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GRETA Website

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More information about GRETA can be found on https://www.interreg-central.eu/greta/

1. The GRETA project

GRETA project aims to decarbonize the last mile delivery in Functional Urban Areas (FUAs) in Central Europe (CE) and create liveable and accessible cities for all by 2030. The project seeks to implement joint sustainable solutions in CE FUAs using zero-emission vehicles and cargo bikes and reorganize urban spaces with curb management. The pilot actions in the cities of Maribor, Reggio Emilia, Verona, Poznan, and Budapest (with Berlin FUA as an observer) have the potential to quickly deploy as pop-up measures in combination with existing measures. GRETA provides capacity-building activities, strategies, action plans, and tools for public authorities, enterprises, and relevant organizations to ensure financial, environmental, and social sustainability beyond the project's lifetime.

Last-mile delivery generates negative impacts, including emissions, noise, and congestion. Due to the Covid-19 crisis, global parcel distribution volume almost doubled, further adding inefficiencies in the peripheral areas. GRETA's FUAs recognize the problems that generate pollution, nuisance, noise, and congestion and jointed recognized three main problems: the lack of use of green zero-emission last-mile vehicles, conflicts between freight and public vehicles, and the lack of knowledge and strategies for a flexible and shared use of the curb and public space. Despite having SUMPs/SULPs, FUAs struggle to activate fitting measures while keeping their centres attractive and alive for residents and tourists.

GRETA addresses the common challenges of all CE FUAs by creating the conditions to promote ZE logistics through the use of micro-hubs, cargo bikes, light e-vehicles, and curb management strategies. Additionally, the project also focuses on paving the way to innovative concepts such as regional collaborative logistics, physical internet, and freight curb management. GRETA facilitates the dialogue towards the acceptance of a business and governance as a service model, where cities must equip themselves with a network of innovative services to guarantee seamless experiences for their users and a mobility plan considering different functions and priorities of the services.

GRETA's objective is to support the urban mobility transition in CE FUAs by jointly developing solutions and strategies with a huge potential for decarbonization of the last mile in line with the Green Deal and the Urban Mobility Package, abating congestion, pollution, and nuisance. The project's success relies on capitalizing on previous experiences, exploiting synergies with ongoing initiatives, testing innovative pilots, improving competences and knowledge among PPs and stakeholders.

2. Executive summary

The rapid surge in e-commerce has intensified pressure on urban freight systems, prompting European cities to experiment with “micro-hubs”—small, modular depots that transfer parcels from trucks to zero-emission vehicles. This document offers insight on the current situation of last mile deliveries in Functional Urban Areas (FUAs) along with the first cross-European classification of micro-hub business models and distils operational lessons for planners and logistics actors. Drawing on desk research, two stakeholder workshops, and 20 richly documented cases—including three ongoing GRETA pilots and 17 external exemplars—we adopt a comparative framework covering asset ownership, governance, revenue logic, user mix and public-private interaction. Five archetypes emerge: (1) publicly initiated & operated hubs, (2) public-private partnerships, (3) private-led but publicly supported facilities, (4) multi-user collaborative hubs managed by a neutral operator, and (5) temporary/tactical deployments that test demand with minimal cap-ex.

Across these models, four enablers consistently underpin success: clearly assigned governance structures, modular container architecture, digital coordination platforms (booking APIs, digital twins or dynamic slot pricing) and a phased financing pathway that shifts from grants to market-based fees. Synthesising these insights, we propose an implementation framework organized around governance, infrastructure, digital layer and financial transition, alongside performance indicators aligned with EU Sustainable Urban Logistics Plan guidance.

Finally, the document identifies unresolved research questions—most notably cost-recovery thresholds, interoperable data governance and equity impacts—and sketches six policy levers, from performance-based permitting to open digital infrastructure, that can help micro-hubs evolve from grant-funded pilots into durable components of low-carbon urban logistics ecosystems.

