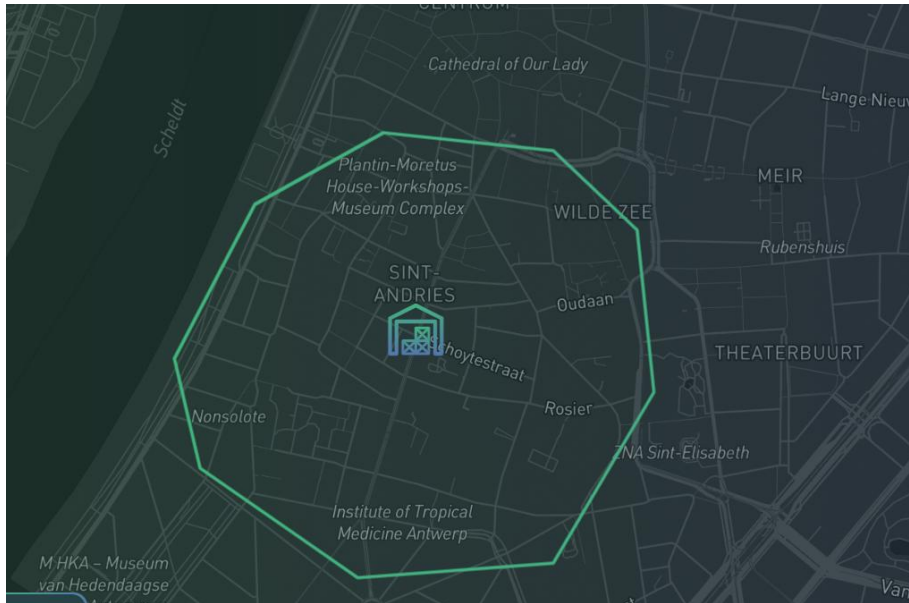


FIGURE 7 CITLOORE UI FOR ANTWERP

The next step we did was inserting the different parameters, show in the Table 3.

TABLE 3 SIMULATION PARAMETERS

Parameter	Input	Reason
First-mile vehicle	Medium truck	Most hospitality deliveries in Antwerp are made by medium trucks.
Deliveries #	100	Assumes the restaurant sells 100 meals per day.
Average packages	25 (fixed)	Small robots can only carry one order at a time, so this figure is not representative for ADV meal delivery.
Number of ADVs	4	A maximum of 4 was chosen to reflect peak-hour demand, where most meals are ordered simultaneously and each ADV handles one order. More ADVs would provide a more accurate estimate.
Supporting vehicle	Scoobic	Mandatory, though not applicable here since deliveries are exclusively by ADVs.
Number of stops	4	One stop per ADV (each order delivered individually).

CBA parameters	5€, 3 year	Delivery cost of €5 per order (approximate current rate in Antwerp) and a 3-year investment horizon.
----------------	------------	--

Running the simulation with these parameters produced the following results. The scenarios revealed challenges in both service coverage and financial viability when ADVs operate independently. These findings align with the SWOT analysis, which highlights the high initial cost associated with ADV acquisition. However, the results should be interpreted with caution, as some parameters could not be fully tailored to this specific use case

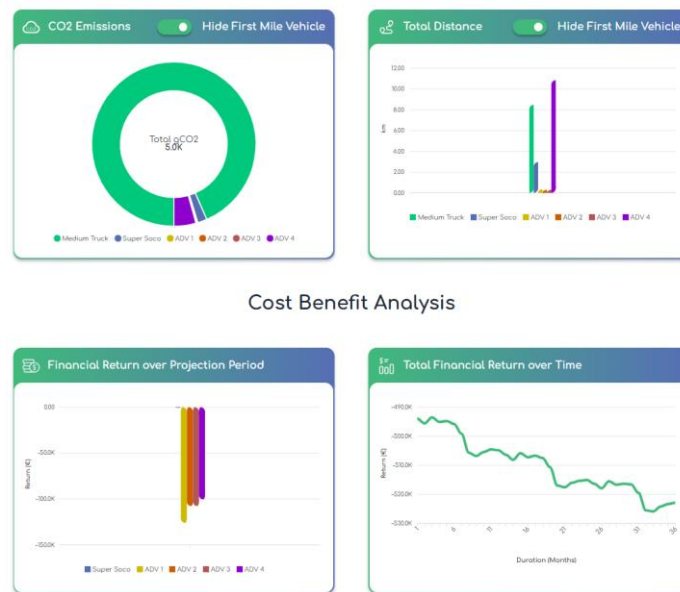


FIGURE 8 SIMULATION RESULT DASHBOARD

3.3 Innovation/use case – Operational Feasibility (SWOT analysis)

3.3.1 Vision and objectives

As cities continue to explore autonomous delivery technologies, the growing interest in robotisation brings with it important legal, spatial, and regulatory questions. In Antwerp, the city is drawing inspiration from Helsinki’s pilot project to assess not only the technological feasibility but also the legislative frameworks required for safe and responsible deployment.

Several companies have expressed interest in deploying such robots for short-distance meal deliveries. Rather than focusing solely on the service aspect, Antwerp is using this opportunity to examine how these technologies interact with public space and existing regulations. The initiative aims to assess the legal frameworks, spatial requirements, and policy implications necessary for safe and responsible integration.

A demonstration in a controlled area can serve as a real-world testbed to explore practical issues such as liability, coordination between local and higher-level regulations, and the types of agreements needed to support future deployments. As a city, Antwerp is not yet familiar with the presence of autonomous robots in the public domain, making this feasibility study an important step in understanding the impact and identifying the conditions under which robots might be safely and effectively introduced.



3.3.2 Strengths and weaknesses, opportunities and threats: SWOT Analysis

TABLE 4 ANTWERP SWOT ANALYSIS

Strengths	Weaknesses
<ul style="list-style-type: none"> • Consistent and contactless delivery service • Low-emission, electric-powered transport • Fewer regulatory hurdles than AV • Compact dimensions of ADV • Low-speed robots complement pedestrian zones 	<ul style="list-style-type: none"> • Limited speed and range • Spatial pressure on the side walks • Privacy & GDPR concerns • High initial investment • Limited Societal/Environmental Value
Opportunities	Threats
<ul style="list-style-type: none"> • Expansion into other sectors • Collaboration with local businesses and international tech companies • Learning lessons from existing pilots and capacity building • Test case in niche zones/events 	<ul style="list-style-type: none"> • Legal/regulatory uncertainty • Lack of public support • Battle for the sidewalks • Conflict with current mobility policy • Safety concerns • Risk of an influx of robots

Inspiring examples

Turku (FI): S Group Retail

In Turku (and 14 other Finnish cities) the deployment of grocery ADVs (Starship) has thrived under a unique set of conditions. Operating within a modest range of 3–4 km, these vehicles benefit from the city’s wide 3-meter footpaths, which offer safe and accessible routes for navigation. Notably, there is no formal data exchange between the ADV companies and the city, and the absence of municipal regulation has allowed for flexible experimentation. A key factor in their success appears to be low contact nature of the service, which resonates well with users who prefer minimal human interaction during deliveries. Importantly, there have been no reports of serious accidents, suggesting that the current setup supports both safety and innovation.

Knokke-Heist (BE): Carrefour

In Knokke-Heist, a short-term pilot with ADVs (Delivers.ai) was conducted in 2023, serving a pop-up Carrefour store over a period of 1.5 months. Operating within a compact radius of 400 meters, three robots completed a total of 200 grocery deliveries. The initiative placed strong emphasis on branding, aiming to create a visible and engaging presence in the city. Unlike Turku, safety concerns (battery issues) were raised by municipal authorities. While the project was initially intended to expand to other Belgian cities, this roll-out did not materialize.

3.3.3 Identification of opportunities

Antwerp’s exploration of autonomous delivery robots opens up a range of opportunities that extend well beyond food delivery. There is clear potential to **expand into other sectors** such as parcel logistics, pharmacy deliveries, and even municipal services. These robots support hygienic, contact-free delivery models, which is particularly valuable in sensitive health contexts where reducing human interaction is essential.



Local businesses also stand to benefit. Retailers in Antwerp can experiment with innovative delivery methods, and there's room for co-creation with local start-ups and universities. If proven effective, these robots could be scaled across multiple neighbourhoods.

Pilot projects play a crucial role in **building knowledge**. Antwerp can draw insights from similar initiatives in cities like Helsinki, Knokke-Heist and Turku, while also developing its own regulatory frameworks and operational guidelines. The robots themselves can collect data to optimize delivery routes and improve customer service, contributing to broader strategies in logistics and urban planning.

The technology lends itself well to deployment in **specific zones (virtual zones) or niches**. Car-free areas, campuses, hospitals, and events are ideal environments for testing and implementation. There's also potential for integration with smart city initiatives such as Antwerp Shift, reinforcing the city's commitment to innovation and sustainable urban development.

Finally, here are a few **additional possibilities** that could contribute to the success of this new delivery method: night deliveries, environmental inventory by robot cameras, weather resistant delivery system, etc.

3.3.4 Analysis of threats

While autonomous delivery robots present intriguing possibilities, their deployment in Antwerp also raises a number of complex challenges that must be carefully considered.

One of the most pressing concerns is the **legal and ethical uncertainty** surrounding their use. Liability in the event of accidents or incidents remains unclear, especially when it comes to coordinating between local, federal, and EU-level regulations. The legal status of autonomous devices in public spaces is still evolving, and questions around data privacy (particularly related to the use of cameras) add another layer of complexity.

Public support is another critical factor. Citizens may express resistance due to concerns about safety, privacy, or the visual impact of robots in their neighbourhoods. There is still uncertainty about how useful these robots truly are and whether they might negatively affect the liveability of urban spaces. Additionally, the risk of vandalism or theft cannot be ignored.

Conflicting policy objectives also come into play. Antwerp has made strong commitments to promoting active mobility and greening the city. The introduction of delivery robots could be perceived as undermining these goals, potentially leading to negative public or political reactions.

Operational challenges further complicate the picture. Deploying robots in busy streets is logistically difficult, and it remains unclear where they should wait or load without obstructing pedestrian flow. This leads to a broader issue: the battle for sidewalk space. Sidewalks are primarily designed for pedestrians, while most logistics operations currently rely on roadways. Introducing robots into this already contested space could create friction.

Safety concerns are a critical consideration when introducing ADVs into public space. These concerns span a wide range of potential risks, from technical failures, to interactions with pedestrians. One example is the risk of battery-related incidents, such as overheating or fire, particularly in densely populated areas. Additionally, road safety must be carefully monitored: robots operating on sidewalks or crossing streets could be involved in collisions, near-misses, or unexpected obstructions, especially in busy or narrow zones. To mitigate these risks, the integration of additional sound signalling devices and enhanced voice communication can help ensure that the robots remain clearly noticeable and audible to those nearby.

Finally, there is the risk of an **uncontrolled influx of robots**. If multiple sectors (for example food delivery, e-commerce, and healthcare) begin to adopt this technology simultaneously, it could result in overcrowding and disruption in the city centre.

3.3.5 Risk mitigation

1. Regulation & legislation

Risk: The absence of formal agreements between the city and service providers may lead to operational disruptions, conflicting interests, limited data sharing, and unclear liability.

Mitigation: Establish an open and ongoing dialogue between the city and providers. Formalize this collaboration through signed agreements and a structured permit application process (refer to *Regulatory and Legal Frameworks*).

2. Behavioural change

Risk: The convenience of autonomous delivery may lead some citizens to choose it over active transportation (e.g., walking or cycling to shops or restaurants), potentially impacting health and sustainability goals.

Mitigation: To balance innovation with active mobility, the city can launch public awareness campaigns, offer incentives for walking and cycling, and align ADV deployment with the objectives of the Pedestrian Programme. This ensures ADVs complement rather than replace active transport options.

3. Space claim

Risk: ADVs may encroach on pedestrian pathways or operate in areas where their presence is undesirable.

Mitigation: The city has already implemented geo-zoning to regulate where shared mobility services are allowed to operate and park, minimizing disruption to pedestrian areas. A similar approach can be applied to Autonomous Delivery Vehicles (ADV), ensuring their integration aligns with urban mobility and public space priorities.

4. Testing

Risk: Safety incidents during pilot operations, including battery-related hazards, road accidents, and failures in remote control responsiveness.

Mitigation: While international pilots suggest that serious incidents are rare, Antwerp's approach includes a cautious evaluation of these risks during the pilot phase, with a focus on real-world testing, citizen feedback, and coordination with emergency services and traffic police. To further reduce risk, remote control and supervision of ADVs will be required during the initial phase. Although many robots operate autonomously, remote operators play a critical role in managing complex or unexpected situations, ensuring timely intervention and maintaining public safety.

5. Public acceptance

Risk: Limited public trust or discomfort with ADVs, potentially leading to resistance, complaints, or negative media attention.

Mitigation: To foster a positive perception, Antwerp might focus on clear and consistent branding that aligns the ADVs with the city's identity and values. The design of the robots will also incorporate human-like features (such as expressive elements on the front) to make them appear more approachable and

relatable. These measures aim to reduce apprehension, encourage curiosity, and promote a sense of familiarity among residents and visitors during the pilot phase.

Action Plan Brainstorm

As part of the short-term action plan, the city opts to closely monitor developments within the sector without taking on a leading role itself. By postponing a potential demonstration (originally scheduled in September 2025), time is gained to explore the appropriate regulatory framework and policy context. Contact with relevant stakeholders is maintained, but the initiative remains “on hold” unless there is a clear demand from the sector. For the long term we refer to *Timelines and Milestones*, which outlines a more structured approach to regulation, policy development, and potential demonstrations.

3.3.6 Required digital and physical infrastructure

To ensure the safe, efficient, and meaningful deployment of autonomous delivery vehicles (ADVs) in Antwerp, a combination of digital and physical infrastructure is essential. This infrastructure not only supports the operational functionality of the robots but also enables the city to extract value through data, planning, and policy development.

Digital Infrastructure

The digital backbone of the project is critical to unlocking its full potential. One of the most valuable aspects for the city lies in the ability of ADVs to collect and share data. These vehicles can provide real-time information on delivery routes, the condition of road and sidewalk infrastructure, and usage patterns. This data can support urban planning, infrastructure maintenance, and mobility strategy development.

To manage this effectively, robust data management systems are required. These systems must be capable of handling route planning, live monitoring, and compliance with privacy regulations—especially considering the use of GPS and onboard cameras. Ensuring that these systems are secure and interoperable with existing city platforms, such as Smart Ways to Antwerp, will be key to integrating robot data into broader urban intelligence efforts.

Reliable connectivity is also essential. ADVs must maintain continuous communication with operators and city systems, which may require enhanced wireless coverage (e.g., 4G/5G or municipal Wi-Fi) in pilot zones and future deployment areas. This connectivity supports not only operational control but also safety, responsiveness, and data transmission.

The Open Mobility Foundations (OMF) Mobility Data Specification (MDS) is regarded as an industry standard. This specification provides the scaffolding for communication between agencies (local governments) and providers (companies) in both ways. Agencies can communicate policy while providers can share data and metrics. This allows for a dynamic governing with data-informed changes in policy.

The same foundation also offers the Curb Data Specification (CDS), a digital tool to govern usage of public infrastructure and essential for governments to understand, optimize and regulate who uses public space for which purposes. CDS enables governing bodies to measure the impact a certain service provider has by calculating ROI and public space productivity through metrics. Companies can easily find public infrastructure that is available for their use case and needs and know which rules apply there.

Both specifications allow governing bodies to define policy and provide a framework in which innovation is facilitated.



Physical Infrastructure

In contrast to some assumptions, the aforementioned international examples show that the deployment of autonomous delivery vehicles (ADV) often does not require significant changes to existing public infrastructure. In many cases, robots are able to navigate sidewalks and public spaces using current layouts, without the need for structural modifications.

However, as a city, Antwerp is taking a proactive and cautious approach. While no immediate adjustments are planned, we acknowledge that certain targeted interventions may be beneficial to ensure safe, intuitive, and non-disruptive integration of ADVs into the urban environment. These adjustments would be considered only where they clearly add value for pedestrians, improve operational efficiency, or enhance safety.

Potential adaptations could include the creation of designated waiting or loading zones (preferably on-site where possible), where robots can pause without obstructing foot traffic or access points. These zones could be clearly marked and located in areas that minimise disruption.

To support public awareness and safety during the initial phase, signage may be installed to inform pedestrians of robot presence and movement patterns. Any such signage would be designed to be clear, minimal, and integrated into the existing visual language of the city. Additionally, accessibility considerations—such as curb ramps or improved lighting—may be evaluated to ensure that ADVs do not hinder mobility for people with disabilities or reduce the comfort of public space users.

Together, these digital and physical infrastructure components form the foundation for a responsible and future-ready approach to autonomous delivery in Antwerp. They support not only the technical feasibility of the initiative but also its alignment with public interest, safety, and long-term urban development goals.

3.3.7 Integration with the existing system

While no major barriers are expected, several practical concerns may arise during the integration of ADVs into Antwerp's urban logistics network. Coordination with existing bike courier services (e.g. Take-Away, Deliveroo and UberEATS) could present scheduling or territorial challenges, especially in high-demand zones. Infrastructure compatibility is another consideration sidewalks, crossings, and delivery zones may need adjustments to accommodate ADVs safely and efficiently. There may also be concerns around data sharing and platform interoperability between ADV operators and existing delivery apps. Finally, public space congestion and competition for curbside access could lead to friction between traditional couriers and autonomous systems, requiring clear guidelines and stakeholder engagement. However, experiences from other cities show that integration can often proceed smoothly, even without active intervention from local authorities. In many cases, ADVs have been introduced alongside existing systems with minimal disruption.

3.3.8 Regulatory and legal frameworks: required permits, compliance, GDPR, etc.

Legislation autonomous vehicles

Small delivery robots that drive exclusively on the pavement are not considered to be:

- motor vehicles within the meaning of the Royal Decree of 15 March 1968 (or Regulation (EU) 2018/858),



- two-, three- or four-wheelers within the meaning of the Royal Decree of 10 October 1964 (or Regulation (EU) 168/2013).

Consequently, the authorisation issued by the Federal Public Service Mobility & Transport for testing automated vehicles on public roads (based on Article 3 of the Royal Decree of 15 March 1968, which applies only to motor vehicles) does not apply to these devices.

A permit from the FPS Mobility is not required for these delivery robots. A permit from the road authority (AWV) or the municipality (city of Antwerp) is required, as the robots will be used on the pavement. Additionally, input from the local police is necessary.

Regulations

The regulatory foundation for ADVs aligns closely with the procedural framework previously established for shared mobility. In order to facilitate a structured and legally sound deployment of ADVs within the city of Antwerp, it is advisable to begin by explicitly prohibiting their use in public spaces through an amendment to the police code. This initial prohibition serves as a legal foundation upon which specific exemptions (granted through permits, licences, or authorisations) can be introduced. This approach reflects a well-established regulatory practice in Belgium.

The proposed procedure consists of three distinct phases:

TABLE 5 THE THREE PHASES TOWARDS ADVS IMPLEMENTATION

Amendment to the police code	General regulatory framework	Permit/licence/authorisation
Establishes the legal basis for regulation by prohibiting ADVs in public spaces, thereby enabling the issuance of controlled exemptions	This document will outline the overarching rules and principles governing the operation of ADVs.	Defines the criteria, procedures, and obligations associated with granting operational permissions to ADV operators.

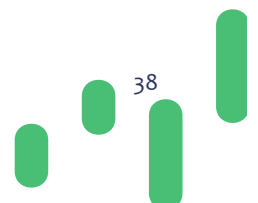
The city of Antwerp already received a guideline of the ADVs of robot company Coco (consisting of product specifications, liability, safety measures, data collection) and the [technical requirements](#) of the Finnish transport and communications agency Traficom. The City of Antwerp will use the provided documents (combined with the legal framework of shared mobility) as a starting point for developing its legal framework regarding AVDs.

3.3.9 Financial Feasibility Estimations: Budget, Costs, Revenue, and Funding Opportunities

The City of Antwerp approaches the exploration of autonomous delivery robots from a regulatory and spatial planning perspective, rather than as a financial stakeholder. As such, the city does not intend to subsidize, co-finance, or provide direct financial support for the deployment or operation of delivery robots in public space.

The financial responsibility for pilot projects and operational deployment lies with the private operators. Companies interested in testing or scaling robot delivery services are expected to cover all associated costs, including:

- Procurement and maintenance of the robots



- Operational logistics, such as charging infrastructure, fleet management, and staffing
- Insurance and liability coverage
- Compliance with legal and spatial requirements, including any necessary permits or adaptations to public infrastructure

While the city may facilitate pilot zones or demonstrations, this support is limited to regulatory coordination and spatial planning. No public funding will be allocated to hardware, software, or operational expenses.

From a revenue perspective, the city may explore cost-recovery mechanisms in the future, such as:

- Permit fees for operating in public space
- Data-sharing agreements that provide value to urban planning or mobility strategies
- Public-private partnerships where mutual benefits are clearly defined and financially neutral for the city

In terms of funding opportunities, companies may seek external grants or innovation funding at the regional, federal, or EU level (e.g. Horizon or [VLAIO](#)). The city can provide guidance or letters of support for such applications, provided they align with Antwerp’s policy goals.

Timeline and Milestones

The City of Antwerp is taking a phased and deliberate approach to exploring autonomous delivery robots, with a primary focus on understanding the regulatory, spatial, and societal implications of their presence in public space. Given that Antwerp is not yet familiar with the operational and legal realities of robots in the public domain, this timeline is designed to support knowledge-building, policy development, and the formation of a clear urban vision.

TABLE 6 TIMELINE AND MILESTONES FOR EXPLORING AUTONOMOUS DELIVERY ROBOTS IMPLEMENTATION

Phase 1: Exploration, Framing & Regulations (Q3–Q4 2025)
<ul style="list-style-type: none"> • Initial stakeholder consultations with legal experts, urban planners, and mobility specialists • Review of international best practices (e.g. Helsinki, Knokke-Heist, & Turku) • Mapping of existing legal frameworks at local, regional, and EU levels • Internal workshops to define Antwerp’s vision on robotisation, with a focus on food delivery and potential extensions to other sectors (e.g. pharmacy, parcel logistics, municipal services) • Concept of the generic regulations for ADVs on public domain • Capacity building for city staff through knowledge exchange, and scenario planning to prepare for future integration of autonomous technologies
Phase 2: Controlled Demonstration & Evaluation (Q1–Q2 2026)
<ul style="list-style-type: none"> • Initial stakeholder consultations with legal experts, urban planners, and mobility specialists • Review of international best practices (e.g. Helsinki, Knokke-Heist, & Turku) • Mapping of existing legal frameworks at local, regional, and EU levels • Internal workshops to define Antwerp’s vision on robotisation, with a focus on food delivery and potential extensions to other sectors (e.g. pharmacy, parcel logistics, municipal services) • Concept of the generic regulations for ADVs on public domain



<ul style="list-style-type: none"> Capacity building for city staff through knowledge exchange, and scenario planning to prepare for future integration of autonomous technologies
Phase 3: Vision consolidation and Policy Development (Q3–Q4 2026)
<ul style="list-style-type: none"> Drafting Antwerp’s official position on autonomous delivery robots Sectoral relevance (food, healthcare, retail) Added value for citizens (hygiene, accessibility, sustainability) Spatial and operational boundaries (car-free zones, campuses, events) Development of local guidelines and permitting procedures
Phase 4: Strategic Decision-Making (2027 and beyond)
<ul style="list-style-type: none"> Decision on broader deployment based on findings and public interest Monitoring and adaptation mechanisms for evolving technologies Integration into smart city strategies (mobility, sustainability, digital innovation) Engagement with regional and EU bodies for policy alignment

Evaluation and Impact Assessment

In the starting phase of the project, a close and continuous monitoring of the defined KPIs will be crucial. These KPIs serve as the foundation for assessing the safety, operational efficiency, and overall impact of ADVs in the urban environment. A robust follow-up mechanism must be in place from the outset to allow for timely adjustments and interventions. If recurring problems, accidents, or safety issues arise, the city retains the authority to withdraw authorisation for deployment.

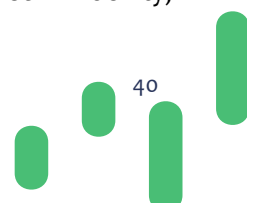
Safety remains the highest priority throughout the pilot phase:

- Vandalism or theft incidents reported: monitoring the frequency and nature of security breaches involving ADVs
- Number of accidents/incidents with ADVs reported: including collisions with pedestrians, cyclists, vehicles, or infrastructure
- Received complaints about unsafe situations: public feedback regarding perceived or actual safety risks

Operational performance will be assessed to determine the efficiency and adaptability of ADVs in the public space:

- Average time robots spend idle or waiting in public space: evaluates logistical efficiency and potential congestion
- Average time in relation to the distance travelled: assesses delivery speed and route optimization
- Number of spatial adjustments required (e.g., signage, markings): indicates the level of infrastructure adaptation needed
- Number of infrastructural incidents or obstructions reported during pilot phase: tracks challenges encountered in the urban landscape
- Aggregate distance and duration of deliveries: provides insight into usage patterns and coverage
- Total number of deliveries completed: measures the scale and reliability of the service
- Percentage of reduced emissions: assesses environmental impact compared to traditional delivery methods

The collected data will be analysed to evaluate the broader impact of the pilot on urban mobility, environmental sustainability, and public perception. This includes:



- Identifying areas where ADVs contribute positively to city logistics
- Highlighting operational bottlenecks or safety concerns
- Assessing the scalability and long-term viability of the technology

3.4 Stakeholders and Governance

3.4.1 Stakeholders analysis and expertise needed

Effective governance is essential to ensure that the deployment and integration of delivery robots in Antwerp is carried out in a coordinated, transparent, and accountable manner. Given the multidisciplinary nature of the initiative, governance will be structured around a collaborative framework that brings together internal city departments, external stakeholders, and strategic partners.

TABLE 7 LIST OF INVOLVED STAKEHOLDERS AND THOSE PLANNED TO BE ENGAGED

Involved partners (confirmed)	
Internal	<ul style="list-style-type: none"> • Communication department • ‘Smart Ways to Antwerp’ department • Urban planning department • Data Department • Road Safety Department • Legal Department • Licensing Department • Business & Innovation Department
External	<ul style="list-style-type: none"> • Traffic Police • Department of Mobility and Public Works • Flanders Investment & Trade • Delivery Robot Provider Coco
Potential partners (To be engaged)	
External	<ul style="list-style-type: none"> • Emergency services (fire brigade, ambulance) • Research Universities <ul style="list-style-type: none"> ○ University of Antwerp ○ University of Hasselt • Local restaurants/SME’s • Delivery robot providers (e.g. Starship, Delivers.ai) • Retail and logistics associations • Logistics companies

3.4.2 Governance Structure

To ensure the successful implementation of delivery robots in Antwerp, a clear and collaborative governance structure will be established. The aim is to keep coordination manageable and locally anchored, while ensuring that all relevant stakeholders are involved and informed.

Strategic Steering Group

This group will guide the overall direction of the project and ensure alignment with city-wide priorities. It will include representatives from key internal departments such as Mobility, Urban Planning, Smart Ways



to Antwerp, and Communication, as well as external partners like the Department of Mobility and Public Works and Traffic Police.

Operational Coordination Team

Responsible operational coordination, this team will bring together project leads from departments including Data, Road Safety, Legal, and Licensing, along with representatives from the delivery robot provider (e.g., Coco). The team will focus on managing data flows, assessing safety, and ensuring legal compliance.

Advisory and Engagement Forum

To foster openness and collaboration, an advisory forum may be set up to engage potential partners and community stakeholders. The forum can serve as a space for feedback, co-creation, and knowledge sharing, particularly during pilot phases and public engagement efforts.

Legal and Ethical Oversight

The Legal Department will ensure that all activities comply with relevant local and EU regulations, including GDPR, liability, and public space usage. Ethical aspects—such as accessibility, fairness, and environmental impact—will be considered throughout the project lifecycle.

3.4.3 Potential future steps for public acceptance and perception, outreach and engagement

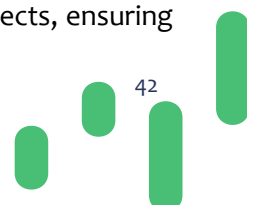
As outlined earlier, the city is actively developing a legal and policy framework that aligns with its broader urban mobility vision. Within this framework, the city retains the authority to determine which sectors may benefit from the use of ADVs, ensuring that deployment remains purposeful and locally relevant. Insights from previous initiatives, such as the Carrefour project, have demonstrated the value of customising robots—whether through city branding or by integrating human-like features—to enhance public familiarity and acceptance. Moving forward, the city aims to engage citizens directly through interviews, questionnaires, and public demonstrations to better understand perceptions and expectations. These outreach efforts will help gauge public opinion and identify areas for improvement. Additionally, all complaints and concerns raised by residents will be actively monitored and addressed, reinforcing the city’s commitment to transparency and responsiveness. By involving the public early and consistently, the city seeks to build trust and foster a sense of shared ownership in the transition toward innovative urban logistics.

3.5 Conclusion and recommendations towards public authorities

The implementation of a Sustainable Urban Logistics Plan (SULP) and related pilot projects has shown that replication in other cities is both possible and desirable. However, replication should never be a “one size fits all” approach. Each city has its own unique characteristics: geography, economic activity, regulatory environment, and stakeholder dynamics, that require tailored solutions. Replication is most effective when it is adapted to local needs, supported by a clear problem definition, and aligned with broader urban mobility and sustainability goals. Offering solutions without first understanding the problem leads to unnecessary work and wasted resources.

1. From Pilots to Policy

One of the most important lessons learned is that testing and demonstration projects must evolve into formal policy measures. Without this transformation, the impact remains fragmented and temporary. Local authorities should finalize the SULP as a guiding instrument for future logistics projects, ensuring



coherence between short-term pilots and long-term strategies. This framework should be embedded into local policy, creating a structured approach that allows cities to influence logistics flows in a meaningful way. Political will is crucial to have improve urban logistics and to tackle the externalities.

2. Creating an Enabling Legal Environment

A critical recommendation is to set the legal framework for Automated Delivery Vehicles (ADV). In many cities, such a framework does not yet exist. Where this is the case, authorities should develop regulations that serve city needs while maintaining flexibility for future technological developments. Rigid rules risk stifling innovation; therefore, adaptability must be a core principle. At the beginning of the Urbane the city of Antwerp had there no legal framework. The city noticed that without the creation of legal framework, it was impossible to have impact on the influx of ADVs. Create a framework that reflects the city's priorities and leaves room for evolution.

3. Strategic Thinking and Prioritization

Authorities must think critically about the problem first. Solutions without a clear problem definition often lead to inefficiencies. Furthermore, while small-scale pilots are valuable, cities should also focus on big volumes, as these offer the greatest potential for reducing congestion and emissions (such as construction logistics). Another strategic question that cities must ask is: what space should be prioritized for logistics? With the rise of new modes (such as ADVs) the question arises whether these vehicles should be allowed in pedestrian areas and footpaths, which traditionally have not been dedicated to logistics flows. This spatial prioritization will become increasingly important as urban logistics evolves.

4. Collaboration and Dialogue

A successful logistics strategy requires open dialogue with the sector. Continuous engagement with logistics operators, technology providers, and citizens ensures mutual benefits and shared ownership of solutions. Local authorities can propose challenges and seek partners to co-develop solutions, but these partnerships must be structured around clear, reciprocal benefits. Without mutual gain (what's in it for me?), projects are destined to fail.

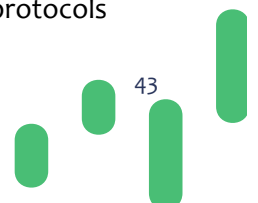
5. Demonstration and Scaling

The administration of the city of Antwerp is rather sceptical of ADVs in public areas. Before allowing ADVs in public areas, begin with demonstrations in restricted areas, allowing for risk mitigation and learning before scaling to complex urban settings. However, pilots should not remain isolated experiments. They must include clear pathways for integration into city-wide policy and infrastructure planning, ensuring that lessons learned translate into long-term impact.

6. Next steps and Initiatives

The next steps for public authorities include:

- Integrating urban logistics objectives into municipal mobility plans and defining performance indicators for efficiency and sustainability
- Launching ADV trials in designated zones with clear evaluation criteria and safety protocols



- Developing digital platforms for data sharing between public and private actors to improve transparency and coordination
- Exploring consolidation centres for high-volume goods, reducing last-mile congestion and emissions
- Building internal capacity by training municipal staff on emerging logistics technologies and regulatory implications
- Facilitating knowledge exchange between cities through networks and best-practice repositories.

7. Final Thoughts

For local authorities, the shift from experimentation to structured policy is critical. While pilots and demonstrations provide valuable insights, they tend to be ad hoc. Their true impact lies in institutionalization. By combining strategic planning, legal adaptability, stakeholder engagement, and evidence-based approaches, cities can create resilient and sustainable urban logistics ecosystems. The question is not whether to act, but how to act in a way that balances innovation, practicality, and long-term urban development goals. The Urbane project has some relevant insights, pilot cases and tools to support local authorities.

4 Feasibility Study: Aarhus

4.1 Background of urban logistics in Aarhus

The Municipality of Aarhus boasts the second largest city in Denmark. The municipality has approximately 375.000 inhabitants with around 75.000 inhabitants living in the city centre within the inner ring road.

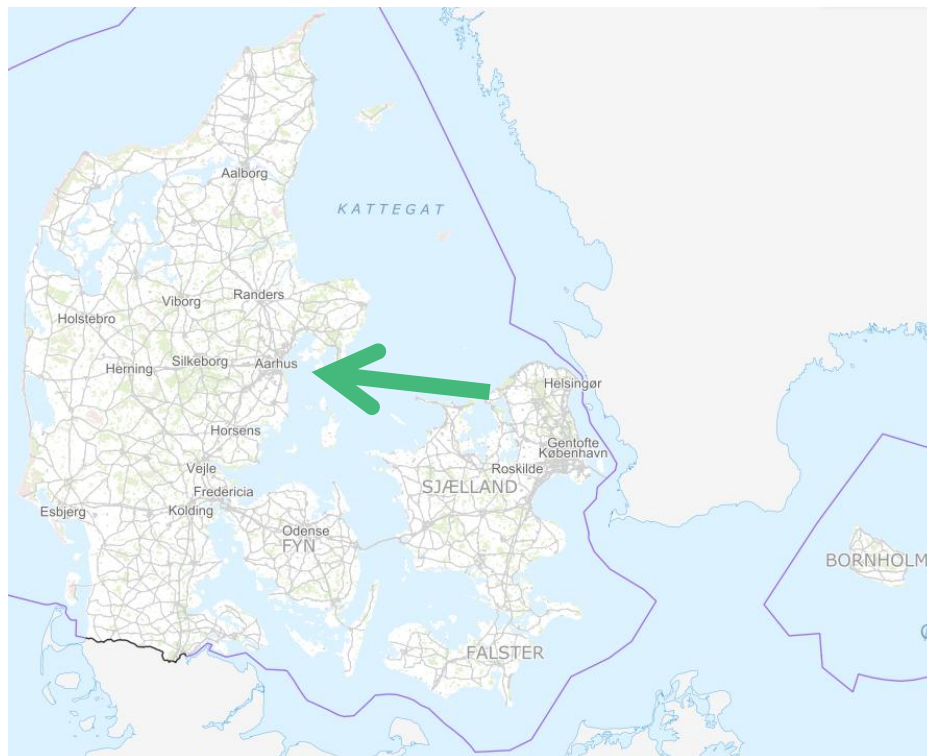


FIGURE 9: GEOGRAPHICAL LOCATION OF THE CITY OF AARHUS.

The modal share of chosen transport mode can be seen on figure 1, where the majority chooses to drive a car when transporting themselves. The shown distribution is for the municipality as a whole, where the closer you get to the city centre, the more the share favours biking and walking.

When looking at the total vehicle kilometres in The Municipality of Aarhus, vans and trucks make up approximately 16 % of all trips even though they only account for 12 % of the total vehicle fleet. The difference between the registered fleet and total driven kilometres could indicate an influx of trucks not registered in Aarhus visiting Aarhus e.g. to the container terminal, or that commercial trucks and vans just spend more time on the streets.



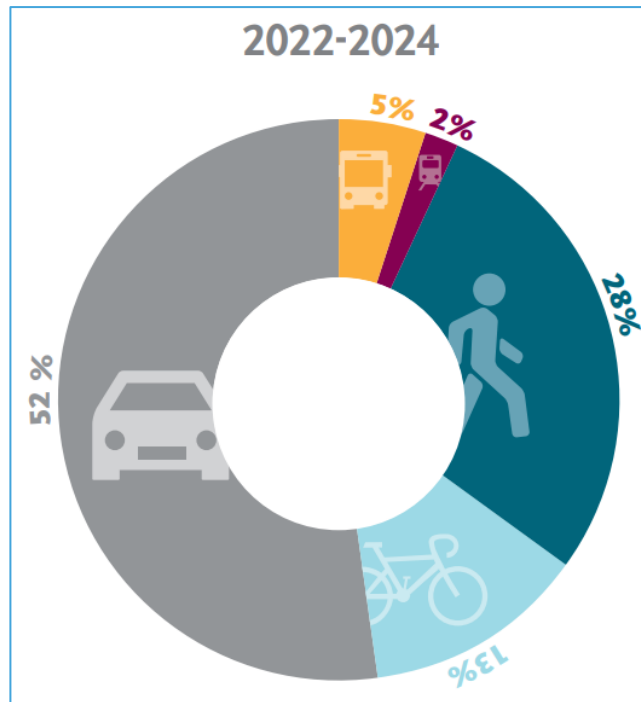


FIGURE 10: MODAL SHARE WITHIN TRANSPORTATION MODES IN THE MUNICIPALITY OF AARHUS.

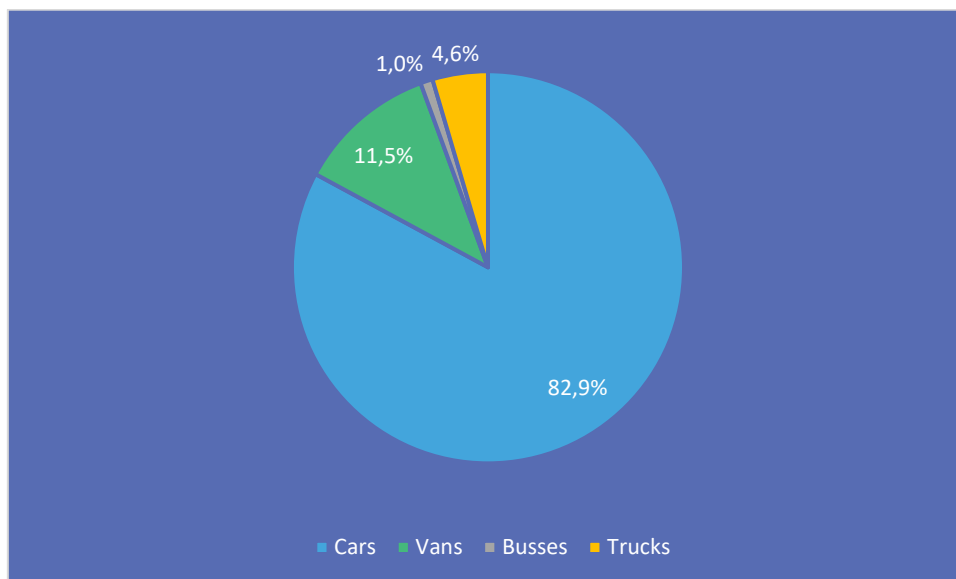


FIGURE 11: MODAL SHARE BASED ON TOTAL VEHICLE KM IN THE MUNICIPALITY OF AARHUS.

