DISC

Data-driven and Dynamic Space Assets for physical internet led Urban Logistics and Planning



DISCO Policy Lessons

DISCOCURB

DISCOLLECTION

Funded by the European Union

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Acronyms and abbreviations

A quick reference for the terms used throughout this brief.

Term	What it means
DISCO	Data-driven and Dynamic Space and Assets for Physical Internet-led Urban Logistics and Planning, the Horizon Europe project behind this brief (Grant Agreement No. 101103954)
DISCOCURB	The DISCO innovation covered in this brief, for dynamic, data-driven curb and loading-zone management
DISCOLLECTION	The companion DISCO data layer that publishes standardised occupancy and booking data from DISCOCURB deployments
Living Lab	A real-world city site where a DISCO innovation was piloted (Starring) or adapted and tested (Twinning)
LUZ	Loading and unloading zone, the curbside space DISCOCURB manages
UFDS	Urban Freight Data Space, the DISCO platform for sharing standardised freight and curbside data
SULP	Sustainable Urban Logistics Plan
SUMP	Sustainable Urban Mobility Plan
LEZ	Low-Emission Zone
ZEZ	Zero-Emission Zone
ZFE	Zone à Faibles Émissions, the French low-emission zone scheme
DUM	Distribució Urbana de Mercaderies, Barcelona's urban freight distribution zones
PI	Physical Internet, the interoperable-logistics principle underpinning DISCO
AI	Artificial intelligence
API	Application programming interface
GeoJSON / CSV	Open data formats used to publish curbside and booking data
LiDAR	Light Detection and Ranging, a laser-based sensing technology
SPRO	Barcelona's municipal parking and loading-zone app
eFTI	Electronic Freight Transport Information (EU Regulation 2020/1056)
DATEX II / APDS	European data-exchange standards for traffic and parking information
NAPCORE	National Access Point Coordination Organisation for Europe
TEN-T	Trans-European Transport Network
CEF	Connecting Europe Facility, the EU's infrastructure co-financing instrument
DPA	Data Protection Authority
MMS	The DISCO Meta-Model Suite of decision-support tools

What is DISCOCURB ?

> ***Dynamic Curbside Management: Turning static, contested curb space into a dynamic, bookable and data-driven assets.***

DISCOCURB addresses one of the most persistent problems in urban logistics: curb space for loading, unloading and parking that is inefficient, poorly allocated or unregulated. Across European cities, delivery drivers face congested zones, unclear availability and conflict with other street users. DISCOCURB addresses this by applying data-driven solutions to transform static, underused curbs into dynamic, responsive assets.

What it could look like in practice

- Sensors or AI cameras that detect occupancy, dwell time and vehicle type in real time, clarifying how loading bays are actually used.
- Drivers reserving a parking bay in advance through a web or mobile platform, with the booking shown on programmable digital signage at the curb.
- Compliance monitoring which flags overstays, unregistered operations and unauthorised parking, supporting enforcement without manual patrols.
- Floating Car Data and demand models that locate where new bays are needed, while Low-Emission Zone simulation tests policy before it is adopted.

This means the curb becomes a shared, multi-operator resource rather than a static line of paint, advancing the Physical Internet principle of shared, interoperable infrastructure.



Figure 1: Helsinki Living Labs mobile sensor for curbside occupancy readings

Paired with DISCOLLECTION

Each DISCOCURB deployment generates standardised occupancy and booking data, published in open formats such as GeoJSON and CSV to the DISCO Urban Freight Data Space (UFDS). DISCOLLECTION refers to the data driven aspects of the innovation, this is: data collection, data analysis and the use of this data for improved decision making.

This curbside data feeds digital twins, municipal mobility catalogues and Sustainable Urban Logistics Plan evidence bases, while the privacy preserving design keeps the system compliant with data protection laws. Within DISCO, each city could also have their own private Smart Data Platforms where they have a say over which data is shared openly and which is kept private, allowing data sovereignty.

Where DISCOCURB was demonstrated

DISCOCURB was the most widely deployed innovation, tested in five Living Labs across two Starring and three Twinning cities, each pairing curbside intelligence with a DISCOLLECTION data layer.

Table 1 Starring Living Labs piloted the original innovations; Twinning Living Labs adapted and stress-tested them in new urban and crisis contexts.