3. Introduction

3.1. Context & Importance

Over the past decade—and especially since the onset of the COVID-19 pandemic—European cities have experienced a marked expansion of e-commerce and associated last-mile activity. EU survey data show a sustained structural shift in consumer behaviour: among people who used the internet in the previous 12 months, the share buying goods or services online rose from 59% in 2014 to 77% in 2024. During 2020 alone, pandemic conditions prompted 12% of EU enterprises to start or increase efforts to sell online, accelerating parcel flows and urban delivery intensity.[1]

This surge interacts with a wider climate and air-quality mandate. Transport accounted for ~28.9% of EU-27 greenhouse-gas emissions in 2022; road transport alone represented 73.2% of transport emissions, underscoring the importance of decarbonising urban road freight and service traffic. Pandemic-related mobility disruptions temporarily depressed transport emissions in 2020, but by 2022 they had largely rebounded, reinforcing the need for structural, demand-resilient solutions.[2]

EU policy has responded by linking urban logistics explicitly to climate, health, and liveability objectives. The European Commission's *Sustainable and Smart Mobility Strategy* frames a transition in which external costs of "millions of deliveries" are internalised, and it calls for Sustainable Urban Mobility Plans (SUMP/SULP) that include first/last-mile solutions and freight-specific measures. The strategy situates these steps within broader recovery and resilience goals ("build back better") and within freight "greening" flagships that emphasise multimodal logistics and performance-based incentives.[3] [4]

Within this policy context, urban logistics hubs (microhubs) have gained prominence as place-based instruments to separate inter-urban and intra-urban flows, consolidate consignments, and facilitate transfers to low- and zero-emission vehicles (e.g., cargo bikes, light electric vehicles), thereby reducing vehicle-kilometres and tailpipe emissions in dense areas.

3.2. Research aims and methodology

This document investigates last mile delivery trends and Micro hub business models across European contexts, drawing from a curated dataset of urban Microhub case studies. Our objectives are threefold:

1) Typology Identification: Develop a classification of Microhub models—publicly led, public–private partnerships, private-led with public support, collaborative multi-user, and temporary tactical approaches—based on ownership, operation, funding, use, and sustainability.
2) Pattern Detection & Viability Assessment: Extract common structural features, enablers (e.g., governance clarity, modular design, digital coordination platforms), and risks (such as funding transition issues and stakeholder complexity).
3) Framework Proposal: Offer a scalable implementation framework supplemented by performance indicators and replicability guidelines, targeting urban planners and logistics stakeholders.

We adopted a multi-method, comparative case-study strategy to identify and generalize business-model archetypes for European urban micro-hubs. Our first step was to build a comprehensive evidence base

[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=E-commerce_statistics_for_individuals
[2] https://www.eea.europa.eu/en/analysis/publications/sustainability-of-europes-mobility-systems/climate
[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789
[4] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52020DC0789

through systematic desk research. We collected and reviewed official project reports, peer-reviewed articles, funding applications, press releases, and operator websites that together document twenty initiatives—three GRETA pilot sites and seventeen external cases.

To strengthen this secondary material, we triangulated it with primary inputs from the GRETA project itself, most notably pilot-generated monitoring data and two workshops in which we convened municipal officers, parcel carriers, technology providers, and research partners. This blend of secondary and primary sources provided a robust foundation for factual validation and contextual insight.

We coded every case against a standardized comparison template. Five core dimensions—asset ownership, governance and operations, revenue logic, user mix, and the public-private interface—were extracted systematically, ensuring comparability across the heterogeneous sample.

4. Background

4.1. Defining Microhubs

Microhubs—often referred to as micro depots or micro distribution centers—are small-scale urban logistics nodes that support consolidation, transshipment, and last mile distribution activities close to delivery endpoints[5] [6]. Typically situated within or near city centers, Microhubs facilitate the transfer of goods from larger vehicles to low or zero emission modes such as cargo bikes, electric trolleys, or light electric vehicles[7].

This concept aligns closely with the European Green Deal's emphasis on sustainable mobility. By highlighting the importance of 'Sustainable and Smart Mobility'—including the uptake of zero emission vehicles and urban consolidation actions—the Green Deal provides a clear policy mandate for Microhub implementation[8].

4.2. Drivers

Environmental Sustainability:

Urban freight accounts for approximately 25 % of transport-related emissions in cities[9], amplifying noise, air pollution, and congestion. Microhubs, by enabling the use of environmentally friendly delivery modes and reducing the diameter of delivery routes, effectively reduce greenhouse gas emissions and support city climate targets.