In Aarhus, the largest container terminal in Denmark can also be found. The terminal yearly handles around 75 % of shipped goods to/from Denmark, which results in over 10 million tonnes of freight. The harbour therefore sees significant number of daily truck trips to/from the container terminal. The harbour has for many years wanted to expand further into the sea with a suggested extension of 105 ha., however the city council has in 2024 paused the project due to a significant backlash from the public. Beside the harbour expansion plan, a harbour tunnel connecting the highway E45 to the container freight terminal has been scheduled to open in 2035. Freight terminal trucks to and from the harbour don't need to drive through residential areas anymore.



As the second largest city in Denmark, Aarhus has a vibrant shopping area with three large shopping malls within the city centre as well as multiple outside. Aarhus also has, since 1972, an extensive pedestrianised area lined with well-known international brands such as H&M, Pandora, Levis, Nike Clothing to name a few. Outside the city centre exists multiple areas for warehouses such as IKEA, Jysk as well as hypermarkets etc.

4.1.1 Logistics plan and vision in Aarhus

There are currently no logistics plan in place in Aarhus. Planning for logistics has been done on an ad hoc basis when needed. Problems have usually been flagged by companies directly to the city council or in a freight transportation working group within the municipality in the technical department. No overall plan has been established, which means that only challenges have been addressed as they came up. In recent years a dedicated “citylogistics” resource person has been in charge of the dialogue with companies within logistics and transportation but also other sectors such as craftsmen etc.

In 2025 the technical department within The Municipality of Aarhus decided, as a part of the passed SUMP, to develop a Sulp which should address future planning within the field of citylogistics.

Sulp development

The Municipality of Aarhus is in the process of developing a Sulp, where the learnings and takeaways from different pilot projects will function as the basis for the logistical plan for Aarhus in the years to come. Aarhus has just passed a SUMP in the city council in August 2025, and therefore the Sulp will function as a part of the SUMP in the future.

The Sulp will be based on different pilot projects which will act as initiatives to pursue or further develop. Projects in the pipeline are:

- Sensor based parking on parking spaces for taxis.
- Sensor based parking on truck on/offloading sites

The sensor projects will serve as a tool for the municipality, as insights into the use of the spaces and to create a foundation for evidence-based decision making. The expected outcome is to gain further insights to in which degree the spaces are being used, and for what purpose

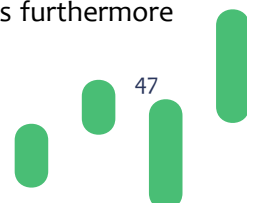
- Logistic microhub – delivery by cargobike
- Concept for night deliveries
- Concept for noise reduced deliveries
- Bookable truck on/offloading sites
- Identifying charging facility locations for heavy freight

The Sulp will be based on what these different types of initiatives can offer the city, and how Aarhus can make deliveries and logistics in the city more sustainable and smooth.

Planning Policy

In the early 2000’s Danish cities began to struggle with congestion. To mitigate the effects of traffic to- and in the city centre, a clear distinction between inner city shops and outer city warehouses has been established in municipal planning.

In 2017 a change in Danish planning legislation introduced the possibility of creating a specialized commercial zone on the outskirts of cities called a “Relief Centre”. The new legislation made it possible for larger shops, that attracted a more car dependant customer base (due to e.g. larger goods such as furniture, electronics, kitchens as well as the need for larger super- and hypermarkets) to locate themselves in clusters on the outskirts of cities. The new zones for warehouse-size shops furthermore



had the possibility of combining shops and service-based companies within e.g. fastfood therefore creating a new type of commercial district to the old “shops only” districts.

The different zones facilitate different types of shops:

City Centres (blue)

Purpose: To serve as the main commercial and experience hub of the town, offering a varied mix of retail, services, and culture.

Types of shops:

- Convenience goods stores (supermarkets, discount stores, kiosks)
- Comparison goods stores (clothing, shoes, electronics, books, etc.)
- Specialty and niche shops
- Service and leisure-oriented functions (cafés, restaurants, hairdressers, banks, cultural venues)

Characteristics:

- High concentration and diversity of shops
- Typically small to medium-sized units
- The city centre should develop from the inside out as a cohesive and vibrant area

District Centres (orange)

Purpose: To serve a larger urban district in cities with more than 20,000 inhabitants and to complement the city centre.

Types of shops:

- Convenience goods stores and some comparison goods stores
- Locally anchored shops (e.g. bakery, pharmacy, hairdresser)
- Small-scale service functions

Characteristics:

- Moderate concentration of retail
- Supports local daily needs and reduces travel distances
- Should complement — not compete with — the main city centre

Out-of-Centre (Relief) Areas (red)

Purpose:

To accommodate larger stores and new retail concepts that cannot easily fit into the city centre and to relieve pressure on it.

Types of shops:

- Large comparison goods stores (e.g. furniture, electronics, sports equipment)
- Retail concepts combining physical stores with e-commerce functions
- Possibly some convenience stores, but the focus is on comparison goods

Characteristics:

- Large retail units and buildings
- Attract customers from a wider catchment area
- Must not cause decline or vacancy in the city centre

The new relief districts were a success and can be found in most medium to large sized cities in Denmark. Aarhus has two of these types of warehouse areas (technically three).

4.1.2 Existing Regulations and Projects

Low Emission Zone

Since 2010 there has been established a Low Emission Zone (LEZ) in Aarhus within the inner ring road. The LEZ restricts the types of vehicles allowed to enter the inner city. First it was only trucks and busses, but from 2023 also cars are affected. The scope is to make larger and older trucks drive around the city centre and not through it.

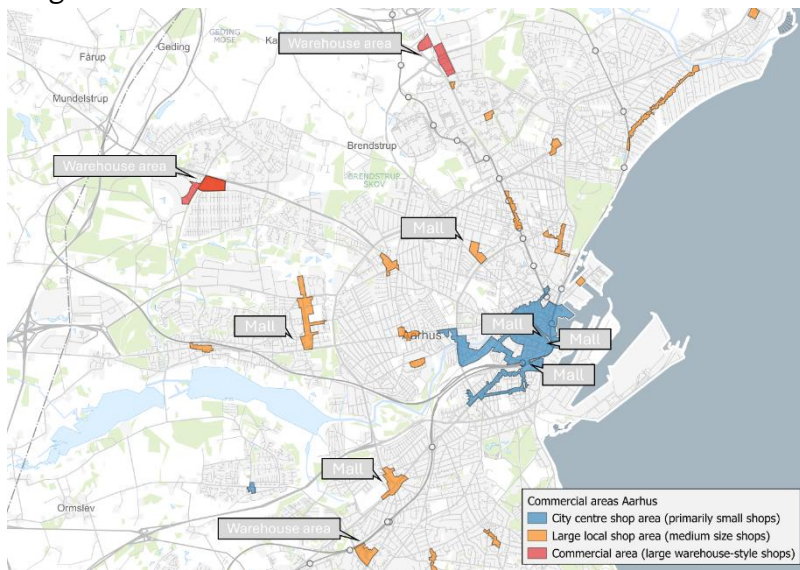


FIGURE 12: DISTINCTION BETWEEN DIFFERENT PLANNING ZONES IN AARHUS.

For cars and vans the euronorm 5 is the minimum, otherwise a particulate filter is needed. For trucks and busses euronorm 6 is the minimum, otherwise a particulate filter is needed. The zone is monitored through ANPR cameras at every access point, and fines are given automatically from a centralised system that has all license plate information. The central system is also used in all other Danish cities that have a LEZ.

Foreign cars and trucks are required to register at the latest on the day they drive in the zone, otherwise they will be fined 1.500kr (200EUR) for cars or 12.500kr (1.667 EUR) for trucks that are not permitted in the zone.

The LEZ imposes regulations on especially older diesel trucks, vans and cars, and aims to limit particle emission through fewer heavy emission vehicles in the city centre.

As seen on the official list of requirements, diesel cars- and vans from before 2011 will have to be registered and either fulfil the euronorm minimum or have a particulate filter installed to be permitted.

For diesel trucks- and busses, the cutoff date is before 2015 and euronorm 6, otherwise a particulate filter is needed.



Køretøj	Beskrivelse	Indregistreret første gang	Minimum Euronorm
	Personbil	Du skal registrere en personbil, hvis den er indregistreret første gang før den 1. januar 2011	5
	Minibus under 3,5 tons og over ni sæder inkl. chauffør	Du skal registrere en minibus, hvis den er indregistreret første gang før den 1. januar 2011	5
	Varebil under 3,5 tons	Du skal registrere en varebil, hvis den er indregistreret første gang før den 1. september 2016	5
	Lastbil over 3,5 tons	Du skal registrere en lastbil, hvis den er indregistreret første gang før den 1. januar 2015	VI
	Bus over 3,5 tons og ni sæder inkl. chauffør	Du skal registrere en bus, hvis den er indregistreret første gang før den 1. januar 2015	VI

FIGURE 13 OFFICIAL LIST OF REQUIREMENTS FOR DIESEL VEHICLES FROM “MILJØZONER.DK”

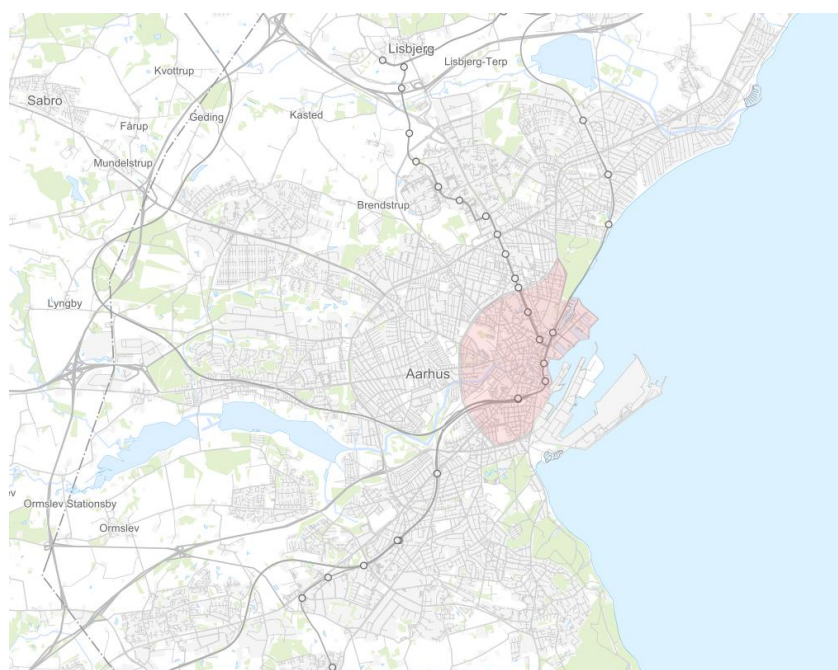
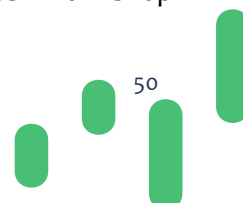


FIGURE 14 LOW EMISSION ZONE IN AARHUS CITY CENTRE WITHIN THE INNER RING ROAD O1.

Pedestrian zone

In city centre a pedestrian area is defined, where time limits for freight drop off is established from 04-11. The pedestrian zone has been established since 1972 and is where the highest valued commercial locations are placed. The zone/streets offer a safe and undisturbed shopping experience for the consumer, with shops ranging from shopping centres to local specialised vendors. In reality imposing car restrictions on a city centre comes with a set of impacts for the commercial industry. First of all, the shop owners need to get used to their costumers not being able to park right outside their shop. Secondly deliveries and freight in general becomes more troublesome because of the various physical and regulatory restrictions. However the benefits outweigh the impacts – costumers don’t want to shop in streets with traffic or dodge a delivery van in a hurry to drop off parcels in rush hour. There is a reason why the shops on the pedestrianised streets have the highest rent and resell value – they attract customers. In the beginning of the pedestrian street expansion, there was a lot of backlash from shop



owners and citizens, however it only took a couple of years before attitudes changed to the positive. Today people can't imagine not having a pedestrianised area.

In general the pedestrianised area in Aarhus is pretty extensive. However the municipality is continuously getting requests from local resident associations to pedestrianise their streets. Often the streets have many cafes and shops with curbside parking and therefore see a lot of traffic. However in many cases the need for resident parking is hard to overlook and therefore the pedestrian area has not been expanded for some years.

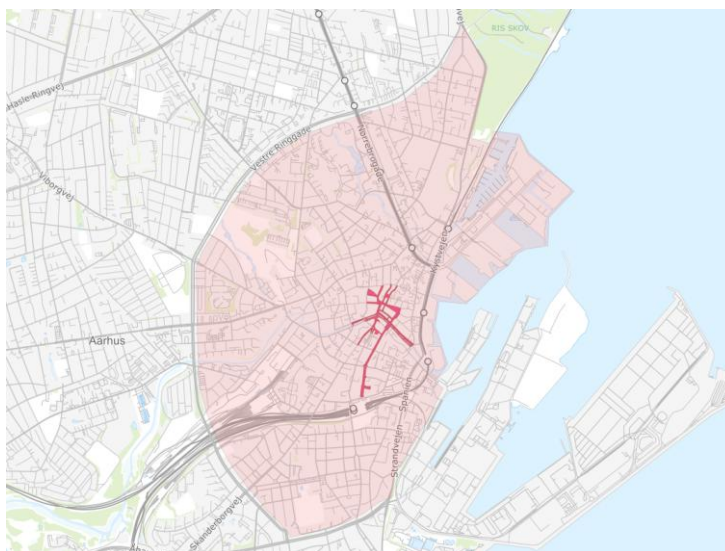


FIGURE 15: WITHIN THE LOW EMISSION ZONE (BRIGHT RED), A PEDESTRIAN ZONE (DARK RED) IS ESTABLISHED, FACILITATING A NETWORK OF CAR-FREE WALKABLE SHOPPING STREETS.

Timespan for logistics

To mitigate some of the challenges with imposing car restrictions on the city centre by creating a pedestrian zone, The Municipality of Aarhus has established a timespan from 04-11 where trucks and delivery vans are allowed to drive and deliver goods in the pedestrian zone. Regulation is technically facilitated by the police, however primarily by using strategically placed retractable bollards. Outside the restricted timespan, the designated offloading sites (outside pedestrian area), cargo bike or walkable delivery is permitted.

Designated offloading sites

Furthermore, off-loading sites have been established throughout the inner-city centre with designated parking spots for trucks. The designated spots are often multipurpose-use, with off-loading from 04-13 for trucks and then being reserved for taxis or for ordinary parking (payment) for the rest of the day. The off-loading sites are strategically placed in the urban centre in near the pedestrian area.

Weight limitations

In the pedestrian area a weight limitation is being enforced. Trucks/vans over 7,5 Tonnes are not permitted to park or stop outside truck offloading zones (if zero emission 9 tonnes). That means that if you operate a truck in the pedestrian area, you should comply with both the timespan restrictions with deliveries from 04-11 and the weight limitations, meaning that you can only park on truck offloading sites.

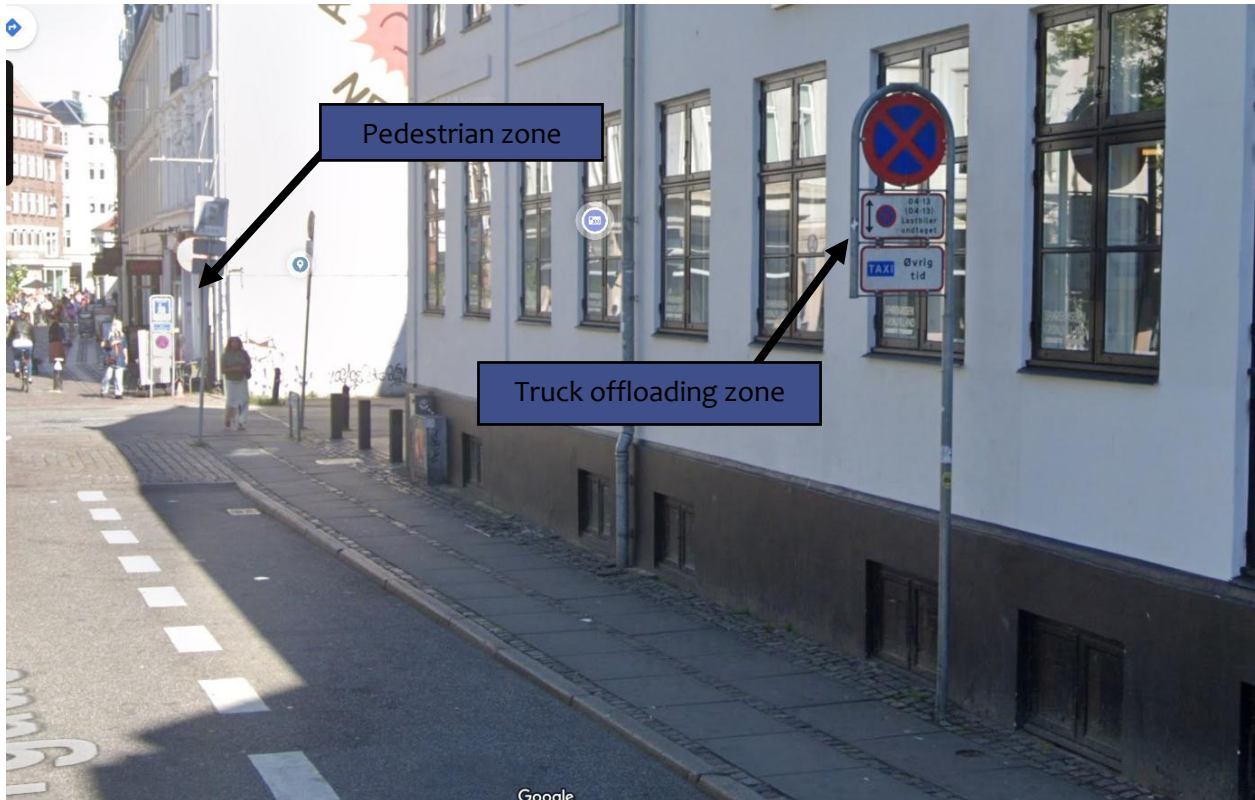


FIGURE 16: EXAMPLE OF A DESIGNATED OFFLOADING SITE FOR TRUCKS IN PROXIMITY TO THE PEDESTRIAN AREA IN AARHUS.

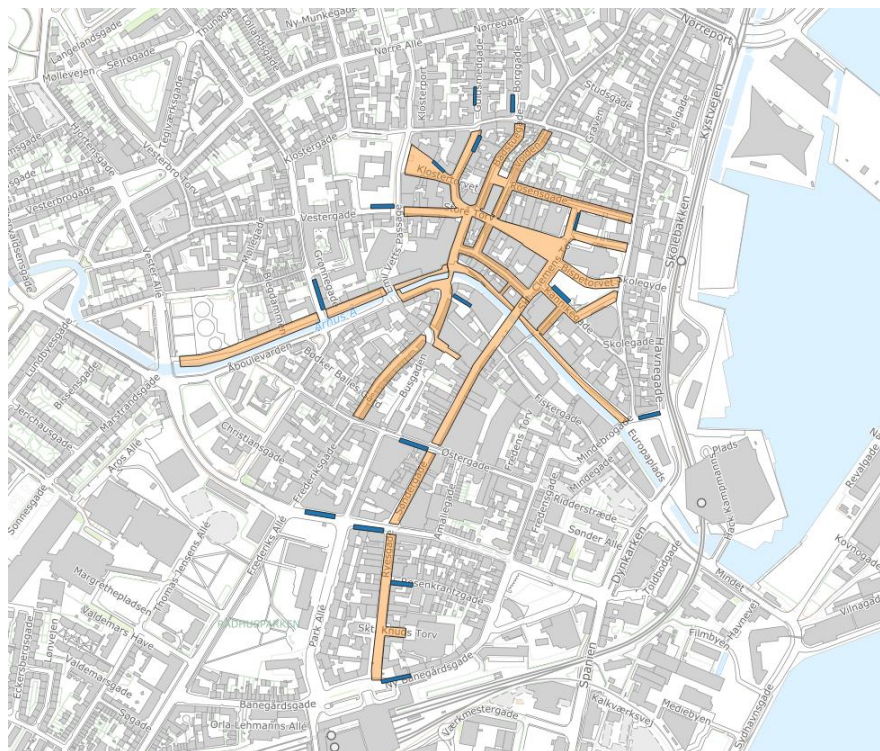
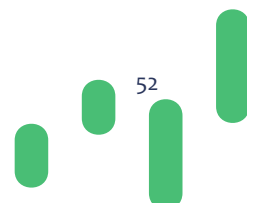


FIGURE 17: DESIGNATED OFFLOADING SITES (IN BLUE) IN CONNECTION WITH THE PEDESTRIAN STREETS IN AARHUS (YELLOW).



4.2 Replicability and lessons learned from URBANE’s Living Labs

The vision for the URBANE project for Aarhus is to set up a microhub in the city centre facilitated by sustainable modes of transport like cargo bikes. The microhub will function as one of the pilot projects feeding into the SULP and is expected to take place over the scope of 1-2 years starting from 2026.

The microhub will, for now, focus on parcels which will be delivered outside peak hours into containers at the hub. A day crew will then deliver the parcels by sustainable modes of transport e.g. cargobikes to the city centre. The goal is to show logistics operators that cargobikes are a viable option for delivering parcels in Aarhus. Our end goal is to get vans and trucks off the streets to mitigate traffic congestion and to emit less CO₂.

The following Living Labs are of interest in an Aarhus context:

TABLE 8 LESSONS LEARNED AND WHAT CAN BE ADAPTED TO THE LOCAL CONTEXT

HELSINKI		
“The biggest constraint turned out to be finding the suitable location for the operations.”	We are looking at both public and private owned locations for a suitable location for the microhub.	We are using other departments within the municipality to find suited locations. They are e.g. working with private development projects already.
“the late selection of the hub location proved to be a challenge for proper planning of the operations.”	The selection of location is the first point in our plan.	
“a neutral party is required to manage hub operations, facilitating collaboration among multiple delivery partners.”	We, Aarhus Municipality, would be the neutral party that managed the hub	We will facilitate the hub location and maybe the infrastructure on site (containers, changing rooms etc.). However the operation will be handled by the different logistical partners in the project.
“From an environmental perspective, it was evident that significant CO ₂ reductions could be achieved, particularly by using renewable energy for charging robots and cargo bikes. Additionally, the shift to ADVs and cargo bikes reduced the kilometers driven by combustion engine vans, thus alleviating urban traffic Congestion.”	We will use the cargo bikes to reduce CO ₂ and alleviate urban traffic. ADV's are not allowed in DK at the moment due to legislation.	
BOLOGNA		
“One challenge encountered was attracting participation from transport operators beyond the	We need to focus on good communication to and with the	

initial project partners.”	operators regarding the project to ensure participation.	
----------------------------	--	--

4.3 Innovation/use case – Operational Feasibility (SWOT analysis)

4.3.1 Vision and objectives - description and benefits

The vision for the URBANE project for Aarhus is to set up a central microhub connected/facilitated by sustainable modes of transport like cargo bikes. The microhub should optimally be used in a PI structure, where the hub facilitates deliveries from multiple distributors. The role of The Municipality of Aarhus could be to facilitate a location for the partners in the project.

TABLE 9 SWOT ANALYSIS

Strengths	Weaknesses
<ul style="list-style-type: none"> • The hub will provide precedence for future collaborations • Incentivizing the use of sustainable modes of micromobility • Reduction of delivery vans in the city centre during the day • Reducing delivery times during peak hours 	<ul style="list-style-type: none"> • Collaboration between distributors may pose challenging • An optimal location may be challenging to find. • Getting enough partners to join the project • Potentially higher delivery cost and longer delivery times for consumers
Opportunities	Threats
<ul style="list-style-type: none"> • Potential to be the first city in Denmark that creates this type of hub. • The micro hub could be part of the solution for logistic delivery within a ZEZ in the future. • Cargo bikes could help reach goal of a modal split of 30 % trips made by cyclists in 2030 	<ul style="list-style-type: none"> • The project depends on the collaboration of logistics • Reaching an agreement with e.g. a private actor for location • The structure of the project could face obstacles from within other departments of the • Obtaining funding may be difficult

4.3.2 Identification of opportunities

The population of Aarhus grows each year and therefore the number of cars on the streets increases each year as well. The Municipality of Aarhus, therefore, has a great focus on reducing both number of cars, car trips, congestion and CO2. The pilot project with a micro logistic hub could potentially open the eyes of logistical operators to the benefits of utilizing micromobility instead of vans when delivering parcels. The hub therefore can be used as a **proof of concept** and can hopefully inspire the operators to use bikes and share locations in the city.

A Zero Emission Zone is on the table in the SUMP developed for The Municipality of Aarhus. The microhub fits well into the structure of a ZEZ, since bikes easily can deliver parcels without the concern for zero emission.



4.3.3 Identification of threats

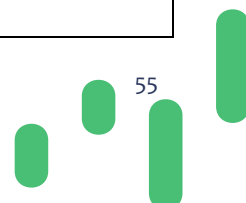
The structure and viability of the project rely on the **cooperation** between the Municipality and the different logistic partners in the project. If project terms cannot be agreed upon, then the hub may pose challenging to implement.

The pilot project needs funding to function and is structured as **cooperatively funded** by the municipality and the enlisted logistical partners. Therefore, if the cost is too great, identifying partners could be a challenge. It is therefore necessary to keep costs down.

4.3.4 Risk Mitigation

TABLE 10 RISKS AND MITIGATION MEASURES PER CATEGORY

	Risk	Mitigation
Hub Location	<ul style="list-style-type: none"> Reduced safety Load on road (heavy transport, capacity) Noise Not being able to make a partnership with location company Internal collaboration within Municipality 	<ul style="list-style-type: none"> Site analysis, interviews with users Estimation of expected impact of ground/road Identify legal restrictions on noise and ask for dispensation if needed, preventive measures. Clear structure and information on opportunities of hub, identify alternative location
Costs	<ul style="list-style-type: none"> High cost - exceeding expectations Distribution of financial responsibility can be challenging 	<ul style="list-style-type: none"> Backcasting of what needs to be done Create cost sheet (expected costs) Define scope of the pilot Collaborate on identifying distribution of responsibilities
Legal restrictions & regulations	<ul style="list-style-type: none"> Obstacles in implementation of pilot Not being able to implement pilot Not being able to get dispensation Time consuming to get dispensation 	<ul style="list-style-type: none"> Identifying potential risks and restrictions of pilot Delivering a clear and specific analysis of pilot – well executed opportunities and reason (less traffic congestion in city center, modal shift) Work progressively and not reactive, finding potential risks before they occur – close collaboration with Danish Road Directorate
Collaboration with logistics operators	<ul style="list-style-type: none"> Potential conflicts among logistic operators (competition) Not being able to find logistic operators wanting to join 	<ul style="list-style-type: none"> Market research Branding of pilot Elaborative agreement contract



<p>Innovation - testing period</p>	<ul style="list-style-type: none"> • Lack of data gathering methods or functionality • Public/political resistance • Heavy transport and cargo bikes contributing to a less safe environment 	<ul style="list-style-type: none"> • Look into opportunity of digital twin, questionnaires, site observation, open forum for inclusion of stakeholders, opportunity for sensors in boxes (counting packages, and timespan for delivery to hub and pick up) • Internal collaboration with department of communication • Assessment of safety (turns, visibility needs), potential impacts of cargo bike use
------------------------------------	---	---

4.3.5 Action Plan Brainstorm

To establish a well-structured pilot in the city of Aarhus the right infrastructure needs to be in place in order to facilitate cooperation between the partners in the project.

4.3.6 Required digital and physical infrastructure

To establish the parcel hub pilot, a secure area needs to be obtained. A secure, insulated fenced-in area with a roof, with access to charging facilities for cargo bikes needs to be in place. The facility needs to be accessible for truck drop off with lighting for safe delivery at night. The facility needs a secure locking mechanism accessible by optimally a passcode or multiple keys for the operators, as well as a security system against intruders.

The facility needs to be night delivery friendly with low noise levels and equipment built for low noise, so a PIEK certificate for operators could be optimal.

4.3.7 Integration with the existing system

The facility should be planned in a way that is easily accessible by trucks at night. Therefore close proximity to the major road grid is essential. The hub will take over the daily deliveries in the city centre, so every parcel delivered will be by cargo bike or similar. The operators, at this stage of the pilot, are working independently, which means that they will have to fit the facility into their individual logistics system. However they will be able to have their own buffer depot at the facility, which should make the transition smooth.

4.3.8 Regulatory and legal frameworks: required permits, compliance, GDPR, etc.

Per Danish regulation the Municipality cannot give special treatment to one single operator. Therefore, we need to make sure that the hub is open to everyone. The plan is to make participation open for all interested parties. Every party need a container as a buffer depot, so depending on interest in the pilot, a maximum of 6 parties can be permitted. Other than that only a contract for the land use is needed.

Some different cargo bike types are not permitted on the streets in Denmark. Permissions depend on different criteria such as weight, size, motor type, speed etc. Therefore a deepdive into Danish regulation is needed in order to identify legal bikes. If the bikes requested in the pilot is not legal, The Municipality of Aarhus will have some degree of leeway to give out dispensations, however it is most likely that the



project need to connect with the Danish Road Directorate to mitigate legal challenges and to apply for pilot dispensations. Therefore a close collaboration with the Danish Road Directorate is essential for the hub to be successful.

4.3.9 Financial Feasibility Estimations: Budget, Costs, Revenue, and Funding Opportunities.

Costs:

- Mobility hub design: 9 containers rental 120.000 kr/16.000 EUR
- Mobility hub location rental: 6 parking spaces 1 year 144.000 kr/19.200 EUR
- Operational cost (power, water etc) 2.000 kr/266 EUR
- Manhours approx. 300 hours over 1 year

No revenue is expected at this time. Potentially a revenue stream could be imposed in the future.

Expenses, such as bikes and employees are expected to be held by the logistic companies with no direct funding is available at the moment.

The total cost for 1 year of operation of a logistics hub in the city centre is estimated to cost approximately up to 35.000 EUR not including the cost of bike purchase or man hours for either the municipality or operators.

At the moment no funding opportunity is available other than the operational budget for mobility measures within the municipality. However the budget calculates with some pilot projects in relation to the development of the Sulp. Therefore the cost could potentially be covered by this.

4.3.10 Timeline and Milestones

1. Locate pilot area (September 2025)
2. Legal cooperation setup with Danish Road Directorate (January 2026)
3. Collaboration framework and contracts (February 2026)
4. Hub launch (June 2026)
5. Hub optimisation (June 2026)
6. Final Evaluation (Fall 2026/Spring 2027)

4.3.11 Evaluation and Impact Assessment

To assess how the hub functions, continuous feedback from the operators is needed to find quick solutions to day-to-day challenges. An in-depth evaluation is structured as well, as a mid-way evaluation and a final summary after end of pilot. The midway analysis aims to find greater challenges in for example structure, economy, operation or dispensations and to streamline efforts forward in the pilot period. The end-of-pilot analysis will act as a proof of concept and is the basis for future collaboration between either the operators or with the municipality.

Some of the methods to the evaluation could be:

Quantitative data

- Trips (duration, distance, time)

- Number of parcels (also oversize parcels)
- Number of cars on streets
- Congestion data for central Aarhus

Qualitative data

- Interviews with employees/drivers
- Interview with operators
- Interview with consumers

4.4 Stakeholders and Governance

Potential future development of the logistics hub includes food and tools. Aarhus Municipality are working on a micro hub for food delivery, with inspiration from Copenhagen (Økoskabet). Like a parcel hub but with cooling boxes ensuring quality standards of food deliveries.

Additionally, Aarhus Municipality is looking into a craftsman tool hub. The idea is to make the trip by car unnecessary by creating central access to shared tools, or to bring needed tools to the construction site. For successfully implementing these initiatives, interested stakeholders need to be identified and a responsibility of progress is needed to be established. The process of implementation of a micro hub begins in finding spaces and creating a good collaborative framework for future expansion of the logistics hub.

Stakeholders				
<i>Internal</i>	The Municipality of Aarhus <ul style="list-style-type: none"> • Department of Mobility • Department of Parking • Department of Communication 			
	<table border="0"> <tr> <td>Logistic operators</td> <td>Consumers</td> </tr> <tr> <td> <ul style="list-style-type: none"> • Packages • Craftsmen </td> <td>Neighborhood association</td> </tr> </table>	Logistic operators	Consumers	<ul style="list-style-type: none"> • Packages • Craftsmen
Logistic operators	Consumers			
<ul style="list-style-type: none"> • Packages • Craftsmen 	Neighborhood association			
<i>External</i>	Local citizens living near the micro hub	Sector associations		
	Trade associations	Development company of "Pier 3"		
	Port of Aarhus	Alternative private landowners (in relation to future expansion of hubs)		
	Local shops, restaurants and cafes	Research Universities		

FIGURE 18: LIST OF STAKEHOLDERS

4.4.1 Governance structure

To successfully implement a micro hub, the aim is to ensure collaborative stakeholder engagement and create a holistic view of potential risks. The vision of less traffic congestion in the city guides the project,



and possible risks need to be known which will be done through incorporation of influential stakeholders and data gathering methods.

Both internal units (e.g., Mobility and Communication) and external groups (logistics companies, neighbourhood associations) must be involved. A shared forum will support knowledge exchange and help identifying key topics for the implementation of the micro hub.

Rental

The landowner of the hub location can oppose the implementation of the project or part of it, if they believe it can have a negative impact on the rental location. Therefore, it is essential to develop a clear scope, structure and an implementation plan for the hub.

It is seen in Danish context to be a good strategy to create temporary pilots within e.g. infrastructure before the development of an area starts. Although there has not been a similar test in a Danish context, the idea is that the hub pilot will act as a proof of concept.

Noise

The located case area is a mixed residential and commercial area, meaning maximum noise must not exceed 40 dB in the timespan 22-07. Although the area is going through an urban transformation, meaning that noise levels is expected already to be up to 70dB.

In regard to noise from the road there must not be an exceed of 58dB. The road leading to the location already have noise exceeding this, mapped as between 65-69dB. Additionally, access to the area is through a main road with noise between 70-74dB.

Taking this into account it is essential to get dispensation for implementation from the Danish Environmental protection Agency and have a good continuous collaboration throughout the process.

Parking on Sidewalk

It is illegal per Danish law to park on sidewalks and biking lanes. To stop and park must not be endangering to pedestrian traffic. If needed to park on sidewalk/bike lane, a dispensation is needed from Ministry of Transport. To park in the case area away from the road should be looked into, and a close collaboration with the Ministry for Transport and the Danish Road Directorate is needed in order to mitigate challenges regarding legislation and proactively apply for dispensations.

The use of cargo bikes

For a cargo bike with overrun brakes the bike can carry a weight of maximum 100kg. Therefore there could potentially be issues with the maximum capacity of the bikes from the operating side. A close collaboration with the Ministry for Transport is needed to find solutions for these potential challenges.

Safety

Heavy transport can reduce safety in the area. At the moment the area is characterised by temporary playgrounds, sports facilities and an area for educating children within riding a bike. This needs to be considered before implementation, however many of the activities takes place during the day and not in the night. Therefore the arrival of heavy transportation at night may not be a challenge. However a close collaboration with neighbourhood councils (residents) is important to establish.



4.5 Conclusion and recommendations towards public authorities

A micro hub for logistics both within last mile delivery of parcels and parcel lockers, but potentially also groceries and construction tools is very desirable in Aarhus. The hub would alleviate traffic from the streets as well as making the logistics sector more sustainable. Furthermore, logistic operators might gain new insights in the role of the cargo bike within a last mile logistics system in the city centre. The hub insights could potentially have a major impact on the SULP in progress for the logistics system in Aarhus in the future.

The replication of parcel lockers combined with a micro consolidation centre for micro mobility is feasible since the scope of such a pilot falls within the scope of the SUMP in place in Aarhus. The hub will be very visible in the cityscape and in combination with the brand as sustainable, there may political backing behind the project.

The next steps of the implementation of micro hub will be listed below:

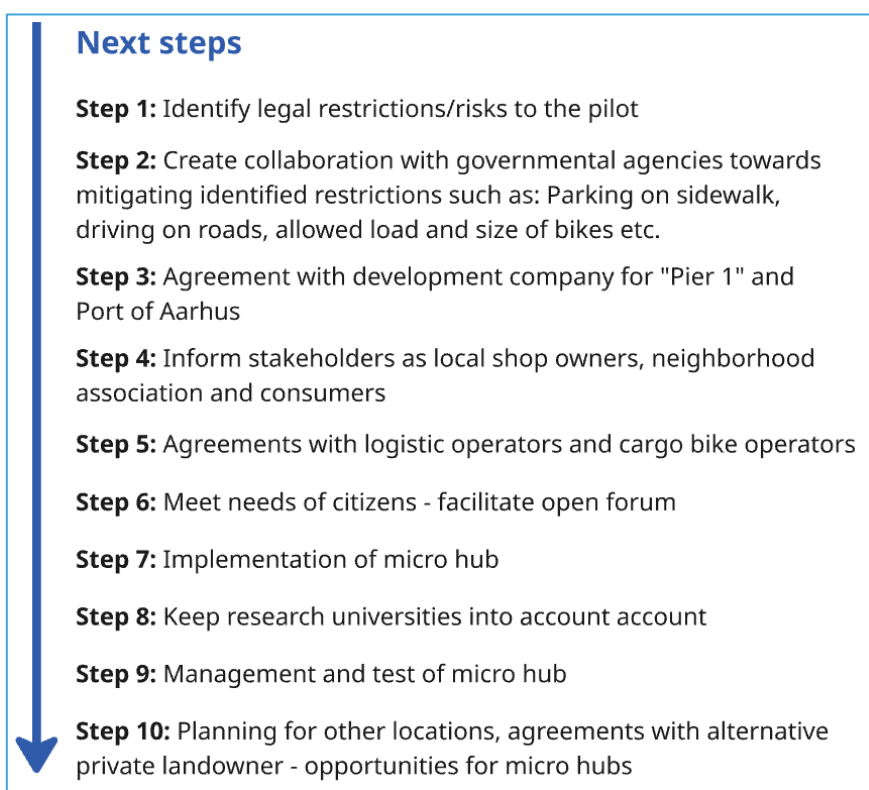


FIGURE 19: NEXT STEPS OF THE IMPLEMENTATION OF THE MICROHUB

The institutional barriers are restrictions by law, lack of tests in the field and making agreements among private stakeholders. Furthermore, dispensations in relation to e.g. size, carry weight, speed and parking are some of the most likely speedbumps on the road to a functional hub from a legal standpoint. Therefore, it is recommended to start up discussions with national agencies in regard to changing legislation or finding dispensations for these challenges.