Living Lab	Level	DISCOCURB approach	DISCOLLECTION data layer
Helsinki	Starring	Combining movable sensors to collect on street parking data, Floating Car Data planning to create a LEZ simulation	Data linked to the Helsinki Mobility Data Catalog and Digital Twin
Copenhagen	Starring	Smart Zones with sensors, signage and a booking platform	Booking and sensor data integrated for usage analytics
Barcelona	Twinning	AI driven cameras with licence plate recognition in three DUM zones	Fusion of the data collected from the on street cameras with the SPRO app to build an objective usage baseline.
Padua	Twinning	On-demand stalls with digital signage and web booking	GeoJSON reservation data shared via RESTful APIs to the UFDS
Zaragoza	Twinning	Zaragoza living lab developed the EDPI, a demand and capacity diagnostic model that identifies the best locations for the positioning of proximity solutions such as hubs and parcel lockers based on demand density. This enabled the modelling of over 779 zones in the Zaragoza metropolitan area.	Reproducible methodology built on open socio-demographic data

Dynamic curbside management treats the curb as a resource whose demand changes throughout the day, using data, sensors, bookings or modelling to manage that demand rather than leaving curb space fixed. Helsinki and Copenhagen went first as Starring Living Labs; Barcelona, Padua and Zaragoza followed as Twinning Living Labs, adapting the approach to their own context.

Matching the tool to the problem

DISCOCURB was not the end itself but a means to an end, cities adopted it in different ways to address the problems that they were facing. This is the suggested approach which is recommended to cities; study the problems that are most prevalent and then look for the best fitting solutions.

Table 2 Approaches addressing DISCO Living Lab core problems

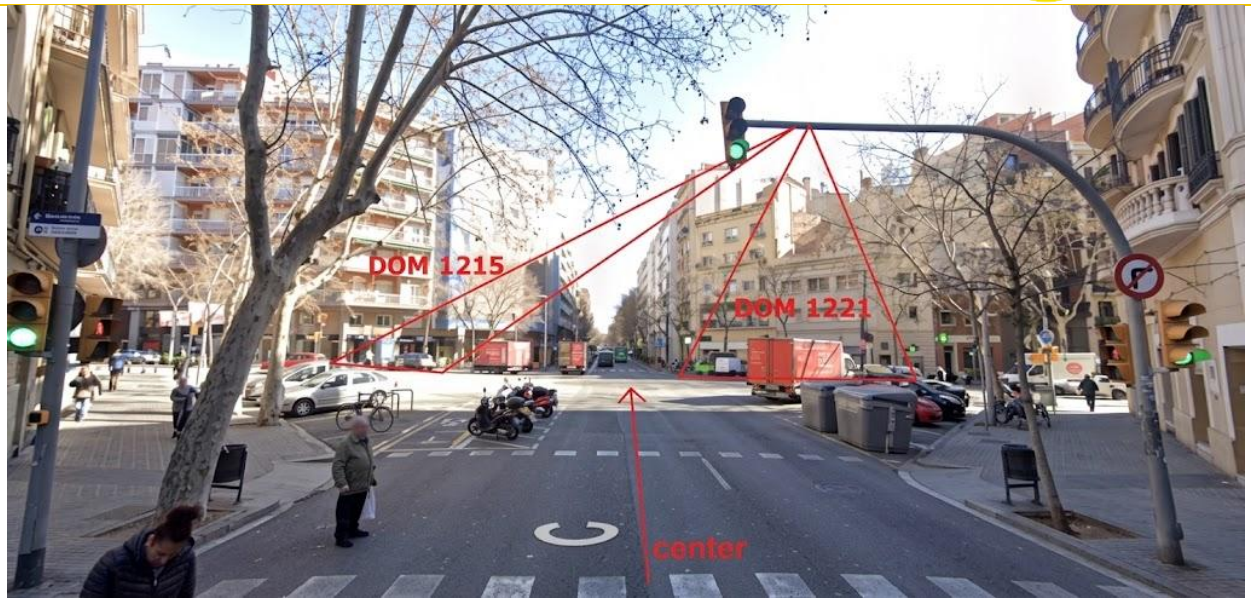
Living Lab	The core problem	The approach chosen
Helsinki	Needed to see what is physically happening on the curb	Three movable, battery-powered sensors (two camera-based, one LiDAR) across seven loading zones, since the curbs lacked mains power
Copenhagen	Needed to manage conflict over scarce, high-value space	Two Smart Zones with six sensors and three signs; booking platform created by Coding the Curbs
Barcelona	Needed to see what is physically happening on the curb	High-resolution cameras with an AI pipeline, validated against the city parking app
Padua	Needed to manage conflict over scarce, high-value space	Twinned the booking-platform idea, procuring a local provider for a live booking platform paired with programmable signage
Zaragoza	Needed to know where to intervene, and whether capacity was even sufficient	Regression on demographic and commercial data plus queuing analysis of 779 existing loading zones — no hardware required