Urban Livability:

By substituting diesel vans with cargo bikes and light EVs in high density zones, Microhubs help alleviate street-level congestion and noise. This contributes to better air quality and safer streets—directly enhancing urban quality of life.

Regulatory and Policy Drivers:

Cities across Europe are increasingly deploying low emission zones, time restricted delivery windows, curb-side regulation, and congestion charges—all creating a favorable policy environment for Microhubs. These measures align with EU-level strategies under the Green Deal and national sustainable freight initiatives.

4.3. EU Policy Framework for Microhubs

The European Union has established a strong policy foundation that underpins the deployment of Microhubs as part of the broader effort to decarbonize urban logistics. This framework stems primarily from the European Green Deal and the Sustainable and Smart Mobility Strategy, supplemented by more specific urban logistics instruments. Each of these provides regulatory backing, funding mechanisms, and operational guidelines that align with local implementation.

[5] https://www.urbanfreightlab.com/wp-content/uploads/2023/04/sustainability-14-00532-v2.pdf
[6] https://www.mwcog.org/assets/1/6/DC_-_TLC_FY23_-_Delivery_Microhub_Study.pdf
[7] https://marketplace.eiturbanmobility.eu/insights/exploring-the-future-of-microhubs-in-last-mile-logistics
[8] https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/transport-and-green-deal_en
[9] https://www.sciencedirect.com/science/article/abs/pii/S0739885917301798

European Green Deal:

Adopted in December 2019, the European Green Deal sets the EU's goal of becoming climate-neutral by 2050. One of its central aims is a 90% reduction in greenhouse gas emissions from transport—demanding cleaner vehicles, reduced freight emissions, and decarbonized delivery systems[10].

Sustainable and Smart Mobility Strategy:

Under the Mobility Strategy launched in December 2020, the EU commits to a green and digital transition in transport via 82 initiatives across public transport, mobility services, and freight (transport.ec.europa.eu). Specific urban goods logistics guidance—outlined in documents like the "Sustainable Urban Logistics Plans" (SULPs)—calls upon local authorities to deploy Microhubs within a 15-minute walk for most residents, coordinate digital logistics infrastructure, and establish measurable KPIs to assess emission, noise, and traffic impacts[11].

Innovation and Digitalization Agenda:

Aligned with the European Green Deal's push for innovation and resilience, the Sustainable and Smart Mobility Strategy emphasizes urban logistics innovation. It encourages the digitalization of assets and use of modular infrastructure to support freight consolidation hubs and collaborative micro-depots[12].

EU Funding Mechanisms:

Microhub deployment is actively supported via:

- European Regional Development Fund (ERDF) and Interreg Central Europe, which fund GRETA and other regional projects focused on spatial optimization and cargo-bike deployment.
- NextGenerationEU and the Recovery and Resilience Facility (RRF)—with at least 37% allocated to green initiatives—provide substantial financing for urban infrastructure and mobility projects[13].
- CIVITAS, ELTIS, and POLIS Network, which support best-practice sharing and innovative urban logistics models through case studies and platforms[14].

[10] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX%3A52020DC0789

[11] https://transport.ec.europa.eu/document/download/b818ff86-2463-4949-9413-d3ca559f60b9_en?filename=EGUM_Recommendations_SG4_D1_SULP.pdf

[12] https://transport.ec.europa.eu/document/download/95e8192e-c6ae-4a3d-b080-66d14cd20deb_en?filename=EGUM_Recommendations_SG4_D3_InnovationUptake.pdf

[13] https://transport.ec.europa.eu/document/download/b818ff86-2463-4949-9413-d3ca559f60b9_en?filename=EGUM_Recommendations_SG4_D1_SULP.pdf

[14] https://www.polisnetwork.eu/wp-content/uploads/2024/06/Master-slides_Whole-day-1.pdf

5. Hypothesis on Business Model enablers

The analysis of Microhub business models could consider four core dimensions—asset ownership, governance, revenue generation, and public private interaction:

- Asset Ownership & Control: Solutions vary from publicly owned Microhubs—often integrated into municipal logistics infrastructure—to private investments in strategic locations, or hybrid arrangements such as public-private partnerships.
- Governance & Operation: Management may rest with public authorities, private delivery firms, or collaborative consortia. Successful multi user hubs rely on neutral governance frameworks facilitating access and scheduling across service providers.
- Revenue & Financial Strategy: In pilot stages, public or EU grants typically support capital and operating costs. However, sustainable scale up demands future revenue streams, such as membership fees, space rental, service charges, or shared revenue from consolidation services.
- Interface in Public-Private Context: Microhubs often require coordination across municipal administrations, regulatory bodies, logistics operators, and community stakeholders. Frameworks like Freight Quality Partnerships (FQPs) and public procurement protocols play crucial roles in ensuring smooth collaboration.

Our desk analysis and pilot research confirm that effective Microhub operations hinge on two enablers: (public) governance structures, modular (public or private) infrastructure.

6. Common patterns across Business Models

Five recurring patterns:

- Asset Ownership & Governance: Municipal vs private vs hybrid.
- Business Lifecycle: Pilot to permanent—public support is key in phase 1.
- Operator Models: Single vs multi-user; digital slot/platform vs physical differentiation.
- Service Scope: Cargo-bikes, electric trolleys, curbside management with time slots.
- Revenue Streams: Rent, service fees, grants, platform usage charges; necessity for transparent models.

Other recuring patterns are:

Shared Infrastructure with Neutral Governance:

Numerous successful micro-hubs—from Berlin's KoMoDo to Helsinki's DISCO hub—employ a landowner or neutral operator (e.g., public authority, municipal parking company, neutral entity like BEHALA or Forum Virium). This arrangement enables multiple carriers to lease modular container space, reducing competition for location while sharing digital platforms for booking, coordination, and data interoperability.

Modular, Container-based Design for Flexibility:

Many micro-hubs utilize reconfigurable shipping containers or trailers—seen in Bremen's ULaaDS depot, Brussels' TNT mobile trailer, Lisbon's Yoob nano-hubs, and Cambridge's UPS container—to support rapid deployment, relocatability, and minimal long-term infrastructure commitment.

Cargo-Bike (or Electric Micro-Vehicle) Last-Mile Integration:

A defining feature across hubs is the handoff from larger vehicles to low- or zero-emission modes—cargo bikes, electric quadricycles, motorcycles, or autonomous robots. These "zero tailpipe emissions in dense cores" operations are common to UPS Cambridge, Madrid, Groningen, Paris logistics hotels, and Brussels—all aligning with theoretical frameworks that underscore cargo bike integration as essential to microhub sustainability.

Public-Private Collaboration & Asset Sharing:

Most cases reveal cooperative models—public land or permit provision combined with private operational funding, leasing, or policy alignment. Paris Sogaris and Madrid Plaza Mayor involve the municipality providing land and permissions, while private firms deliver operations. Cases such as Bremen ULaaDS (city owns facility but carriers lease modular units) and Barcelona/Stockholm HALLO (park management companies partner with EIT) mirror business model types from MDPI typology analyses .

Dynamic Slot Pricing, Digital Platforms, and Monitoring:

Advanced hubs—Bremen ULaaDS, Helsinki's DISCO, Berlin KoMoDo, and Helsinki RUOHOLAHTI—implement booking apps, digital twins, or dynamic slot pricing based on real-time data and emissions feedback.

7. Typologies of Microhub Business Models

7.1. Public initiated and operated

Oslo – City Hub

London (Westminster) – Park Lane & Pimlico micro-logistics hubs

Barcelona & Stockholm – HALLO network

In this model the municipality, or a wholly-owned utility, provides the land, funds infrastructure, and runs the hub. Private carriers simply rent space or purchase services. Oslo's City Hub illustrates the approach: the city, port authority, and roads agency secured a prime waterfront plot, installed modular container buildings, and linked the site to Oslo's zero-emission zone. DB Schenker is anchor tenant but owns none of the assets. Westminster's Park Lane and Pimlico hubs follow the same script: parking bays were converted into cargo-bike depots, managed directly, with curb-use data feeding into freight policy[15]. Barcelona and Stockholm's HALLO network extends the idea—municipal parking companies repurposed surplus space, with EIT Urban Mobility funding the build and cities covering operating costs[16]. The attraction is maximum policy control, but it comes with financial and operational risk[17].