The hub itself will potentially also face challenges regarding e.g. cooperation between operators, landowner and The Municipality. Therefore, it is recommended to begin the co-creation process, and early on creating a stakeholder group driving the creation of the hub forward together.



5 Feasibility study in La Rochelle

5.1 Background of urban logistics in La Rochelle

5.1.1 Local plans and linked key initiatives - city's logistics vision

La Rochelle has long been one of the principal maritime cities on the French Atlantic coast, situated between Nantes and Bordeaux its port entrance was protected historically. The city of La Rochelle has a population of around 78 535 which is now the principal urban concentration at the core of a political and administrative entity created in 1992 and extended in 2014 to include an additional 10 municipalities - the La Rochelle Urban Community (Communauté d'Agglomération de La Rochelle). Today this grouping of 28 municipalities covers a territorial area of 327km² with an Atlantic coastline of some 70km, gathering 178 217 inhabitants in 2024 and 27 922 enterprises.

As part of its "Zero Carbon Territory" initiative, the Communauté d'Agglomération de La Rochelle and its partners have set themselves ambitious targets for reducing carbon emissions by 2030.

With more than €80 million allocated to decarbonising the region's activities, including more than €5 million between 2020 and 2027 for mobility, this 'Zero Carbon Territory' project led by the La Rochelle Urban Community brings together and involves more than 110 partners from the institutional, academic and civil society sectors, as well as businesses. The main financier of the project is the Banque des Territoires, which belongs to the Caisse des Dépôts et Consignations.

In terms of mobility, the region has committed to rolling out a new mobility application called Mobility-as-a-Service (MaaS) to promote intermodality and public transport. The project also supports behaviour change initiatives among vulnerable groups and businesses, and highlights events that promote cycling culture in the region.

Travel accounts for 27% of the region's greenhouse gas emissions, with goods transport accounting for a third of total travel-related greenhouse gas emissions.

This means that 19,000 movements of goods are generated every day, or 8,300 vehicles carrying out daily delivery operations throughout the region. As a coastal region, the La Rochelle Conurbation is at the "end of the chain" for logistics players. A number of professionals are based in Niort and Rochefort. The analysis highlighted the strong logistical pressure on La Rochelle, and particularly its city centre. La Rochelle accounts for 12% of the weekly movements of goods in the intercommunal area, and the city centre alone accounts for 25% of the goods movements in the municipality. The town centre also stands out for its town centre regulations, which aim to create a calmer zone and encourage soft mobility, and for its special urban planning, with a protected area that is restricted in terms of road width in particular. This strategy is entitled 'Delivering in city centres: making way for sustainable solutions'.

5.1.2 Existing projects and trends

In 2019, the city of La Rochelle adopted a strategy « Delivering in city centres: making way for sustainable solutions ». aimed at limiting access to the city centre for large delivery vehicles in order to limit noise pollution, air quality and greenhouse gas emissions, as well as protecting the city's heritage buildings and calming down the city centre. Cycling companies have also set up to provide last-mile deliveries for retailers and restaurateurs, particularly when delivery slots no longer allow motorised vehicles access to the town centre.



Early-morning delivery times have been set in order to limit road congestion during the day. Retractable bollards have been installed on the outskirts of the town centre to control access for residents and professionals (food markets, shops, etc.). The leaflet below summarises the main findings

After carrying out a diagnostic study of urban logistics in 2017-2018 as part of a previous European Urbact Freight Tails project, and establishing a delivery strategy for its historic city centre, the La Rochelle Conurbation Authority wanted to take its work in this area further. As a reminder, the Urbact Freight Tails programme enabled a community local logistics players to be brought together, and this multi-stakeholder consultation forum has continued to the present day.

Especially on the issues of microhubs, lockers and deliveries by autonomous vehicles. These three themes are the focus of the work of our elected representatives responsible for transport and roads in the La Rochelle conurbation and the city of La Rochelle.

In 2025, the conurbation is committing to the InTerLud programme+ in order to continue and finalise its action plan and implement these actions, benefiting from the expertise of CEREMA and Logistic Low Carbon. This programme provides local authorities with a framework for developing a shared and concerted action plan for greener and more energy-efficient urban logistics. On the basis of the diagnosis carried out in 2017-2018, consultation workshops have been organised in 2022 and 2023 with local stakeholders in order to consolidate the input data and to objectivise and understand the way in which logistics and its stakeholders are organised in the conurbation.

Lastly, 2024 and 2025, the La Rochelle conurbation will be supporting an autonomous urban logistics experiment run by La Poste and Milla, with the aim of demonstrating the feasibility of autonomous delivery by light commercial vehicle on roads open to the public.

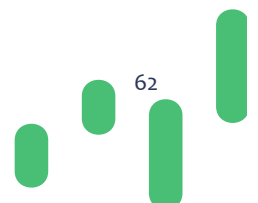
The city of La Rochelle is supporting an initiative led by La Poste by authorising the use of an autonomous delivery shuttle on its roads between the company's warehouses and three loading and unloading hubs in the city of La Rochelle. These loading and unloading hubs are three public parking spaces where the company's delivery staff, who travel by bicycle, can pick up parcels. This saves them a considerable amount of time, as they do not have to return to the warehouse to restock, which is more than 5 kilometres away from their delivery area.

5.2 Replicability and lessons learned from URBANE's Living Labs

5.2.1 Lessons learned and what can be adapted to local context (adopting options)

Today, urban logistics is at the heart of urban development and sustainability issues. Against a backdrop of growth in e-commerce, environmental pressures and saturated city centres, Europe's metropolises are having to reinvent their urban distribution models.

Through exchanges with the cities of Helsinki (Finland) and Bologna (Italy), a number of lessons were learnt relating to the optimisation of last-mile logistics, the energy transition, the use of digital tools, and the replicability of solutions in the French context.



The Helsinki experience: a focus on microhubs and automated delivery

TABLE 11 FOCUS ON LESSONS LEARNT, MEASURES TAKEN AND UNSOLVED ISSUES INSPIRED BY THE HELSINKI LL

Theme	Lessons learnt	Measures taken / recommendations	Unsolved issues
Logistics microhubs	Essential infrastructure for sharing between operators and coordination between ADV and cargo bikes.	Creation of a shared microhub; strong commitment from the city required to provide land.	How can sustainable land accessibility be guaranteed in dense city centres?
Autonomous vehicles (ADV)	Proven operational feasibility in dense and harsh urban conditions (snow, ice).	Testing in successive phases with gradual integration of ADV.	What is the long-term reliability in extreme weather conditions? Fog is a limiting factor, as is very high heat for cameras and lidars, which can prevent shuttle traffic.
Critical parcel volume	Essential for achieving economic viability of the model (economies of scale).	Flow planning, pooling between operators to increase the volume processed.	How can this critical threshold be reached in medium-sized cities (150,000 inhabitants)?
Social acceptability	The perception of autonomous vehicles by residents is influenced by communication and awareness.	Implementation of information and communication campaigns to increase acceptability..	Which communication strategy is most effective according to sociological profiles? Should it be specified on the vehicle that it is a driverless vehicle in order to limit dangerous behaviour by motorists?
Regulations and authorisations	ADV authorisation requires a flexible but rigorous legal framework and close dialogue with the authorities.	Close collaboration with the city's legal, technical and political departments.	How can local, national and European regulations be harmonised to speed up projects?
Project governance	Proactive multi-stakeholder governance is essential from the earliest stages.	Strong involvement of stakeholders (city, logistics providers, citizens).	Which governance model guarantees the best operational efficiency?
Mapping / Digital twin	A digital twin is necessary to accurately guide ADV.	Investments in digital modelling of urban space.	What cost and degree of accuracy are necessary for an optimal digital twin?



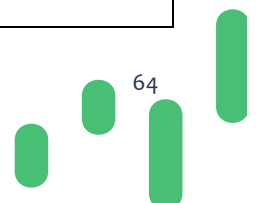
Economic model	Economic efficiency is based on pooling and optimising delivery routes.	Collaborative approach between different logistics operators around a microhub.	Who bears the initial investment and how are the profits distributed among the operators? It is difficult to get competitors to cooperate. What solutions are there to mitigate this risk?
Climate resilience	Helsinki's harsh climate tests the technical robustness of solutions (snow, ice, cold).	Equipment adaptation (ADV adapted to winter conditions).	Are the technologies ready for widespread use in other extreme climates?

The Helsinki trials examined the integration of autonomous delivery vehicles with cargo bikes and shared logistics microhubs in a dense, weather-challenged urban environment. Conducted in three iterative phases, the project assessed operational feasibility and a shared logistics model. Key success factors included the central role of urban microhubs, sufficient parcel volumes for economic viability, strong municipal involvement, public acceptance through effective communication, and supportive regulatory frameworks. Despite technological immaturity, the trials highlighted the importance of digital city mapping and agile regulation, offering valuable lessons for future implementations.

Learning from Bologna: towards an operational mapping of parcel collection

TABLE 12 FOCUS ON LESSONS LEARNT, MEASURES TAKEN AND UNSOLVED ISSUES INSPIRED BY THE BOLOGNA LL

Theme	Lessons learnt	Measures taken / recommendations	Unresolved issues
Nearby Delivery Area (NDA)	The NDA is a proximity delivery hub designed to relieve congestion in the Limited Traffic Zone (ZTL) and reduce environmental impact.	Implementation of lockers and transfer to electric vehicles for last-mile delivery.	Can this model be replicated in cities with a less dense urban fabric?
Cooperation between Operators	Inter-company cooperation, even among competitors, is possible within a neutral and well-governed framework.	Defined shared governance, digital tools for managing use, stakeholder consultation from the start.	Who should take long-term responsibility for neutral governance?
Collaborative Digital Tools	Digital tools are essential for coordinating locker use	Deployment of shared platforms for planning,	How can we ensure interoperability of these tools between cities and operators?



	and preventing conflicts.	monitoring, and resource sharing.	
Reduction of Urban Nuisances	Switching to soft mobility reduces noise, emissions, and congestion in city centers.	Exclusive use of electric vehicles for last-mile delivery.	What is the best method to accurately measure environmental and social impacts?
Economic Model of Lockers	The model currently relies on public support: financial independence remains uncertain without subsidies.	Cost/benefit study including investment, maintenance costs, and logistical savings.	What viable economic model can sustain locker deployment without subsidies?
Hybrid Collection Solutions	Combining lockers and in-store pickup points expands the urban delivery offer.	Detailed mapping of existing collection points and extension to hybrid solutions.	How can the database remain up to date in a constantly changing commercial context?
Energy Autonomy	Integrating solar panels reduces energy dependency and allows for installations in underserved areas.	Inclusion of photovoltaic panels in locker projects to ensure energy self-sufficiency.	What is the return on investment for solar lockers in areas with low delivery volumes?
Territorial Knowledge	A thorough understanding of the local economic fabric is essential to properly size the logistics offer.	Mapping of businesses, shops, and delivery flows to tailor the NDA system.	How often should the mapping be updated to ensure continued relevance?
Integrated Strategic Framework	Embedding the NDA within strategic plans (SUMP and Sulp) ensures consistency with sustainable mobility policies.	Integration of the project into urban planning documents to guarantee its sustainability.	How can alignment be ensured between logistics, mobility, and urban planning strategies in other cities?

The Bologna experiment implements a Nearby Delivery Area (NDA) to improve urban logistics in the city centre by using lockers as microhubs and zero-emission vehicles for last-mile delivery. Integrated into local mobility plans, the scheme reduces pollution, noise and congestion while improving efficiency. A key innovation is cooperation between competing logistics operators within a neutral framework. The project combines physical and digital solutions, performance monitoring and territorial analysis. Results show environmental benefits and feasible collaboration, though economic sustainability remains a challenge. Overall, Bologna highlights the value of modular, locally adapted and digitally supported urban logistics systems.



5.3 Innovation/use case – Operational Feasibility (SWOT analysis)

At a time when the ecological transition is at the heart of local and national concerns, the issue of decarbonising urban logistics is emerging as a crucial challenge for towns and cities. Freight transport accounts for a significant proportion of CO² emissions in La Rochelle, 10% of total emissions in 2017. However, solutions do exist to reduce this impact, and the deployment of lockers and microhubs can help to decarbonise parcel delivery.

Lockers have already been deployed in La Rochelle by private operators on private land. In recent years, the delivery operators deploying lockers (Mondial Relay, Amazon, La Poste, etc.) have set up lockers in strategic locations in the town centre, at shopkeepers' premises and in supermarket car parks.

The Mobility department of the La Rochelle conurbation, in line with the vision of the local councillors in charge of transport and roads, is considering opening up the public domain to private companies in order to deploy new lockers in strategic locations: mobility hubs near the railway station, bus stops or significant tourist and cultural sites.

In terms of the business model, the public authorities do not bear the financial costs of installing, operating and maintaining lockers and microhubs. These costs are borne by the private companies deploying these solutions.

The public authorities issue a call for expressions of interest, to which private companies respond by proposing a number of lockers, locations and remuneration to the conurbation for occupying the public domain.

In exchange, the companies operate the lockers and microhubs according to their own rules. Each year, the companies must pay a financial contribution to the city of La Rochelle for occupying the public domain. This contribution is proportional to the number of square metres occupied by the lockers and microhubs.

In the town of La Rochelle, we have carried out a census of all the delivery points in shops and lockers. Some delivery points are single-brand (the logos of the brands appear clearly on the map), while other delivery points are multi-brand and are represented by a generic logo (parcels).



FIGURE 20: MAP SHOWING ALL DELIVERY POINTS IN SHOPS AND LOCKERS IN LA ROCHELLE

For example, the screenshot below details the model as ‘Locker, 24/7, Carrefour’. This is a locker, accessible 24/7 on the website of a Carrefour supermarket.

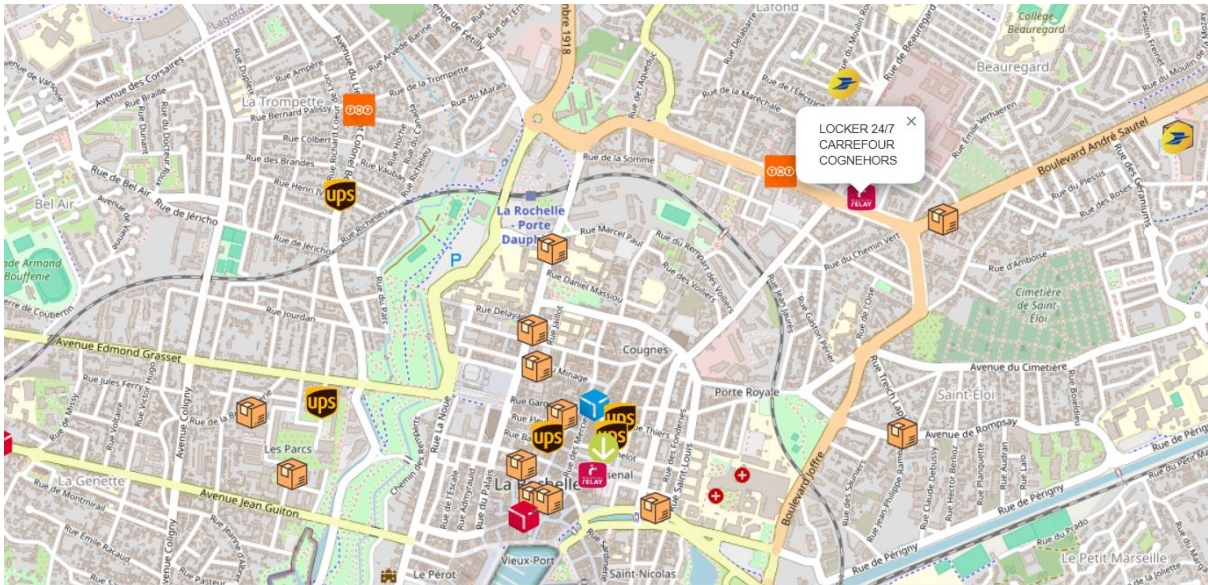


FIGURE 21: EXAMPLE OF A CARREFOUR LOCKER LOCATED IN LA ROCHELLE (SOURCE: CITY OF LA ROCHELLE)

Taking into account the vision and the business model, we present below the main elements of the SWOT analysis.

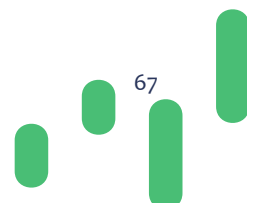
TABLE 13 SWOT ANALYSIS

Strengths	Weaknesses
<ul style="list-style-type: none"> • Accessibility and proximity • Reduction in logistics costs • Attractiveness for retailers • Compliance with urban regulations 	<ul style="list-style-type: none"> • Heritage-related constraints • Administrative complexity for public space use • High initial investment & maintenance costs • Technological obsolescence • Anti-terrorism constraints
Opportunities	Threats
<ul style="list-style-type: none"> • Continuous growth of e-commerce • Synergies with cultural tourism and shopping activity • Carbon emissions: theoretically better delivery grouping rate • Potential for collecting an additional fee for the City of La Rochelle 	<ul style="list-style-type: none"> • Competition or opposition from operators • Security issues and vandalism • Regulatory and heritage-related developments • Local acceptability

5.3.1 Strengths and Weaknesses – current status

Strengths

→ Installation near transport hubs (train stations, shops, bus stops, universities, shopping centres) allows 24/7 access.



The location of lockers near transport hubs is a major strategic advantage. This allows users to easily pick up or drop off their parcels as part of their daily commute (commuting to work, school, shopping, etc.). This permanent availability enhances the attractiveness of the service by meeting consumers' expectations for flexibility, while reducing the need for home deliveries and reducing the carbon footprint.

→ **Pooling delivery routes: reducing empty deliveries and labour costs.**

Concentrating parcels at fixed points allows operators to streamline their delivery routes. By grouping several deliveries in one place, the number of unnecessary or partial journeys is reduced, which lowers logistics costs and the carbon footprint. However, this efficiency depends on the volume handled: with the increase in flows linked to the explosion of e-commerce (particularly via Shein and Temu), logistical gains must be measured against the backdrop of heavy demand on infrastructure.

→ **Offer a complementary service to local shops' parcel collection points, with the option of providing self-service collection points known as 'lockers'.**

Delivery companies can take advantage of lockers to offer their customers pick-up outside of store opening hours. For this to work, the interface between the retailer's system and the locker system must be simple, intuitive and reliable for all users.

→ **By positioning the lockers on the outskirts of the heritage area, the constraints imposed by the ABF are reduced.**

Compliance with heritage rules is easier when lockers are located outside the protected perimeter. This strategy avoids complex authorisation procedures with the ABF, while maintaining a certain proximity to the city centre. This preserves the aesthetics of the historic urban setting while offering a modern and functional service.

Weaknesses

→ **Any installation in or near a protected area requires a visual impact study and an opinion from the ABF.**

The integration of modern facilities into historic urban areas is strictly regulated in France, particularly in historic cities. The city centre of La Rochelle is a protected area, meaning that it is protected because it has a strong historical and heritage character that justifies its conservation and enhancement. The protected area of La Rochelle was created in 1970 on 75 hectares and extended in 2008 to 180 hectares. As a result, even the slightest alteration to the listed urban landscape can lead to administrative refusals or delays. Before new public facilities can be deployed within this area, discussions and approvals from the Architecte des Bâtiments de France (ABF) are essential.

New installations (including lockers and microhubs) must comply with strict criteria in terms of design, size, colour and materials, which can slow down the rapid deployment of lockers. Technical discussions with the local Architecte des Bâtiments de France unit have encouraged us to plan the deployment of lockers and microhubs outside the protected area.



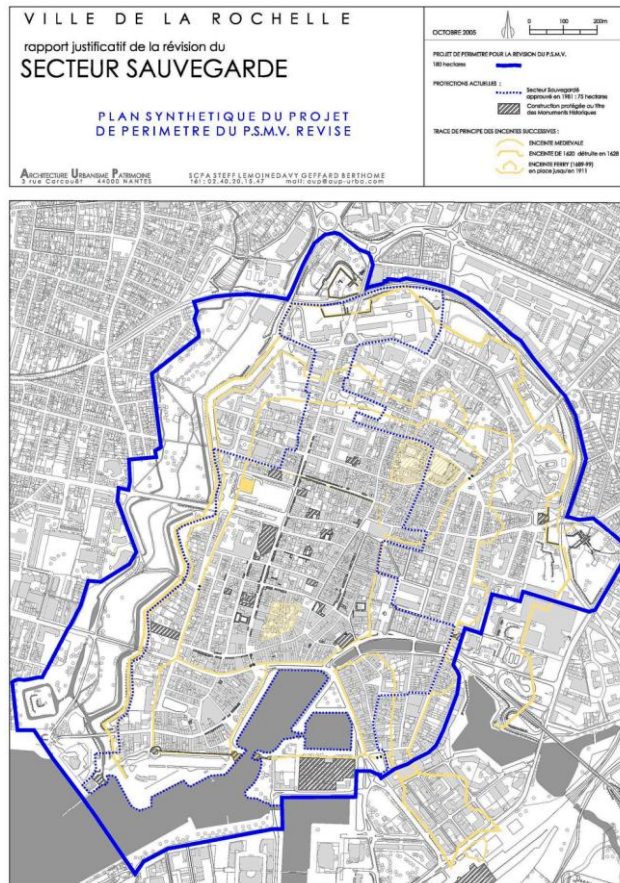


FIGURE 22: MAP REPRESENTING THE SIZE OF THE PROTECTED AREA IN THE CITY CENTRE (SOURCE: CITY OF LA ROCHELLE)

→ **Need to obtain a public domain occupancy permit (AODP) from the town hall, which involves a fee.**

Installation on public land requires administrative authorisation, which can often take a long time to obtain. It must take into account technical criteria such as accessibility for people with reduced mobility, non-obstruction of pedestrian walkways, and compliance with dimensional standards. The local authority may also impose a fee for occupying public land, increasing operating costs for the operator. This fee collection solution is provided for in the La Rochelle scheme.

→ **Purchase, installation, electrical connection, security, 24-hour maintenance, possible solar power supply.**

The initial cost of lockers remains high, especially when infrastructure work (connections, foundations, etc.) is taken into account. Added to this are the costs of regular maintenance, insurance, replacement parts, and energy supply (including autonomous solutions such as solar power). These costs can be a deterrent for some delivery companies.

→ **Need for regular updates (mobile applications, software maintenance).**

With technology evolving rapidly, instructions must remain compatible with new digital standards (real-time notifications via apps). This requires regular investment in software and hardware maintenance. This risk is largely borne by the operator.

→ **Obligation to comply with the Vigipirate plan: enhanced security checks, marking of security zones.**

The security of lockers in urban areas is an essential requirement under the Vigipirate plan. Equipment must be approved by the prefecture and comply with public building regulations. Surveillance, lighting and signage systems may be required, which will have an impact on the location and overall cost of the project.

5.3.2 Opportunities and Threats

Opportunities

→ **The increase in online shopping is driving demand for flexible collection solutions.**

Lockers allow consumers to choose when to collect their purchases, without having to depend on shop opening hours or delivery schedules, thereby increasing their satisfaction and loyalty. Locally, the annual growth in parcel deliveries over the period 2017-2023 is 7.8%, which represents a doubling in the volume of parcels delivered in 9 years.

→ **Tourists can leave their luggage there so they can visit the city hands-free.**

The La Rochelle metropolitan area, which welcomes 3 million tourists annually and has a population of 180,000, can promote lockers as a temporary luggage storage solution. This would improve the experience of visitors who arrive early or leave late and are looking for a secure place to store their personal belongings. It may also be of interest to residents of the metropolitan area who come into town via park-and-ride facilities.

→ **Improved delivery consolidation rate: reduction in CO₂ emissions per parcel.**

Centralising deliveries to collection points reduces the number of individual home delivery trips. This improves the carbon footprint of urban logistics. This environmental benefit is a strong selling point for local authorities committed to ecological transition, as is the case with the 'La Rochelle Zero Carbon Territory' project.

→ **Launch of an expression of interest for deployment in public spaces: possibility of charging a fee.**

The City of La Rochelle would like to regulate deployment via a call for expressions of interest (AMI) to select one or more operators, while imposing specifications. This system would enable the city to collect fees in return for the occupation of public space, thereby helping to finance other municipal actions.

Threats

→ **Presence of dominant players (Chronopost, Amazon, Mondial Relay, La Poste (PickUp), etc.) and monopolies.**

The market is highly concentrated around a few major players, including La Poste, which holds half of the parcel delivery market. This can limit the room for manoeuvre for new entrants or local initiatives. These large operators have resources and infrastructure that give them a clear competitive advantage.

→ **Risks of damage and burglary: need for cameras and patrols.**



Freely accessible equipment is exposed to vandalism and theft attempts. It may be necessary to install surveillance cameras or increase security patrols, which also raises GDPR compliance issues. This may affect users' perception of the service's security.

→ **Possible changes to the PLUi (local urban planning plan) or heritage regulations.**

Changes to urban planning or heritage regulations could call into question certain existing developments or block future projects. Local authorities must therefore anticipate these changes and incorporate a legal dimension into their deployment strategy.

→ **Risk of resistance from residents and shopkeepers.**

Installing lockers in old neighbourhoods or shopping areas may provoke opposition: fear of a negative visual impact, concern about inconvenience to passers-by or unfair competition from local businesses. Prior consultation and mediation are essential to ensure the project is accepted.

5.3.3 Analysis of challenges

The main challenges can be grouped into two categories:

a. The choice of locations: a strategic constraint

The siting of lockers and microhub in a city with such a high heritage value as La Rochelle represents a major technical and political challenge. The historic centre is subject to the regulations of the Architectes des Bâtiments de France (ABF), making it difficult, if not impossible, to install any visible structures within the protected area. Even on the outskirts, there are still constraints: accessibility for people with reduced mobility (PRM), distance from pedestrian walkways, respect for street furniture, and availability of public land. The ideal location is often at the interface between urban flows (stations, shopping centres, park-and-ride facilities, bus stops), but these spaces are sometimes saturated or shared with other services.

The success of the system therefore depends on a detailed urban analysis, coupled with a map of parcel flows and user needs, incorporating urban planning tools (PLUi, SUMP/SULP, etc.) and data on the use of interchanges. A coordinated approach with the GIS services of the La Rochelle conurbation is essential.

b. Technical and material constraints: cost, power supply, safety, etc.

In addition to land, lockers require reliable infrastructure: electrical connection or autonomous power supply (via solar panels), secure connection (data, locker opening), ongoing maintenance (software and hardware), surveillance systems (in line with Vigipirate). The hardware must also be resistant to damage, vandalism and the elements.

In addition, evolving requirements (new parcel sizes, new software interfaces, payment systems, interoperability with e-commerce platforms or local shops) mean regular investment by the operator. This need for flexibility and technological sustainability must be anticipated right from the project design phase.

In addition, public/private management means finding a model that is balanced to guarantee public interest and operational efficiency.

a. The role of the local authority: strategist, regulator and facilitator

As part of a call for expressions of interest (AMI), the local authority defines the selection criteria, the authorised location of the facilities, the conditions for occupying the public domain and any fees. It acts



as the guarantor of territorial balance, urban coherence and the social acceptability of the scheme. It must also ensure regulatory compliance (ABF, accessibility, Vigipirate, ERP) and technological neutrality, to avoid situations of monopoly or dependence on a single operator.

However, the local authority has neither the vocation nor the capacity to technically operate this equipment. It will therefore need to be clear about the division of roles, by including monitoring, performance and reversibility clauses in the call for tenders (reversion to the local authority in the event of failure), and by ensuring rigorous contractual monitoring via its departments.

b. Expectations and constraints for private operators

For operators, the profitability of the system depends on a critical volume of parcels, good visibility of lockers, and interoperability with e-commerce platforms. The framework defined by the local authority must therefore be both sufficiently precise to guarantee the public interest (town planning, accessibility, safety), but also sufficiently flexible to allow innovation and economic adaptability.

Operators can also offer additional services (temporary luggage storage, use by local traders, etc.), but this requires a mixed business model (B2C, B2B, local partnership). Success depends very much on a balanced and lasting dialogue between the public sector and the local companies selected, with reciprocal commitments clearly formalised at the selection stage.

5.3.4 Risk mitigation

The main risks are the choice of locations for lockers and microhubs selected by the city, the pricing policy of the private operator, and the technology used for the facilities (lockers and mobile application for users).

a. The choice of locations: a strategic constraint

To mitigate the risks, one of the essential keys is the choice of strategic locations proposed by the city of La Rochelle to the private operator.

A census of all the delivery points has been made within the shops and lockers. Some collection points are monobranded, so the brand logo is highlighted on the cartography. For sites with a parcel logo, this means that they are multi-operator.

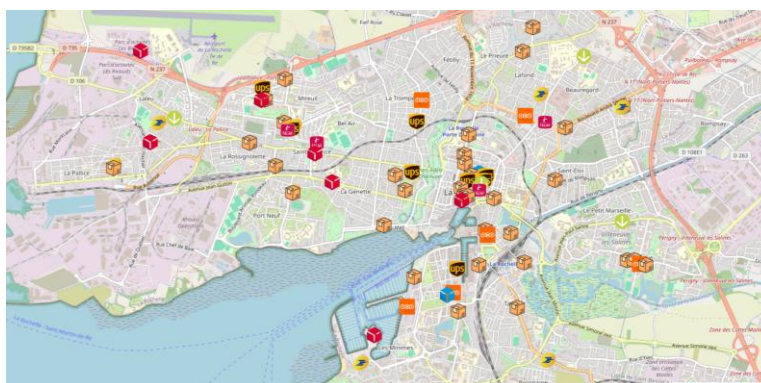


FIGURE 23: LOCATION OF DELIVERY POINTS IN LA ROCHELLE (SOURCE: CITY OF LA ROCHELLE)

It has been decided to prioritise 10 potential locations for lockers/microhubs. Their locations in relation to the public transport system has been considered: the Yélo bus network (coloured) and its stops (in yellow) in the area. Lockers and relay points appear in grey and yellow (square) on the map.





FIGURE 24: LOCATION OF LOCKERS AND RELAY POINTS IN LA ROCHELLE (SOURCE: CITY OF LA ROCHELLE)

The lockers could be located close to key bus stops to make it easier for users to collect their items. Proximity to transport is therefore the number 1 criterion.

The second criterion is proximity to existing relay points and lockers. There are many shops in La Rochelle whose secondary activity is parcel drop-off and collection (existing relay points and lockers are shown in grey on the map). All the shops are shown in blue.

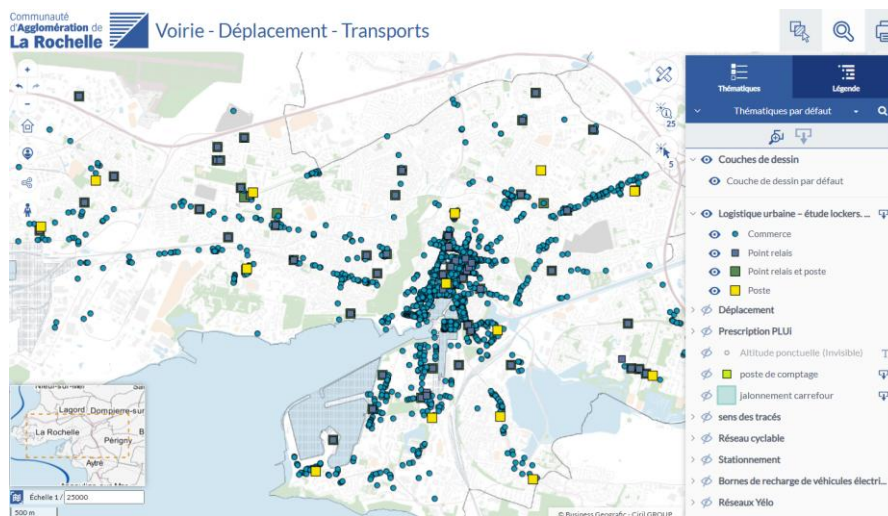


FIGURE 25: LOCATION OF SHOPS WITH PARCEL DROP-OFF AND COLLECTION OPTION IN LA ROCHELLE (SOURCE: CITY OF LA ROCHELLE)

The lockers complement and/or replace the relay points already present in the area. The wide range of hours of access to lockers, 24 hours a day, 7 days a week, is a major advantage of this parcel collection solution. Lockers complement the distribution of parcels by local businesses, which account for a significant proportion of their turnover - around 30% of local businesses.

The third and final criterion is population density. On the basis of another database (INSEE), the city centre of La Rochelle, the major transport routes (high service level bus, road, rail), tourist areas, university areas and establishments open to the public were identified as priorities. University areas should also be taken into consideration, as La Rochelle has 14,000 students, a population that makes

extensive use of digital technology and consumes goods online. The key locations for deploying lockers and microhubs are as follows:

- 1- Mairie de Mireuil (parking)
- 2- Piscine de La Rochelle (parking)
- 3- Port Neuf (bus stop)
- 4- Office de tourisme de La Rochelle (paved forecourt)
- 5- Médiathèque (paved forecourt)
- 6- Gare SNCF La Rochelle (paved forecourt)
- 7- Lycée Valin (forecourt)
- 8- Mairie de Villeneuve les Salines (bus stop “14 juillet”)
- 9- Minimés (45 avenue de Lazaret)
- 10- Maison de la Charente Maritime (bus stop)



FIGURE 26: THE KEY LOCATIONS FOR DEPLOYING LOCKERS AND MICROHUBS, RED DOTS (SOURCE: CITY OF LA ROCHELLE)

B. The operator: master of its pricing policy and business model

The free administration of a pricing policy by a private operator within the framework of a public contract offers numerous advantages, in terms of both economic efficiency and quality of service. By allowing the operator to define and adjust its fares, it can better adapt its offering to market realities, user expectations and economic trends. It also makes it possible to optimise revenue to ensure that the service is economically balanced over the long term, without increasing the cost to the local authority.

The operator is therefore responsible for its pricing policy. The same applies to its business model. If the operator considers that the location proposed by the city of La Rochelle is not sufficiently attractive, it is free to propose one or more alternative locations to deploy its lockers or microhubs, subject to technical feasibility and location.

The technical and financial feasibility is the responsibility of the operator in terms of budget, investment and operating costs, income from operations and fees paid to the local authority.

5.3.5 Action Plan Brainstorm

Deliver detailed specifications to select an operator

As part of the call for expressions of interest for the installation of urban lockers, the specifications will precisely define the conditions of installation and operation. A total of xx m² of public space will be made available, spread over several of the strategic locations detailed above, selected outside the ABF (Architectes des Bâtiments de France) perimeter, flood zones or sensitive heritage sites. The lockers will have to be highly modular, with a variety of sizes to accommodate different types of parcel, and be equipped with modern technological solutions for payment, secure collection and traceability of deposits. Opening up the digital platform to local retailers, who will be able to drop off parcels for their customers, is a powerful way of boosting local trade. The fee for occupying the public domain will be set according to the value of the spaces, with a 5-year operating period. All maintenance, operating and technical supervision costs will be borne in full by the selected operator.

Undertake consultations with stakeholders (retailers and users alike) to ensure that the lockers are used and positioned correctly.

At the same time, active consultation will be held with the businesses involved in the ‘Cœur de villes’ initiative, local delivery companies and the regional representatives of the major e-commerce delivery companies. The aim is to adapt the access times, drop-off/pick-up procedures and functionalities of the solution to the realities and constraints of the local players. The aim is to encourage the smooth integration of the system into the local dynamic: retailers will be able to expand their range of services, delivery drivers will have an optimised relay point, and users will benefit from a simple, accessible solution that respects their urban environment. The consultation will also be an opportunity to gather information on the frequency of deliveries, delivery zoning and parcel returns, so as to ensure the logistical coherence of the project throughout the city.

5.3.6 Required digital and physical infrastructure

In order to deploy lockers and ensure that they are used appropriately by the local population, the local authority will ensure during the application review phase that the digital tools deployed by the respondent companies are practical.

The operator's digital and physical tools will also have to meet security standards in the event of incidents, fire, terrorist attack or installation in the local architecture. In addition, the digital tools must comply with French standards on the protection of personal data.

5.3.7 Regulatory, legal frameworks & financial feasibility

Once the operator has been chosen following the AMI, it will have to go through a number of administrative procedures prior to deploying its lockers/microhub in the area.

Among the compulsory administrative procedures, the agreement for temporary occupation of the public domain is a key document for determining:

- Purpose
- Duration
- Nature of the authorisation
- The city's obligations
- Technical assessment, provision and occupation of space
- Conditions of occupation
- Relocation of lockers



- Communication support
- Financial conditions (occupancy fees)
- Liability
- Insurance cover
- Termination of contract
- Fate of facilities
- Endorsement
- Settlement of disputes
- Transferability
- Confidentiality

In the event of a serious disagreement between the parties, and in accordance with the agreement, the local authority may withdraw the operator's right to operate. The operator must then remove its facilities at its own expense, in accordance with the terms and conditions set out in the agreement.

One of the potential stumbling blocks is the issue of the occupation fee. The French municipality of Hem (Hauts de France) has established an occupation fee based on the following terms and conditions:

"In return for occupying the public domain, the Occupier undertakes to pay the city a fee based on €0.55/sq.m/day, i.e. €200.75/sq.m/year for the total area of a locker (6.58 sq.m), in accordance with the decision to adjust the rates and decisions relating to occupations of the city's public domain under the police powers for traffic, parking and conservation, approved by the City Council on 14 December 2022."

In order to deploy a minimum of 10 lockers and microhubs in the area, the local authority could collect around €13,000 in annual fees.

As part of the specifications for the AMI, it will be specified that the operator is free to deploy several lockers on the same site, subject to technical feasibility.

Finally, the company chosen to deploy lockers must ensure compliance with the General Data Protection Regulation (GDPR). This means guaranteeing the protection of users' personal data from the design stage of the service ('privacy by design') and throughout its operation. In particular, the company must clearly inform users of the purposes for which data is collected (identification, geolocation, usage history, etc.), obtain their explicit consent where necessary, and offer them easy access to their rights (access, rectification, deletion, objection). It must also secure the IT systems embedded in the consignments (interfaces, mobile applications, payment terminals) to prevent any risk of leakage or intrusion. As a data controller or subcontractor, the company is required to document all its procedures (data processing register, impact analysis if necessary) and to cooperate with the relevant authorities, in particular the CNIL in France.