What made the implementations successful

- **Helsinki —** adapting the tool to physical constraints rather than forcing one technology everywhere.
- **Copenhagen —** securing durable political backing, since it carries the work through setbacks (momentum held after losing 600 parking spaces to a council decision).
- **Barcelona —** reusing existing assets to move faster (an existing research camera was repurposed).
- **Padua and Zaragoza —** designing for reuse from the start, through Padua's modular API and Zaragoza's reproducible demand formula.

Challenges faced by DISCO living labs

- **Helsinki —** hardware can fail unexpectedly; some ground sensors stopped working in winter.
- **Barcelona and Copenhagen —** legal and administrative work often outweighs the technical work, from extensive permitting and data-protection authority coordination to strict legal agreements just to clean operator data.
- **Padua —** coordination gaps between city departments can affect good design, this was seen in enforcement gaps and unsynchronised permits between maintenance crews and the booking system.
- **Copenhagen —** systems can miss their intended users; about 40 percent of professional drivers found real-time data unhelpful because routes are planned days ahead.



Barcelona's DUM zones: AI cameras with licence-plate recognition build an objective baseline of loading-zone use and compliance.

Results and policy fit

Overall results

Across the five Living Labs, DISCOCURB consistently turned an opaque public asset into a measured, manageable one. Sensor and camera monitoring repeatedly exposed the same underlying problem: unauthorised and private-car occupancy, not delivery demand, is the dominant constraint on loading capacity.

Real-time data proved most valuable when integrated into earlier planning rather than offered only at the moment of delivery. Where cities combined detection with data fusion, as in Barcelona, they replaced unreliable self-declared figures with an objective compliance baseline. Diagnostic modelling, as in Zaragoza, showed that meaningful curbside policy can advance at low cost even where physical deployment is not yet feasible.

Key results at a glance

Living Lab	Most notable result
Helsinki	Movable sensors plus LEZ simulation identifying a 307-tonne CO2 reduction potential
Copenhagen	Smart Zones generating evidence on dwell time and vehicle mix from 89 bookings
Barcelona	First objective, validated baseline of loading-zone compliance through AI and booking app data fusion
Padua	Live platform-to-signage synchronisation enabling enforceable on-demand stalls
Zaragoza	Reproducible demand and capacity model assessing 779 loading zones

Best Suited policy and regulatory targets

Based on the Living Lab evidence, DISCOCURB is best suited to policy and regulatory targets that concern curbside allocation, access enforcement and the data foundations of urban logistics planning are:

Framework or instrument	How DISCOCURB contributes
Sustainable Urban Logistics and Mobility Plans	Supplies measured evidence for loading-zone optimisation, curb allocation and access-rule enforcement, addressing the technical dimensions where SULP compliance is strongest.
EU Urban Mobility Framework	Demonstrates data-driven management of urban space and emissions, supporting the Framework's objective of efficient, low-emission urban logistics.
Low- and Zero-Emission Zone enforcement	Provides occupancy, compliance and simulation evidence to design and monitor access regulation and emission zones.
Data-protection and surveillance rules	Offers a privacy-by-design model for camera and licence-plate processing that keeps enforcement lawful.
Freight data standards (DATEX II, NAPCORE)	Generates standardised curbside data in open formats, ready for national access points and data spaces.

Recommended first steps

Policy goes hand in hand with planning and implementation at every step. The DISCOCURB Generalised Transition Path sets out a recommended structured route for a city to follow when implementing DISCOCURB: it starts by defining scope and objectives, then works through to a fully operational dynamic curb management system.

