MAGPIE

SMART GREEN PORTS

LOGISTIC MODEL FOR SUSTAINABLE HINTERLAND NETWORKS AND HUBS

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D6.7 Logistic model for sustainable hinterland networks and hubs

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Abbreviations

B2C	Business-to-Consumers
BPEX	German Parcel and Express Association (DE: Bundesverband Paket und Expresslogistik)
CEP	Courier, Express and Parcel
DC	Distribution Centre
ELWIS	Electronical Waterway Information System (DE: elektronisches Wasserstraßeninformationssystem)
FCL	Full-Container Load
IWT	Inland Waterway Transport
LCL	Less than Container Load
WGCN	West-German canal network

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Executive Summary

The freight corridor between the Port of Rotterdam and the Ruhr Area is part of one of Europe's busiest TEN-T corridors and faces pressure from congestion, aging infrastructure, and bridge rehabilitation requirements. Truck transport dominates hinterland traffic and last-mile distribution, straining already congested urban road infrastructure. Integrating Inland Waterway Transport (IWT) into the supply chain for Business-to-Consumer (B2C) shipments and into urban logistics represents a potential opportunity to relieve road infrastructure while improving supply chain sustainability.

This deliverable comprises (i) the *Logistic Concept for Sustainable Hinterland Networks and Hubs* (hereafter referred to as the "Logistic Concept") and (ii) a feasibility assessment carried out by modelling the Logistic Concept within the PLANCO Synculator, a simulation tool for synchromodal and multimodal mode-choice, developed within MAGPIE (see D6.6).

The Logistic Concept addresses the hinterland network of the Port of Rotterdam by proposing a new approach to B2C distribution that shifts a share of last-mile and hinterland traffic from road to inland waterway, thereby aiming to relieve the road network and mitigate the congestion pressures outlined above. This achieved by an integrated three-stage logistics chain: B2C containers are routed from Rotterdam to the hinterland hub DeltaPort, where shipments are consolidated, then distributed via the West-German canal network to decentralized micro-depots located in densely populated urban areas, where last-mile delivery is completed by cargo bikes and electric vehicles.

From a market perspective, there is substantial potential. Within the catchment area of the selected micro-depots, 4 million inhabitants generate approximately 125 million B2C shipments annually. A 5% market penetration would be sufficient to achieve high utilization rate of a vessel that operates two weekly roundtrips through the West German canal network in order to supply the micro-depots.

However, assessing the economic feasibility Logistic Concept reveals a critical trade-off between transport costs and transport times for waterborne transport. IWT achieves cost savings on the main-haul from Rotterdam to Emmelsum but faces substantial disadvantages in transit times, conflicting with consumer expectations for next-day or same-day delivery. These time disadvantages could be mitigated through higher service frequencies and tightly coordinated transshipment processes at the micro-depots, so that shipments move from container to delivery vehicle with minimal intermediate storage.

Moreover, implementation faces additional barriers such as establishing a parallel micro-depot, the technical integration of IWT into an existing system of the Courier, Express and Parcel (CEP) providers' systems, and the capital investments (e.g. for site acquisition, remediation or handling equipment). The latter must compete with the structural cost advantage of incumbent CEP providers operating already-amortized infrastructure.

Despite these challenges, the model can be economically viable through a strategic and phased implementation, starting with active port sites where existing port infrastructure reduces initial costs. Crucially, public co-financing through EU and German infrastructure and mobility programs can reduce the financial burden on private operators of micro-depots.

Economic feasibility strengthens under changing market conditions such as higher road tolls, expanded carbon pricing mechanisms, and increasing B2C shipment volumes. Technological developments will also shape this balance in two opposite directions: (semi-)autonomous inland navigation can reduce crew costs and make IWT more competitive, while the ongoing shift from diesel to electric trucks – particularly as long as electric trucks exempt from tolls and other charges and taxes – narrows both the cost and sustainability advantage of IWT.

The Logistic Concept's feasibility ultimately hinges on three interrelated factors: the cost and time competitiveness of IWT relative to truck transport, the successful integration of IWT and micro-depots into existing CEP structures, and the availability of public funding for the necessary (micro-depot) infrastructure. Even in the absence of such initial funding, the Logistic Concept can still prove viable as a niche solution for corridors where IWT offers clear operational advantages.