5.3.8 Timeline and Milestones

In France, the year 2026 will be marked by the municipal elections, which will lead to a number of upheavals and the appointment of new vice-presidents in charge of Mobility, Town and Country Planning and the Economic City. As the elections will take place in March 2026, we can envisage the project being launched 3 months after these elections, i.e. in May 2026. The deployment of the lockers/microhubs will theoretically begin 12 months after the start of the project and will be preceded by 2 months of testing. The authorisation to operate on the public domain will last for 5 years.



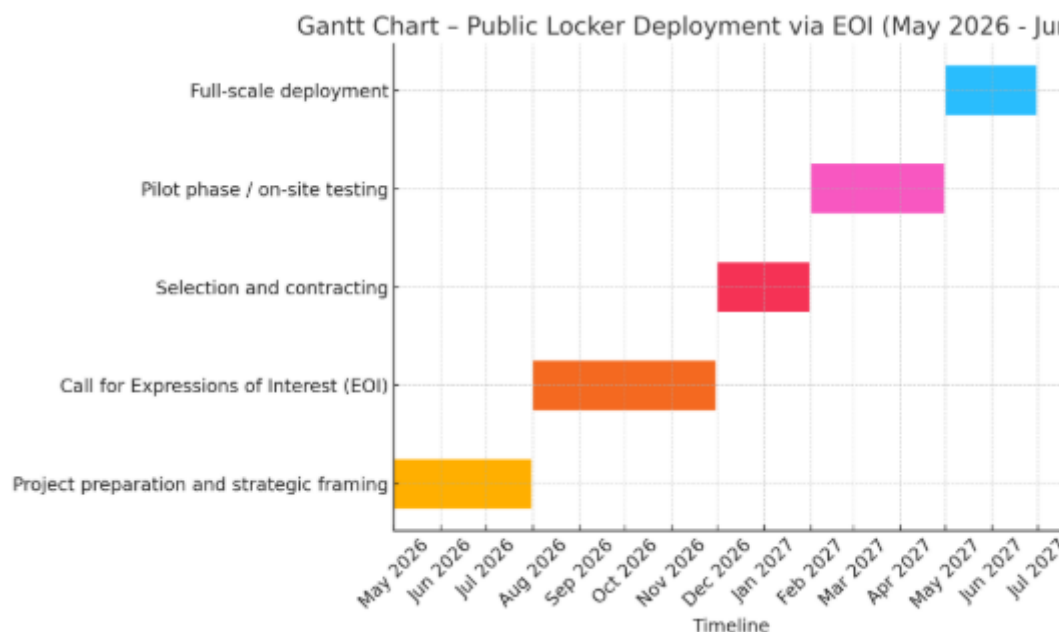


FIGURE 27: ALL STEPS OF PUBLIC LOCKER DEPLOYMENT (SOURCE: CITY OF LA ROCHELLE)

5.3.9 Evaluation and Impact Assessment

In a similar way to a public procurement contract, we are proposing a structured procedure for the evaluation of a locker operator on the public domain by a local authority, as part of a 5-year public domain occupation agreement (CODP). This procedure enables the local authority to ensure that the operator's commitments are respected, to optimise the public service provided and to anticipate the renewal or re-tendering of the contract at the end of the 5-year period.

Each year, the operator must send the local authority a report containing at least the following information:

- Usage data (number of parcels, volume, occupancy rate)
- Technical incidents and interventions
- Energy balance
- Planned developments (software, site extensions, new functions)
- Summary of user feedback (survey or qualitative analysis)

At mid-term, i.e. the 3rd year, an interim evaluation will have to be carried out in order to make any necessary adjustments and sign an agreement to this effect:

- Interim performance report
- Bilateral meeting between the local authority and the operator
- Possibility of amending the agreement (e.g. adjusting the number of sites, location)

One year before the end of the contract, the operator must submit its final consolidated report for the 4 years in order to inform the renewal decision, which will be put out to tender again by the local authority. This report will contain at least :

- Consolidated final report for the 4 years
- External technical audit



- Impact assessment on urban logistics and environmental objectives
- Summary of revenue/fees for the local authority

5.4 Stakeholders and governance

5.4.1 Identification and classification of stakeholders

The implementation of innovative urban logistics solutions, such as automatic lockers and micro-hubs, requires clear and shared governance. To ensure consistent, inclusive and sustainable deployment across the La Rochelle metropolitan area, this governance will be based on a collaborative approach involving:

Public authorities

- City of La Rochelle and the La Rochelle inter-municipal authority (authorisation to set up in public spaces, regulations)
- Technical services (urban planning, roads, mobility, economic development)

Logistics and delivery operators

- Carriers/couriers (Colissimo, Chronopost, DHL, Amazon, Mondial Relay, Vinted etc.)
- Innovative urban logistics companies (cargo bikes, flow sharing)

Retailers and host companies

- Partner shops or brands (supermarkets, petrol stations, tobacconists, newsagents, etc.)
- Landlords/property managers (shopping centres, car parks, stations, commercial or residential buildings)

End users

- Residents and consumers
- Neighbourhood associations
- Technical solution providers
- Manufacturers and installers of lockers and microhubs
- Digital solution providers (management software, collection applications, data security)

Institutional and economic partners

- Consular chambers (Chamber of Commerce and Industry, Chamber of Trades and Crafts)
- Trade associations (acceptance or integration into the commercial fabric)

Based on Davidson's participation wheel, the level of involvement of the various stakeholders must be distinguished. The table below specifies the role of each stakeholder mentioned above.

TABLE 14 STAKEHOLDER ROLE AND LEVEL OF INVOLVEMENT

Inform (level 1)
<p>Communicate project decisions and details.</p> <ul style="list-style-type: none"> • Residents/consumers (information on existence, use, location) • Neighbourhood associations (information on implementation, potential nuisances)
Consult (level 2)
<p>Gather opinions and feedback, but without any obligation to take them into account.</p> <ul style="list-style-type: none"> • Chambers of commerce and industry (CCI), chambers of trades and crafts (CMA)
Involve (level 3)
<p>Active participation in defining certain project details.</p> <ul style="list-style-type: none"> • Managers of spaces hosting lockers (stations, car parks, supermarkets, landlords) • Locker manufacturers/installers (technical constraints, security, urban design) • Digital solution providers (user interface, data, cybersecurity) • Retailers' associations (impact on local businesses, customer flow) • Retailers' associations (impact on local businesses, customer flow)
Collaborate (level 4)
<p>Co-construction and sharing of ideas during implementation.</p> <ul style="list-style-type: none"> • Local authorities (town hall, inter-municipal cooperation, technical services) • Logistics and delivery operators (Colissimo, Chronopost, Amazon, Mondial Relay, etc.)
Empower/Decide together (level 5)
<p>Co-decision and shared governance (less common).</p> <ul style="list-style-type: none"> • Local authorities and logistics operators (AMI, partnership agreement, strategic choices regarding location and access)

5.4.2 Governance

In order to ensure the successful deployment of lockers and microhubs in the city of La Rochelle, a shared and structured governance system must be put in place, based on previous work with logistics groups that led to the creation of the Interlud + responsible logistics charter. This project governance aims to ensure consistency in implementation, regulatory compliance, transparency of the process and the support of local stakeholders.

1. Governance structure

Governance will be based on three complementary levels:

- A steering committee (COFIL), bringing together the City of La Rochelle, the Urban Community, the selected operator (or operators), as well as representatives of logistics companies, retailers and users. It will set strategic guidelines, approve locations and arbitrate major decisions.



- A technical committee (COTECH), composed of the local authority's technical services and representatives of the operator, will be responsible for operational monitoring: technical validation of sites, processing of temporary occupation permits (AOT), monitoring of works and maintenance, etc.
- Local consultation groups, including the local logistics group for the area, as well as local residents, shopkeepers and economic stakeholders. The groups will ensure transparency, communication and user ownership of the scheme.

2. Administrative and financial framework

The installation of lockers will be governed by a temporary occupation permit for public property (AOT) specifying the nature, duration and conditions of the permit, the respective obligations of the parties, the procedures for removing the equipment and the insurance and liability clauses. This involves the selected operator (or operators) entering into a contract with the legal services of the municipality of La Rochelle.

3. Regulatory compliance and data protection

The operator(s) must ensure strict compliance with the General Data Protection Regulation (GDPR). They shall guarantee the security and confidentiality of the data collected (identification, geolocation, usage history), in accordance with the principles of 'privacy by design'. They shall keep the required documentation up to date (processing register, impact assessment where applicable) and cooperate with the City's data protection officer and the CNIL.

4. Monitoring, evaluation and communication

An annual report shall be presented to the COPIIL to evaluate the deployment (occupancy rate, user satisfaction, compliance with obligations). Adjustments may be made depending on the results or regulatory changes. The City and the operator will conduct coordinated communication to inform users, promote the environmental benefits and encourage the use of sustainable urban logistics solutions.

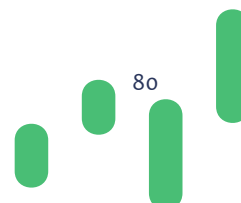
5.5 Conclusions and recommendations

To summarise, the case of Bologna is particularly relevant for La Rochelle because it is based on:

- a local hub located on the outskirts of the restricted city centre (ZTL), which has similarities with our city centre;
- a system combining lockers + electric fleets for the last kilometre;
- a neutral governance model, enabling cooperation between competing operators;
- detailed mapping of collection points, including shops;
- in-depth consideration of energy autonomy via solar panels.

The Living Lab demonstrates that a network of lockers can be sustainably integrated into a mobility policy by being included in strategic documents (SUMP, Sulp) — which is in line with La Rochelle's ambitions. In addition, **Bologna highlights a crucial point: the uncertainty of the economic model without public subsidies**, and the need for in-depth consideration of value sharing between local authorities and operators. **The La Rochelle feasibility study proposes an alternative model for managing automatic lockers.** The model adopted by the Agglomeration provides for:

- opening up public space to private operators via a Call for Expressions of Interest (AMI);
- full financing of installations, maintenance and operation by operators;



- an annual fee proportional to the occupation of public land (≈€13,000/year for 10 lockers based on French national examples);
- preferential location in mobility hubs, tourist areas and collective housing.

The public authority plays a strategic and regulatory role, ensuring urban coherence without bearing the operational costs. Furthermore, the La Rochelle area is atypical due to its old buildings and its extensive conservation area (180 ha), which is subject to the strict approval of the Architectes des Bâtiments de France (ABF) for the deployment of street furniture. The requirements of the French national plan for vigilance, prevention and protection against terrorist threats (Vigipirate) are another constraint to be taken into account when deploying lockers, as are the technical constraints of installation (connection, security, maintenance, etc.). Based on these cross-referenced criteria (traffic flow, transport, population density, presence of shops, tourist activity), the study has identified ten potential sites:

1. Mireuil local council offices
2. La Rochelle municipal swimming pool car park
3. Port Neuf
4. La Rochelle tourist office
5. Media library
6. La Rochelle railway station
7. Car park near Lycée Valin
8. Simone Veil park-and-ride car park,
9. Port des Minimes car park
10. Maison de la Charente-Maritime

In order to ensure harmonised and sustainable deployment, next ten key steps have been identified:

1. Finalise the regional strategy and validate priority sites.
2. Draft the regulatory framework for the future AMI.
3. Conduct structured consultations with retailers, operators and users.
4. Produce a detailed implementation file for each site.
5. Define a sustainable economic framework and an appropriate fee.
6. Officially launch the AMI (forecast: May 2026).
7. Conclude agreements for the occupation of public land.
8. Supervise installation and commissioning.
9. Establish an annual evaluation protocol and a mid-term review.
10. Anticipate the renewal or extension of the network before the fifth year.

If the city of La Rochelle and the metropolitan area wish to deploy automated lockers in the region, the success of the scheme will depend on:

- if economic stakeholders (retailers, logistics providers, transport operators) are involved in the process and taken into account,
- if heritage and security constraints are clearly identified and solutions provided,
- if the governance established with the operators selected following the call for expressions of interest is efficient and successful.

Thus, automatic lockers could be a key lever for decarbonising the last mile while responding to changing consumer habits, with citizens increasingly turning to online shopping.

6 Mechelen’s feasibility study

Mechelen is a medium-sized city in the province of Antwerp, strategically positioned halfway between Brussels and Antwerp along the heavily trafficked Brussels–Antwerp corridor. Its central location, with direct access to the E19 highway, regional roads, and one of Belgium’s busiest railway stations, has historically made it a key hub for logistics and trade.

At its heart lies a medieval city centre, characterised by narrow streets, historic buildings, and high activity density. While this creates challenges for goods delivery, parking, and vehicle access, it also strengthens the case for sustainable mobility solutions such as active travel, public transport, and urban consolidation. The historic core is enclosed by an inner ring road, which functions as a main distributor and transition to suburban districts and rural villages such as Mechelen-Noord, Muizen, Walem, and Leest. These peripheral zones, with their lower densities and car-dependent travel patterns, face growing pressures from urban sprawl, commuting, and logistics activity.

Mechelen plays an important bridging role in both passenger and freight transport. Thousands commute daily to Brussels and Antwerp, supported by its major rail station now being redeveloped into a multimodal hub for train, bus, cycling, and walking. Its proximity to logistics clusters in Willebroek, Boom, and the Brussels periphery also makes it a significant freight node. Yet rising delivery traffic into the compact city center raises issues of congestion, emissions, and livability, spurring the city to test measures such as zero-emission zones, consolidation centers, and bike logistics.

Covering 65 km² with around 87,000 residents, and with continued demographic growth expected, Mechelen faces the challenge of balancing densification, accessibility, and sustainability while safeguarding quality of life.

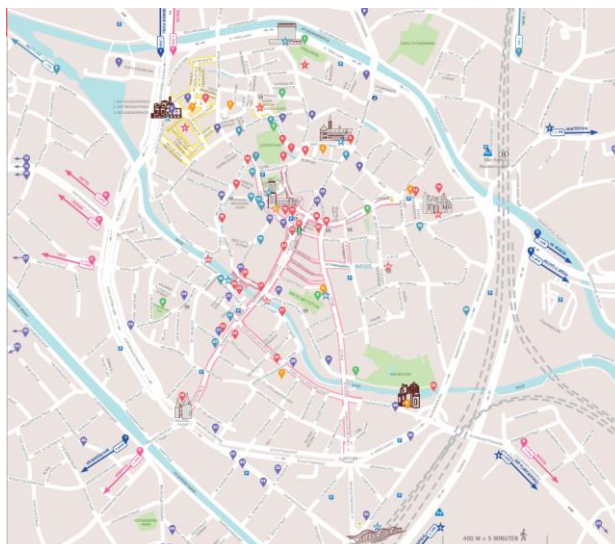
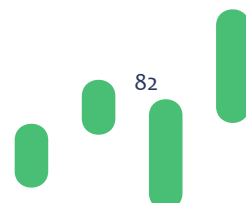


FIGURE 28 THE CITY MAP – THE INNER CITY AND RING ROAD CLEARLY VISIBLE

The city of Mechelen has drawn up a map to indicate when and where car traffic is restricted in the city centre. These car-free zones are part of the mobility policy to make the city centre safer, more liveable and more sustainable. ANPR cameras track the incoming traffic and fine if needed.



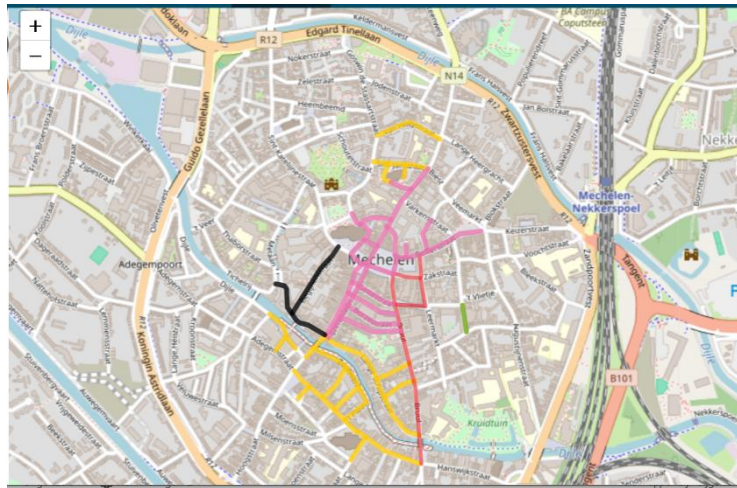


FIGURE 29 STREETS IN DIFFERENT COLOURS, EACH WITH A SPECIFIC ACCESS REGULATION AT CERTAIN TIMES

TABLE 15 STREETS IN DIFFERENT COLOURS, EACH WITH A SPECIFIC ACCESS REGULATION AT CERTAIN TIMES

Zone colour	Access restrictions	Exceptions
Yellow	Car-free 11:00 – 18:00 daily	–
Black	Car-free 11:30 – 06:00 next day (Sundays: 13:30 – 06:00)	Applies to Vismarkt, Begijnenstraat, Nauwstraat, Drabstraat
Pink	Car-free 11:00 – 18:00 daily (Saturdays: 07:30 – 18:00)	–
Green	Car-free 11:00 – 22:00 daily	–

At the moment, no emission zones are defined. The colours on the map only indicate where limited traffic is allowed during specific hours. With the covenant for sustainable urban logistics¹, the city has set as a goal to make the inner city a zero emission logistics zone. Regardless of passenger mobility, the covenant tries to keep the horizon of 2030 alive for entrepreneurs, interested organisations, general logistics companies and big courier companies to make a green change in their deliveries.

6.1 Background of urban logistics in Mechelen

Urban logistics – covering parcel deliveries, shop supplies, and waste collection – contributes disproportionately to pollution, accounting for a quarter of CO₂ emissions and up to half of nitrogen oxides and particulate matter. It also adds to congestion, noise, safety risks, and space pressure. In Mechelen, logistics already makes up 10% of all traffic and continues to grow annually, fueled by both commercial deliveries and the rapid rise of e-commerce. Eight percent of residential deliveries fail on the first attempt, causing repeated trips and further inefficiency.

To safeguard sustainability, livability, and safety, Mechelen aims to make freight transport more sustainable and efficient, with a focus on the city centre and station area. This involves reducing traffic

¹



volumes, kilometres driven, CO₂ emissions, and improving air quality. A key step is the introduction of a zero-emission zone for logistics by 2030, banning polluting vans and trucks while encouraging cargo bike logistics and consolidation at the city’s edge for companies not yet ready to invest in zero-emission fleets. To realize this transition, the city launched the Covenant for Sustainable Urban Logistics, a strategic agreement with logistics operators and stakeholders. Signed in 2020, the covenant sets a shared ambition for zero-emission urban distribution, providing companies with policy certainty to plan investments in vehicles and infrastructure. Since its launch, 37 partners have joined, underlining the collective commitment to creating a cleaner, safer, and more efficient logistics system in Mechelen.

A relevant selection of signatories includes:

TABLE 16 STREETS IN DIFFERENT COLOURS, EACH WITH A SPECIFIC ACCESS REGULATION AT CERTAIN TIMES

Category	Stakeholders
Logistics Companies	UPS, DPD, DHL, GLS, PostNL, FedEx, Bpost, Van Dievel, VPD, Dematra, Ninatrans, T'Seyen Foodservice
Business and Industry	Bond Beter Leefmilieu, Transport en Logistiek Vlaanderen, Horeca Vlaanderen, Febetra, Unizo, Voka
Local Businesses and Initiatives	Mechelen MeeMaken vzw, De Vleeshalle, VAWI (hospitality wholesaler)
Large Retailers	Colruyt Group

These parties have committed to taking concrete steps toward more sustainable and efficient city logistics, including reducing the number of vehicle kilometers driven, bundling deliveries, and investing in zero-emission transport solutions. A link to the covenant can be found [here](#).

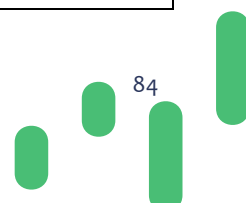
The Covenant for Sustainable Urban Logistics in Mechelen was not developed in isolation, but rather emerged from years of active participation in European projects focused on innovative urban mobility and logistics. Through initiatives such as Cyclelogistics Ahead, Mechelen explored the potential of cargo bikes for last-mile deliveries, demonstrating how cycling logistics can reduce congestion and emissions in dense city centers. Mobimix focused on multimodal urban transport strategies, including the integration of shared mobility services and behavioral change campaigns to encourage more sustainable travel and delivery patterns. As part of the Surflogh project, Mechelen piloted one of Belgium’s first “Ecozones” – zones with strategically placed lockers delivered via zero-emission transport – setting the groundwork for broader locker-based delivery systems. These projects, along with others, have helped Mechelen build both expertise and networks, enabling the city to take a leading role in shaping the logistics of tomorrow.

6.1.1 Existing projects and trends

The following table provides with an overview of European mobility and logistics projects in the city of Mechelen, in the past and currently running.

TABLE 17 LIST OF ONGOING PROJECTS

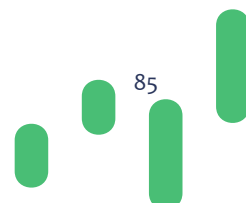
Project Name	Duration	Theme	Role of Mechelen
Cyclelogistics Ahead	2014–2017	Bicycle logistics	Promotion and testing of cargo bikes for last-mile deliveries.



Novelog	2015-2018	Data on logistics	ANPR-analysis and Bringme lockers
Mobimix	2019-2022	Multimodal mobility	Implementation of shared mobility services and awareness campaigns.
Surflogh	2017-2021	Urban distribution & lockers	Deployment of Ecozone with zero-emission locker delivery system.
ULaaDS	2020-2023	Urban logistics as a service	Pilot city for cargo hitching on an autonomous vehicle. Main conclusion at the time: the technology is nearly there, Belgian legislation to accept ADV's on the road, is lagging.
CityChangerCargobike	2018-2021	Bicycle logistics	Follow up of Cyclelogistics Ahead.
URBANE	2022-2026	Physical Internet & shared infrastructure	Adapting Bologna use cases to Mechelen, focusing on open locker networks.
Unchain	2023-2026	Supply chain sustainability & digital twin	Exploring chain transparency and digitization of city logistics.
SELECT	2024-2027	Charging infrastructure	Mapping the need for charging infrastructure in the logistics sector
GLEAM NSR	2023-2027	Green logistics & governance	Mapping Mechelen's logistics ecosystem and involving SMEs in green policy design.
MOLO-hubs	2023-2026	Bicycle logistics	Pilot to perform inner city service logistics on a cargo bike.
Greenlog	2023-2026	Sustainable urban logistics ecosystems	Supporting the development of green logistics zones and resilient supply chains through co-creation with stakeholders.
Spotlog	2024-2027	Green and socially responsible city logistics innovations	Cocreation of regional policy instruments concerning urban logistics.

6.1.2 Lockers as part of the solution

The first locker trial in Mechelen took place during the NOVELOG project, using Bringme lockers. This pilot quickly demonstrated the potential of parcel lockers, but also revealed limitations: because of the used materials of the locker, it was imperative that they were placed indoors, so they were not accessible 24/7. Later, within the Surflogh project, four Cubee lockers were installed on public domain, providing round-the-clock access and confirming their added value. As a result, Mechelen was already convinced of the benefits of lockers well before the first contact with bpost in 2019. This early experience laid the groundwork for the city's later collaboration with bpost, building on lessons learned from both private and public domain pilots.



Bpost is Belgium’s national postal operator, historically state-owned and still partially controlled by the government. Today, it is also the country’s leading logistics and parcel delivery company, holding a dominant position in the B2C e-commerce market.

An extensive network of parcel lockers was first introduced in 2020 through the Interreg North Sea Region project Surflogh in collaboration with bpost. At that time, the city was preparing its Covenant for Sustainable Urban Logistics, while bpost was shifting towards greener operations with its Ecozone principle: a dense network of lockers within walking distance, combined with zero-emission deliveries and ideally zero-emission pick-ups by customers.

This shared ambition led to a pilot in Mechelen to test the feasibility and impact of such a system. The questions at stake were clear: Can lockers be operated profitably with zero-emission delivery? Can consumers be incentivized to collect their parcels in a sustainable way? And what measurable effect would this have on emissions and urban livability? The trial positioned Mechelen as a frontrunner in exploring lockers as a practical tool for cleaner, more efficient urban logistics.

Here is a short movie that incentivized the Mechelen inhabitants to make use of the lockers: <https://www.youtube.com/watch?v=h-6qyolkzaE>

This is business as usual today, but at the time, it was innovative and unsure. After a year of trialling, the university of Brussels (VUB) did a study on the positive and negative effects of the zero emission way of dropping of and picking up parcels. Here are the results:

CO₂ emissions from parcel delivery

Business as usual vs. Ecozone

2019 - Business as usual → 126.6 tons CO₂/year

- 125.9 tons CO₂ by bpost
- 0.7 tons CO₂ customer travel to parcel locker

2021 - Ecozone Mechelen → 3.6 tons CO₂/year

- -122.4 tons CO₂ thanks to bpost emission-free services
- -0.6 tons CO₂ from changes in travel behavior

The difference between both reference years is 97% less emissions, which was at the time equivalent to the European ambition set for 2050.

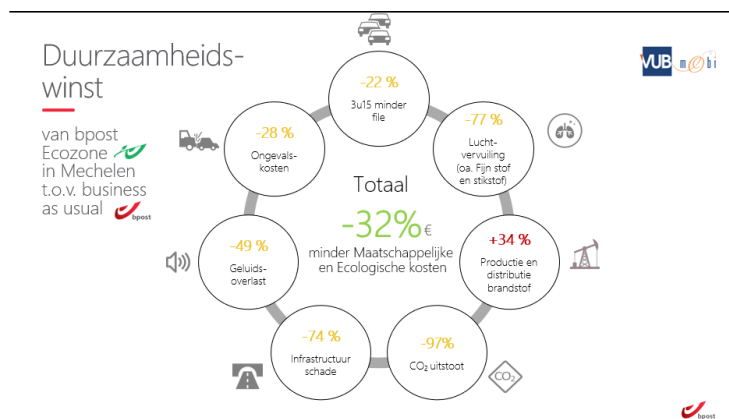


FIGURE 30 SUSTAINABILITY GAINS IN THE MECHELEN ECOZONE, COMPARED WITH BUSINESS AS USUAL OPERATIONS(SOURCE: VUB, BPOST)

The image above shows the sustainability gains for different areas: noise nuisance, CO₂-emissions, accident numbers, damage to infrastructure, air pollution and traffic jams. The only sustainability loss is due to the production and distribution of extra electricity to charge the vans and bicycles.

6.1.3 From pilot to citywide locker network

Mechelen was one of the first Belgian cities to experiment with parcel lockers in an Ecozone setting. What started with skepticism from businesses and residents soon turned into strong support: citizens began requesting lockers in their own neighborhoods once the benefits became clear. To channel this momentum, the city launched a public tender to install and operate a citywide locker network. The tender emphasized three priorities:

- Public-domain locations only, ensuring accessibility (24/7), safety, and visibility.
- Long-term stability, with a five-year contract and the option to extend annually up to ten years.
- Openness, requiring that the network be available for multiple logistics operators, not just one.

Bpost was the only applicant and won the tender, guaranteeing a reliable and strategically distributed locker system. However, while the contract foresaw an open network, in practice this proved challenging: Bpost raised concerns about data-sharing with competitors and technical integration of IT systems, while other couriers showed little interest without neutral governance or price agreements. Indeed, the big competitors in B2C e-commerce argued that we gave bpost an advantage and hence disturbed a level playing field.

This experience highlighted a key lesson: lockers occupy scarce public space, so duplication is not an option. Instead, the focus must be on optimizing and opening up the existing infrastructure to maximize sustainability gains.

Earlier pilots with private-property lockers, such as Bringme (tested in EU projects Cyclelogistics Ahead and NOVELOG), confirmed the potential of smart lockers but also showed their limits: restricted access hours, not enough weather proof, dependence on parking locations, and reduced city control. The tendered public-domain network overcame these issues, giving the city a steering role in sustainable last-mile logistics. Today, Mechelen operates more than 50 lockers across its territory, forming a backbone for zero-emission delivery solutions.



FIGURE 31 THE LOCATION OF SMART LOCKERS IN THE CITY CENTRE (SOURCE: CITY OF MECHELEN)

An absolute strength: this network is very functional with more lockers that were placed since this last image. The potential of these lockers, when opened up for other logistic players, is huge.

6.1.4 Towards an open locker network

The city of Mechelen remains in close contact with Bpost to achieve an open locker system. In late 2024, Bpost reported that it had approached competitors to enable shared parcel deliveries through its network. Meanwhile, the Wij.leveren 2.0 project, led by Leuven and Mechelen with Flemish support, aims to open Bpost's lockers to multiple logistics providers, reducing delivery traffic, cutting CO₂ emissions, and making last-mile logistics more efficient. Building on the success of Bpost's Ecozones, this project envisions an inclusive delivery ecosystem that fosters collaboration, optimizes routes, and supports both customer convenience and local businesses.

Progress, however, has stalled. Bpost promised to open lockers by Q1 2025 but missed the deadline. The city is therefore preparing legal action. Our legal department sees two options: ending the contract due to non-compliance with tender conditions, or imposing penalties. Since Bpost did not receive subsidies but only the right to install lockers on public space, the second option is not viable. Technically, opening lockers is possible, as shown by ECOkoeriers, a local bike courier already accessing the network.

Looking forward, the opportunity is clear: an open locker network is feasible, but depends on both competitive willingness and city policy. As long as polluting vans are allowed free entry for door-to-door deliveries, operators lack incentives to cooperate. Stricter access rules and higher costs for urban entry would shift the balance toward locker-based solutions. The Flemish Framework Agreement for Zero-Emission Urban Logistics, signed in June 2024, could serve as a catalyst. With ZEZs planned from 2027, pilot projects already running, and uniform regulations in preparation, the stage is set. By aligning local locker strategies with this framework, Mechelen can accelerate cleaner logistics and ensure fair competition in last-mile delivery.

6.1.5 Current status

As of mid-2024, the framework agreement was finalized under the previous Flemish government and included a clear roadmap toward the implementation of Zero-Emission Zones (ZEZ) from 2027 onwards. However, since the formation of the new Flemish government, this framework has not been embraced with the same level of political commitment.

At present, the role of the Flemish Region in supporting and coordinating the rollout of zero-emission urban logistics is under debate. Key questions remain unanswered: Will the regional government continue to steer the transition? Will uniform rules still apply? And what support mechanisms, if any, will be maintained?

This political uncertainty has led to a temporary standstill. Cities across Flanders are now in a wait-and-see position, with many local authorities hesitant to take decisive steps without clarity from the regional level. As a result, momentum has slowed, and stakeholders are looking to one another for direction, causing delays in the preparation and implementation of Zero Emission Zone (ZEZ) policies.

Despite this pause, the framework still serves as a valuable reference for cities that wish to move forward independently. However, without regional alignment and support, consistent and effective implementation across Flanders is at risk.

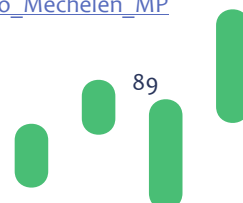
6.2 Replicability and lessons learned from URBANE’s Living Labs

The Bologna Living Lab introduces a novel approach by fostering collaboration between potential competitors in parcel delivery, sharing a common micro-hub. It involves the implementation of Nearby Delivery Areas (NDAs) - a measure listed in Bologna's Sustainable Urban Mobility Plan (SUMP) and Sustainable Urban Logistics Plan (SULP) - combined with a collaborative approach among logistics operators and the use of zero-emission vehicles. Additionally, the report describes the collaborative efforts with local authorities and business stakeholders, highlighting the constraints and measures for the transition to Physical Internet (PI)-enabled last mile deliveries.

TABLE 18 FOCUS ON LESSONS LEARNT FROM BOLOGNA LL

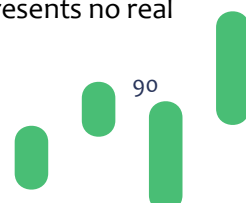
Lessons Learned from Bologna	Adopted to local level	Questions & Answers
SULP as a framework for further decisions.	The city of Mechelen doesn't currently have a SULP. The existence of a SULP would give a framework to which further decisions could be taken in a supported environment with clear ambitions and goals.	The city doesn't have a SUMP either. Instead, we follow the regional mobility plan, as organised by the Flemish government. Limited zero emission guidelines are taken up in this plan as well ² .
A locker system that is open for different logistics players, is actually possible and viable.	Up until today, it's not possible for big competitors (PostNL, DPD, FedEx, UPS) to drop off or pick up parcels in the Ecozone bpost lockers.	Two exceptions should be mentioned: bpost has a B2C agreement with DHL to drop off their parcels in lockers. In addition, GLS is able to drop off parcels in the big lockers with a screen (not the small Ecozone lockers).
Bologna has different locker providers on its premises: Due Torri, TYP, Amazon, Inpost.	Mechelen has only one 'brand' of lockers, namely those of bpost. Therefore, the city should negotiate with one partner only, instead of	Would extra competition for bpost be a driver for change?

² https://www.vlaanderen.be/basisbereikbaarheid/mobiliteitsuitdagingen-regionaal-aanpakken/vervoerregios/vervoerregio-brugge/regionaal-mobiliteitsplan-0#bekijk-het-regionaal-mobiliteitsplan%20en%20https://assets.vlaanderen.be/image/upload/v1705515249/231219_Eindnota_Vervoerregio_Mechelen_MP_gfp5f5.pdf



	multiple partners, as is the case in Bologna.	
Bologna tested Freight as a Service (FaaS) and the Physical Internet approach in urban freight distribution, thanks to the use of vehicles with modular units able to make transshipment flexible, fast and sustainable	Mechelen has no experience with FaaS and would be very interested in learning more about it.	Should the city take the lead in introducing FaaS, or should it be left to private players?
The Municipality and the Metropolitan City of Bologna are the main responsible entities for the regulatory and policy contexts of the LL area with LTZ, Sulp introduction and implementing loading bays.	This is also true for Mechelen. However, the city of Mechelen is much smaller and very close to other cities in Flanders (Antwerp, Leuven, Brussels...). That's why a more general framework would be wiser, equal and complementary to other cities. The region of Flanders could take up a leading role to realize this.	Should cities wait for Flanders to formulate a generally accepted policy?
Two potential competitors collaborate in the distribution of parcels and use the same micro-hubs, which means a concrete step towards the PI concept.	It's not feasible nor desirable for bpost to make it a commercially viable business case, even though it's possible on a practical level.	Smart city initiatives in Mechelen are slowly starting, but aren't common practice. Physical Internet (PI)-enabled last mile deliveries would be new.
Authorized freight vehicles can use loading and unloading bays in the LTZ for free for the first 30 mins. After that, they must pay a fare (5€/30mins)	A time limit, as well as the need for freight handlers to get an authorization, would give Mechelen more control over the deliveries in the center.	In Belgium, every spot can be a loading and unloading bay, as long as using it, doesn't hinder any other road users. There's no legislation to force freight vehicles to use dedicated spots.
API's to connect the lockers to the different platforms of each competitor are easily set up by GEL. The technological process is very straightforward to set up and poses no problems.	Bpost objects to sharing data with external parties due to sensitive information. Other LSPs are also very reluctant in sharing data. It is a requirement in the covenant, but has not yet been realised.	GEL claims to have a waterproof solution. GEL only sees hurdles for LSP's in changing their daily operational processes because of integrating into a new system.

In Bologna, GEL set up the infrastructure needed for the trial and confirmed that connecting lockers to competitors' platforms via APIs is technically simple. The process is straightforward and presents no real



barriers. This is notable, since logistics service providers (LSPs) in Mechelen often claimed that data sensitivity was the main obstacle suggesting competitors could gain insights into volumes or routes. GEL's experience shows otherwise.

Instead, the real resistance lies in daily operational changes. According to GEL, tasks like scanning codes, linking parcels to the right locker, and adapting workflows create practical challenges for LSPs. These hurdles are behavioral and procedural, not technological.

To address this, the URBANE consortium offered Mechelen the opportunity to inform local LSPs about smart contracts, as done in Bologna. This would include both a strategic dimension - demonstrations to show stakeholders the benefits of smart contracts - and an operational dimension, where tools are tailored to the specific realities of LSPs.

6.3 Innovation/use case – Operational Feasibility (SWOT analysis)

6.3.1 Vision and objectives - description and benefits

This feasibility study explores how the City of Mechelen – and by extension all Flemish cities hosting bpost lockers in the public domain – can build a sustainable partnership with bpost while at the same time opening the infrastructure to competitors. The aim is to create a level playing field where locker systems contribute to more efficient and greener urban logistics. This shift is urgently needed: the medieval city centers of Flanders face increasing congestion from delivery traffic, while public space remains scarce and must serve a wide variety of citizen needs. Looking ahead, shared locker infrastructure could become a cornerstone of urban logistics policy, offering a scalable and fair solution that balances sustainability, accessibility, and competition.

At the moment of writing (August 2025) an RFI is being organized. The cities of Leuven and Mechelen are taking the lead to write a new tender for installing lockers in both cities. Before doing so, they want to request information in order to:

- Gain knowledge about the future prospects of parcel locker providers;
- Gain knowledge of the financial model used when operating parcel lockers in a concession context;
- Assess the feasibility of the open system (and under which scenario) and the willingness to collaborate with various logistics operators;
- Gain knowledge about the technical characteristics of the lockers when installed on public property;
- Gain knowledge about the possibilities for guaranteeing emission-free deliveries and fair working conditions in multi-operator setups.

Below is a schematic SWOT analysis to better understand the current situation and options for the future.



TABLE 19 THE SWOT ANALYSIS

Strengths	Weaknesses
<ul style="list-style-type: none"> • Mechelen already has a locker infrastructure in place, owned by the National courier service, called Bpost • Central location near other Flemish cities enables potential for regional cooperation. • The city is partner in different EU projects where multiple lessons can be learned to enhance the locker network functioning. • Smart city initiatives on logistics are starting and could be scaled up. • - Existence of the Covenant for Sustainable Urban Logistics • The postal law stipulates that all the postal infrastructure including lockers should be open for everyone. 	<ul style="list-style-type: none"> • The city follows a general, more high level SUMP of the ‘vervoerregio’. • Bpost is reluctant to open its lockers to competitors • No local experience with Freight as a Service (FaaS) or the Physical Internet (PI) concepts. • Weak legal framework: no obligation for freight vehicles to use specific loading zones, reducing logistical control.
Opportunities	Threats
<ul style="list-style-type: none"> • Regional collaboration (e.g. with the Flemish government) could lead to uniform logistics policies. • Competitor collaboration (as tested in Bologna) could enable shared microhubs and real PI implementation. • An open locker network could enhance Mechelen’s appeal for sustainable e-commerce logistics. • Testing FaaS or PI in Mechelen could position the city as a pioneer in sustainable logistics in Belgium. • Mechelen is talking to other Flemish cities to approach the matter as a joint effort. Leuven and Hasselt already stated their interest. This could strengthen our position towards Bpost. • The cabinet of minister Matz, responsible for government companies like Bpost, was contacted. It promised to re-open discussions with Bpost and other courier companies. This could maybe deblock the situation. 	<ul style="list-style-type: none"> • Bpost’s refusal to cooperate might hinder innovation and block system-wide efficiency gains. Their contract could end earliest at Q4 2026. • Despite simple API integration, LSPs may resist changing their operational routines, slowing adoption. • Without a clear policy framework (SULP), logistics efforts lack direction and long-term vision. • Mechelen’s small size limits its bargaining power with dominant logistics players like Bpost.