Why choose this model: Maximum policy control, integration with emission or pricing regimes, and scope to treat hubs as living labs. Trade-off: the city carries most of the risk.

7.2. Public-Private Partnership (PPP)

Paris – Sogaris logistics hotels

Madrid – Plaza Mayor underground microhub

Bremen – ULaaDS Micro-Depot

PPP hubs keep public objectives front-and-center while unlocking private capital and expertise. Cities grant access to strategic land—often rail-connected or heritage sites—on favorable terms, while private developers finance and run operations[18]. Paris's Sogaris "logistics hotels" are the flagship: the City of Paris holds 49 per cent, Sogaris 51 per cent, combining municipal land-use power with a specialist landlord's balance sheet[19]. Madrid's underground hub beneath Plaza Mayor follows suit; EMT Madrid leases car-park space to CITYlogin, shares data via a digital twin, and taps EU funding. Bremen provides land and modular containers while carriers lease slots month-to-month under a dynamic pricing regime that also feeds the ULaaDS decision-support platform. Success hinges on clear risk-sharing and lease lengths long enough to reassure both sides[20].

Why choose this model: Unlocks private capital, accelerates delivery, and safeguards public objectives. Success depends on robust risk-sharing and long-horizon leases.

[15]https://www.westminster.gov.uk/sites/default/files/media/documents/A%20Year%20of%20Delivery_1.pdf

[16]https://sustainablemobility.iclei.org/berlin-and-barcelona-take-on-cycle-logistics/

[17]https://www.toi.no/getfile.php?mmfileid=51225&utm_

[18]https://urban-mobility-observatory.transport.ec.europa.eu/news-events/news/madrid-develops-logistics-microhub-boost-low-emissions-delivery-2021-10-27_en?prefLang=bg

[19]https://knowledge-hub.circle-economy.com/article/9066

[20]https://ulaads.eu/cities/bremen/

7.3. Private Led, Publicly Supported

Cambridge (UK) – UPS Cycle Hub

Utrecht (NL) – DHL City Hub

Groningen (NL) – PostNL City Hub

Here a logistics operator funds and manages the hub, while the municipality provides soft incentives—free curb access, reduced bay fees, or regulatory exemptions—to make the business case viable. UPS's Cycle Hub in Cambridge shows the formula: UPS paid for the e-Quad fleet and container, while the city waived loading-bay charges under its Clean Air Initiative[21]. DHL's City Hub in Utrecht applies the same logic: DHL invested in trailer modules and Cubicycles, the municipality offered land beside the Jaarbeurs center, and tied the project to its 2030 climate plan[22]. In Groningen, PostNL and Dropper financed a depot that scaled quickly with support from the city's Green Covenant. The model enables rapid rollout with little public cost but depends on carriers with dense local volumes and cities offering strong non-cash incentives[23].

Why choose this model: Low burden on public budgets and fast deployment—best when a carrier already has local density and the city provides meaningful incentives.

7.4. Multi User Collaborative Hubs

KoMoDo – Berlin

SMUD Pilot – Munich & Helsinki

DISCO Pilot – Helsinki (Ruoholahti Hub)

Collaborative hubs rely on a neutral operator—often a city-backed intermediary—to manage space, slots, and digital interfaces so rival carriers can co-locate without conflict. Berlin's KoMoDo showed the mechanics: BEHALA leased containers to five parcel firms and ran a shared booking API for bike dispatches within three kilometers[24]. Munich and Helsinki pilots road-tested a Fraunhofer toolkit for modular curbside depots. Helsinki's DISCO hub went further: Forum Virium set common rules for multiple carriers and added shared offices plus a single booking platform[25]. The payoff is fewer vans across fleets, but the governance load is heavy: data-sharing, liability, and a trusted referee are essential[26].

Why choose this model: Delivers maximum street-level impact and shared costs, but needs strong governance and a neutral convener.