On this basis, the Logistic Concept for Sustainable Hinterland Networks and Hubs represents a viable complementary solution for regional logistics networks such as the LOG4NRW initiative, which positions DeltaPort as a hinterland hub for the Ruhr Area. The results elaborated in this deliverable are used for further development of LOG4NRW. Moreover, this deliverable provides a realistic pathway toward implementation of the concept. Beyond the specific case of rolling out the Logistic Concept within LOG4NRW, the results are also transferable to other regions aiming to establish innovative waterborne transport solutions, contributing to the broader EU objective of shifting freight transport toward more sustainable modes of transport and establishing resilient hinterland networks.

1. Introduction

1.1 Motivation

MAGPIE (sMArt Green Ports as Integrated Efficient multimodal hubs) is an EU-funded project and an international collaboration that demonstrates technical, operational, and procedural solutions for energy supply and digital digitalization within a living lab environment. Its goal is to advance green, smart, and integrated multimodal transport, ensuring uptake through the European Green Port of the Future Master Plan alongside dedicated dissemination and exploitation activities. The consortium is coordinated by the Port of Rotterdam and consists of 44 partners, thereof 3 other ports (DeltaPort, Sines and HAROPA) as well as research institutes and universities, private companies. The project is divided in 10 main work packages which include energy supply chains, digital tools, 10 demonstrators for maritime, inland waterway, road, and rail transport, non-technological innovations and the development of a Masterplan for European Green ports.

Europe's largest seaport and MAGPIE consortium partner the Port of Rotterdam, serves as a major gateway for international trade, where large volumes of containerized cargo are transhipped destined for industrial, commercial, and consumer markets across Europe.

An important hinterland region for the Port of Rotterdam is the Ruhr Area, in North Rhine-Westphalia, Germany. The Ruhr Area is among the most populous metropolitan regions in Germany. As part of the TEN-T network Rotterdam – Genoa, the freight corridor Rotterdam – Ruhr Area is one of the busiest in Europe. Although a dense transport infrastructure network, recurring congestion, construction works on road and railway infrastructure, and ageing bridge rehabilitation – especially in North Rhine-Westphalia - increasingly affect the reliability and capacity of the corridor.

These challenges highlight the need for innovative logistics solutions for Rotterdam's hinterland. A shift to Inland Waterway Transport (IWT) can relieve road infrastructure, ease congestion, improve supply chain resilience as well as sustainability of the hinterland transport.

The negative effects of congested roads are evident not only on interregional roads and highways but also in inner-city areas. Given the limited availability of space within cities on the one hand, and the growing importance of e-commerce and parcel deliveries on the other hand, integrating IWT into e-commerce supply chains could therefore be a key element of future urban logistics. However, e-commerce depends on fast delivery ("next-day" or same-day"), which places high demands on the integration of IWT into last-mile logistics. The inherent disadvantage of comparatively slow waterborne transport can be diminished by a network of strategically located micro-depots, which bundle shipments and enable fast last-mile delivery to the consumer. Successful examples can already be found in Berlin, where DHL and BEHALA are collaborating to operate two solar-powered package boats to deliver packages to package stations[1].

1.2 Objectives

Against this background, the *Logistic Concept for Sustainable Hinterland Networks and Hubs* (hereafter referred to as the "Logistic Concept") elaborated in this deliverable considers the whole supply chain on European territory: the main-haul from the Port of

[1] See https://www.electrive.com/2026/04/27/dhl-deploys-second-solar-powered-parcel-transport-ship-in-berlin/.

Rotterdam to the hinterland hub DeltaPort, the distribution-haul, i.e. the consolidation of shipments and distribution to decentralized micro-depots, as well as last-mile delivery from the micro-depots to the end consumer. The concept combines IWT, decentralized logistics hubs, innovative urban logistics, and last-mile distribution to create an alternative and complementary network that can be integrated into existing parcel logistics structures.

By creating additional transport and distribution opportunities, the implementation of the Logistic Concept could strengthen the resilience of cargo flows along the Rotterdam-Ruhr corridor, reduces road congestion on interregional roads and in cities, and contributes to the development of environmentally friendlier supply chains.