6.3.2 Identification of opportunities

TABLE 20 FOCUS ON OPPORTUNITIES IDENTIFIED, SUBDIVIDED PER TOPIC

Topics	Opportunity	Actions that could be taken
--------	-------------	-----------------------------

Uniform logistics policies	Regional collaboration (e.g. with the Flemish government) could lead to uniform logistics policies.	Propose a pilot zone in Mechelen aligned with Flemish zero-emission goals. Organize quarterly coordination meetings with the Flemish government + neighboring cities. Draft a shared framework for delivery time windows and vehicle standards.
Competitor collaboration	Competitor collaboration (as tested in Bologna) could enable shared microhubs and real PI implementation.	Set up a neutral convener (city-led roundtable) with local logistics players. Launch a microhub pilot with at least 2 competing couriers.
Sustainable e-commerce logistics	An open locker network could enhance Mechelen’s appeal for sustainable e-commerce logistics.	Issue a new public tender that obliges interoperability (open API) for all locker providers.
Testing	Testing FaaS or PI in Mechelen could position the city as a pioneer in sustainable logistics in Belgium.	Partner with a local IT-provider/university to build a digital freight exchange platform. Apply for EU or Flemish funding to de-risk the pilot for participating SMEs.

6.3.3 Challenges and barriers

While an open locker network presents significant opportunities for Mechelen and other Flemish cities, several challenges must be addressed to ensure successful implementation and long-term sustainability.

1. Regulatory and legal complexity

- Ensuring compliance with national and EU regulations, including the new Belgian rules requiring interoperability of lockers (De Sutter’s policy).
- Navigating GDPR compliance for handling sensitive delivery and user data.

2. Stakeholder alignment

- Achieving cooperation between competing logistics providers who may be reluctant to share infrastructure (bpost).
- Balancing the interests of public authorities, logistics companies, local retailers, and residents.
- Defining a fair and transparent governance model for access, fees, and maintenance responsibilities.

3. Financial sustainability

- High upfront costs for locker infrastructure, particularly if smart and interoperable technology is required.
- Uncertainty about demand and usage rates, especially in the initial pilot phase.

4. Technological and operational hurdles



- Ensuring interoperability across different logistics players and digital platforms.
- Cybersecurity and data protection risks associated with shared digital infrastructures.
- Need for robust maintenance and 24/7 reliability to guarantee user and operational trust.

5. Behavioural and social acceptance

- Encouraging citizens to adopt lockers instead of home delivery.
- Building trust that lockers are secure, reliable, and convenient.
- Overcoming habits of “free home delivery” fostered by e-commerce platforms.

In short, the main challenge lies not in the technical feasibility of lockers - the technology is proven - but in governance, financing, and behavioural change. Overcoming these barriers requires clear regulatory backing and strong stakeholder engagement to demonstrate that open lockers provide tangible benefits for all parties involved.

6.3.4 Risk mitigation

Given that the physical locker infrastructure already exists in Mechelen, the focus of risk mitigation should shift towards policy, governance, and stakeholder alignment.

1. Regulatory and Legal Risks

Risk: Delays in legal enforcement or unclear interpretation of the “open locker” requirement under Belgian policy.

Mitigation: Work closely with the federal government and regulator to clarify the framework and ensure early compliance. Position Mechelen as a pilot city that operationalises the policy, turning regulation into an opportunity rather than a barrier.

2. Stakeholder Resistance

Risk: Bpost or competing logistics providers may resist opening access or may fear losing competitive advantage.

Mitigation: Develop a neutral governance model, e.g. through a city-facilitated cooperative or third-party platform, where access rules and fees are transparent and equal for all operators. Pilot bilateral agreements with one or two alternative providers first, to demonstrate benefits before scaling.

3. Financial Sustainability

Risk: Costs of interoperability upgrades, software integration, and management may outweigh initial revenues.

Mitigation: Seek co-funding through EU projects (e.g. Horizon Europe), Flemish government smart mobility programmes, or partnerships with e-commerce platforms. Explore a pricing model where larger logistics operators pay proportionally more, ensuring a fair balance of costs.

4. Technological Interoperability

Risk: Existing lockers may not be fully interoperable with other logistics players’ software.

Mitigation: Partner with neutral tech providers who can integrate multiple APIs into the existing locker system. Start with a limited technical pilot (e.g. one zone in Mechelen) to resolve issues before scaling.

5. Behavioural Change

Risk: Citizens may continue to prefer home delivery, reducing the impact of open lockers.

Mitigation: Incentivise locker use through reduced delivery fees, faster availability, or green branding (“choose lockers, reduce vans in your street”). Collaborate with local retailers to promote lockers as the default collection option.

The key mitigation principle is leveraging what already exists (the bpost lockers) while ensuring that opening them up creates added value rather than conflict. This requires neutral governance, transparent cost/revenue models, technical interoperability and strong citizen communication.

6.3.5 Action plan brainstorm

To translate the vision of open-access lockers and zero-emission logistics into practice, the following steps could be considered:

Immediate actions (2025–2026)

- Request for Information (RFI): The Cities of Mechelen and Leuven will send out an RFI to both locker providers and courier companies. The aim is to gather insights on:
 - What technical and operational needs must be met for an open locker network.
 - How logistics players perceive the future of shared infrastructure.
 - What conditions would enable their participation.

Contract enforcement with bpost: The city will issue a *notice of default* to bpost, underlining that the current locker system - granted through the existing tender - has not been implemented as an open system, as required.

Stakeholder engagement

- Map concerns (e.g. costs, technical integration, competitive neutrality).
- Identify frontrunners willing to test the open system.
- Technical and operational assessment
- Review requirements for software integration, access systems, and security.
- Benchmark examples from other European cities.
- Explore interoperability
- Business model exploration
- Explore revenue-sharing models between operators.

Policy and regulatory alignment

- Ensure compliance with federal legislation (e.g. De Sutter’s open locker framework).

- Link with Flemish and European mobility and climate goals.
- Ensure consistency with the city's Zero Emission planning.

Pilot design

- Select one or two sites for the first pilot of open lockers.
- Define technical standards and KPIs (emission reduction, efficiency, cost).

Funding opportunities

- Explore EU funding, federal and Flemish subsidies.
- Involve private logistics players in co-financing.

Communication and outreach

- Communicate clearly with retailers and residents on benefits.
- Publish transparent guidelines for operators.
- Collect feedback throughout the pilot.

Monitoring and evaluation

- Evaluate the pilot KPIs
- Evaluate replicability for other Flemish cities.

6.3.6 Regulatory and legal frameworks: required permits, compliance, GDPR, etc.

The regulatory environment in Belgium has recently evolved in a way that is highly relevant for locker-based urban logistics. In July 2023, the Belgian Postal Law was amended under the initiative of Minister Petra De Sutter. This amendment empowers the postal regulator (BIPT) to require that parcel locker networks be made accessible to all delivery companies whenever this contributes to sustainability goals. In practice, this means that couriers such as DPD could be obliged to deposit parcels in, for example, bpost lockers, regardless of ownership. The measure aims to reduce unnecessary transport movements, enhance efficiency, and promote lower CO₂ emissions through shared use of infrastructure.

For the City of Mechelen, this creates a strong legal foundation to require that locker infrastructure on public domain remains open, interoperable, and accessible to all logistics providers. It allows municipalities to align their mobility and sustainability objectives with national legislation, ensuring that locker networks serve the public interest rather than being monopolised by a single operator.

In addition, other legal aspects need to be considered:

- Permits and urban planning regulations for placing lockers in public space.
- E-commerce legislation (e.g. Belgian law requires webshops to offer at least two delivery options, including parcel lockers), which supports consumer uptake of locker networks.
- GDPR compliance, since lockers involve the processing of personal data related to delivery, pick-up, and identity verification.

Taken together, this evolving legal framework enables Flemish cities to integrate parcel lockers into their sustainable mobility strategies, while ensuring fair competition, data protection, and efficient use of scarce public domain.

6.3.7 Financial feasibility estimations: budget, costs, revenue, and funding opportunities.

The financial feasibility of an open parcel locker network in Mechelen depends on a careful balance between initial investment, ongoing operational costs, and potential revenue streams. While precise figures will require detailed business modelling, the following key elements can be identified:

Budget & costs

- Infrastructure investment: purchasing locker units, installation and integration with digital platforms. More than 50 lockers are already in place, so if bpost would continue its activities, the extra cost is mostly linked to placing additional lockers.
- Operational costs: maintenance, software updates, customer support, and energy consumption.
- Administrative costs: compliance with GDPR and safety standards.
- Enforcement and monitoring: ensuring interoperability and fair access for all logistics providers.
- Communication materials

Revenue opportunities

- Service fees: logistics providers paying a fee per parcel deposited or retrieved.
- Advertising: lockers can generate income through local advertising displays.
- Value-added services: integration with returns management, local retailers, or circular economy initiatives (e.g. drop-off points for reusable packaging).
- Reduced societal costs: while not direct revenue, benefits such as lower congestion, fewer emissions, and improved liveability represent significant long-term economic gains.

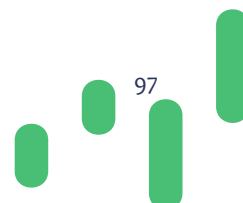
Funding opportunities

- European funding: EU programs can support innovative and sustainable logistics infrastructure.
- Regional and national support: Flemish government and Belgian federal funding for sustainable mobility and digital innovation.
- Public-private partnerships: co-investment models with logistics providers, real estate companies, and local businesses that benefit from increased foot traffic.
- Overall, a phased approach could be considered: starting with a pilot project supported by EU or Flemish funds, then scaling up.

6.3.8 Timeline and milestones

Phase 1 Preparation & partnership setup (months 1-4)

- Identify and confirm pilot partners (City of Mechelen, bpost, alternative couriers, tech provider, university).
- Define governance model and data-sharing agreements.
- Technical audit of existing locker infrastructure (hardware & API capabilities).
 - Milestone: Consortium agreement and technical framework validated.



Phase 2 System design & interoperability testing (months 5-8)

- Develop or adapt API for multi-operator locker access.
- Define user flow (courier access, end-user pickup, reporting).
- Conduct interoperability tests with at least two logistics operators.
 - Milestone: Working prototype of open locker interface demonstrated.

Phase 3 Pilot deployment (months 9-18)

- Select 1 or 2 locker sites in Mechelen city centre and one at the edge-of-town location.
- Launch real-life operations with participating logistics operators.
- Collect operational data: number of parcels, failed deliveries, emissions saved, user satisfaction.
 - Milestone: Pilot fully operational for at least 9 months with active data collection.

Phase 4 Evaluation & policy integration (months 19-24)

- Quantitative and qualitative evaluation of technical, economic and social impacts.
- Formulate recommendations for scaling up and integrating open locker principles into city policy.
- Engage with regional/federal actors (BIPT, VLAIO, ...) for regulatory follow-up.
 - Milestone: Final evaluation report and roadmap for long-term integration.

6.3.9 Evaluation and impact Assessment

The open locker feasibility study in Mechelen did not involve a live pilot, but the research nonetheless delivered valuable evidence and strategic insights. Its main impact lies in demonstrating that open access locker networks are technically feasible and policy-relevant, shifting the discussion from “if” to “how” such systems can be realized in practice.

From a technical point of view, interoperability between locker providers and logistics operators is already achievable. The main challenges identified were therefore governance and business alignment, rather than technological barriers. This finding represents an important step forward: it allows the city and its partners to focus future resources on developing shared standards, transparent pricing models and data-exchange protocols.

The impact of the study can thus be summarized in three dimensions:

- 1) Knowledge impact - providing the city with concrete, evidence-based understanding of locker interoperability.
- 2) Policy impact - clarifying what regulatory and governance conditions must be in place for open access models to work.
- 3) Network impact - creating trust and collaboration among stakeholders who previously operated in isolation.



6.4 Stakeholders and Governance

6.4.1 Stakeholder analysis and expertise needed

The feasibility study identified several stakeholder groups that are essential for the successful implementation of an open locker network in Mechelen. Each of them brings specific expertise and interests that must be aligned through transparent governance and clear data-sharing agreements. Key stakeholders include:

- Public authorities: City of Mechelen (Mobility, Environment, Economy), responsible for spatial planning, sustainable logistics policy, and coordination among partners.
- National regulators: The Belgian Institute for Postal Services and Telecommunications (BIPT), which oversees the regulatory framework for access to parcel locker networks and competition in the postal sector.
- Locker owners and logistics operators: bpost (current main operator in Mechelen) and potential new entrants such as InPost, Mondial Relay, DPD... These actors provide operational capacity and infrastructure.
- Technology providers and research institutions offering technical expertise on interoperability, API development and data governance.
- Regional and sectoral organizations: VLAIO Smart Region, VVSG, and logistics platforms that can facilitate replication in other Flemish cities.

For future implementation, additional expertise will be required in urban data management, contractual frameworks, interoperability standards, and business modelling - areas where collaboration with academia and private innovation hubs can be particularly valuable.

Opening lockers to multiple operators requires coordinated input from public authorities, logistics actors, technology providers, and end-users. Each brings essential expertise to ensure technical feasibility, regulatory compliance, and real-world usability.

Public authorities

Stakeholders: City of Mechelen, Flemish agencies (BIPT, VLOCA, ABB), national regulators.
Expertise needed: urban logistics, legal/regulatory knowledge (postal market, competition law, GDPR), procurement, governance, and stakeholder facilitation.

Logistics operators

Stakeholders: bpost (locker owner), competing carriers (DPD, PostNL, UPS...), zero-emission last-mile operators.

Expertise needed: operational insights into parcel flows and routing, locker access standards, service-level agreements, pricing models, and maintenance requirements.

Technology providers

Stakeholders: locker manufacturers, software/API providers, interoperability experts, research partners.
Expertise needed: API integration, cybersecurity, authentication, data protection, and long-term infrastructure management.

Retailers and end-users



Stakeholders: local SMEs, e-commerce retailers, residents.
Expertise needed: user needs, demand patterns, acceptance, accessibility issues, and barriers to adoption.

Academic and research partners

Stakeholders: universities.

Expertise needed: impact analysis, modelling, technical validation, and translating research into policy guidance.

6.4.2 Governance structure

Implementing an open locker ecosystem requires a governance model that balances regulatory oversight, operational coordination, and technical interoperability. The proposed governance structure distributes responsibilities across three complementary layers:

1. Regulatory and strategic layer - public authorities

Actors: City of Mechelen, Flemish regulators (BIPT, ABB, VLOCA), national postal authorities.

Role:

- Define the legal and policy framework for open access.
- Ensure compliance with competition rules, data protection, and accessibility standards.
- Facilitate multi-stakeholder agreements and long-term policy alignment.

2. Operational layer - logistics operators

Actors: bpost (current locker owner), competing carriers, zero-emission last-mile operators.

Role:

- Manage day-to-day operations, parcel flows, maintenance, and customer service.
- Coordinate shared service-level agreements and ensure reliable multi-operator access.
- Provide data for monitoring performance and impact.
- 3. Technical and innovation layer - technology providers & research partners

Actors: locker manufacturers, API/software providers, academic partners.

Role:

- Ensure interoperability standards, cybersecurity, and reliable API integration.
- Support pilots, testing environments, and iterative technical improvements.
- Validate performance and support scalability.

This layered governance structure ensures that:

- a) public authorities set the rules,
- b) operators implement them, and
- c) technology partners make interoperability technically possible.

It creates a stable foundation for transitioning from feasibility to real-world deployment in Mechelen.

6.4.3 Potential future steps for public acceptance and perception, outreach and engagement

For an open locker ecosystem to succeed in Mechelen, public acceptance and clear communication are essential. While the concept is largely invisible to most residents, its impact- fewer delivery vans, cleaner air, and more reliable parcel services - must be made visible. The following steps can support broad acceptance and stakeholder engagement:

1. Communicate the benefits clearly

Highlight how open lockers reduce traffic, emissions, and failed deliveries. Use simple visuals, neighborhood examples, and real data from the feasibility study to make the impact tangible.

2. Engage early with local SMEs

Organize info sessions and demonstrations for retailers, horeca, and smaller e-commerce shops. Their endorsement increases trust and speeds up adoption.

3. Run a small-scale pilot with public visibility

Even a limited pilot (e.g., one open-access locker bank) helps residents and operators experience the model first-hand. This creates credibility and reduces perceived risk.

4. Provide transparent governance updates

Share progress, agreements, and next steps through the city website and newsletters. Transparency reinforces trust among citizens, operators, and policymakers.

5. Integrate citizen feedback loops

Short surveys, feedback panels, and user testing moments help refine the service and demonstrate that the city values citizen input.

6. Align messaging with broader mobility and climate goals

Present open lockers as part of Mechelen's wider efforts on zero-emission logistics and livable neighborhoods. Framing it as a piece of a larger puzzle increases acceptance.

6.5 Conclusion and recommendations towards public authorities

The feasibility study confirms that an open locker ecosystem is technically achievable and strategically aligned with Mechelen's long-term goals for zero-emission logistics. Remaining barriers are primarily organisational, contractual and regulatory rather than technological.

Key conclusions

1. Technical feasibility exists, based on emerging European standards for interoperability. Alignment on APIs and operational protocols between operators is still required but achievable.
2. Governance is the main barrier: private competitors need a neutral, non-discriminatory framework that guarantees fair access.
3. Open lockers can reduce a portion of residential last-mile delivery traffic, depending on user uptake and service integration.
4. Residents, couriers and parcel operators benefit most, through fewer failed deliveries, fewer vans in neighbourhoods and improved efficiency.



5. Cities benefit indirectly via cleaner streets and reduced traffic pressure, particularly in dense areas.

Recommendations to Public Authorities

1. Establish a clear regulatory mandate for locker interoperability

Federal or Flemish authorities can play a key role in ensuring that the existing BIPT framework is applied consistently. A clear mandate on non-discriminatory access would accelerate market adoption.

2. Facilitate a neutral governance structure

A multi-operator governance model - ensuring transparent pricing, fair access and compliance with competition rules - is essential for long-term trust and investment.

3. Support cities in testing and implementation

Provide templates, legal guidance and optional funding channels so cities can explore open locker models without excessive administrative or financial burden.

4. Guarantee fair access for smaller market players

Ensure pricing transparency and straightforward onboarding for all certified operators, not only the largest parcel companies.

5. Integrate open lockers into wider urban mobility and climate strategies

Position open lockers as part of a broader package of zero-emission logistics measures, linking them to citywide air quality, congestion and liveability goals.

6. Promote inter-city knowledge sharing

Encourage collaboration between Belgian cities via networks such as VVSG and VLOCA. Harmonised approaches across cities reduce fragmentation and increase scalability.

7. Support long-term financial sustainability

While cities do not need to invest directly in locker infrastructure, they can provide the regulatory stability required for operators to commit long-term investments. Follow-up EU or regional programmes can help sustain momentum.

Desirability of replication?

Replicating the open locker interoperability model explored in Mechelen is attractive for many cities, but its desirability depends on local logistics patterns, operator presence, and political priorities. The feasibility study shows that the model is technically achievable and aligns with broader goals around cleaner logistics, but its success relies on both regulatory support and market readiness.

Why replication is desirable

Reduces fragmentation in the parcel locker landscape by enabling multiple operators to use the same infrastructure, improving the efficiency of last-mile delivery networks.

Supports cities' goals for reduced delivery traffic by shifting a portion of residential home deliveries to consolidated pickup points.

Strengthens consumer convenience by offering flexible pickup and return options, regardless of the parcel operator.

Creates a more level playing field where smaller logistics operators can access infrastructure that is typically dominated by one or two major players.

Aligns with European trends toward shared infrastructure, multimodal logistics, and data-driven urban freight management.

When replication is less desirable

Replication should be carefully considered in places where:

Locker density is low or unevenly distributed, making interoperability less impactful.

Local delivery patterns rely heavily on B2B or horeca delivery, which lockers do not influence.

Operators are unwilling to collaborate, making governance arrangements difficult or slow.

Political priorities lie elsewhere, or administrative capacity is limited.

Key insights for other cities

- a) Cities should view replication not as a simple technical copy, but as a strategic exploration requiring:
- b) A clear understanding of the local delivery ecosystem
- c) Early dialogue with locker owners and competing operators
- d) Alignment with broader mobility, climate and public space goals
- e) Regulatory clarity at regional or federal level to reduce friction between private parties

Overall assessment

Replication is desirable where conditions allow for meaningful impact on delivery flows, but it requires strong policy alignment, early stakeholder involvement and a realistic understanding of what lockers can - and cannot - solve within urban logistics.

Recommendations and advice for public authorities towards implementation: policy measures, next steps, projects, initiatives to be taken, etc.

Implementing an open, interoperable parcel locker system requires coordinated action across regulatory, operational, and strategic levels. The following recommendations translate the study's findings into concrete steps for public authorities.

1. Establish clear regulatory conditions for interoperability

- f) Ensure that the existing BIPT framework on shared access is actively applied.
- g) Provide guidelines on non-discriminatory access, data exchange formats, pricing transparency and service levels.
- h) Clarify the responsibilities of locker owners vs. parcel operators in shared models.

2. Develop a regional reference model

- i) Create a harmonised Flemish blueprint for locker interoperability: governance, legal templates, technical requirements and business models.
- j) This reduces local administrative burden and increases scalability across cities.

3. Facilitate a multi-operator governance structure

- k) Support the setup of a neutral governance mechanism (e.g., cooperative, concession model or public-private framework).
- l) Ensure compliance with competition rules and GDPR.
- m) Consider a regional or intercity governance body to reduce fragmentation.

4. Enable cities to start with low-risk experiments

- n) Provide optional funding, regulatory flexibility or legal support for feasibility assessments and micro-pilots.
- o) Encourage cross-city pilots so results are comparable and transferable.

5. Integrate open lockers into broader zero-emission logistics strategies

- p) Treat lockers as one tool within a wider package of measures (urban consolidation, LEZ/ZEZ strategies, curbside management, delivery time-windows).
- q) Use lockers strategically to support neighborhoods with high home-delivery pressure.

6. Enhance collaboration with parcel operators

- r) Facilitate structured dialogue between operators, especially in markets where one actor dominates locker infrastructure.
- s) Mediate discussions on shared pricing, data access, time-slot allocation and maintenance responsibilities.

7. Provide SMEs and citizens with a clear value proposition

- t) Explain the benefits (convenience, fewer delivery failures, fewer vans in narrow streets).
- u) Ensure tariffs remain predictable and fair across operators.
- v) Offer clear communication and user-friendly digital interfaces.

8. Ensure long-term financial sustainability

- a) Give private operators regulatory certainty so that they can invest in open lockers.
- b) Support cities with guidance on cost-sharing, concession models and public-space management.
- c) Encourage blended funding (EU, regional, private investment).

7 Feasibility Study: Prague

7.1 5.1 Background of urban logistics in Prague

7.1.1 Local plans and linked key initiatives – city’s logistics vision

Prague 6, formally the municipal district Prague 6 (Mestská část Praha 6), is the largest Prague district. The whole city of Prague has 22 municipal districts with their own town halls, which are also self-governing and have broader powers than smaller neighborhoods. These districts are often referred to as "municipal districts with extended powers" or simply large municipal districts. The population of Prague is approximately 1.4 million people. Prague 6 is located in the north-west of Prague. It covers 41.54 km² and has 100,600 inhabitants (31.12.2008). The administrative district of the same name comprises Prague 6 and municipal districts Lysolaje, Nebusice, Přední Kopanina and Suchbátka. Prague 6 includes cadastral areas Ruzyně, Liboc, Vešelava, Vokovice, Dejvice, Střešovice and parts of cadastral areas Brevnov, Sedlec, Bubeneč and Hradčany. The district contains several sites and cultural institutions. Also the biggest airport in the Czech Republic, the Václav Havel Airport Prague is located in this district.

There are many residential areas, the university campus is in the middle and on a side it borders with the Prague Castle and the Old Town. Evropská street is the main street connecting the center of the district with the airport.



FIGURE 32 THE LOCATION OF PRAGUE 6 WITHIN THE CITY AGGLOMERATION

Prague 6 is closely connected to the entire capital city of Prague in its mobility and sustainable mobility strategies. This integration is crucial for ensuring an efficient and sustainable transportation system that responds to the needs of residents and visitors. Within these strategies, logistics plays an important role, focusing on optimizing the transport of goods and services in the urban space.

Collaboration with other city districts and institutions enables the coordination of transportation and logistics measures, the support of ecological initiatives, and the development of infrastructure that contributes to improving the quality of life in the region. The goal is to create a harmonized and sustainable transportation system that is effectively linked to other parts of the city, thereby supporting overall mobility and logistics in Prague. This ensures not only the smooth flow of personal transportation

but also efficient and eco-friendly goods transport, which is essential for the development of the urban economy and sustainability.

Formal collaboration amongst the constituent municipal districts of Prague is secured through several mechanisms. Foremost amongst these is the co-ordination facilitated by the Prague City Hall, which serves as the central administrative body and oversees matters of city-wide import. Whilst the municipal districts enjoy self-governance, they also engage in collaborative efforts through various commissions, working groups, and co-ordinating bodies, addressing shared challenges, development planning, transport, environmental concerns, and other pertinent domains.

Cooperation with different city districts can pose a significant challenge, as varying administrative procedures are encountered, priorities, budgetary constraints, and communication channels that complicate the coordination of activities and the achievement of consistent results. Successful collaboration therefore requires careful planning, a clear delineation of responsibilities, and systematic communication tailored to local specifics.

Furthermore, both informal and formal agreements or contracts exist between the municipal districts, enabling the sharing of services, infrastructure, or joint projects. By way of illustration, certain functions, such as public transport, and security, are frequently co-ordinated at the city-wide level.

The focus is on connecting the transport infrastructure in Prague with an emphasis on modern and sustainable approaches is very relevant and aligns with current trends in mobility and environmental issues. The integration of zero-emission transport, new technologies, and means of transport is crucial for ensuring sustainable urban transport development.

7.1.2 Key Aspects and Challenges

The successful development of sustainable mobility in Prague 6 requires well-structured coordination among the district's departments (transport, environment, urban planning) as well as systematic cooperation with the Prague City Hall. A unified approach to planning and project implementation is essential to avoid duplication, prevent scheduling conflicts, and ensure that investments make sense within the broader metropolitan context.

A fundamental framework is provided by national programmes and strategic documents, such as the National Action Plan for Clean Mobility, whose objectives and measures must be consistently reflected in the preparation and delivery of local projects. These programmes set the course for emissions reduction, support the development of cycling infrastructure, and improve air quality, while also ensuring full compliance with applicable European Union regulations and directives.

The introduction of modern technologies and zero-emission transport is a key driver of change. This includes the development of charging infrastructure for electric vehicles, the expansion of shared mobility (car-sharing, bike-sharing), the integration of intelligent transport systems, including smart traffic management, and the support of efficient, smart last-mile logistics. These innovations increase system efficiency, reduce emissions, and enhance the quality of urban life.



Equally important is proactive engagement with the public. Involving residents in planning and decision-making, maintaining transparent communication, and applying participatory approaches significantly increase trust and support for proposed changes. Ongoing information-sharing, consultations, and feedback collection help better target measures and achieve sustainable, long-term outcomes.

7.1.3 Regulations in Logistics and Transportation

Prague 6 would be guided by integrated mobility planning that encompasses all modes of transport and aligns with city-wide strategies. New technologies and approaches will be tested through pilot projects, such as the introduction of low-emission zones or smart parking systems. The development of sustainable transport and the modernization of infrastructure will be systematically supported by leveraging available national and European funding programmes. The impacts of implemented measures on air quality, traffic conditions, and resident satisfaction will be continuously and regularly monitored and evaluated to enable timely strategy adjustments and to achieve lasting, sustainable outcomes. This vision and approach can help create a modern, sustainable, and efficient transport infrastructure that meets the needs of residents and environmental goals.

Regulations in logistics and transportation also affect districts like Prague 6. One key area is data protection and cybersecurity (Act no. 181/2024 - Act on Cybersecurity). With the increasing use of cloud solutions and the digitalization of logistics processes, there is a strong emphasis on protection against cyberattacks. Companies operating in Prague 6 must comply with European directives such as GDPR and implement advanced security protocols (GDPR – Act no. 110/2019, Regulation (EU) 2016/679 (General Data Protection Regulation)).

Laws related to logistics include those concerning road transport and roads; the key law regarding the placement of parcel lockers is Act No. 128/2000 - Act on Municipalities.

Another significant area of regulation is emission reduction and sustainability. The European Green Deal and strict CO₂ emission standards require logistics companies to transition to low-emission or zero-emission vehicles, optimize routes, and adopt eco-friendly packaging. In Prague 6, this is reflected in the promotion of electromobility, the establishment of low-emission zones, and the development of charging infrastructure for electric vehicles.

This situation entails an inevitable need to establish communication with logistics companies, as they have hitherto operated predominantly within the private sector, conducting their activities according to their own requirements. In the future, they will be subject to increased pressure from the city authorities, specifically from the entire City of Prague, with the aim of ensuring coordination and compliance with established regulations and objectives.

In terms of working conditions and social regulations, directives on the posting of workers and regulations on drivers' working hours in line with current laws and regulations play a crucial role. These rules ensure fair working conditions and road safety, which impact logistics operations even in urban districts like Prague 6.



Regulations also support digitalization and standardization. Logistics companies may be required to use electronic documents for the transportation of goods within the EU, simplifying administration and increasing transparency. Prague 6, as part of the capital city, may be involved in implementing these changes, for example, through the modernization of logistics centres and the introduction of intelligent traffic systems. Based on this, Prague 6 is also striving to gather information from projects that could contribute to future development. At the same time, it is actively analysing possibilities and further developments to effectively respond to new requirements and trends in the field of digitalization and logistics modernization.

Prague 6, with its strategic location and well-developed transportation infrastructure, plays a key role in implementing new trends and regulations in logistics. This district is not only an important hub for goods distribution but also a testing ground for innovative technologies such as autonomous vehicles, intelligent traffic systems, and sustainable energy sources. Thanks to its well-developed transportation infrastructure, openness to innovation, and emphasis on sustainable development, Prague 6 plays a key role in introducing new logistics trends. A crucial role in this process is also played by the Czech Technical University (CTU/ČVUT), which, as part of Prague 6, actively participates in the development and implementation of innovative solutions for more efficient and environmentally friendly transportation.

For example, the establishment of low-emission zones and the promotion of electromobility in Prague 6 may contribute to meeting the goals of the European requirements. Additionally, projects focused on sustainability, such as the use of renewable energy in logistics centres or the promotion of recyclable packaging, are being developed in the district.

Logistics and transportation in the Czech Republic are undergoing a major transformation driven by technological innovations, increasing demands for sustainability, and stricter regulations. Prague 6, as a significant district, is becoming an important part of this system. The implementation of modern technologies, support for sustainability, and adherence to new regulations contribute to more efficient and environmentally friendly logistics operations, positively impacting the entire industry and the quality of life for residents.

Václav Havel Airport, situated in Prague 6, is the largest airport in the Czech Republic and serves as a key logistics hub not only for Prague 6, but for the entire nation. It facilitates the rapid transportation of goods and passengers, supports international trade, and ensures integration into global logistics networks. In this capacity, the airport significantly influences transportation, the economy, and the development of both the region and the country.

Regrettably, the airport is not currently connected to the railway network, which limits its logistics potential and the convenience of transportation. Nevertheless, preparations are underway for the construction of a railway link between the centre of Prague and the airport, which is expected to significantly enhance the airport's accessibility and reinforce its role within the European transport infrastructure. The implementation of this project is anticipated to provide faster and more convenient transport for both passengers and goods, thereby further increasing the airport's importance as a modern logistics hub.



7.1.4 Existing projects and trends

Prague 6 is currently engaged in several projects, with a particular emphasis on mobility. One of these projects (**DISCO**) focuses on new trends in urban logistics, aiming to enhance the quality of life for residents and visitors alike. This initiative seeks to empower end-to-end processes across the supply chain by leveraging smart data collection, effective street management, and the optimization of shared spaces. By integrating these elements, the project aims to create a more efficient and sustainable urban environment that meets the needs of the community.

Another significant project (**Gemini**) concentrates on car sharing and bike sharing, addressing the broader concept of micro-mobility. This initiative recognizes the growing demand for flexible transportation options and aims to provide residents with convenient alternatives to traditional car ownership. One of a key component of this project may be "MaaS" – Mobility as a Service, which integrates various transportation services into a single accessible platform. This approach not only simplifies the user experience but also promotes the use of sustainable transport options, ultimately contributing to a reduction in traffic congestion and environmental impact in the city.

Prague 6 anticipates that these projects will unlock new opportunities and enable more efficient operations within the district. The expected outcomes include improved mobility options for residents, enhanced sustainability, and a higher quality of life through innovative transportation solutions and optimized urban logistics.

7.2 Replicability and lessons learned from URBANE's Living Labs

7.2.1 Lessons learned and what can be adapted to Prague's local context (adopting options)

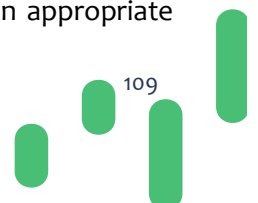
The Prague 6 district could focus on two distinct concepts related to last-mile delivery. The first involves shared lockers located in public spaces, which provide residents with a convenient place to collect parcels while reducing reliance on individual home deliveries. The second concept relates to Nearby Delivery Areas (NDAs), that is, designated zones situated close to residential areas where consignments intended for a wider group of recipients are consolidated. While shared lockers represent a tangible physical infrastructure, NDAs serve as a broader organisational framework that may integrate various forms of delivery points and contribute to greater efficiency and sustainability in urban logistics.

Thessaloniki LL

Prague 6 could draw inspiration from the experiences of the URBANE project in LL Thessaloniki, where the effective use of lockers is one of the elements of sustainable urban logistics.

Prague 6 is considering the **installation of parcel lockers in public open-air spaces**. These lockers would likely not be designated exclusively for a single company, but could instead be shared by multiple businesses for the delivery and collection of parcels.

In practice, this means that in certain locations there is a higher concentration of lockers from various companies, which leads to inefficient use of space and reduced accessibility for residents. Therefore, shared lockers, which could serve multiple providers simultaneously, are perceived as an appropriate



solution. Some companies are already making use of shared lockers on their own initiative, which demonstrates that this model is feasible and brings tangible benefits.

It would be appropriate to **conduct an analysis of the current situation** and to pose similar questions to those addressed in LL Thessaloniki – namely, to map the distribution of lockers within Prague 6, assess their capacity, accessibility, and utilisation, benefits and also to identify areas with either insufficient or excessive provision of lockers. The results of such an analysis would enable a better understanding of the current needs of residents and the efficiency of the existing system, which is crucial for designing an effective solution.

At the same time, it would be essential to **initiate a dialogue with private providers** of parcel lockers. Prague 6 would like to jointly discuss the possibilities of sharing lockers, coordinating their placement, and the potential use of public spaces. Cooperation with the main operators may lead to more efficient use of infrastructure and improved service accessibility for residents.

From a logistics perspective, the hub and spoke system is also of great interest, whereby deliveries are organised through an **agnostic micro consolidation centre** and subsequently distributed to individual lockers. This model can contribute to more efficient operations, a reduction in the number of vehicles on the streets, and, overall, a more sustainable urban environment.

The experiences gleaned from the Thessaloniki living lab offer valuable insights for the development of urban logistics in Prague 6. Specifically, the **implementation of a digital twin** could prove instrumental in simulating and optimising urban logistics in real-time, leading to more efficient planning of parcel locker networks, enhanced parcel tracking, and a reduction in overall environmental impact. Similarly, the integration of blockchain technology holds significant potential for increasing transparency and reliability in the tracking and tracing of consignments across multiple service providers.

However, a critical prerequisite for the successful adoption of these innovations is the **availability and sharing of data**. A common challenge encountered in practice is the reluctance of private entities to provide detailed operational information, which is indispensable for effective data-driven planning. Therefore, it is imperative to explore avenues for collaboration and incentivise companies to share relevant data, perhaps through public-private partnerships (use of public spaces) or mutually beneficial agreements.

Concurrently, any proposed solutions must meticulously consider **user preferences**. Factors such as willingness to walk to parcel lockers, price sensitivity, and desired delivery speed are paramount. A judicious combination of advanced technology, data analytics, and a keen understanding of residents' needs can pave the way for a more efficient, sustainable, and user-friendly urban logistics system in Prague 6.

The experience from LL Thessaloniki may demonstrate that a coordinated approach to the development and operation of lockers, including the involvement of public spaces and collaboration between the city and private companies, can bring significant benefits both for residents and for the city itself. Prague 6 would therefore like to open a discussion regarding the possibilities of shared lockers and the potential



inclusion of public spaces in this system. Prague 6 must also ask itself similar questions to those considered during the study conducted in LL Thessaloniki.

Bologna LL

Prague 6 could significantly enhance its last-mile logistics by implementing a similar system related to the lockers in LL Bologna. This model, also in connection with LL Thessaloniki, offers a range of benefits that could also prove advantageous for the Prague district. Prague 6 could, within the framework of the LL Bologna, draw particular technical inspiration from the implementation of **shared lockers**; however, the LL Thessaloniki project remains the primary source of inspiration.

Within the framework of the study, shared parcel lockers appear suitable, for example, for districts such as **Dejvice**, which have historically high population density, as well as for areas like **Dědina**, where a large number of residents live within a large housing estate.

A system of automated micro-hubs, situated on the periphery of the historical centre, has demonstrated a notable reduction in CO₂ emissions and an improvement in delivery quality. Instead of traditional door-to-door delivery, van drivers deposit parcels at these hubs, from where they are subsequently distributed into the centre using light electric vehicles.

Prague 6 could similarly establish strategically located micro-hubs on the borders of its busiest areas, thereby restricting the entry of delivery vehicles into residential zones and alleviating traffic congestion. Each hub could be equipped with a modular system of lockers in various sizes (small, medium, large). The application of specific lockers would depend on particular requirements; however, the specifications of lockers used in LL Bologna may serve as inspiration.

- The implementation of such a system would yield:
- A reduction in CO₂ emissions and an improvement in air quality
- A limitation of traffic congestion in residential areas
- More efficient deliveries with fewer failed attempts
- Enhanced security of parcels

7.2.2 Use of the Transferability Platform and Digital Tools

We find the tool presented at the provided link (<https://ia-radar.imet.gr/locker-network-optimization>) very interesting and promising. Its capabilities in locker network optimization could offer valuable support for our logistics and distribution processes. The approach and technology behind this tool align well with our goals to improve efficiency and customer service.