7.5. Temporary / Tactical Deployments

TNT Mobile Depot – Brussels

DISCO Pilot – Helsinki (Ruoholahti Hub)

Yoob Micro/Nano-hubs – Lisbon

[21]https://about.ups.com/us/en/our-stories/innovation-driven/ups-cambridge-cycle-hub-paves-the-way-for-sustainable-city-deliv.html

[22]https://www.dhlecommerce.nl/en/business/knowledge-platform/news/city-hub

[23]https://northsearegion.eu/surflogh/pilots/city-hub-groningen-i-e-cargo-bike-deliveries/

[24]https://sustainablemobility.iclei.org/berlin-and-barcelona-take-on-cycle-logistics/

[25]https://forumvirium.fi/en/publication/lessons-learned-from-the-microhub-pilot-collected-in-a-concept-report/

[26]https://www.eit.europa.eu/sites/default/files/stakeholderevent_summary.pdf

Some hubs are designed as pop-ups: low-capex, short-term trials that let cities test demand, gather data, or bridge construction phases. TNT's Brussels Mobile Depot parked a 14-metre trailer in a city park for three months, showing electric tricycles could replace vans and cut CO_2 by a quarter[27]. Helsinki's DISCO pilot was time-boxed to five months so findings could feed into policy and Horizon Europe research. In Lisbon, start-up Yoob deploys 36 m^2 micro-hubs and sub-5 m^2 nano-hubs that can be moved or replicated within days, guided by machine-learning analysis of delivery data[28]. These tactical sites help de-risk new tech or build community trust, with curb space quickly reclaimed if results disappoint.

Why choose this model: Ideal for data-gathering, community buy-in, or testing new tech before committing permanent space.

7.6. Comparative mapping of 17 urban microhubs by business model, regulatory alignment, and spatial design

Table 1 maps the 17 European microhubs across three dimensions: Business Model (governance and funding archetype), Regulatory Framework (policy context or incentives governing participation), and Spatial/Physical Design (the siting and infrastructure type).

Microhub Project	Business Model Archetype	Regulatory Alignment	Spatial/Physical Design
Oslo City Hub (DB Schenker)	Publicly initiated & operated	Voluntary market adoption	Off-street modular hub on port land (shipping containers)
London - Westminster (Park Lane)	Publicly initiated & operated	Tariff-based nudging	Curbside "micro-pad" (repurposed on-street parking bays)
London - Westminster (Pimlico)	Publicly initiated & operated	Tariff-based nudging	Off-street retrofit in parking garage (Q-Park underground)
Barcelona HALLO network	Publicly initiated & operated	Tariff-based nudging	Curbside hubs (50–120 m^2) on street/parking margins
Stockholm HALLO network	Publicly initiated & operated	Tariff-based nudging	Off-street depot (~100 m^2) using municipal parking assets
Paris "Logistics Hotels" (Sogaris)	Public–Private Partnership (PPP)	Procurement-anchored demand	Large mixed-use freight hubs (75,000 m^2) with rail/river links
Madrid Plaza Mayor Hub	Public–Private Partnership (PPP)	Tariff-based nudging	Sub-surface retrofit (200 m^2 in an underground car park)
Bremen ULaaDS Micro-Depot	Public–Private Partnership (PPP)	Tariff-based nudging	Off-street modular depot (leased shipping containers on city land)

[27]https://origin.tnt.com/corporate/en/data/press/2013/05/tnt-express-introduces-mobile-depot-in-Brussels.html

[28]https://research.unl.pt/ws/portalfiles/portal/64266957/Data_Driven_Spatiotemporal_Analysis_of_e_Cargo_Bike_Network_Lisbon_Yoob_Case.pdf

Microhub Project	Business Model Archetype	Regulatory Alignment	Spatial/Physical Design
Cambridge UPS e-Quad Hub	Private-led, publicly supported	Voluntary market adoption	Curbside container micro-depot (converted shipping container)
Utrecht DHL City Hub	Private-led, publicly supported	Voluntary market adoption	Off-street mobile depot (trailer & "Cubicycle" containers adjacent to event center)
Groningen PostNL City Hub	Private-led, publicly supported	Voluntary market adoption	Off-street depot (city pilot site in Europapark, with dynamic routing software)
Berlin KoMoDo Hub	Multi-user collaborative hub	Tariff-based nudging	Off-street shared container yard (5 carriers leasing containers in a lot)
Munich SMUD pilot	Multi-user collaborative hub	Procurement-anchored demand	Curbside modular pilot (containers integrated into street infrastructure)
Helsinki SMUD pilot	Multi-user collaborative hub	Procurement-anchored demand	Off-street modular pilot (central wood cabin + containers on public land)
Helsinki DISCO Hub (Ruoholahti)	Multi-user collaborative hub (temporary)	Tariff-based nudging	Off-street shared pilot hub (100 m^2 on underutilized city land; mixed cargo bikes & robots)
Brussels TNT Mobile Depot	Temporary/tactical deployment	Voluntary market adoption	Mobile hub (14 m trailer pop-up in a city park for 3-month pilot)
Lisbon Yoob Micro/Nano-Hubs	Temporary/tactical deployment	Voluntary market adoption	Flexible micro-hub network (36 m^2 container + sub-5 m^2 "nano" units; movable)