The objective of this deliverable is to assess the economic performance of the Logistic Concept. This done by modelling the Logistic Concept within the PLANCO Synculator - a simulation tool for synchromodal and multimodal mode-choices -, which has been developed in the context of MAGPIE D6.6. Moreover, the technical feasibility of the concept is assessed, while evaluating how IWT can contribute to a more sustainable hinterland logistics network.

Conclusively, this deliverable outlines pathways towards an implementation of the Logistic Concept. These findings will directly inform the further development of LOG4NRW – an initiative aimed at easing road congestion by shifting road transport to railway and inland waterways. Beyond this specific case, the results are also transferable to other regions aiming to establish innovative waterborne transport solutions.

2. Study Area and Transport System

2.1 Ruhr Area

The study area, the Ruhr Area, encompasses eleven NUTS3-regions with a combined population of 4.04 million inhabitants (see Table 1 and Figure 1). In terms of economic output, Essen and Dortmund are the largest economies with GDP figures of €31.7 billion and €29.5 billion respectively. GDP per employed person varies moderately across the region, ranging from €74.064 in Bottrop to €96.001 in Mülheim, suggesting comparable labour productivity levels.

Table 1: Demographic and economic data for the Ruhr Area

City / NUTS3	Population (2025)	GDP (2023) In mill. €	GDP / employed person (2023) In €
Bochum	358,426	15,879.00	79,458.00
Bottrop	118,555	3,448.00	74,064.00
Dortmund	602,386	29,519.00	85,112.00
Duisburg	500,131	20,218.00	87,140.00
Essen	574,387	31,672.00	90,508.00
Gelsenkirchen	267,733	10,330.00	87,601.00
Herne	155,817	5,341.00	80,471.00
Mülheim an der Ruhr	172,031	7,911.00	96,001.00
Oberhausen	213,349	7,479.00	77,578.00
Recklinghausen	620,348	19,083.00	74,733.00
Wesel	457,906	15,994.00	77,903.00

Source: State Statistical Office of North Rhine-Westphalia (2026).

2.2 Transport Corridor and Infrastructure Context

As part of the TEN-T corridor Rotterdam–Genua, the freight corridor between the Port of Rotterdam and the Ruhr Area consists of a dense trimodal network of roads, railways and inland waterways (see Figure 1).
Road connectivity is provided by different motorway axes: the A12 (NL) – A3 (DE), the A77 (NL) – A57 (DE) and the A67 (NL) – A40 (DE). Within the Ruhr Area, there is a dense motorway network from West to East (A2, A40, A42) and from North to South (A59, A3, A43, A1). However, this road network is increasingly subject to capacity constraints, dilapidated bridges[2], and recurring congestion.

The central railway corridor is the Betuwe-Line, which is dedicated to freight transport between the Port of Rotterdam and the Dutch-German border. On the German side, the Emmerich-Oberhausen line[3] connects to the Betuwe-Line, linking major industrial hubs such as the Port of Duisburg to the corridor. Within the Ruhr Area, a dense railway network links industrial, logistical and urban centres.

The Rhine River enables efficient IWT between the Port of Rotterdam and the ports within the Ruhr Area such as Duisburg or DeltaPort. The West-German canal network (WGCN) –