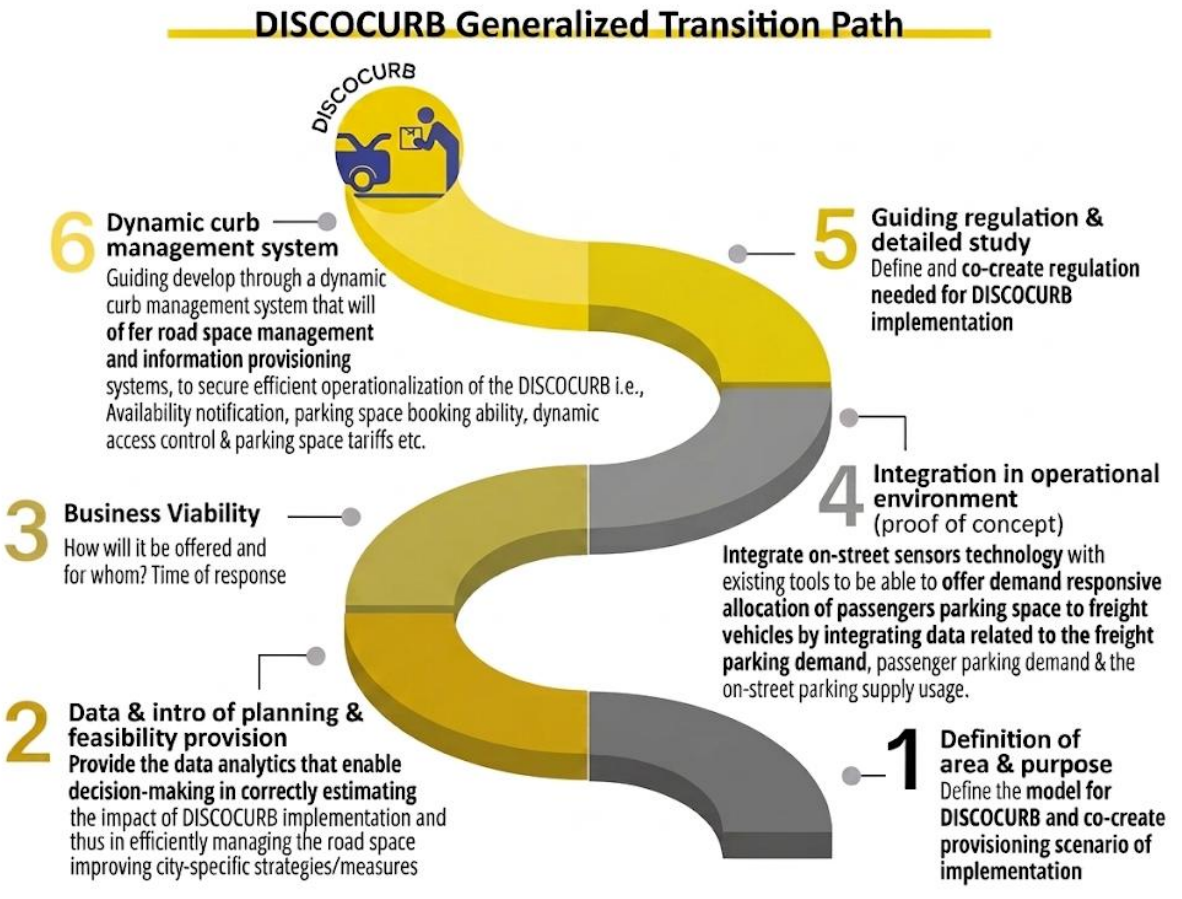


Figure 2: Generalized transition path for dynamic curbside management – See DISCO deliverable D2.1. for full insight.

Although DISCOCURB Living Labs followed the generalized transition pathway. Each city chose its approach to fit a specific gap. The generalized transition path was thus developed under the Meta Model Suite (explained in page 12) to provide a roadmap for the considerations that cities need to make and dedicate resources towards in order to plan and execute the development of the dynamic curbside solution.

Step	What it involves
1. Definition of area and purpose	Define the model for DISCOCURB and co-create the provisioning scenario for implementation with stakeholders, including representatives from the private sector and residents. Prioritise the problems that you want to address.
2. Data, planning and feasibility	Find data that quantifies or qualifies the problem requiring curbside solutions, this will enable decision making, so the impact of DISCOCURB can be correctly estimated and city specific strategies improved. In parallel, take a closer look at the policies in the urban areas, what could enable or become a barrier in implementing the solutions, what kind of permits are necessary and which departments are these obtained from and what the timelines are from application to receipt. It may be crucial to apply for policy exemptions prior to pilot, allowing for sufficient room for decision making.
3. Business viability	Work out how the service will be offered, to whom, and within what response time. In public private collaborations working out the flow of revenue and profitability is just as important as societal impact.
4. Integration in operational environment (proof of concept)	Integrate on-street sensor technology with existing tools to offer demand-responsive allocation of parking space to freight vehicles, drawing on freight demand, passenger demand and on-street supply data.
5. Guiding regulation and detailed study	After the preliminary policy audits (step 2) it is necessary to vet the policy impacts of the pilots with stakeholders to jointly discuss or debate the policies openly and what effects they will have on the residents, businesses, logistics service providers and the local authority. This ensures that decisions are not made in a vacuum and there is willingness to address the problems from different perspectives. Policy implementation is the delicate balance between societal, political and business will and this could be a lengthy process, however, engagement and data collection is crucial.
6. Dynamic curb management system	Guide development of a system offering road space management and information provisioning availability notification, booking, dynamic access control and parking tariffs to operationalise DISCOCURB efficiently.