However, at this moment, we do not have complete data from private companies, which limits our ability to fully leverage such a tool. Access to comprehensive and accurate data is essential for effective implementation and optimization. We hope to address this gap in the near future to enable productive collaboration and make the most of this promising solution.

Adding to our previous assessment, we believe that a tool like the locker network optimization system presented could be highly adaptable and applicable to the specific context of Prague 6. given the district's



strategic location, diverse population, and ongoing efforts to enhance urban logistics, the ability to optimize locker placements and network efficiency would be particularly beneficial. This will involve the challenge of convincing private stakeholders to optimize their networks.

A system of parcel lockers does currently exist in Prague 6, these lockers are installed by individual private companies and are mostly located on private land. At present, Prague 6 does not provide public spaces for these lockers. Similar parcel locker systems are already operating throughout Prague and in other cities across the Czech Republic; the still vast majority are operated by private companies, and the lockers themselves are situated on privately owned land.

7.3 Innovation/use case – Operational Feasibility (SWOT analysis)

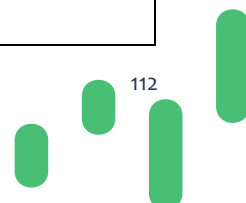
7.3.1 Vision and objectives - description and benefits

Prague 6 is evaluating the feasibility of adopting certain outputs from the URBANE project within the framework of its sustainable urban logistics strategy, which forms part of a broader objective to enhance the quality of life for residents and protect the environment. The primary aim of this initiative is to optimise the last-mile delivery system for parcels, rendering it more efficient, environmentally friendly, and amenable to residential areas. Drawing inspiration from the experiences in LL Thessaloniki and LL Bologna may facilitate the implementation of a coordinated system of shared parcel lockers and micro-hubs, which will reduce the number of vehicles in the city centre and lower CO2 emissions, thereby contributing to the sustainable development of urban transport.

This study will serve as a basis for the planning and implementation of innovative solutions in the field of urban logistics, fostering collaboration between the public sector and private service providers. The feasibility assessment of introducing shared parcel lockers and micro-hubs in Prague 6 will be crucial for the effective utilisation of public spaces, enhancing service accessibility for residents, and alleviating traffic congestion in residential areas. In this manner, it will be possible to fulfil the general objectives of sustainable urban development and contribute to the city's ecological and social prosperity.

TABLE 21 THE SWOT ANALYSIS

Strengths	Weaknesses
<ul style="list-style-type: none"> Strategic location with well-developed transport infrastructure, including Václav Havel Airport Ongoing sustainable mobility initiatives Strong institutional coordination between municipal districts and Prague City Hall Potential for collaboration with Czech Technical University (ČVUT) on innovative solutions Existing parcel locker systems demonstrate feasibility and user acceptance 	<ul style="list-style-type: none"> Parcel lockers mainly on private land, resulting in inefficient use of space and limited access Lack of designated public spaces for shared parcel lockers, causing uneven distribution Limited data sharing by private logistics companies, hindering network optimisation Absence of a rail connection to Václav Havel Airport restricts logistical potential Need for improved integration of digital tools and comprehensive data availability
Opportunities	Threats
<ul style="list-style-type: none"> Introduction of shared parcel lockers in public spaces, improving infrastructure utilisation 	<ul style="list-style-type: none"> Regulatory challenges (GDPR, emissions standards, labour laws)



<ul style="list-style-type: none"> • Establishment of micro-hubs on the periphery to limit delivery vehicle entry into residential areas • Deployment of digital platforms for optimising the parcel locker network and delivery routes • Growing public and political support for emissions reduction and smart city solutions • Inspiration from successful initiatives in Thessaloniki 	<ul style="list-style-type: none"> • Scepticism from private logistics firms regarding increased coordination and new requirements • Negative impact on the visual and spatial arrangement of public spaces (requires sensitive design) • Cybersecurity risks associated with the digitalisation of logistics processes • Delays in infrastructure projects, such as the airport rail link, may limit anticipated benefits
---	--

7.3.2 Strengths and Weaknesses – current status

Prague 6 possesses several strengths that support the realization of this vision. These include a strategic location with a well-developed transport infrastructure, notably Václav Havel Airport, which serves as a key logistics hub. Additionally, projects focused on sustainable mobility have already commenced in the area. Strong institutional coordination between the municipal districts and the Prague City Hall enables unified planning and implementation of projects. The Czech Technical University (ČVUT) could actively contribute to the development of innovative transport solutions. The existing parcel locker system, operated by private companies, demonstrates feasibility and user acceptance.

Conversely, weaknesses lie in the fact that parcel lockers are predominantly situated on private land, leading to inefficient use of space and accessibility issues. There is a lack of public spaces designated for shared parcel lockers, resulting in uneven distribution and potential oversaturation in certain locations. Limited data sharing by private logistics firms hinders full network optimization. The absence of a rail connection to Václav Havel Airport restricts logistical potential. Furthermore, there is a need to improve the integration of digital tools and ensure the availability of comprehensive data.

7.3.3 Opportunities and Threats

Opportunities include the potential to introduce shared parcel lockers in public spaces, leading to better infrastructure utilization and increased service accessibility. Establishing micro-hubs on the periphery of the municipal district could restrict the entry of delivery vehicles into residential areas, thereby reducing traffic congestion and improving the quality of life for residents. Digital platforms for optimising the parcel locker network represent a further opportunity for enhancing efficiency. Growing public and political support for emissions reduction and smart city solutions creates a favorable environment for the implementation of these projects.

Threats lie in regulatory challenges, which include compliance with GDPR, emissions standards, and labour laws. Private logistics firms may be skeptical towards increased coordination and requirements, which could complicate implementation. The installation of parcel lockers may negatively affect the visual and spatial arrangement of public spaces, necessitating sensitive design and planning. The digitisation of logistics processes introduces cybersecurity risks that must be managed. Delays in infrastructure projects, such as the airport rail link, could limit the anticipated benefits.



7.3.4 Identification of opportunities

A key opportunity lies in establishing a coordinated dialogue with private parcel locker operators, enabling shared use and integration into public spaces. Inspiration can be drawn from Bologna and Thessaloniki, where such approaches have led to reductions in CO₂ emissions and improvements in delivery quality. The utilisation of smart data and intelligent traffic management will allow for the optimisation of delivery routes and the placement of parcel lockers. The development of electromobility and infrastructure for light electric vehicles will support environmentally friendly last-mile deliveries. Modular parcel locker systems, adaptable to various parcel sizes and locations, will enhance flexibility and efficiency.

Key opportunities include the introduction of shared parcel lockers in public spaces, which will improve the utilisation of existing infrastructure and provide more convenient access for residents. Micro-hubs can be established on city outskirts to limit the entry of delivery vehicles into residential areas, reducing traffic load and emissions while streamlining the last mile. Digital platforms will play a crucial role by enabling smart network planning for lockers and optimising delivery routes. These steps are supported by growing public and political momentum for emissions reduction and smart city solutions, with inspiration drawn from successful initiatives in Thessaloniki.

Additional potential lies in the development of electromobility and infrastructure for light electric vehicles, which are ideal for quiet and clean operation in urban environments. Implementing modular and flexible parcel locker systems will allow rapid scaling and adaptation to local needs, from temporary installations to robust nodes in high-demand locations. Combining these approaches can significantly increase the efficiency of urban logistics, improve neighbourhood quality of life, and strengthen the long-term sustainability of transport flows.

7.3.5 Analysis of challenges

The main challenges include ensuring coordination between the various departments of Prague 6 and the Prague City Council to enable unified planning and implementation of projects. And the integration of other Prague's districts' systems. Additionally, it is necessary to balance the placement of parcel lockers to prevent visual pollution of public spaces and to preserve their quality, which requires adherence to manuals and urban planning guidelines. Obtaining comprehensive data from private logistics companies is essential for effective digital optimisation, although this may prove challenging. Navigating complex regulatory frameworks, including data protection, emission standards, and labour law, presents a further challenge. Finally, managing public acceptance of the project through transparent communication and participatory planning is crucial.

7.3.6 Risk mitigation

For risk management, it is advisable to utilise the outputs from pilot projects or from the URBANE project within other living labs that focus on similar issues. An important aspect is the monitoring of environmental and social impacts. The design of parcel lockers should be modular, mobile, and visually adaptable to minimize negative spatial effects. Outputs from this project can also serve as valuable guidance in this regard.

It is essential to establish clear data-sharing agreements and cybersecurity protocols with logistics entities. Early involvement of all stakeholders, including residents, private companies, and regulatory authorities, will help build consensus and support. Lastly, implementation must align with national and European strategies to ensure regulatory compliance.

We have an established risk management system that continuously identifies, evaluates, and monitors individual risks throughout the project. Each risk will be actively managed by assigning responsibilities, setting early warning indicators, and implementing appropriate preventive and corrective measures. In line with available options and priorities, risks will be systematically mitigated to minimize their impact on the project's schedule, budget, quality, and overall objectives.

At present, the results of the elections in the autumn of 2026 are viewed as one of the main risks, as they will fundamentally determine the strategic direction of the municipal district—and thus the future of this project. The political priorities of the new leadership may affect the scope, timeline, and budget.

7.3.7 Action Plan Brainstorm

The action plan should commence with a detailed analysis of the current network of parcel lockers, including their capacity and utilisation, followed by the organisation of workshops with stakeholders to discuss models of shared parcel lockers and the use of public spaces. Subsequently, pilot micro-hubs equipped with modular parcel lockers and a fleet of electric delivery vehicles should be developed. Digital tools for optimising the parcel locker network and real-time monitoring should be integrated at the earliest opportunity.

As part of the proposed action plan, a feasibility study to verify the project's viability and identify key assumptions will be conducted. Based on its findings, a detailed implementation plan will be developed during 2026, including a timeline, milestones, responsibilities, and resource allocation. Subsequently, we will proceed with potential budget determination, taking into account identified priorities, scope of work, and cost optimization.

- Analysis
- Implementation Plan
- Budget

Required digital and physical infrastructure

From an infrastructure perspective, it is essential to develop a digital platform for optimising the parcel locker network—potentially inspired by the URBANE tool, Radar—enabling real-time parcel tracking, analytical capabilities, and cybersecurity. Physically, the installation of modular parcel lockers of various sizes is required, with micro-hub facilities located on the outskirts of the district serving as a potential solution, alongside charging stations for electric delivery vehicles. All of these elements are interconnected with the overall transport strategy of Prague 6 and, ultimately, with the broader strategy of the City of Prague.

Integration with the existing system The integration of the new system should be coordinated with existing private parcel locker operators to enable shared access and optimise spatial distribution. This integration will involve aligning the private sector's current operations and established services with a network of parcel lockers located on publicly accessible sites, including the negotiation of access arrangements, harmonisation of technical and operational standards, and coordinated spatial planning. Stakeholder engagement will be crucial at this stage, both for the timely identification of the needs and expectations of all parties and for securing their buy-in, aligning priorities, and minimizing risks arising from potential ambiguities or resistance to change.

7.3.8 Regulatory and legal frameworks: required permits, compliance, GDPR, etc.

The regulatory framework requires compliance with GDPR for the protection of personal data within digital logistics systems, adherence to the emission standards set forth by the European Green Deal — including the transition to low- and zero-emission vehicles — and observance of labour laws concerning working hours and conditions. The installation of parcel lockers in public spaces must be authorised in accordance with the relevant manuals and urban planning guidelines. The project must be coordinated with municipal and national authorities, particularly regarding infrastructure development and the acquisition of funding. It is also important to reflect the significant changes and the role of regulations already mentioned earlier in this document, particularly those concerning cybersecurity (a current trend) and GDPR.

7.3.9 Financial Feasibility Estimations: Budget, Costs, Revenue, and Funding Opportunities

In the future, the budget will be determined only after a detailed implementation plan has been prepared by the city hall. This plan will be based on local needs and priorities and will also take into account the relevant findings and recommendations of this feasibility study. Only on the basis of a refined scope of work, schedule, and expected outputs will it be possible to responsibly quantify and approve the budget.

At the same time, potential funding sources (including grant programs or partnerships) may be systematically considered in subsequent phases of the process, with regard to suitability, availability, and timing

7.3.10 Timeline and Milestones

In 2026, an implementation plan should be prepared and the related principles should be approved. As part of this implementation plan, it is also possible to consider the outputs of this feasibility study. At the same time, it is essential to account for risks arising from potential changes in the political leadership of the municipal district. Upon completion of the implementation plan, third parties (stakeholders) will also be invited to participate in the next steps.

Evaluation and Impact Assessment

Evaluation and impact assessments should be conducted regularly, with particular attention paid to levels of CO₂ emissions, traffic congestion, and air quality. Additionally, user satisfaction surveys and monitoring



of delivery success rates should be carried out. The impact on public spaces and the visual integration of parcel lockers should also be thoroughly assessed.

7.4 Stakeholders and Governance

7.4.1 Stakeholder analysis and expertise needed

The stakeholders in general in the field of urban logistics in Prague 6 primarily include the Prague 6 municipal district and its individual departments (transport, environment, urban development), the Prague City Hall, private logistics companies (in particular, operators of parcel lockers and carriers), providers of digital platforms, the Czech Technical University (CTU) and other research institutions, residents, and local entrepreneurs. Václav Havel Airport also plays a significant role as a logistics hub.

For the successful implementation of innovations, it is necessary to involve experts in urban planning, transport, digitalisation and cybersecurity, as well as specialists in sustainable mobility, lawyers specialising in GDPR and labour law, experts in public participation and communication, and data analysts for the optimisation of the parcel locker network and route planning.

Cooperation with parcel locker operators and carriers is also crucial, as they must be willing to share data and participate in joint projects, for example in the area of shared lockers in public spaces. The involvement of CTU enables the utilisation of the latest technologies and research findings.

Analysis and key players

Primary Public Stakeholder – Prague 6 Municipality

The Prague 6 municipal district is the key stakeholder, as it is both the author of this feasibility study and the authority responsible for regulating the use of public space. Its role is to ensure that shared parcel lockers are introduced in line with city-wide strategies, European sustainability goals, and urban planning regulations. The municipality acts as the central coordinator, balancing logistics efficiency with environmental and social objectives, while safeguarding the quality and accessibility of public space for residents.

Private Logistics Companies

Private logistics companies represent one of the principal stakeholder groups, as they already operate parcel lockers on private land and directly manage last-mile delivery processes. However, establishing effective communication with these actors is often challenging. They tend to prioritise their own commercial strategies and may be reluctant to engage in coordinated, shared solutions initiated by public authorities. A critical task, therefore, is to demonstrate convincingly that the implementation of shared parcel lockers in public space is also aligned with their own interests – for example, by reducing operational inefficiencies, cutting costs, and improving accessibility for customers. Building mutual trust and a clear framework of benefits will be essential for their active participation in the project.



TABLE 22 STAKEHOLDER MATRIX – POWER VS. INTEREST

Stakeholder Group	Power (influence over decision-making)	Interest (level of involvement/impact)	Engagement
Prague 6 Municipality	High – determines use of public space and leads the study	High – initiator and regulator of project	Key Player
Prague City Hall (Central Authority)	High – coordinates city-wide policies, permits, EU compliance	Medium – not directly implementing, but strategic oversight	Keep Satisfied
Private Logistics & Delivery Companies	Medium – operate lockers & control last-mile delivery	High – business operations depend on locker network	Manage Closely
Residents & Local Community	Low-to-Medium – limited formal power, but can influence acceptance	High – direct users and beneficiaries	Keep Informed
Residents & Local Community	Low-to-Medium – limited formal power, but can influence acceptance	High – direct users and beneficiaries	Keep Informed
Czech Technical University (CTU) & Research Institutions	Medium – expertise and innovation influence implementation	Medium – supportive but not decisive	Collaborate/Consult

7.4.2 Governance structure

Project management in the field of urban logistics in Prague 6 is carried out in close cooperation between the Prague 6 municipal district and the Prague City Hall, which ensures coordination at the city-wide level. Municipal districts have self-governing powers, but also participate in joint committees, working groups, and coordinating bodies that address shared challenges in transport, the environment, and development.

Both formal and informal agreements between municipal districts enable the sharing of services, infrastructure, and the implementation of joint projects. The involvement of the specialist departments of the municipal district (transport, urban development, environment) and their coordination with the City Hall is key. Cooperation with research institutions (such as CTU) and the private sector also plays a significant role.

For the successful implementation of innovations, it is essential to establish clear rules for data sharing, cybersecurity, and the protection of personal data (GDPR), as well as transparent processes for permitting the installation of parcel lockers in public spaces.

7.4.3 Potential future steps for public acceptance and perception, outreach and engagement

For the successful implementation of innovations in urban logistics, it is crucial to gain public support and trust. Further steps may be included:



- **Participatory Planning:** Organising public workshops, round tables, and online consultations where residents can express their needs, comments, and suggestions regarding the placement of parcel lockers, micro-hubs, or electric vehicle routes. Active public involvement increases the likelihood of project acceptance and eliminates potential conflicts.
- **Information and Awareness Campaigns:** Transparent communication regarding the objectives, benefits, and possible risks of the projects (e.g. reduction of emissions, improvement of air quality, reduction of traffic in residential areas, increased security of deliveries). Explaining how new technologies and shared infrastructure will contribute to the quality of life in Prague 6.
- **Regular Impact Assessment:** Monitoring and publishing results (e.g. CO₂ emission savings, reduction of traffic load, user satisfaction, visual impact on public space). Openness in communicating results strengthens public trust.
- **Sensitive Urban Integration:** Cooperation with architects and urban planners in the design of parcel lockers and micro-hubs so that they do not disrupt the aesthetics and functionality of public spaces. The possibility of using modular and mobile solutions that can be adapted to specific locations.
- **Dialogue with the Private Sector:** Active negotiations with parcel locker operators and logistics companies regarding the possibilities of sharing infrastructure, coordinating locations, and using public spaces. Drawing inspiration from cities such as Thessaloniki or Bologna, where similar approaches have led to emission reductions and improved delivery quality.
- **Use of Digital Tools:** The adoption of modern platforms for optimising the parcel locker network, route planning, and real-time monitoring. These tools will enable more efficient operations and a better response to the needs of residents.

7.5 Conclusion and recommendations towards public authorities

Prague 6 has strong prerequisites for modernizing urban logistics: a strategic location with an airport, institutional capacities, and existing acceptance of parcel lockers. However, a key barrier is the fragmented network of lockers on private land, limited data sharing, and the lack of public infrastructure for a shared, multi-operator solution. The aim should therefore be an integrated architecture combining shared lockers in public space, micro-consolidation hubs at the edges of congested zones, and a digital optimization platform for the design and management of the network.

Experience in Thessaloniki and Bologna confirms that coordinated locker networks and micro-hubs can reduce emissions, improve delivery efficiency and alleviate traffic congestion in residential areas. These approaches are highly transferable to Prague 6, particularly in densely populated areas such as Dejvice and Dědina. However, success depends on data collaboration with operators, clear standards, urbanistically sensitive location selection, and transparent public participation.

The recommended approach is incremental: first mapping and analyzing the existing network, then an implementation plan, and the deployment of potential digital tools for optimization and monitoring. Governance should ensure robust frameworks for GDPR/cybersecurity and conditions for private partners in exchange for access to public space, which will be addressed in the future as part of third-party involvement. A program conceived in this way is realistic, aligned with municipal strategies, and has the potential to tangibly improve the quality of life for the residents of Prague 6.

Desirability of replication?



Recommendations and advice for public authorities towards implementation: policy measures, next steps, projects, initiatives to be taken, etc.

An important next step is to develop an implementation plan that reflects current standards and methodologies, clearly defines the schedule and implementation milestones, and systematically incorporates the outputs of this feasibility study. The plan should also include risk management, definition of responsibilities, success metrics, and a framework for ongoing impact evaluation. It is also essential to thoughtfully design and structure the involvement of third parties, especially relevant private companies, and, in connection with this, coordination with the authorities of Prague's municipal self-government to ensure substantive, legal, and procedural continuity.

Within the scope of policy measures, it is necessary to take into account the municipal elections planned for autumn 2026, the results of which may influence the strategic direction of the city district. We therefore recommend choosing an implementation model that ensures the stability of key activities across electoral cycles, including a transparent governance framework, continuous communication with the public and stakeholders, and prepared scenarios in the event of changes in political priorities. This approach will minimize project interruptions and strengthen the predictability and legitimacy of the entire process.

At the same time, it is advisable to draw on the practices of LL Thessaloniki and LL Bologna, which this study repeatedly references. Particularly inspiring are the experiences with shared parcel lockers, potential placement in public spaces, coordination with private operators, and the use of digital tools to optimize the network. For Prague 6, it is possible to adopt principles of shared infrastructure, the introduction of micro-hubs at the interfaces of high-demand zones, and the participation and negotiation procedures with service providers that were implemented in the aforementioned living labs.

8 Feasibility study: Ravenna

8.1 Background of urban logistics in Ravenna

8.1.1 Local plans and linked key initiatives – city’s logistics vision

Ravenna is a city with 8 UNESCO monuments and 6 of them are in the central area, where there is also a very high concentration of shops, restaurants, hotels and commercial activities in general. As easy to imagine, the narrow streets are crawled of people but also traffic, and delivery means represent a relevant part of the total amount, with problems of congestion, pollution, road safety and liveability. The growing number of couriers, combined with the increase in tourists, has highlighted the need to rethink delivery management in the historic centre. An urban logistic plan of the historical centre of Ravenna must take into consideration, from one hand the desires shared by all citizens of attractiveness, healthiness, urban quality, etc., on the other hand the needs of shopkeepers/business owners in order to manage successfully their activities.

The path to regulate the accesses in the historic centre started in 1990, with the implementation of the first Limited Traffic Zones (LTZ) and pedestrian areas within the city centre, starting with the main square, Piazza del Popolo, at that time used as a parking area. During the years, often facing hostility from citizens and shopkeepers, worried to loose parking slots and clients, the LTZ has been expanded to its current size, to cover the whole historical area:

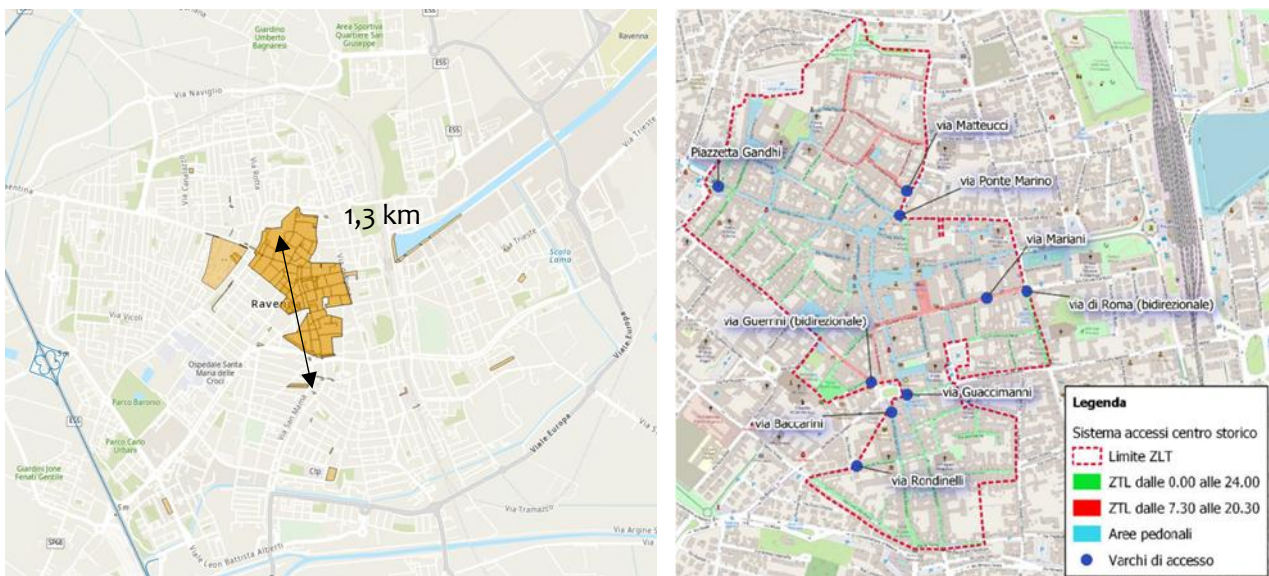


FIGURE 33 RAVENNA LTZ (LEFT) AND ACCESS SYSTEM FOR THE HISTORIC CENTRE (RIGHT)

In a wider area, roughly covering the rest of the city, limitations on vehicles are set up according to the following plans, that impact on the logistic organization of freight delivery are displayed and explained at Table 23 below

TABLE 23 PLANNING AND POLICY INSTRUMENTS AT REGIONAL AND MUNICIPAL LEVEL IN RAVENNA

o	Scale	Effects on urban logistics
PAIR (Air Quality Integrated Plan)	Regional	<ul style="list-style-type: none"> ▪ Extension of: LTZ, pedestrian areas, 30 km/h areas, preferential lanes; ▪ Structural limitation of private circulation in residential areas on weekdays (Mon-Fri 8.30 – 18.30): no diesel Euro 5; ▪ Increasing number of charging stations for electric vehicles; ▪ Sustainability and optimization of short-haul freight logistics: <ul style="list-style-type: none"> ▪ a) Develop an app for the optimization and statistical detection of short-haul freight transport in order to increase the average saturation of vehicles in circulation: fuller trucks and vans, fewer vehicles in circulation, fewer total kilometres travelled. ▪ b) Promote the spread of cargo bikes for freight transport in urban areas, also through funding. ▪ Harmonization of Limited Traffic Zone (ZTL) rules for urban logistics; ▪ Promotion of homogeneous access methods for commercial vehicles to ZTLs in the main municipalities; ▪ Limiting access for the most polluting trucks and vans, optimization of routes and remote acquisition of permits.
SUMP	Municipal	<ul style="list-style-type: none"> ▪ Extension of: LTZ, pedestrian areas, 30 km/h areas, preferential lanes;
PGTU (General Urban Traffic Plan)	Municipal, urban area	<ul style="list-style-type: none"> ▪ Extension of: LTZ, pedestrian areas, 30 km/h areas, preferential lanes;

Delivery in LTZ:

After Ravenna, many other cities in Emilia Romagna Region implemented their own LTZ; in 2013 the Region started its first attempt to standardize the access windows, defining a common minimum time interval: 9:00 – 10:30 and 15:00 – 16:30.

During the years, with the extension of the areas, small changes have been introduced.

The regional scale standardization of timetables and rules is still ongoing.

In 2025, LTZ deliveries in Ravenna requires a specific “TM” pass: it costs 20€/year, applicants must prove their activities in the LTZ area with contracts and procurements.

Time windows to access the LTZ:

- from 3 am to 10 am – pedestrian area included
- from 2 pm to 4 pm

Electronic controls with cameras are active.



A heavy vehicle LTZ is active in a wider ring around the city.

Local plan and linked key initiatives – city’s logistics vision 2025

Due to the small dimension of the historical centre, less the 1,5 km diameter, the possibility to optimize the participatory process of some relevant stakeholders, and the complexity of the approbation process of each plan that involves urban areas, the Municipality of Ravenna decided to insert the logistics planning in the framework of its new SUMP, under approbation in 2025.

The logistic aspects are part of a specific SUMP’s annex – the Strategic Document on Logistics – that summarize the results of “Feasibility Study for the realization of a sustainable goods delivery service in the historic centre of the municipality of Ravenna”, developed in 2022-2023.

The study saw an extremely detailed participatory process, supported by questionnaires, in-person interviews, and meetings with all the stakeholders involved in any form, from shopkeepers to cargo bike operators active in other cities.

Methodology and results driven to the identification of the following strategies to put into effect in the medium/long period:

- actions on the access regulation
- implementation of new sustainable ways to deliver goods to shops and citizens in LTZ
- direct, and constant, involvement of the main actors of urban logistics in the city area
- increment of the loading/unloading slots in the city centre.

Those actions have been introduced in the SUMP’s scenarios.

The studies involved in the SUMP have been carried out in the last years, with a strong involvement of trade associations, commercial activities and operators.

SURF (Sustainable URban Freight) 2021-2022

Thanks to the SURF³ instant project – a result from the joint effort of Environmental Defense Fund Europe and POLIS Network - Ravenna had the opportunity to develop a roadmap for the implementation of a ZEZ, Zero Emissions Zone, together with its stakeholders: trade associations, retailers/shops, logistic operators, cargo bikers (experiences from Parma and Bologna) and couriers.

This work was particularly important because the involvement of relevant city logistics stakeholders is the basis to make the ZEZ accepted by the local shops, companies and citizens.

The Administration of Ravenna organized a Freight Quality Partnership – a new round table, composed for the this specific project, aimed to build trust with stakeholders and the larger freight community of Ravenna - focusing on the possible introduction of a ZEZ.

The Action Plan included the following aspects:

- continuous dialogue with the stakeholders,
- analysis of the costs and opportunities related to the e-vehicles,
- research on e-commerce trends within the city center of Ravenna
- the step-by-step introduction of testing measures.

During the SURF project Ravenna carried out:

³ <https://www.polisnetwork.eu/news/surf-final-report-is-now-available-to-give-insights-on-sustainable-urban-freight/>

- 3 workshops (Freight Quality Partnership) focused on various aspects of the introduction of a ZEZ, starting from the experience of cargo bikers and the initiatives/experiences of the couriers. Stakeholders were able to share their views, focused on problems - like the lack of parking slots, the legal, cost, and time issues related to performing a cargo break during deliveries – considered, from them, insurmountable;
- A survey to the shop owners of via Cavour, the main shopping street in Ravenna, which was potentially identify as a good site for testing a ZEZ. Of about 100 shops that could answer, only 6 did it: the inertia of the Administration in fostering the participation, the lack of interest and support by the trade associations, and the retailers' refusal to any form of change, has severely limited the effectiveness of the action;
- Background research on good practices and measures/supporting the FQP.

The meetings revolved around the explanation of what a ZEZ is and the steps for the implementation. The reaction of the stakeholders was quite strong since they then contacted the council members to further discuss the ZEZ, moving the discussion from a technical point of view to a political one. No actions or any form of implementation followed the discussion, but the instant project left some lessons to the Administration:

- Involvement of the stakeholders is key factor and not so easy;
- The stakeholders may not immediately understand the importance of a ZEZ;
- It is necessary to work closely with stakeholders.

The attempt has been considered as a test for the launch of a more in-depth and targeted survey. The difficulties in reaching the target group provide a measure of the effort necessary to run a wider range campaign, the disagreement with the stakeholders has sparked more discussion, also at political level, on innovative logistics measure such as the ZEZ.

8.1.2 Existing projects and trends

The Feasibility Study can be considered as the prosecution of the SURF project, conducted not in the framework of an instant European project, but as a part of the Ravenna's SUMP redaction.

A further step forward from SURF has been the introduction of a focus on the economic feasibility of a cargo bike service inside the LTZ, with the simulation of different scenarios based on real data collected thanks on-site surveys and interviews. Stakeholders involvement have been pillar of the study: SURF's same actors have been invited, but, this time, with a "one on one" approach.

The feasibility study carried out is intended as a tool to find solutions that will enable the implementation of what is envisaged in the Plans' strategies (SUMP, PAIR. Etc...): its objective is to identify freight transport solutions to be implemented through the use of zero/low emission vehicles. The solution analysed consists of the use of micro urban consolidation centres and pedal-assisted cargo bikes for last-mile delivery, with the aim not to replace existing models entirely, but to complement them in order to increase the level of efficiency of the overall system.

The Feasibility study can be summarized in 6 main actions plus one – the stakeholders involvement – that is a constant in all:



Methodology: 6 Main Activities + constant stakeholders involvement	Comparison and sharing with trade associations	1) Supply demand analysis	2) Analysis of the offer of the city logistics services and of the use of loading/unloading bays	3) Definition of the offer of the transport system (simulation model)
		<ul style="list-style-type: none"> Mapping and classification of commercial activities inside LTZ 	<ul style="list-style-type: none"> Identification of the main logistics operators 	<ul style="list-style-type: none"> Updating the road graph
		<ul style="list-style-type: none"> Interviews with the identified sample 	<ul style="list-style-type: none"> Interviews / survey 	<ul style="list-style-type: none"> Collection of information on cargo-bike characteristics
		<ul style="list-style-type: none"> Estimation of the daily quantity of goods suitable for transport by cargo bike 	<ul style="list-style-type: none"> Analysis of loading/unloading bays utilization 	<ul style="list-style-type: none"> Route testing (one consolidation center: Orto Siboni)
		4) Simulation model construction		
		5) Definition and simulation of scenarios for service implementation		
		6) Evaluation of economic sustainability scenarios		

The first 3 actions are the more relevant in order to describe the current situation and the real possibility to implement a sustainable last mile delivery service: they are made by sub-actions that foreseen the collection of information by different stakeholders and that define existing problems, but also positive elements that can foster the change:

Actions	Problems highlighted	Changing factors
1) Supply demand analysis	<ul style="list-style-type: none"> Congestion in the city center; Lack of scheduling and/or flexibility of deliveries or unavailability at particular times or days; LTZ time windows not respected; Perception of lack of dedicated parking spaces for delivery vehicles; Difficulties in accessing and moving goods from loading/unloading bays to locations. 	<ul style="list-style-type: none"> Couriers and logistic services as main mode of procurement: big change in the last few years; About half of the deliveries are represented by small packs; Strong need for flexibility – delivery timetable – that could lead to try different ways of procurement.



<p>2) Analysis of the offer of the city logistics services and of the use of loading/unloading bays</p>	<ul style="list-style-type: none"> ▪ Huge amount of irregular stops in the loading/unloading bays, even 100%; <p>Traditional operators:</p> <ul style="list-style-type: none"> ▪ Lack of knowledge of LTZ time windows ▪ LTZ time windows incompatibility with the opening hours of certain categories of commercial activities. <p>Cargo operators:</p> <ul style="list-style-type: none"> ▪ No activity in Ravenna. 	<p>Traditional operators:</p> <ul style="list-style-type: none"> ▪ Between 30-50% of the total amount with a envelopes/packets of 3 – 5 kg (private users); <p>Cargo operators information compatible with Ravenna’s characteristics (operators active outside Ravenna):</p> <ul style="list-style-type: none"> ▪ The average distance/day was about 20 km; ▪ Average day consist of 80 to 150 deliveries pick-ups; ▪ Sustainable urban distribution services on behalf of traditional express couriers already active (e.g. SDA, GLS, BRT, etc..).
<p>3) Definition of the offer of the transport system (simulation model)</p>	<ul style="list-style-type: none"> ▪ Need for consolidation center very close to the LTZ; ▪ Need for adequate spaces/road conditions; ▪ Consolidation hub expensive, space demanding and with security problem; ▪ Lack of competitiveness without stricter access rules and effective controls; 	<ul style="list-style-type: none"> ▪ Public space, close to the LTZ, available for free as contribution of the Ravenna Municipality to the implementation of the service; ▪ Adequate bike paths or road (speed limit 30 km/h)

Actions from 4 to 6 are the consequences – and the possible scenarios – derived from the first three actions: they are simulations, technical and economical, that need some changes in the actual situation, mainly LTZ accesses regulation, to be realized.

It is important to underline that all the different scenarios show economic sustainability of the activity (see the Annex I).

Lessons learned:

- Stakeholders are more collaborative if involved in a one on one relationship: a direct conversation can lead to more information, even the informal ones, than an official meeting with other stakeholders;
- Consider to organize small meetings (2 stakeholders) to start collaborations;
- Consider the whole chain involved in the delivery: a lack of flexibility could be due to the landing time of the cargo flight that transports the goods. To be a credible interlocutor you must be informed about all aspects of the business;



- Focus on concrete problems and needs: connects "intangible" goals to the resolution of difficulties and concrete improvements in daily activities;
- Show that the problems emerged have, sometimes, already found a solution in other city, in the same country;
- Focus on changing factors already present;
- Focus on the advantages of different solutions, even in a wider view;
- Prepare physical (LTZ camera system, controls, paths, roads, speed limits, etc...) and normative (LTZ rules) infrastructures to be ready to foster the change.

8.2 Replicability and lessons learned from URBANE's Living Labs

8.2.1 Lessons learned and what can be adopted to local context (adopting options)

The Ravenna URBANE Feasibility study consider two Living Labs: Bologna and Valladolid.

They deal with different aspects, both of interest to the city of Ravenna: the solution tested in Valladolid - *Monitoring of loading and unloading areas using AI* – could help to create the right context that is needed to implement the kind of solution tried in Bologna, *Micro-hubs networks and light EDVS – PI last mile deliveries*.

In this framework, both the LLs are analysed in order to evaluate their replicability in Ravenna.

Bologna

Bologna: Implementation of the Nearby Delivery Area (NDA)

Use case 1: Micro-hubs networks and light EDVS – PI last mile deliveries

Ravenna is a very old city, with a small city center, with narrow streets that sometimes have been built on the basis of the - tortuous - path of channels o small rivers: not only there is no space to allocate the increasing quantity of freight means, but it is easy to reach congestion and the air pollution effects are worsened due to the structure of the city. Moreover, it is important to underline that the historical center is the part of the city with six UNESCO monuments, crowded by tourists, activities and residents.

According to the Feasibility study above reported, a relevant amount of commercial activities that are in the historical center could be served by cargobike (considering the kind of goods, their volume, weight, transport conditions: not all the types of goods can be delivered by bike – e.g. food requiring refrigeration).

This ways of delivery – mainly devoted to B2B, but that can include also B2C - would increase road safety, liveability, air quality in the central area and, at the same time, be able to reduce the number of freight means freeing up spaces for special commercial vehicles (e.g. refrigerated vehicles).

The Bologna case study presents many aspects that could be replicated in Ravenna are presented in Table 24 and 25 along with the possible adoption options.