Supply-chain Integration Depth vs. Regulatory Alignment and Incentive Mix:

The comparative analysis shows microhub business models are closely tied to their regulatory context. None of the surveyed hubs were mandated by law; most relied on voluntary participation or incentive-based nudges. Voluntary, single-carrier hubs were common: five cases (Oslo, UPS Cambridge, PostNL Groningen, TNT Brussels, DHL Utrecht) involved one company acting mainly on sustainability goals. These private-led hubs mobilize quickly and self-finance but serve only one network and depend on the firm's commitment. By contrast, city-led or PPP hubs serve multiple users under policy incentives. Westminster and HALLO offered subsidized space and data integration, while collaborative hubs (Berlin KoMoDo, Helsinki DISCO, Bremen ULaaDS) used grants and discounted leases to foster cooperation. Market-driven hubs scale fast but lack city-wide reach; policy-supported hubs align with urban plans but need more coordination.

Spatial and Design Patterns: Many projects used modular containers, enabling rapid deployment. Oslo, Helsinki, and Lisbon's Yoob network all favored container or nano-hub formats; Westminster and HALLO reused curb space cheaply. These small hubs fit neighborhood needs but handle limited volume. Larger PPP hubs (Paris's Sogaris, Madrid's Plaza Mayor) integrated rail or underground garages, offering scale and multimodal links but requiring heavy capital. Paris's Chapelle International—75,000 m^2 with freight, offices, and urban farming—illustrates the opposite extreme. Mid-scale designs (Pimlico garage, Plaza Mayor

basement) show how retrofits can work in dense areas, though often with higher site-prep costs. Mobile pop-ups like TNT Brussels offered tactical flexibility but struggled with efficiency.

Trade-offs: Multi-operator hubs achieved greater traffic reduction but required heavy governance and a trusted referee. Single-carrier hubs reached efficiency quickly but only displaced one fleet. Many hubs began as pilots (KoMoDo 12 months, DISCO 5 months) to collect data, but permanence is needed for private buy-in. Digital maturity is another key axis: Madrid used a digital twin, Lisbon applied machine-learning, and Bremen tested dynamic pricing. None of the hubs were mandated, but Utrecht's 2025 zero-emission zone could effectively create compulsory microhubs.

Conclusion: Microhubs must be read across three dimensions: business model (who pays and operates), policy environment (why actors join), and spatial form (what infrastructure is used). Publicly led hubs often use curbside or city property with incentives; private-led hubs opt for flexible lots tied to corporate goals. Hybrids exist—Oslo's City Hub was built as a PPP but functions as single-carrier. Key trade-offs emerge between speed vs. scale, flexibility vs. coordination, and experiment vs. investment.

Digital Maturity Typology:

- Analogue: manual booking, manifests
- Basic API: track-and-trace integration
- Real-time: IoT sensors, curb occupancy feeds
- Digital twin: predictive routing, scenario testing (Madrid, Bremen)
- Autonomy-ready: V2I beacons, robot paths (Helsinki DISCO)

The impact of digital depth on durability remains open, but integration with logistics systems appears critical.

7.7. Key Take-aways across the typology

- No single "best" model—choices hinge on land availability, carrier market structure, and political appetite for risk.
- Modularity is universal. Whether public or private, shipping-container architecture keeps costs predictable and allows quick pivoting between typologies as projects mature.
- Digital layers increasingly decide success. Booking platforms, sensor dashboards, and digital twins are what let multiple actors share space, measure impact, and—crucially—justify rents once grant funding dries up.