Practical tips for getting started

- To transfer lessons from another city, prioritise data format and interfaces over any specific sensor or hardware; standards travel between cities better than equipment does.
- Deploying a booking system without an enforceable rule behind it does not encourage use by logistics service providers.
- Reserve dynamic curbside management for locations where demand genuinely exceeds space.
- Build in privacy protection from day one when using cameras or AI, working with your data protection authority from the start.

- If conditions are not yet right for full rollout, start with simulation or demand modelling to generate evidence while larger decisions remain on hold.
- Confirm who will use any real-time data, and at what point in their planning process, before investing in it data that arrives too late adds little value and sometimes you don't need to gather all the data, minimum data to be able to operate the system, clarify this beforehand.

Policy recommendations

These recommendations draw on four sources: direct experience from DISCOCURB pilots and DISCO Living Labs, a review of existing EU and national policy instruments, lessons from comparator Horizon Europe projects, and four policy workshops with multiple European cities held between April and June 2026. Applying Rose's lesson-drawing framework, they are organised across European, national and city governance levels.

No single level can resolve the challenges of dynamic loading zone management alone. European action is needed to standardise data and platform requirements across borders, national frameworks must resolve questions of enforcement authority and registry access that fall outside city competence, and city-level action remains essential for the practical deployment, inventory and management of loading zones on the ground.

A. European Union level

Establish an EU standard for loading-zone data and booking APIs

No EU-level specification currently covers dynamic freight loading-zone data exchange. APDS and DATEX II address parking data but not real-time freight LUZ management. The Commission should mandate a common data schema, aligned with the European Mobility Data Space, enabling cross-city interoperability of DISCOCURB-type deployments.

Require a dynamic loading area management chapter in all SULP frameworks

Current EGUM SULP Topic Guidelines reference delivery-area management but do not specify digital management architecture. Revised SULP guidance should require cities with TEN-T urban node status to document LUZ inventory, occupancy monitoring methods, booking system access, and enforcement protocols as baseline SULP deliverables.

Recognise DISCOCURB systems as eligible infrastructure under TEN-T urban node obligations

The TEN-T Regulation (EU 2024/1679) requires a SUMP/SULP for all 431 urban nodes. Cities should be able to claim CEF co-financing for smart LUZ sensor infrastructure and booking platforms as part of their urban node compliance package, reducing the funding gap that currently makes pilots unsustainable post-project.

B. National level

Mandate that national ZEZ frameworks specify LUZ management requirements

National zero-emission zone policies (the Dutch ZEZ-F Agenda, French ZFE-m Crit'Air) create access pressure without specifying how loading demand should be managed at the curb. National frameworks should require

ZEZ-implementing cities to publish a dynamic LUZ plan as a condition of zone activation, closing the gap between access restriction and operational management.

Create a national framework for LUZ enforcement authority and cost sharing

Workshop evidence from Belgium and France confirmed that the legal basis for curbside enforcement: who can issue fines, at what rate, and how revenue is shared between city and national government; varies by jurisdiction in ways that make enforcement economically unattractive for cities. A national statutory framework for LUZ enforcement rights and revenue allocation is needed.

Require national vehicle-classification registries to be accessible for LUZ booking systems

DISCOCURB booking platforms must verify vehicle emission class and type in real time. This requires programmatic access to national vehicle registration databases, which are currently accessible only via manual query or bilateral data-sharing agreements. API access for certified LUZ platforms should be enacted at national level.

C. City level

Conduct and publish a city-wide LUZ inventory as a planning baseline

Bergamo and Barcelona confirmed that cities cannot manage what they have not mapped. Every city operating under a SULP should publish a georeferenced, open inventory of all LUZs, including dimensions, permitted uses, time windows, sensor status and booking availability, as a minimum data standard.