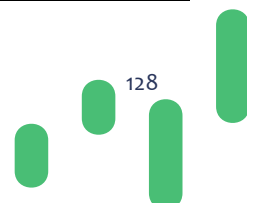



TABLE 24 URBANE INNOVATION TRANSFERABILITY PLATFORM TOOLS

Technologies	<ul style="list-style-type: none"> ▪ Blockchain & smart contracts ▪ Collaborative delivery model ▪ Digital Twin to plan the interventions in the city centres ▪ Impact Assessment Radar
Tools	<ul style="list-style-type: none"> ▪ Automated and unattended micro-hubs with SW integration ▪ Green last-mile operator
Processes	<ul style="list-style-type: none"> ▪ Stakeholders mapping ▪ Desk research ▪ Qualitative governance analysis ▪ Interest mapping through interviews ▪ Survey-based public perception feedback data ▪ Sustainability impact analysis ▪ Promote the collaboration between logistics operator, that can be current or potential competitor in the logistics sector

TABLE 25 URBANE INNOVATION TRANSFERABILITY PLATFORM TOOLS ADOPTING OPTIONS

Stakeholders' collaboration and engagement	<p>Work on trust:</p> <ul style="list-style-type: none"> ▪ Trade associations involved since first steps; ▪ Use the Feasibility study surveys results (commercial activities, loading/unloading bays occupations, traditional logistics operators, cargo bike operators); ▪ Consolidate the relationships between all the stakeholders, enhanced the collaboration among all the actors and in particular between the different logistics operators involved as partners that are potential competitors in the logistics sector; ▪ Focus on blockchain security aspects with all the stakeholders: the technology was not available in the previous study, the theme was one of the main concerns for the operators ▪ Hold specific meetings with larger couriers like UPS, GLS, and Poste Italiane to: <ul style="list-style-type: none"> ▪ explore their potential involvement in the activities and beyond the project to expand the solution; ▪ foster collaboration among different transport operators ▪ integrate other last-mile delivery operators directly contracted by each courier; ▪ reassure: the blockchain allow to certify the occurrence of events relating to the logistics process, such as the Proof of Delivery. In this regard, blockchain can be used as an argument against the reluctance of transport operators' participation on collaborative delivery methods. ▪ developpe specific questionnaires for transport companies to assess their interest in the microhub solution and similar innovative approaches to urban goods delivery;
Urban mobility and Logistics regulations	<ul style="list-style-type: none"> ▪ NDAs – Orto Siboni and Anastagi - have a strategic locations: at the limit of the LTZ, public parking areas with spaces available, easy to reach by the vans, well connected with the bike paths in the city center and 30 km/h zone:



	 <ul style="list-style-type: none"> ■ Historical center ■ Speed limit zone, 30 km/h ■ LTZ <ul style="list-style-type: none"> ▪ availability of high rotation parking slots in case the microhub could be also a pickup point for the final recipient. ▪ Enhance the current city center LTZ monitoring system: <ul style="list-style-type: none"> ▪ possibility to controll all the accesses and the respect of the time windows ▪ improve th technology to be able to differentiate between commercial vehicle categories, but also volume and type of commercial vehicles (e.g., delivery vans) and transport operators ▪ LTZ regulation: <ul style="list-style-type: none"> ▪ after the improvement of the camera system, with the possibility of recording the types of vehicles and for each one the respect of the entry and exit time slots, introduce some real advantage for the cargo bike operators ▪ increase the costs of the pass to enter in the LTZ for delivery means
<p><i>Platform and technology</i></p>	<ul style="list-style-type: none"> ▪ Explain the logical and physical flow from the start to make them aware and involved; ▪ Make clear that the management platform, the software driving microhub operations, is mandatory; ▪ Underline the advantages derived from the platform: optimization of the number of delivery vehicles, by including key parameters such as depot location, predefined delivery locations, vehicle availability, type, and capacity, allowed delivery timeframes, and route/area constraints (including real-time traffic conditions), operators can gain critical insights into fleet optimization.
<p><i>Shipment typology and pick up point</i></p>	<ul style="list-style-type: none"> ▪ Adapt the kind of shipments – single-item or multi-item – to the characteristics of the carriers’ costumers, in order to foster their participation; ▪ Remind that the microhub has limitations related to capacity for the multi-item deliveries, having a limited number of available compartments and specific dimensions for the parcels it can hold; ▪ Consider a double function: the microhub would give a greater benefit if it were also exploited also as a pickup point directly by the final recipient. This would provide: 24/7 access, accessible at any time of day, allowing recipients to pick up parcels when most convenient for them. Double functions could be an aspect to investigate: previous Ravenna study focused on hub devoted only to operators and with the possibility to storage the material during the night: it was expensive, space demanding and with



	security problem. The solution accessible for the private customers and without the storage function could be more cost effective.
<i>Solution physical and technical installation and implementation</i>	A specific “technical requirements” form will be prepared in order to include any possible need – and problem – related to installation and operation for the NDAs.

Bologna – Technologies

Technologies play a fundamental role in the implementation of a sustainable last mile delivery service: clarify how they work and the reasons why they are used can foster trust from the involved stakeholders and sustain a positive approach. Table 26 represents the ones used in Bologna, that could be transferred into the Ravenna’s case.

TABLE 26 OVERVIEW OF DIGITAL ENABLERS RELEVANT FOR RAVENNA UCs

	Objective	Motivation	Physical Internet
Blockchain	Integrate a blockchain technology on the existing delivery process	Certify specific steps of the process (assignment and delivery); K proof of delivery.	Centralize sensible information from different carriers that may be involved in other simmlar project; To foster the trust: BC is able to guarantee the trasparency level of all the information to be shared.
Collaborative Routing Model	Suggest better delivery process for last milers and to understand how the solution can be financially sustainable if other stakeholders collaborate	Reduce travel times and reduce CO2 emissions for Last Milers that don't have zero-emission fleets	Reduce/improve traffic in the city center. Voluntary data sharing from transport operators is important
Digital Twin	Improvement of green routing and rerouting of last milers	Optimise last-mile network based on traffic flow conditins and environment sustainability	Further support to municipality's objectives for efficient deliveries in city center from multiple LSPs (carriers and last milers)

Valladolid *Monitoring of loading and unloading areas using AI*

USE CASE 1: Monitoring of loading and unloading areas using artificial intelligence (AI)

Installation of cameras in the busiest zones to characterise the flow of delivery vehicles through the data recorded: according to the survey made in the city center in the framwork of the Feasibility study (2022), the amount of illegal occupation of loading/unloading bays (mainly private car, but also van for very long



time) can reach the 100% in some areas, with the consequences of illegal parking, worsening congestion, road safety and decreasing urban quality.

The Valladolid Use case 1 presents many aspects that could be replicated in Ravenna:

<p>Definition of the monitoring zone</p>	<p>Definition, in close collaboration with the municipal government, of the features of the L/U zones to be monitored (e.g parking of unauthorised vehicles, double-parking violations, occupancy level of the zones, etc.):</p> <ul style="list-style-type: none"> Data about illegal occupation already available: zone with high level of infringements have been defined Map of Municipality’s camera system available: possibility to use the same infrastructures (electricity supply, lighting, signal, etc) <div style="display: flex; justify-content: space-around;"> <div data-bbox="405 723 919 1267"> <p>Camera system map</p> </div> <div data-bbox="959 723 1513 1267"> <ul style="list-style-type: none"> More than 80 per cent of the monitored stops in the time slot between 7 a.m. and 10 a.m. are irregular. 68 illegally parked cars were monitored with an average parking time of 35 minutes <p>LEGENDA</p> <ul style="list-style-type: none"> Loading/unloading area Interviewed activity LIZ gate </div> </div> <ul style="list-style-type: none"> Camera system technology to improve (old SW) Possibility to add new cameras (technical data comparison from Valladolid’s ones)
<p>Privacy</p>	<p>The Municipality’s camera system already accomplish all the legal requirements: new cameras would part of the same framework</p>
<p>Technologies</p>	<ul style="list-style-type: none"> Computer vision-based system (to install cameras in the busiest zones to characterise the flow of delivery vehicles through the data recorded) Network optimization thanks to IT-assisted decision making Deployment and use of L/U infrastructure (PI-nodes)
<p>Tools</p>	<ul style="list-style-type: none"> Online booking app for loading and unloading zones

Valladolid’s technologies, that can be used, or considered as reference, in the Ravenna’s case:

<p>Technologies</p>	<p>Objective and functioning</p>
<p>YOLOv8</p>	<p>Vehicle detection.</p>

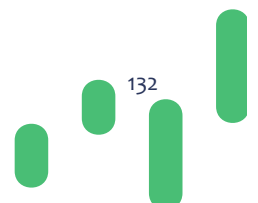
	The tracking algorithm included in the model on Use Case 1 needs to be accurate enough to avoid errors in the measurement of parking time. Another algorithm different from the one used should be also used to raise the level of accuracy, penalising the processing time
DeepSORT	vehicle tracking
V2X communication system	Vehicle-infrastructure communication is necessary to improve urban logistics, and in particular to facilitate L/U operations and minimise traffic congestion since vehicles can receive real-time information about available loading zones, allowing them to navigate directly to the nearest spot, thereby reducing unnecessary circling and associated traffic congestion. Additionally, smart infrastructure can reserve loading spaces for delivery vehicles, further minimizing disruptions
Digital models	<ul style="list-style-type: none"> i) The computer vision algorithm that allows identifying different vehicle typologies, developed by CIDAUT: to detect the presence of a vehicle and classify it according to whether it is a “car” or a “truck”(vans are included in this category for the sake of simplicity) and assign a synthetic ID to each one of them (so data is anonymised); ii) the computer vision algorithm that allows tracking objects (vehicles) across video frames, developed also by CIDAUT: the IDs are tracked across the subsequent video frames to determine variables such as “In-time”, “Exit time”, and “Parking violation”. Three parking violations are targeted: double parking, exceeding of the maximum allowed parking time (30’) and parking of vehicles not allowed; iii) VLTN’s Dynamic parcel reshuffling model: this model will generalize the results coming from the two previous models and that the study will benefit from the availability of data from AI pattern recognition algorithms.

8.2.2 Use of Transferability Platform and Digital Tools

Impact Assessment Radar: Strategic level: Assesses the city's overall capacity and readiness for implementing new logistics solutions.

The city of Ravenna doesn't have any Sulp, due to the fact that its logistic plan is included in the Sump under approbation in 2026. There are not last mile operators: the deliveries are totally managed by the main operators. The LTZ regulation need some adjustments, under the technological and normative points of view, to better support the introduction of a sustainable last mile delivery service.

Question	Level (L, M, H)
1	M
2	M
3	M



4	L
5	M
6	L
7	M
8	M
9	1,2,3,4,8,9
10	L
11	2
12	L
13	L
14	M
15	L
16	L
17	M
18	L
19	L
20	M
21	L
22	1

TABLE 27 RAVENNA ANSWERS TO IMPACT ASSESSMENT RADAR LEVEL 1 QUESTIONNAIRE

Tactical level

At the tactical level, data from demand sources and last-mile delivery providers are used to simulate alternative scenarios and to estimate operational needs, such as the optimal number of lockers. These simulations support decisions related to infrastructure placement and the definition of initial planning assumptions. The tool also serves as a common analytical basis for engaging stakeholders and jointly developing solutions to last-mile delivery challenges. Based on these parameters, a set of scenarios was defined and analysed to assess different operational configurations.

Micro-hub simulation (ia-radar.imet.gr)

The simulation was conducted using parameters corresponding to two delivery companies operating through two micro-hubs. These parameters were used to run a number of scenarios and to evaluate their implications for last-mile delivery performance.



Step 3: Results

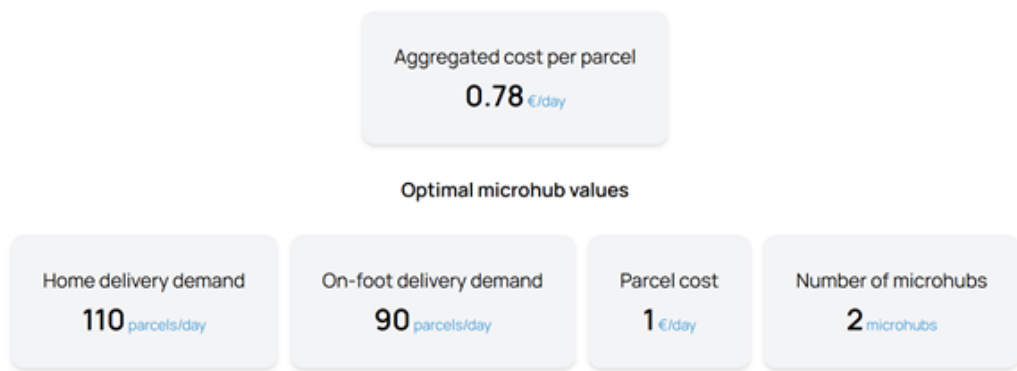


FIGURE 34 RAVENNA SIMULATION RESULTS USING IMPACT ASSESSMENT RADAR

As a city, we believe that at the operational level (particularly for SMEs) this tool can deliver substantial benefits. Larger companies likely already have systems in place to measure and manage their performance.

Blockchain Technology

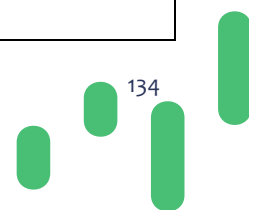
Currently, the city has limited experience with blockchain technology. In future projects blockchain could serve as a reliable framework for establishing partnerships and securely sharing data.

CitiQore tool (Simulation scenario -Collaborative delivery between last milers)

Finally, Ravenna also used the CitiQore application to run and compare different scenarios, leveraging the tool’s collaborative delivery simulation capabilities. These simulations enabled the assessment of alternative operational configurations under shared assumptions. Table 28 presents the scenario parameters used as inputs for the simulations.

TABLE 28 SIMULATION PARAMETERS

Parameter	Input	Reason
Depot (s)	Light truck	
N° of lockers	2	A better distribution to cover the city center
Locker’s capacity	55	Fixed
Deliveries #	110	Max according to the fixed data
Supporting vehicle	Scoobic	
CBA parameters	Labor cost for parcel: 0,78 Revenue per delivery: 2,5 €	Cost derived by the IAR Micro Hub Simulation



	Years: 6	Revenue per delivery according to the previous 2022 Feasibility Study (see Annex)
--	----------	--

Running the simulation with these parameters produced the following results. However, these results should be interpreted with caution, as some parameters could not be fully customised to reflect the specific characteristics of this use case.

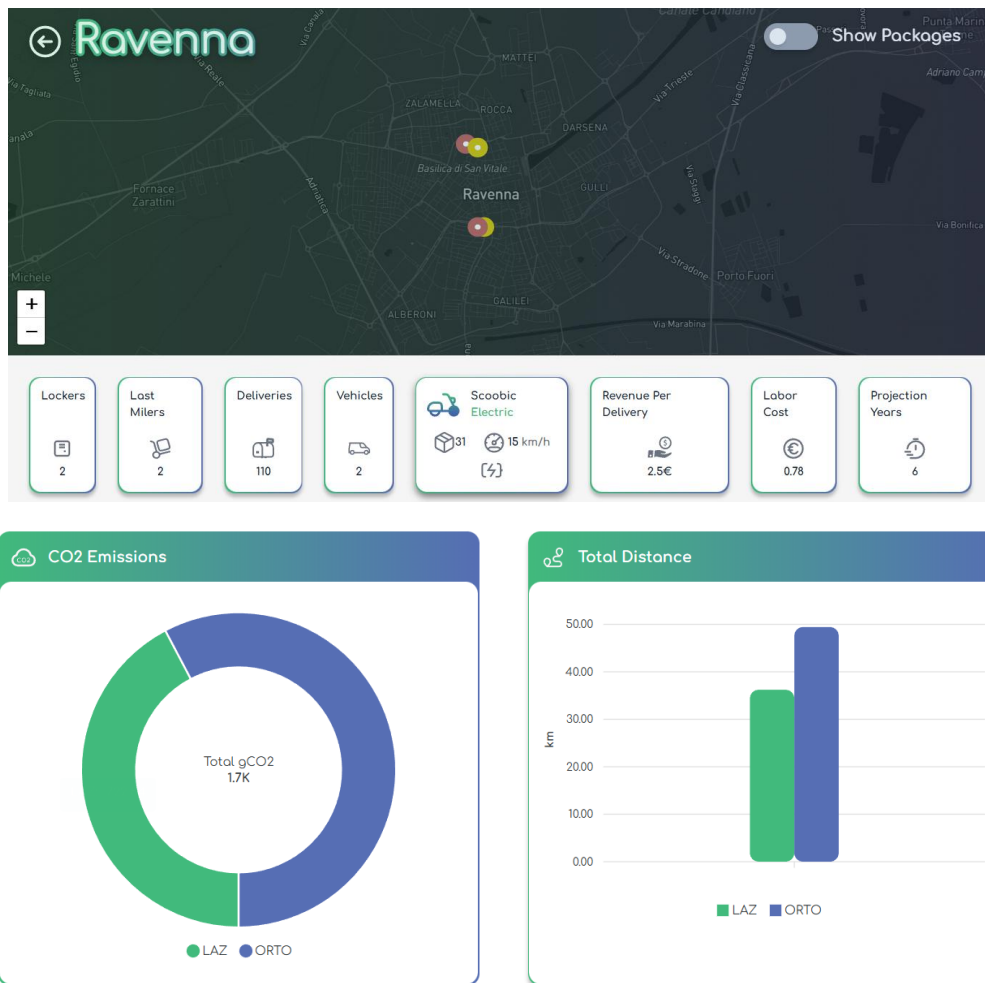


FIGURE 35 CITLQORE SIMULATION RESULTS

Finally, Figure 36 provides a high-level overview of how the project tools support decision-making across the strategic, tactical, and operational levels, and how they are applied in the Ravenna use case. It illustrates the role of each tool, from impact assessment and digital-twin simulation to smart contracts and KPI monitoring, —in supporting planning, scenario analysis, and day-to-day optimisation of urban logistics systems.



FIGURE 36 URBANE INNOVATION TRANSFERABILITY PLATFORM AND MAPPING OF TOOLS AND THEIR USE

	Strategic Level		Tactical Level		Operational Level	
	Bo	Vall	Use in Ravenna	Bo	Vall	Use in Ravenna
<p>IAR - The Impact Assessment Radar is a tool designed to evaluate a city's readiness for implementing innovative urban logistics solutions, such as micro-consolidation centers with automated lockers.</p>	It helps cities understand their capacity in areas like regulations, infrastructure, logistics networks, and stakeholder involvement.	It helps cities understand their capacity in areas like regulations, infrastructure, logistics networks, and stakeholder involvement.	It helps cities understand their capacity in areas like regulations, infrastructure, logistics networks, and stakeholder involvement.	uses data from city demand and last-mile delivery providers to simulate scenarios for decision-making		monitors key performance indicators (KPIs) to optimise operations
<p>CitiQORE - The URBANE Digital Twin Platform (DT) simulates various delivery scenarios, allowing users to test strategies like adding micro hubs or changing delivery vehicles to evaluate their impact on efficiency, costs, and environmental outcomes before real-world implementation.</p>				CitiQORE allows users to input specific parameters, such as vehicle types or delivery numbers, and place lockers and depots on a map interface		
<p>Smart Contracts - The blockchain system was designed to:</p> <ul style="list-style-type: none"> ensure non-repudiation in the shipment process involving multiple parties by tracking key transfer events; assess the performance of services against predefined service level agreements (SLAs) 				designed to ensure non-repudiation in the shipment process involving multiple parties by tracking key transfer events; to assess the performance of services against predefined service level agreements (SLAs); smart contract must be created before tracking;		

8.3 Innovation/use case – Operational Feasibility (SWOT analysis)

8.3.1 Vision and objectives

Congestion, pollution and road safety are increasing concern in the city center area: the 6 UNESCO monuments in the area are attracting more and more tourists and the narrow streets of the historical centre can't be shared with delivery trucks anymore.

A last mile delivery service with cargo bike could help to reduce the issues and increase city center liveability and attractiveness. No cargo bike delivery service has ever been implemented in Ravenna, for multiple reasons: from a LTZ access management system and controls which allows access to all means of delivery, to security issues and the legal liability of having multiple operators handling the same delivery, an aspect strongly underlined by logistics operators. Moreover, the need for spaces adjacent to the ZTL to effectively manage the business constitutes a further limitation.

With its presence in the URBANE project, the Municipality of Ravenna aims to be able to support the implementation of a cargo bikes delivery in a concrete way:

- Thanks to the blockchain and the operators platform tested in the Bologna's case study, the problems related to the security issues and legal liability have an answer: it is possible, and already done, to share the same delivery among different operators, optimizing time and costs;
- Valladolid shows that it is possible to implement forms of automatic control of vehicles not only when entering the LTZ, but also when parking illegally in the loading and unloading bays.

The aims of the Municipality of Ravenna is to prepare the conditions to enable private companies to launch an effective and economically sustainable cargo bike delivery business.

This feasibility study is a commitment for the Municipality of Ravenna to work on LTZ regulation and controls, on stakeholders' involvement and support, on promotion of the new technologies as a way to optimize and improve the last mile delivery: the removal of the obstacles that, till now, have discouraged the start-up of cargo bike businesses.

Recognizing the public purpose of last-mile delivery with cargo bikes the Administration will provide for free, through a public tender, strategic areas for setting up lockers and carrying out loading and unloading activities to an operator (or group of operators) who wants to start a cargo bike delivery activity in the city center of Ravenna. The two areas, Orto Siboni and Anastagi, are indicated in the map:



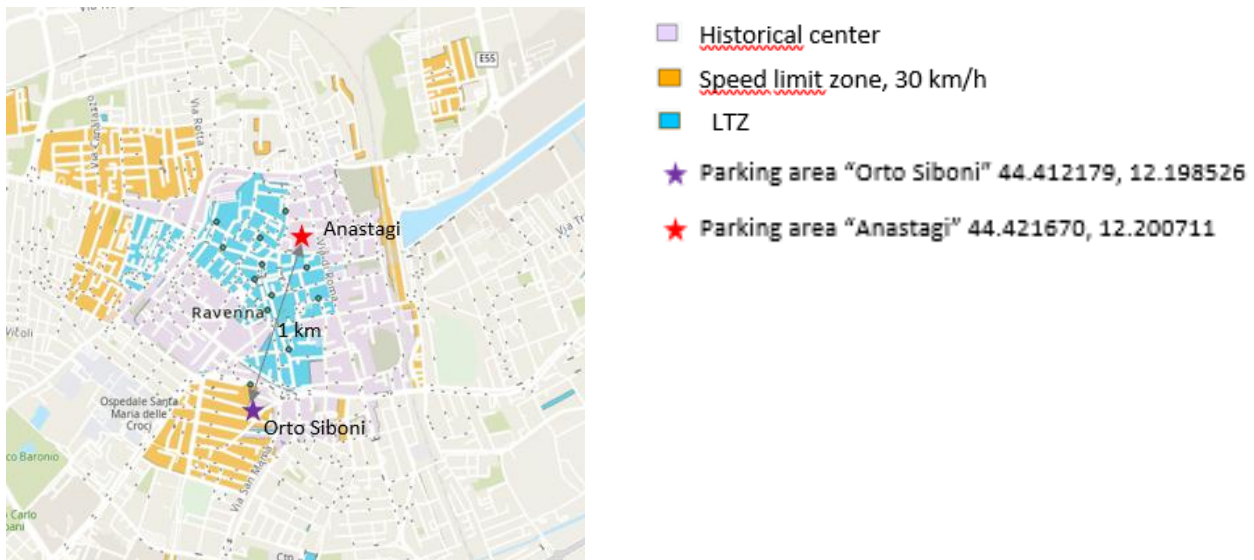


FIGURE 37 . LOCATION OF PROPOSED NDAs IN RAVENNA

8.3.2 Strengths and weaknesses, opportunities and threats: SWOT Analysis

In order to face the problems created in the city center by an increasing number of delivery means, the implementation of a last mile system based on cargo bike could benefit from the small size of the center, from the request of residents and tourist operators to limit the accesses of trucks, from the presence of a LTZ already implemented but that, to be effective, needs some changes.

Changes in LTZ controls, time windows, costs, requirements in term of emissions and size and the new technologies could drive the logistic operators to the conclusion that it is more convenient to entrust deliveries in the historic center to operators authorized to access all areas and without time limits.

Those changes are not easy to obtain because the LTZ is one of the most dangerous topics for the local Administration.

Another relevant issues is the shared opinion, among the stakeholders – mainly small shops and artisans trade associations, traditional logistic operators – that changes in the logistic chain is too expensive and would harm their affiliates, economically and/or by reducing the current level of convenience in managing deliveries.

In this framework the lack of political support is a condition capable of blocking any possibility of implementing an alternative delivery system to the current one. Political support is needed to improve the LTZ, to involve and manage the different stakeholders, to foster the collaboration among operators and to support the starting of a new activity/es by conceding public areas for free.



<p><u>STRENGTHS</u></p> <ul style="list-style-type: none"> • Small city center with high shops density • LTZ with passes and surveillance camera system • Data about shops location and classification, deliveries, logistics operators, needs • Strong stakeholders involvement • Public debate on the topic 	<p><u>WEAKNESSES</u></p> <ul style="list-style-type: none"> • Narrow streets shared among pedestrian, cyclists, group of tourists and trucks: congestion, pollution and danger • Lack of controls: daily abuses in accesses and L/U parking slots occupations • LTZ timetable often not compatible with shops opening hours and operators' activities • Lack of – real – political support • Every change in the logistic chain is considered too expensive, or difficult to realize, by local stakeholders
<p><u>OPPORTUNITIES</u></p> <ul style="list-style-type: none"> • Increasing tourism pushes to change the last mile delivery in the historical city • Political will to improve safety and liveability of the main areas, with direct action to promote sustainable last mile deliveries • New technologies available to improve surveillance camera system on accesses and L/U parking slots occupation • Blockchain technology to share the same delivery between different operators in a secure way • Operators platform to optimize all the delivery related aspects • Implementation of modular and flexible parcel locker system • Use of 2 public areas for free thank to the Administration support • 1 cargo bike already used in the city center by a trade association for promotional campaign 	<p><u>THREATS</u></p> <ul style="list-style-type: none"> • Lack of political support • Lack of funds • Stakeholders contrariety or scepticism from private logistics firm regarding increased coordination and new requirements • Cybersecurity risk • National law framework against LTZ and accesses regulation in the city center • Financial crisis and reduction of the number of shops in the city center • Lack of interest from cargo bike operators to start a new activity in Ravenna

FIGURE 38 RAVENNA SWOT ANALYSIS

8.3.3 Identification of opportunities

There are many aspects that could push a more sustainable delivery service in the city center: from the new technologies that URBANE project brings in the field of the last mile delivery – making possible actions that local logistic operator have always considered not applicable - to the city marketing that need to emphasize the “calm and cozy” sentiment of Ravenna.

The combination of different needs can promote an important change in the Ravenna’s approach to its urban delivery. Table 27 presents a more detailed analysis of them

TABLE 29 OPPORTUNITIES ANALYSIS WITHIN THE RAVENNA SWOT FRAMEWORK

Opportunity	Actions
City marketing	The city marketing, the need to improve the liveability and the safety of the city center to better “sell the city”, can be an instrument to push the shift from trucks to cargo bikes. Artisans and trade associations must be involved in order to explain to their affiliates that a more attractive urban environment improves their business.
Political will	Changes in accesses regulation, fostering the more sustainable means: let the cargo bikes – only them – free to deliver at any time: could be also a solution to the problems related to lack of flexibility and compatibility between the shops opening hours and the time window delivery in LTZ;
	Use the data about the illegal parking to increase the control of the loading/unloading bays;
	Work on communication to connect the deliveries with cargo bikes to the improvement of the city reputation (inclusive, safe, etc...)
	Make, through a public tender, public spaces where install the lockers available for free

Technology, Control and surveillance	Improve the LTZ accesses control with new cameras and more sophisticated SW
	Link the costs of the passes for delivery means – cost that must be increased - to the emissions level (and dimensions?)
	Improve the control on the loading/unloading bays occupation (AI)
Technology, hub related:	Blockchain can be used against the reluctance of transport operators’ participation on collaborative delivery methods;
	Involvement of larger couriers like UPS, GLS, and Poste Italiane
	Blockchain, and main couriers involvement, can be used to underline the profitability of cargo bike mode, due to the volume of deliveries that the main operators are able to ensure
	Operators platform to share the delivery but also to optimize all the activities (optimization of the number of delivery vehicles, type, and capacity, allowed delivery timeframes, and route/area constraints (including real-time traffic conditions), operators can gain critical insights into fleet optimization)
	Platform make possible to have a real time hub situation, to organize the activity to avoid any goods inside the hub during the night
	Possibility to adapt the kind of shipments – single-item or multi-item – to the characteristics of the carriers’ costumers, in order to foster their participation;
Public acceptance	<p>Citizens and tourists have already seen a cargo bike in the city center; some citizens have their own version to accompany children to school: the vehicles are already accepted by the population.</p> <p>To improve their presence, the Administration could verify the suitability of some path for cargo bikes.</p>
Public spaces for free	The Administration will provide for free, through a public tender, strategic areas for setting up lockers and carrying out loading and unloading activities to an operator (or group of operators) who want to start a cargo bike delivery activity in the city center of Ravenna.

8.3.4 Analysis of challenges (and “Risk mitigation”?)

The actions needed to successfully build a framework to implement a last mile cargo bike delivery system could face a wide range of difficult.

As a first point, the lack of political support could stop any attempt: to be convenient, the cargo bike delivery system must be able to rely on an existing, functioning LTZ that offers it clear advantages over a traditional operator, in term of accesses to all the area, costs, absence of time windows.

The introduction of a stronger LTZ in Ravenna, with stricter access rules (emissions, size), increased pass costs, reduction in the number of parking spaces, etc.... will meet, at least initially, strong opposition from citizens, trade association, stakeholders.

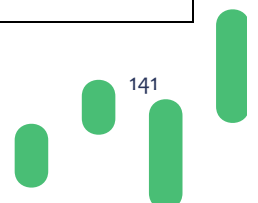
The national law framework could make the situation even worse by issuing regulations that, regardless of any scientific data and research, severely limit the possibility of creating LTZs and any form of accesses regulation in urban centres.

As a second point, stakeholders, mainly the trade associations, usually defend the “status quo” and can manifest contrariety to any action that could lead some changes in their associates’ habits, regardless the costs.

Finally, Ravenna has never had a logistics operator with cargo bikes for deliveries: in all likelihood, the activity has not been considered profitable. Some reasons for this opinion could be the ZTL regulation, that doesn’t reward cargo bike, the small volume of goods in absence of the possibility to ally with a major operator/s, the lack of spaces in which start the activity. Table 28 presents the possible risks and mitigations in more detail

TABLE 30 RAVENNA SWOT THREATS AND RISK MITIGATION ACTIONS

Threats	Actions
Lack of political support	<ul style="list-style-type: none"> ▪ Turn the narrow streets, the congestion, the pollution, the road safety problems into a “positive” element that force the change in the last mile delivery; ▪ Involvement of tourism related stakeholders in order to “make pression” on the Administration to realize a more “tourist friendly” and safer city; ▪ Focus the general attention on the last mile delivery problem (city center residents’ involvement); ▪ Work on communication to link the delivery with cargo bikes to the improvement of the city reputation (inclusive, safe, etc...) and political success;
Lack of fund	<ul style="list-style-type: none"> ▪ The implementation of an improved LTZ control system can be expensive, the amount must be paid from public coffers;
National law framework against LTZ and accesses regulation in the city center	<ul style="list-style-type: none"> ▪ Be creative using other kind of area protection: 6 of 8 UNESCO monuments are in the city center, there are laws about the protection of areas with schools, parks, monuments, hospitals and clinics...; ▪ Work with residents to make social pressure to the Administration; ▪ Drastic speed limit reduction and related drastic controls; ▪ Definition of loading/unloading area with stringent controls regarding their use (IA); ▪ Work on the use of public space (e.g. define bike paths in the space previously taken by cars, eliminate parking along the streets replacing them with parking in dedicated structures, etc....);
Stakeholders contrariety or scepticism	<ul style="list-style-type: none"> ▪ Involvement of tourism related stakeholders: let them work with their colleagues; ▪ Focus on the solutions that have been proposed in order to solve the problems that they have underlined during the participation process; ▪ Point attention on their specific advantages ▪ Involve them and their associated in to the project
Financial crisis and reduction of the number of shops in the city center	<ul style="list-style-type: none"> ▪ <i>Creates a tighter network between activities, to maximize any economies of scale;</i> ▪ <i>As Administration, make deal to let use empty space for free (temporary extension of existing activities or pop up shops, exhibition of art, of products of local artisans or schools, etc....)</i>



Lack of interest from cargo bike operators to start a new activity in Ravenna	<ul style="list-style-type: none"> ▪ Underline and make clear the implication of the new technologies: <ul style="list-style-type: none"> ▪ Blockchain to share the deliveries between more operators in a secure way ▪ Main logistic operators already involved thank to the blockchain ▪ Platform to optimize every aspects of the delivery ▪ HUB working also as a lokers with real time remote control; ▪ Underline the financial sustainability of the project ▪ Build an access regulation that gives a strong advantage - in term of accesses in all the areas, no time windows, no costs - to the cargo bike operators, to reward the sustainability and the increase liveability of the city. ▪ As Administration, grant free use of areas suitable for hosting hubs
---	--

8.3.5 Action plan

The action plan starting point is the current situation that requires to work on different topics:

- Political support
- Stakeholder information and involvement, with specific actions according to the different role of each one
- Technical requirement
- Legal and normative framework
- Evaluation of side actions (e.g.: LTZ access rules).

8.3.6 Required digital and physical infrastructure (and 3h-Integration with the existing system)

HUBs

General needs:

- Power supply,
- Internet connection,
- Reserved space for safely parking vehicles for loading and unloading activities,
- Area well connected to both the main road network and the LTZ.

With the reference to the Bologna’s micro hub infrastructure:

Each micro-hub is composed by 3 modules: 1 Master + 2 Slave as per the dimensions displayed in Figure 36.

MASTER MODULE	SLAVE MODULE
Dimensions: mm (960L x 500W x 2,025.5H) Canopy overhang: 130 mm	Dimensions: mm (960L x 500W x 2,025.5H) Canopy overhang: 130 mm
Control Unit + 13 cell	16 cells
3 L: mm (365L x 480P x 334H)	4 L: mm (365L x 480P x 334H)
7 M: mm (365L x 480P x 216H)	8 M: mm (365L x 480P x 216H)
3 S: mm (365L x 480P x 98H)	4 S: mm (365L x 480P x 98H)

FIGURE 39 MICRO-HUB LOCKER MODULES: DIMENSIONS, CELL SIZES, AND CONFIGURATION



The Master module is the brain of the operations, containing the Control Unit managing and coordinating the entire system and it has also 13 cells.

The Control Unit includes a user interface comprised of a touchscreen monitor, a QR/barcode scanner and a NFC reader (badge reader). The Slave module is the subordinate unit controlled by the Master module and contains 16 cells.

- Material: Powder-coated sheet metal
- Structure: ▪ Modular ▪ Adjustable feet
- User Interfaces: ▪ 15” touchscreen monitor ▪ QR/barcode scanner ▪ NFC reader (badge reader)

Note: The installed NFC badge reader is an ACR122U model. If incompatible with the customer's badge, additional devices and software integration will be quoted separately following technical analysis.

- Languages: Italian and English
- Data Connection: Ethernet cable with RJ-45 connector
- Power Supply: 110V – 230V, 50Hz – 60 Hz
- Control Module Power: 160W
- Storage Module: Negligible
- Control Module Consumption: 3.8 KWh/24h
- Storage Module Consumption: Negligible
- Doors: ▪ Electric anti-intrusion lock ▪ Manual emergency release
- Sensors: ▪ Anti-intrusion ▪ Machine status
- Weight per module: 160 kg

Additional equipment/infrastructure needed:

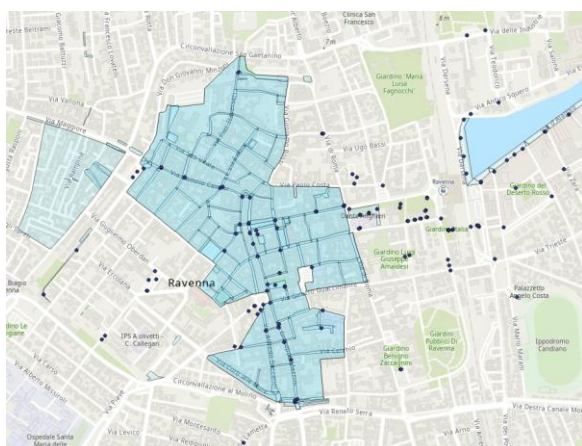
The required additional equipment/infrastructure for the implementation of the activities are internet connection, road markings and the security cameras.

- Internet connection: power and internet lines are available in both the locations.
- Mobile SIM cards for the microhubs connectivity provided 200 GB of data with automatic monthly renewal.
- Road markings: need the municipal ordinance
- Security cameras: to protect the micro-hubs from vandalism and monitor the operations.

To manage the delivery flow to the micro-hubs it is necessary for all the operators (Transport Operators and Last Miler) to carry out a technological integration on their systems, e.g. with GEL Proximity, which acts as orchestrator/integrator of all the information that must be shared for the correct management of the process.

Computer vision-based system for monitoring the use of loading and unloading zones

The new video system can be integrated in the surveillance system already active in the historic center according to the following map and functioning scheme:



LTZ security cameras

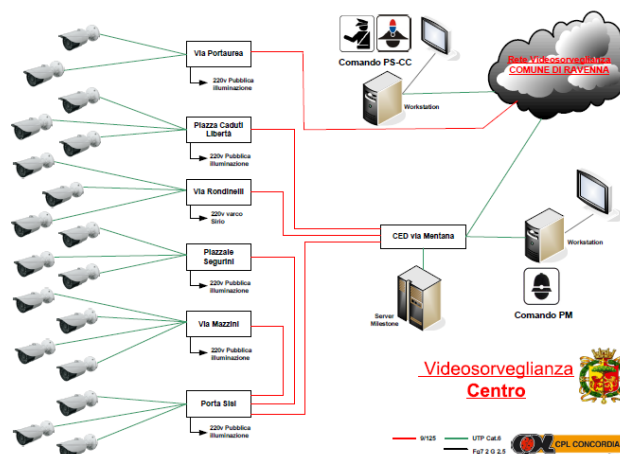


FIGURE 40 POTENTIAL LOCATIONS FOR SMART CAMERAS INSTALLATION

The most relevant aspects are referred to the purchase of new cameras and an algorithms to get the occupancy status and number or parking violations. Specifically, YOLOv8 and DeepSORT algorithms – the same of Valladolid case - could be used for vehicle detection and tracking.

8.3.7 Regulatory and legal frameworks

Hubs

- Public space occupancy: municipal ordinance
- Camera on public space:
 - Dir. UE 2016/679, GDPR – implemented by the Italian legal system with D.lgs. 101/2018
 - Dir. UE 2016/680 – implemented by the Italian legal system with D.lgs. 51/2018
 - Video Surveillance Handbook for Municipalities and Unions of Municipalities – Emilia Romagna Region

Computer vision-based system for monitoring the use of loading and unloading zones

- Camera on public space:
 - Dir. UE 2016/679, GDPR – implemented by the Italian legal system with D.lgs. 101/2018
 - Dir. UE 2016/680 – implemented by the Italian legal system with D.lgs. 51/2018 – Emilia Romagna Region

The regulatory framework is the same already respected by the existing control system.

8.3.8 3l – Financial feasibility estimations: budget, costs, revenue and funding opportunities

In the Annex I it is possible find a brief analysis of budget, revenues and costs referred to the Feasibility Study carried out in 2022: it deserve to be considered that, even with the following up, not adopted in the current study, the activity still convenient in economic terms:

- purchase of containers as storage and office;
- single HUB without the function of locker for costumers
- single cargo bike company involved



- no collaboration with the main logistic operators (SDA, UPS, etc...)