Cities starting their own Microhub-journey can therefore treat these five archetypes as a sliding scale rather than silos: many successful programms evolve from a tactical pilot into a public-lead facility or a PPP, as evidence, partners, and funding lines solidify.

8. Future Research & Policy Implications

8.1. Research Gaps

1. Economic viability and scalability

Future work must clarify the conditions under which microhubs can survive without subsidies. Key questions include: What parcel volumes or delivery densities ensure breakeven? How do dynamic pricing models (e.g. Bremen's off-peak slots) or phased financing affect utilization and long-term viability? Comparative techno-economic studies and sensitivity analyses across cities are essential.

2. Digital infrastructure and data governance

As hubs integrate booking platforms, sensors, and digital twins (e.g. Madrid, Berlin, Helsinki), research should benchmark interoperability standards, transaction costs, and cybersecurity requirements. Questions remain around governance: should slot-booking APIs be treated as public utilities to ensure openness and trust?

3. Standardized impact metrics

Most pilots report isolated figures, but methodologies differ. Harmonized KPI frameworks (e.g. emissions per parcel, curb occupancy reduction) and consistent sensor protocols would allow longitudinal, cross-city evaluations. Multi-city living labs could deliver comparable datasets across hubs in, say, Westminster, Stockholm, and Madrid.

4. Social, labor, and land-use impacts

Research must go beyond efficiency and emissions to assess labor conditions (e.g. courier job quality), distributional effects of reallocating curb space, and planning rules for unconventional sites. Examples such as Oslo's waterfront container hub or Lisbon's nano-hubs highlight the need for zoning categories that recognize "temporary logistics structures."

8.2. Methodological Priorities

- Living-lab consortia: Multi-city pilots with identical KPIs and sensors for quasi-experimental robustness.
- System dynamics modeling: Linking hub flows to city-wide freight models to capture rebound effects.
- Participatory foresight: Scenario workshops with carriers, residents, and planners to stress-test hubs under emerging paradigms (e.g. Physical Internet, autonomous delivery).

8.3. Policy Levers for the Next Decade

- Performance-based permits: Tie hub leases to KPI thresholds, reviewed every three years.
- Step-down financing: Blend grants with rent rebates tapering over five to seven years to avoid subsidy cliffs.
- Open digital infrastructure: Mandate open booking and emissions data standards as public utilities.
- Flexible zoning: Create fast-track permits for modular, temporary logistics structures.
- Integrated curb strategies: Combine tariffs, low-emission zones, and delivery-time windows to make hub use competitive.

- Knowledge exchange: Formalize cross-city learning networks so insights from large pilots flow to smaller municipalities.

8.4. Refining the Typology

Microhubs should be described through four dimensions: governance (public–private spectrum), regulatory regime (voluntary vs. mandated), spatial form (curbside pad, retrofit, mobile, logistics center), and temporal scope (pilot vs. permanent). This multidimensional approach avoids oversimplification and better reflects hybrid cases—for example, Helsinki's DISCO hub as both a collaborative and tactical pilot. By mapping projects along these axes, underexplored models (e.g. mandated multi-operator hubs or fully private multi-user ventures) can be identified, while recognizing spatial and regulatory contexts as central to hub viability.

9. Conclusions

Microhubs have moved from curiosity to credible policy tool, yet their long-term viability now hinges on closing research gaps around economics, data, and equity, while deploying policy instruments that reward measurable performance. If cities, carriers, and researchers align on these next-step agendas, micro-hubs can evolve from tactical pilots into the backbone of a low-carbon, high-liveability urban freight ecosystem.

If European cities, logistics operators and researchers align on the agendas outlined above, micro-hubs can graduate from grant-supported pilots to a structurally embedded component of low-carbon urban logistics. The next research cycle must therefore shift from proof-of-concept to proof-of-scalability, while policy makers should pivot from permissive experimentation to performance-oriented incentive regimes. By closing the evidence gaps on finance, data and equity—and by deploying targeted regulatory and fiscal instruments—we can ensure that micro-hubs deliver on their promise of cleaner air, quieter streets and more resilient last-mile delivery networks.