Adopt a mandatory LUZ pre-booking requirement in LEZ-regulated areas

Copenhagen demonstrated that multifunctional Smart Zones combining logistics, cycling and recreation are technically viable and reduce illegal occupation significantly. Cities should mandate booking for all commercial freight vehicles in LEZ-designated areas, with a short free booking grace period to minimise compliance burden on small operators.

Establish a neutral city platform for LUZ data aggregation and enforcement integration

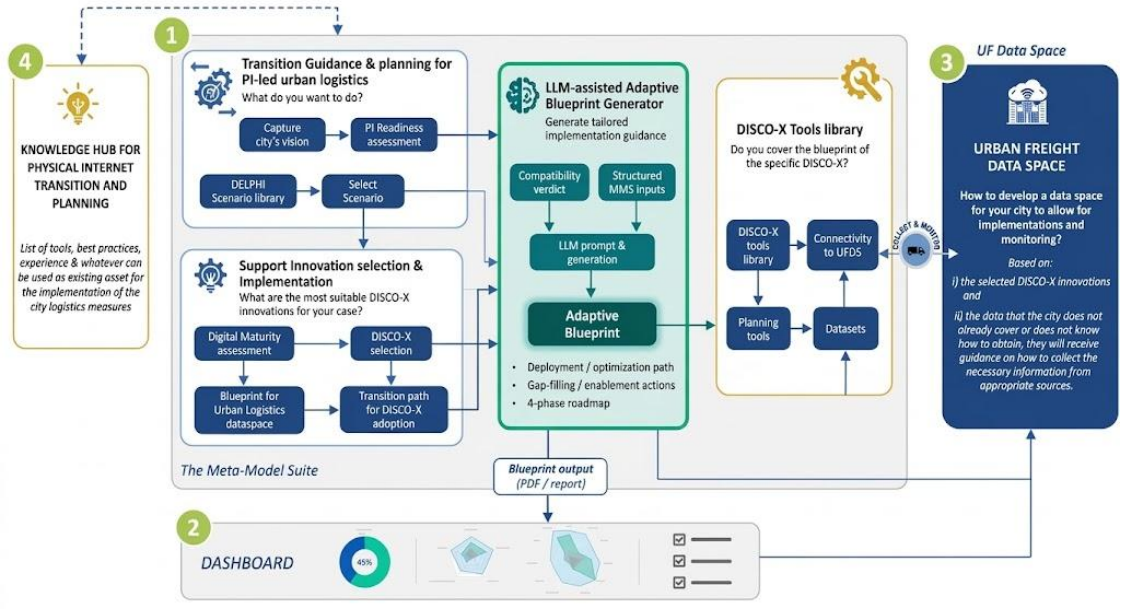
Lisbon's ePark and Barcelona's SPRO show that no single private operator should own LUZ booking data. Cities should operate or procure a neutral platform that aggregates sensor data, manages operator bookings and exposes occupancy data to enforcement authorities, preventing lock-in to any single technology provider.

> ***DISCOCURB is most powerful as the evidence engine of a Sustainable Urban Logistics Plan, where measured curbside use, lawful enforcement and standardised data combine to make scarce public space fairer and cleaner.***

Where can cities start? The Meta-Model Suite

DISCO has created a Meta-Model Suite: a set of interoperable decision-support tools developed across the DISCO project to let planners test urban logistics interventions before committing to physical investment or regulatory change.

For planners, this means the ability to run scenario comparisons that guide cities towards the DISCO innovation that suits their local context, together with a step-by-step transition guideline and advisory.



The Meta-Model Suite: from capturing a city's vision and readiness, through LLM-assisted blueprint generation, to a dashboard output connected to the Urban Freight Data Space.

In plain terms, the suite works in four linked parts:

- **Transition guidance and planning —** captures a city's vision and Physical Internet readiness, then helps select the most suitable scenario.
- **Adaptive blueprint generator —** an LLM-assisted tool that turns a city's inputs into a tailored implementation blueprint, complete with a deployment path, gap-filling actions and a four-phase roadmap.
- **DISCO-X tools library —** connects the blueprint to the specific planning tools, datasets and Urban Freight Data Space connectivity a city will need.
- **Knowledge hub —** a running list of tools, best practices and experience that cities can draw on when implementing any DISCO-X measure.

The suite also supports the kind of lesson drawing that underpins the policy recommendations in this report. Because the models share a common structure across partner cities, planners in a new context can adapt parameters from a comparable DISCO deployment rather than starting from first principles, shortening the path from policy intent to a testable local plan.

Explore the step-by-step analysis and guided feedback at metamodelsuite.imet.gr/meta-model-suite

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