In order to focus on the present Feasibility Study, and consider related costs and revenues, some information must be clarified:

Key Activities

- Management of transshipment microhub lockers, where the transshipment between the first-mile and last-mile of the delivery takes place to carry out that last mile with light electric vehicles and to securely store the parcels.
- The lockers serve the function of both a transshipment micro-facility and a pick-up location, for both B2B and B2C services.

Key Infrastructure and resources & key regulatory framework

- Identification of (public) real estate in the perimeter of the LEZ for the locker facility
- Facility needs to have charging outlets
- Enabling regulations such as SUMP to allow for the implementation of an LEZ
- Digital Twin
- Integrated platform
- Microhub lockers need to have varying sizes, especially large-size storage for B2B large parcels; the different locker sizes would allow to do both B2C and B2B deliveries.
- The lockers would be maximised as they would cover two uses (pick-up and transshipment).
- Model devised to allow for potential future expansion of the locker network if the LTZ is extended.
- Identification of optimal location for transshipment lockers, according to the catchment areas within the city centre.

Budget cost structure

- Microhub lockers (covered by last-miler)
- Light electric vehicles for last mile (covered by last-miler)
- Charging infrastructure (covered by Local Authority)
- Integrated platform (covered by IT provider)
- Maintenance costs for outdoor damage (covered by locker manufacturer)
- Personnel costs (covered by last-miler)
- Cameras (covered by Local Authority)
- Public space real estate (covered by Local Authority)
- Call centre/Customer service costs (All)

Revenue streams

- Logistics operators pay last-miler for booking locker spaces and last-mile delivery services.
- Last-miler charges per delivery.
- Locker manufacturers charges for lockers and maintenance services.

Funding opportunities

Name	Level	Recipients	How it works
Ecobonus mobilità sostenibile	National (Ministry of Business and Made in Italy)	<ul style="list-style-type: none"> Citizens Small and medium-sized enterprises 	30% on the purchase of: <ul style="list-style-type: none"> Electric, hybrid, and internal combustion engine cars with CO₂ emissions of up to 135 g/km and an emission class of at least Euro 6; Electric and non-electric motorcycles and mopeds with an emission class of at least Euro 5; Electric commercial vehicles.
ANCI	National association of Italian municipalities	Local administration	Possibility of funding, topics change frequently
Passes	Municipal	Administration	Part of the amount derived by the increased cost of the TM pass can be used to foster a sustainable delivery service (e.g.: TM in Ravenna: 20 €/year, TM in Verona 500 €/year)

8.3.9 Timeline and milestone

Implementation milestones:

1. New LTZ rules and related communication campaigns (stakeholders involvement);
2. Meetings open to all cargo bike delivery operators that could be interested to start their activity in Ravenna;
3. Publication of the public tender for the free use of areas where lockers can be installed and vehicle loading and unloading activities can be managed;
4. Starting of delivery activities;

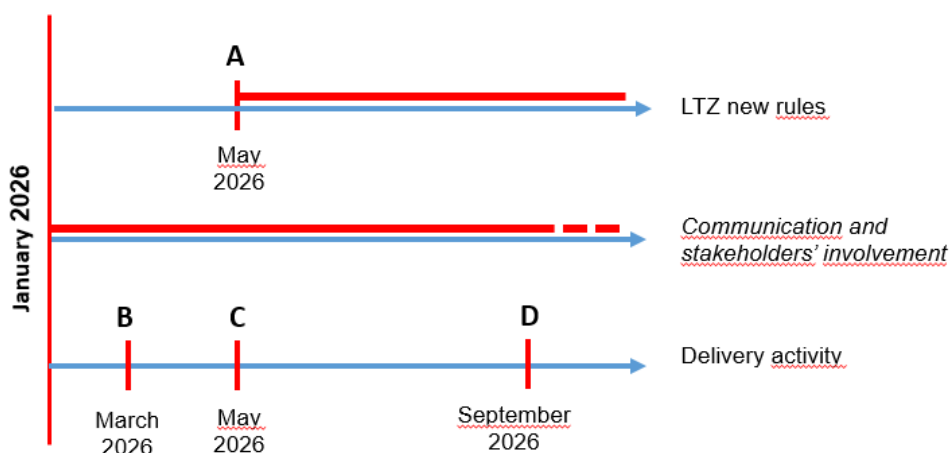


FIGURE 41 PRELIMINARY IMPLEMENTATION TIMELINE

8.3.10 Evaluation and Impact Assessment

The consequences of the implementation of the new delivery system should be monitored regularly, better if with the definition of few – misurable - indicators that must primarily evaluate the changes in the problems that the new delivery system is called to solve:

Problem	Indicators	Data collection methods	Data providers
Pollution	Air quality in the city center: level of PM10, PM 2.5, NO2, O3, Benzene, CO, SO2	pollutant monitoring stations	ARPAE: monitoring stations located outside the LTZ, possibility of surveys within the area thanks to mobile laboratories;
Congestion	N° of heavy vehicles/trucks entered in the LTZ	LTZ camera system;	Municipal Police: every access is record with reference to the kind of vehicle
	N° of heavy vehicles/trucks passes released after the implementation of the new LTZ rules	N° passes	Municipal Police
Road safety	Accidents involving freight vehicles in the LTZ	N° of road accidents	Municipal Police
	People killed or seriously injured in collisions involving freight vehicles	N° of people killed or seriously injured in collisions involving freight vehicles	Municipal Police

TABLE 31 EVALUATION AND IMPACT ASSESSMENT MATRIX I

And then considerate the quality of the solution, in order to define areas of improvement:

	Indicators	Data collection methods	Data providers
Public space	sqm of public space recuperated from parking slots	removal of signs (each slot 25 sqm)	Municipality of Ravenna
Delivery success rates	Rate of deliveries and pick ups made in the right form (i.e. not damaged)/total number of deliveries and pick ups	Vehicles and microhub monitoring through GEL parcel tracking system and cameras. It can be facilitated through blockchain.	Tracking SW



Security of deliveries (no losses or thefts)	Number of deliveries and pick ups made in the right quantity (no loss or theft)/total number of deliveries and pick ups	Vehicles and microhub monitoring through GEL parcel tracking system and cameras. It can be facilitated through blockchain.	Tracking SW
Quality of transport services	(% of on time deliveries on total deliveries): number of deliveries taking place at the appointed time/ Total number of deliveries planned	Vehicles and microhub monitoring through parcel tracking system and cameras. The quality level is linked to the transit time according to the geographical zone of the delivery agreed with the client. The baseline is the media of the delivery respecting the agreed service levels. It can be facilitated through blockchain.	Tracking SW
Users satisfaction (B2B)	Global level of satisfaction (quality of the transport method, flexibility, ease of management, etc.)	Survey	Administration/trade associations
Users satisfaction (B2C)	Global level of satisfaction (quality of the transport method, flexibility, ease of management, etc.)	Survey	Administration/trade associations

TABLE 32: EVALUATION AND IMPACT ASSESSMENT MATRIX II



8.4 Stakeholders and Governance

8.4.1 Stakeholders analysis and expertise needed

As the previous studies have already underlined, it is important to involve all the main stakeholders since the first steps. Not all of them have the same power or influence, so it can be useful to build a map to better define their role.

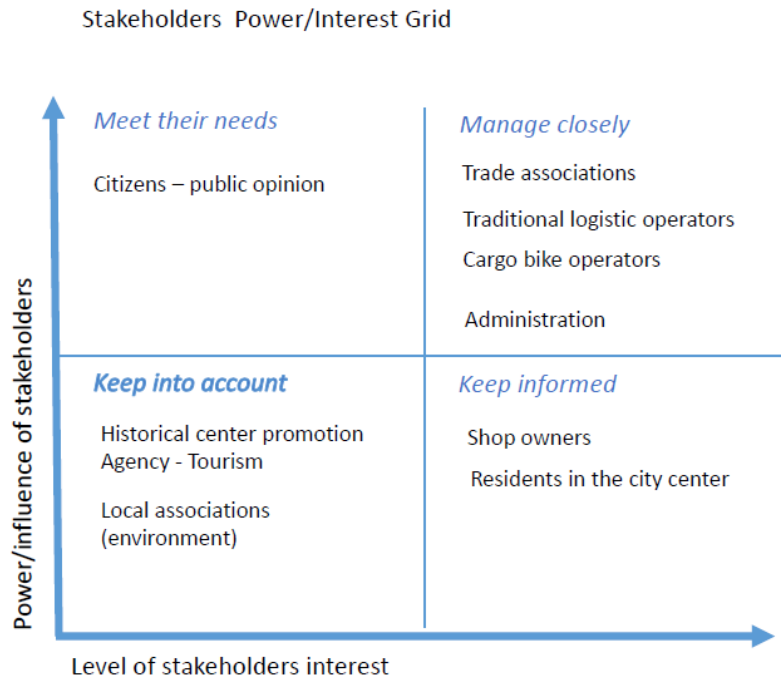


FIGURE 42 MATRIX SHOWING RATIO OF INFLUENCE AND LEVEL OF STAKEHOLDER INTEREST

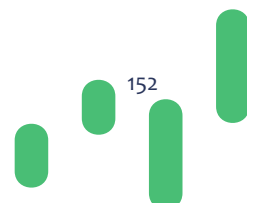
TABLE 33 STAKEHOLDERS MATRIX

	Ability to influence the feasibility		How to involve
	Negative	Positive	
Shop owners	<ul style="list-style-type: none"> Refusal to use the cargo bike service (costs, discomfort, eg...); Refusal to change delivery schedules; For small businesses, return to self-service transportation in the event of LTZ access restrictions; 	<ul style="list-style-type: none"> Willingness to test the new modality; Willingness to change their habit; Be part of economies of scale and synergies that could be developed with other activities; 	<ul style="list-style-type: none"> Already involved in the 2022 survey. Direct contacts or through Associations

Trade associations	<ul style="list-style-type: none"> Ability to influence their affiliates, the public opinion and the Administration's choices. Their contrariety - motivated, eg, with the believe that the change is not possible, with a potential discomfort due to the new method, or an increase in costs, even a small one - could lead an opposition from a relevant part of the activities in the city center. 	<ul style="list-style-type: none"> Ability to influence their affiliates, the public opinion and the Administration's choices. Optimizations through economies of scale in deliveries; Synergies with local artisans; Promotion of service among affiliates; Cargo bike delivery as element of promotion for the city. 	<ul style="list-style-type: none"> Involvement through specific tables (alredy active). Founders, with the Municipality of Ravenna, of “in Ravenna” an association born to promote artisans and shops of the city center: close collaboration between Associations and Administration that could include the last mile delivery modes.
Historical Center Promotion Agency - Tourism	<ul style="list-style-type: none"> Opposition to a tightening of the LTZ rules, scared that tourists could be discouraged to visit the city if forced to park their car far from the monuments 	<ul style="list-style-type: none"> Ability to influence their affiliates, the public opinion and the Administration's choices. Optimizations through economies of scale in deliveries; Synergies with local artisans; Promotion of service among affiliates; Cargo bike delivery as element of promotion for the city. 	<ul style="list-style-type: none"> Professional communication campaigns across all media, meetings, and experiments to illustrate the needs underlying the restrictive measures to be implemented in the LTZ; Activities to promote the historic center; Focus of Ravenna as a safe, friendly and cozy city where you can walk and cycle
Traditional logistic operators	<ul style="list-style-type: none"> Opposition to a tightening of the rules for access to the LTZ; Refusal to accept other operators active on the same delivery; Refusal to use digital platforms other than one's own; Refusal to use hubs; 	<ul style="list-style-type: none"> Openness to sharing the same delivery with other operators; Openness to using a digital platform for shared deliveries; Openness to a different company organization that limits deliveries outside the LTZ 	<p>Involvement through specific tables: active listening but also explanation of:</p> <ul style="list-style-type: none"> LTZ new rules Legal and technical framework in sharing the same delivery (focus on time, costs, economies of scale)

Cargo bike operators	<ul style="list-style-type: none"> ▪ Lack of will to start an activity in Ravenna; ▪ Lack of will to collaborate with other operators (traditional but even cargo); ▪ Lack of will, or expertise, to use the platform to organize the deliveries; ▪ Lack of collaboration with the main operators; 	<ul style="list-style-type: none"> ▪ Will to collaborate with other operators (traditional but even cargo); ▪ Ability to use the platform to organize the deliveries; ▪ Plan to implement and foster collaboration with the main operators; ▪ Flexibility in time windows; 	<ul style="list-style-type: none"> ▪ Administration's intention to support the introduction of a cargo bike delivery service by providing free space. ▪ Opening of a discussion group open to all interested operators to gather information and suggestions. ▪ Connecting traditional operators active in the city with the cargo bike operator group through specific meetings.
Citizens – public opinion	<ul style="list-style-type: none"> ▪ Opposition to a tightening of the LTZ rules; ▪ Lack of interest, and so political pressure, on the theme; 	<ul style="list-style-type: none"> ▪ Put pressure on the Administration to act to solve the problem of the trucks in the city center; ▪ Support a tightening of the LTZ rules; 	<ul style="list-style-type: none"> ▪ Professional communication campaigns across all media, meetings, and experiments to illustrate the needs underlying the restrictive measures to be implemented in the LTZ; ▪ Activities to promote the historic center; ▪ Communication;
Residents in the city center	<ul style="list-style-type: none"> ▪ Opposition to a tightening of the rules for access to the LTZ; ▪ Lack of interest, and so political pressure, on the theme; 	<ul style="list-style-type: none"> ▪ Put pressure on the Administration to act to solve the problem of the trucks in the city center; ▪ Support a tightening of the LTZ rules; 	<ul style="list-style-type: none"> ▪ Professional communication campaigns across all media, meetings, and experiments to illustrate the needs underlying the restrictive measures to be implemented in the LTZ; ▪ Activities to promote the historic center; ▪ Communication; ▪ Focus group with residents;
Local associations (environment)	/	<ul style="list-style-type: none"> ▪ Daily actions to report illegal vehicles and/or vehicles outside of permitted time slots and spaces; ▪ Collect data on pollution in the historic center; ▪ Put pressure on the Administration for a tightening of the LTZ rules and to improve the city's livability, safety, and beauty; 	<ul style="list-style-type: none"> ▪ Involvement in the phases of explanation of the the needs underlying the restrictive measures to be implemented in the LTZ; ▪ Involvement in communication and promotion of the city center;

Administration	<ul style="list-style-type: none"> ▪ Opposition to a tightening of the LTZ rules; ▪ Lack of will to control accesses and loading and unloading bays; ▪ Lack of will to make the city center a real 30 Km/h area; ▪ Lack of trust in the change; ▪ Subservience to trade associations and traditional transport operators; ▪ No funding; 	<ul style="list-style-type: none"> ▪ Stricter rules for access and parking in LTZ; ▪ Increase in the cost of the LTZ entry pass, the amount of which should depends on the size of the vehicle and its emissions class; ▪ Updating access control tools; ▪ Checks on the legality of loading and unloading bay occupancy; ▪ Explaining the potential of the cargo bike delivery system to traditional operators and trade associations; ▪ Organizing meetings between operators - cargo bikes ones and traditional - and major logistics companies; ▪ Call for tenders for the free transfer of public space; ▪ All media communication campainings; ▪ Promotion of the business; ▪ Linking cargo bike delivery to the city's tourism image; 	/
----------------	---	--	---



8.4.2 Governance structure

In order to implement the new delivery service devoted both to B2B and B2C, but that – considering the different types of goods - will complement existing delivery services, it is important to define some collaborations:

- Trade associations
- Logistics operators (both traditional and with bikes)
- Shops owners
- Neighborhood Council
- Municipal Administration (at least mobility office, road maintenance, environment, local police).

This governance structure is needed to assure a real and effective coordination in the sharing of services and infrastructures.

Round tables could be useful, before and during the implementation.

8.4.3 Potential future steps for public acceptance and perception, outreach and engagement

The introduction of a cargo bike delivery service could face some resistance from, mainly, shop owners that are used to rely on the traditional operators and their trade associations.

Specific meetings devoted to them must be organized to explain the service, the security guaranteed by the technologies and the advantages that the cargo bike will have in term of flexibility, possibility to reach every part of the city center, the absence of time windows.

Cargo bike deliveries could also be advertised and supported by associations that promote the historic center, transforming it as a symbol of care and attention to the liveability of the city.

Promotion and awareness campaigns could help to explain the reasons and the functioning of the service: both its relevance in term of environmental impact and reliability due to the high level of technology involved.

A regular public monitoring (e.g. emission savings, but also reduction of the number of delivery vehicles in the LTZ, etc...) could be useful to increase the public acceptance and support to the new service; action focused to underline the improvement of the liveability and beauty of the city (visual impact) could be effective on large audience.

8.5 Conclusion and recommendations towards public authorities

Desirability of replication

The Bologna's case represent a very relevant example of a sustainable last mile delivery system able – thanks to the technologies applied – to answer to all the security and legal problems opposed by the Ravenna's stakeholders during a previous participatory path.

It's extremely important for the Administration give real, applicable and functioning answers when working on change. Moreover, Bologna and Ravenna are in the same region, Emilia-Romagna and they share the same legal framework.

Due to the different city scale some aspects must be adapted to the Ravenna's context, but the Administration is interested in replicability also because it is perfectly aligned with the objective to improve liveability, safety and care of the historical center.

Recommendations and advice for public authorities towards implementation: policy measures, next steps, projects, initiatives to be taken, etc..

A sustainable last mile delivery in the historical city center is a relevant topic, able to involve many aspects, many needs and many interests: frequently there have been not convergence among them, as a consequences, during the years, very few results have been reached.

I. Description of problems and context(s)

Collect data considering multiple aspects: traffic, LTZ accesses (type of vehicle, time windows, frequency, etc...), pollutant, congestion, type of goods delivered, quantity, deliveries' characteristics, destinations, parking slots occupation, infrastructures, characteristics of possible sustainable vehicles, etc...

Don't forget to start the stakeholders' involvement in this phase.

II. Definition of goals

Define clearly what is the final objective: is it to introduce a agile sustainable delivery system devoted only to B2C? Work with trade associations to target the B2B related to e-commerce?

Mix the target? What kind of vehicles could be use, considering the context?

Do you have some environmental objectives to be achieved?

III. Definition the role of the Public Administration and the limits of the actions that is willing to implement

There are many ways in which the Administration could be involved, it is important define its role, its limits, in order to be a reliable figure.

IV. Individuation, and classification, of all the stakeholders

Another aspect to clarify is the definition of all the stakeholders, in a wide view: listen to them, involve them and make them aware of the needs of other stakeholders, highlighting common aspects but also differences in the requests made.

Awareness and global view of the topic are important to define a common ground to build on.

At the same time not all the stakeholders have the same "weight" in order to reach the goal: classify them but remember to take all of them informed about the actions foreseen: the "surprise effect" may not be appreciated and lead to dissociative reactions.

V. Customization of the solutions

A relevant aspect is the customization of the solutions: there is no a ready-solution that work for all the cities. Even inside a very small city center like Ravenna's one, every area has different characteristics that could lead to operate different choices to optimize both the services and the liveability of the area. Be ready to adapt the main guidelines according to the specific implementation area.

VI. Flexibility

Solutions could require changes that transcend mobility.

9 Conclusions and Lessons Learned

Under Task 6.3, the six follower cities—Aarhus, Antwerp, Prague 6, Mechelen, Ravenna, and La Rochelle—participated in a structured and systematic process aimed at evaluating the feasibility of transferring and adopting innovations developed and tested within URBANE’s Living Labs in Helsinki, Bologna, Thessaloniki, and Valladolid.

Drawing on the experiences, results, and lessons learned from the Wave 1 pilot sites, and making use of the URBANE Innovation Transferability Platform, each city undertook a comprehensive review of its existing urban mobility and logistics strategies, policy priorities, and operational frameworks. This assessment enabled the cities to explore how solutions such as shared parcel lockers, urban micro-hubs, collaborative and consolidated delivery models, automated vehicle applications, and smart contract technologies could be adapted to their specific local conditions.

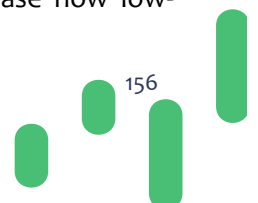
Through a series of interactive and collaborative workshops and exchanges, the follower cities jointly analysed the outcomes of the Living Labs, clarified their own strategic needs, and mapped their key priorities in relation to sustainable urban logistics. This process allowed them to identify realistic and context-sensitive pathways for adoption, taking into account local governance structures, regulatory environments, operational constraints, and broader policy objectives. As a result, each city developed a clearer understanding of which innovations could deliver the greatest value locally and what steps would be required to support successful implementation. The main conclusions are the following:

Antwerp’s study focused on integrating autonomous delivery vehicles and exploring micro-hub and locker-based models. Through its feasibility study, Antwerp aims to finalise its Sulp and push for clear regulatory frameworks for new delivery modes. The city sees high potential in digital tools and recognises that improved data exchange between operators and authorities is fundamental to future interventions. Establishing a flexible legal framework, particularly for ADVs, is essential to foster innovation without stifling development.

Strategic planning requires clear problem definition, prioritization of high-volume logistics, and thoughtful spatial allocation. Collaboration with logistics operators, technology providers, and citizens ensures shared ownership and effective solutions. Pilots should begin in controlled environments and include pathways for city-wide integration.

Next steps include embedding logistics in municipal mobility plans, launching ADV trials, developing data-sharing platforms, exploring consolidation centers, building internal capacity, and promoting intercity knowledge exchange. Institutionalizing these strategies transforms ad hoc experiments into sustainable, resilient urban logistics systems.

Aarhus evaluated the establishment of a centrally located micro-hub operated through cargo bikes, embedded in the city’s Sulp, under development. In fact, a micro logistics hub in Aarhus for last-mile deliveries, parcel lockers, groceries, and tools would be highly desirable. It would reduce street traffic, improve sustainability, and provide insights into the use of cargo bikes in city logistics, potentially influencing the future Sulp under development. The city of Aarhus intends to showcase how low-



emission delivery systems can function effectively in an environment with intense freight traffic associated with Denmark's largest container port. Findings from the URBANE Living Labs underline the value of selecting locations early, ensuring neutral management of hubs, and maintaining clear dialogue with logistics companies to encourage engagement.

Replicating parcel lockers with a micro consolidation centre is feasible. With the feasibility study, Aarhus hopes to position the micro-hub as a future building block of a potential Zero-Emission Zone and an instrument to reduce delivery-related congestion in the historic city centre. Though, key implementation challenges include legal restrictions, lack of field testing, and coordination among private stakeholders, particularly regarding vehicle size, weight, speed, and parking. Early dialogue with national authorities and co-creation among operators, landowners, and the municipality are recommended.

La Rochelle's study examined opportunities to expand lockers and micro-hubs within a broader decarbonisation strategy, leveraging the city's strong mobility policies and experience with autonomous delivery pilots. The Bologna case is relevant to La Rochelle due to its peripheral city hub, combined locker and electric fleet system, neutral governance, mapped collection points, and energy-autonomous design via solar panels. It demonstrates that lockers can be integrated into mobility policies (SUMP, Sulp), but highlights economic uncertainty without public subsidies, emphasizing value-sharing between authorities and operators.

The analysis showed high potential for integrating lockers at transport hubs and tourist nodes, offering flexible delivery solutions while reducing city-centre congestion. La Rochelle's feasibility study proposes opening public space to private operators through an expressions of Interest, with operators fully funding installation, maintenance, and operation, paying an annual fee. Priority sites include transport hubs, tourist areas, and collective housing, accounting for heritage, security (Vigipirate), and technical constraints.

Key considerations included securing suitable public-domain locations, establishing fair contractual models with operators, and ensuring alignment with heritage protection and local acceptability requirements. Success depends on engaging economic stakeholders, addressing heritage/security constraints, and ensuring effective governance, positioning lockers as a sustainable, decarbonising solution for last-mile logistics and evolving consumer habits.

Mechelen's feasibility study focused on transforming its extensive public-domain locker network into an open, multi-operator system. The feasibility study finds that an open, interoperable parcel locker ecosystem is technically achievable and aligns well with Mechelen's and other cities' zero-emission logistics goals. The main barriers are not technological but organisational, contractual and regulatory, particularly governance and fair access between competing operators.

Open lockers can reduce residential last-mile traffic, improve delivery efficiency, and benefit residents, couriers and cities through fewer failed deliveries, reduced van traffic and cleaner streets. Replication is desirable where locker density, operator willingness and political priorities support meaningful impact. It helps reduce market fragmentation, improves consumer convenience, supports smaller operators and aligns with European trends toward shared logistics infrastructure.

However, replication is less effective in areas with low locker density, B2B-dominated deliveries or limited administrative capacity. Successful implementation requires clear regulatory mandates, neutral multi-



operator governance, integration into wider mobility and climate strategies, low-risk pilot projects, inter-city knowledge sharing and long-term regulatory stability to enable private investment.

Prague 6 has strong conditions for modern urban logistics, including a strategic location, institutional capacity, and public acceptance of parcel lockers. Nevertheless, key barriers are fragmented private locker networks, limited data sharing, and the absence of shared public infrastructure. An integrated model is recommended, combining shared lockers in public space, micro-consolidation hubs, and digital optimization tools.

Experiences from Thessaloniki and Bologna show these solutions can reduce emissions, congestion, and improve efficiency, and are transferable to Prague 6 if supported by data cooperation, clear standards, sensitive urban placement, and public engagement. Prague 6's ambitions are enabled by strong institutional links with Prague City Hall and the Czech Technical University, yet hindered by uneven access to public space and limited operator data.

The feasibility study highlights the need for better and denser parcel infrastructure and to improve the sustainability of the last mile in line with national and local climate strategies. Stable governance across electoral cycles, coordination with municipal authorities, and structured private-sector involvement are essential to ensure continuity, legitimacy, and improved quality of life.

Ravenna

Ravenna's work centred on the potential introduction of cargo-bike delivery supported by micro-hubs at the edge of its historic centre Limited Traffic Zone (LTZ). Ravenna identified clear inefficiencies in current delivery patterns, with high levels of illegal curbside use and strong suitability for light zero-emission operations.

The Bologna case demonstrates a replicable, technology-enabled sustainable last-mile delivery system that addresses security and legal concerns previously raised in Ravenna. Replication is feasible because both cities share the same regional and legal framework, though adaptations are needed due to scale differences. The approach supports objectives of liveability, safety, and protection of historic centers.

The study found that although technology and innovative operational models are viable, real progress relies on better access regulations, stronger LTZ enforcement, and continued collaboration with couriers and business associations. Successful implementation requires thorough data collection, early stakeholder involvement, clear goal setting, and a well-defined role for public authorities. Identifying and classifying stakeholders, customizing solutions to local contexts, and maintaining flexibility are essential.

All six cities carried out comprehensive SWOT analyses and developed detailed theoretical implementation plans. These plans systematically identified the key requirements for successful urban logistics innovations, including necessary infrastructure, essential data sources, digital tools, regulatory considerations, governance models, cost estimations, and potential funding opportunities.

Across the different case studies, several common challenges emerged. These included a lack of sufficient operator data, which made it difficult to fully understand delivery patterns and optimize logistics solutions; competing demands for limited public space, which constrained options for micro-hubs and last-mile delivery operations; regulatory uncertainty surrounding emerging delivery modes such as cargo



bikes, e-cargo vehicles, and autonomous delivery robots; and the need for clearer, well-defined KPIs to monitor and guide progress within local urban logistics strategies.

Despite the differences in local contexts and logistical landscapes, the studies collectively demonstrate that URBANE innovations are broadly transferable, provided they are adapted to the specific conditions of each city. The analyses confirmed that with thoughtful tailoring, these solutions could effectively improve urban freight efficiency while supporting broader sustainability goals.

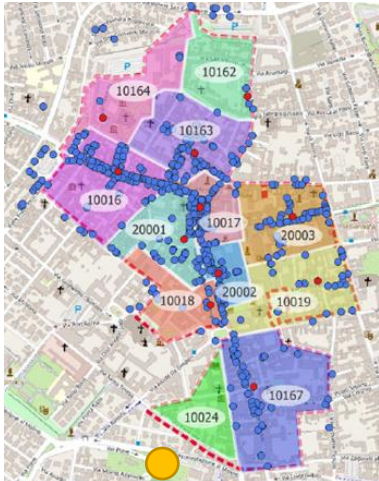
Finally, the consolidated recommendations across all six cities propose a structured pathway for implementing URBANE innovations. These steps include clarifying LTZ rules to reduce confusion and improve compliance, piloting collaborative micro-hubs to streamline local deliveries, standardizing access policies to ensure equitable use of urban spaces, and strengthening governance frameworks for shared infrastructure to maximize efficiency and coordination. Overall, these recommendations align with URBANE's overarching objectives: reducing urban emissions, enhancing delivery reliability, and supporting a transition toward more sustainable, low-impact urban mobility systems.

ANNEX I – Ravenna Financial feasibility estimations: budget, costs, revenue

A previous feasibility study (2022) on the basis of:

- Mapping of all the commercial activities in the city center
- Shop owners survey (more than 25% of the universe involved), devoted to collect data about deliveries characteristics (from the kind of goods to the delivery timetable, etc)
- Splitting the city center in 13 centroids, to create a simulation of the area

defined the amount of goods delivered daily for each area and how much of them can be moved with a cargo bike:



Zone	Delivered goods (kg/day)
10016	4286
10017	4072
10018	858
10019	505
10162	775
10163	3379
10164	564
10167	2521
20001	3075
20002	1568
20003	2628

Having these data as a starting point, considering a single consolidation point in Orto Siboni (the yellow dot in the map above) and considering the possibility, for the cargo bike, to deliver during the whole day, 3 scenarios have been studied. The quantity, 5.200 kg, and the cargo bikes characteristics are the same for all the scenarios, the variations is only in the distribution of deliveries during the day according to the different number of means and employees:



Hypothesis	Scenario A	Scenario B	Scenario C
Goods transported by cargobike (ton/day)	5,2	5,2	5,2
Distribution of deliveries morning/afternoon	76% morning – 24% afternoon (as evaluated by surveys)	57% morning – 43% afternoon (*)	65% morning – 35% afternoon
Cargo bikes characteristics	Average speed: 12 km/h Range: 55km Capacity: 150 kg Loading factor: 0,8 Delivery time: 3,5 min	Average speed: 12 km/h Range: 55km Capacity: 150 kg Loading factor: 0,8 Delivery time: 3,5 min	Average speed: 12 km/h Range: 55km Capacity: 150 kg Loading factor: 0,8 Delivery time: 3,5 min
Durata del servizio	Morning → 4h Afternoon → 4h	Morning → 4h Afternoon → 4h	Morning → 4h Afternoon → 4h

(*) For «Clothing», «Jewelry» and «Books/paper» deliveries are shifted to afternoon. Those activities showed a great interest in changing the timetable for the deliveries.

Results	Scenario A	Scenario B	Scenario C
N. Cargobikes (tricycles)	7 (morning) 2 (afternoon)	5 (morning) 4 (afternoon)	6 (morning) 3 (afternoon)
Length of the service (per cargo bike)	3,6 h (morning) 3,8 h (afternoon)	3,8 h (morning) 3,4 h (afternoon)	3,5 h (morning) 3,8 h (afternoon)
Min. number of employees	7 (2 full-time [8h] + 5 part-time [4h])	5 (4 full-time [8h] + 1 part-time [4h])	6 (3 full-time [8h] + 3 part-time [4h])

Important: the collaboration with main delivery operators has not been considered, so the volumes are underestimated.

In order to define a financial estimation, some hypothesis have been established:

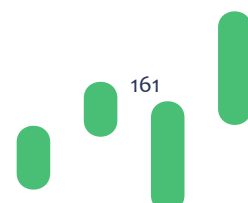
- 1) Time horizon of the investment analysis: 10 years.
- 2) Initial investments: Information gathered through interviews with the sectors’ operators (benchmark analysis):

Initial investments	Unit cost (€)	Service life	Scenario A		Scenario B		Scenario C	
			n. units	euro	n. units	euro	n. units	euro
1) Tangible fixed assets								
Logistic micro hub	14.000	12 anni	2	28.000	2	28.000	2	28.000
Service module (office)	7.000	12 anni	1	7.000	1	7.000	1	7.000
Cargo bikes (tricycle)	5.000	5 anni	5	25.000	3	15.000	4	20.000
Cargo bikes (quadricycle)	13.000	5 anni	2	26.000	2	26.000	2	26.000
Additional batteries	900	5 anni	7	6.300	5	4.500	6	5.400
Charging stations	200	12 anni	10	2.000	10	2.000	10	2.000
Alarm system	1.000	12 anni	1	1.000	1	1.000	1	1.000
2) Intangible fixed assets								
Website and software	5.000	5 anni	1	5.000	1	5.000	1	5.000
Construction costs	3.500	5 anni	1	3.500	1	3.500	1	3.500
Total (1 + 2)				103.800		92.000		97.900

In the cited study (2022) was foreseen buy and use container as office and depot: their costs are included in the table above; at the same time, the SW was less relevant.

The amounts above are reported in order to give a reference scale of the magnitude of the investment.

- 3) Financing sources: money brought to NewCo by shareholders as share capital.
- 4) Capital recomposition: after 5 years they are repurchased (financed entirely by the business of delivering goods):



- a. cargo bike
- b. additional batteries
- c. software.

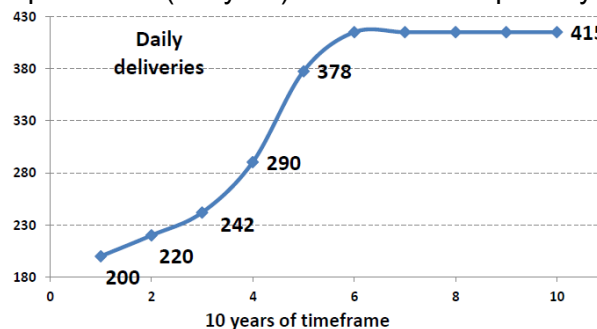
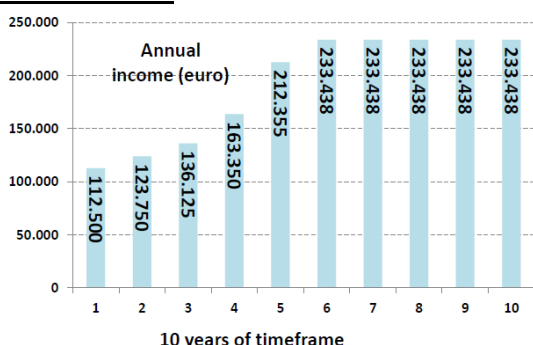
5) Labour, maintenance, insurance, electric recharge and various costs (€/year):

Annual cost	Unit cost (€)	Scenario A		Scenario B		Scenario C	
		n.	euro	n.	euro	n.	euro
1) Full time employees (8 h/day)	24.388	2	48.776	4	97.552	3	73.164
2) Part time employees (4 h/day)	12.194	6	73.164	2	24.388	4	48.776
Annual total cost of workers		8	121.940	6	121.940	7	121.940

Annual cost	Unit Cost (€)	Scenario A		Scenario B		Scenario C	
		n.	euro	n.	euro	n.	euro
1) Cargo bike recharge	56,25	7	394	5	281	6	338
2) Additional batteries recharge	56,25	7	394	5	281	6	338
Total annual costs for electrical recharge			788		562		676

Ordinary maintenance €/year	tricycles	200
	quadricycle	700
	micro-hub log and office module	1.000
Insurance €/year	Rider	1.500
	facilities and equipment	2.000
	Surveillance services	1.000
various costs €/year	Utilities and (telephones; office, energy)	2.000

Result estimated: Potential demand: when fully operational (6th year): 415 deliveries per day



Operating revenue: EUR 2.50 per delivery (for 5 days/week, for 45 weeks per year) amount to 233,000 € per year from year 6 onwards.

Result of the cash flow analysis:

Given the hypothesis⁴, in economic terms, it is convenient to activate the cargo bike service:

- 1) Net Present Value is positive: it means that the revenues of the first 10 years are sufficient to cover the initial investment and operating costs

- 2) Internal Rate of Return is positive
- 3) "Benefit-to-cost" ratio is greater than 1

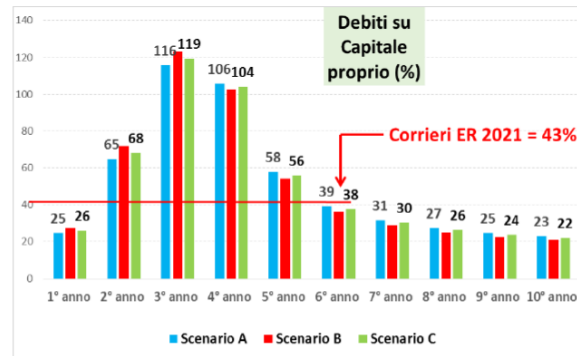
	Scenario A	Scenario B	Scenario C
1) N.P.V. (1000 €)	+108	+131	+119
2) I.R.R. (%)	21%	25%	23%
3) Benefit-to-cost	1,10	1,12	1,11

Capital and financial structure of the EFP

Since year 5, the company has

- good financial autonomy from banks and lenders
- limited debt exposure (most resources are provided by shareholders)

Since year 5, debts have been steadily decreasing and the company's own means exceed third-party means.



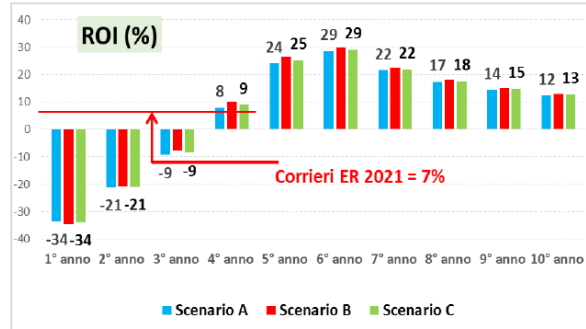
Fonte: hypothesis elaboration (data in previous slides)

Return on capital

Since year 5, the company has shown a good return on capital. At full capacity, the ROI exceeds 20%.

From year 7 it decreases because the capital invested in the company increases

It is more than 7% of the 'courier' sector in Emilia-Romagna



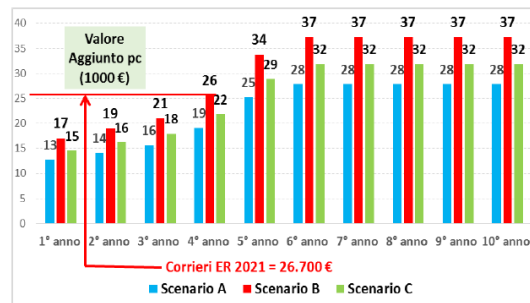
Fonte: hypothesis elaboration (data in previous slides)

Labour productivity

From the very first years of operation, the company shows good labour productivity. And it grows over time.

Added value per capita is higher than labour costs per capita.

Emilia-Romagna 'Couriers':
Added value pc: 26,700
Labour cost pc: 21,300



Fonte: hypothesis elaboration (data in previous slides)

Given the hypotheses, in economic terms it is convenient to activate the cargo bike service.