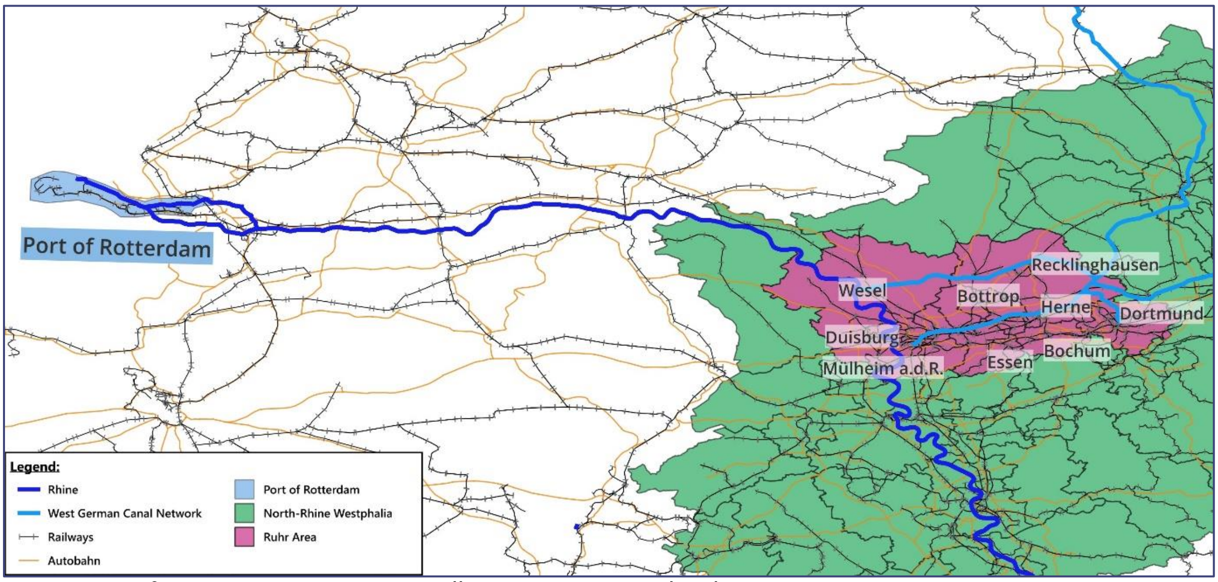
[2] See also the NRW Bridge Monitor ("NRW Brückenmonitor") published by the Chamber of Industry and Commerce of North Rhine-Westphalia, Link.
[3] The Emmerich-Oberhausen rail corridor is currently undergoing expansion through 2027 to ensure sufficient capacity for both passenger and freight traffic.

including the Wesel-Datteln-Canal, the Rhine-Herne-Canal, the Dortmund-Ems-Canal and the Datteln-Hamm-Canal – and the Ruhr River enable deep hinterland connections to central logistics and industrial nodes.

MAGPIE consortia partner DeltaPort – consisting of the ports Wesel, Rhine-Lippe and Emmelsum – can be considered as a gateway and hinterland hub for cargo flows between the Port of Rotterdam and the Ruhr Area. DeltaPort is located at the main transport axes:

- Road: A4 / A59
- Railway: Emmerich-Oberhausen railway corridor
- Inland waterway: at the Delta of the River Rhine and the Wesel-Datteln-Canal.

DeltaPort is strategically located just outside the Ruhr region, enabling it to consolidate freight volumes between the Port of Rotterdam and the Ruhr region and transport them efficiently via a trimodal system.



Source: Data from OpenStreetMap, own illustration composed with QGIS.

Figure 1: Transport Infrastructure Rotterdam - Ruhr Area

2.3 Current Container Flows

According to the Port of Rotterdam, 58 % of containers destined for the hinterland are transported by truck, followed by 34 % by barge (Port of Rotterdam, 2025).

When focusing on the container flow between Rotterdam and the Ruhr Area specifically, IWT dominates with a 75 % share, reflecting the excellent connectivity via the Rhine River, while rail accounts for 11 % and truck for 14 % (see

Table 2)[4].

[4] Data from the Federal Ministry of Transport "2040 Traffic Forecast – Part 2: 2040 Economic and Traffic Development Forecast" (Research Reference VB970423). Note: this data is based on 2019 data. More recent relation-specific data on container traffic is not available for road transport.

However, this modal share is highly context-dependent: when considering container flows between the Ruhr Area and all seaports – particularly those along the Nordrange[5] and some ports in the Mediterranean – the share of IWT drops to 56 %. If we broaden the perspective to the entire volume of container traffic originating from or destined for the Ruhr Area, the modal split of IWT falls further to 30 % (see row "all regions" in Table 2); however, this still represents a significant share. Conversely, the modal split of rail transport increases as the geographic scope of the analysis expands.

It should be note that these figures are limited to origin-destination container flows between the Port of Rotterdam and the Ruhr Area; transit traffic through the region is not considered. A further limitation arises from containers stripped at or near the Port of Rotterdam. While the maritime container remains close to the seaport, shipments are subsequently loaded onto, for example, curtain-sider trailers for efficient onward transport. These shipments are not included into the container traffic statistics, likely resulting in an underestimation of truck modal share for originally containerized goods. Thus, despite the high modal share of IWT on the Rotterdam-Ruhr corridor, truck transport should be considered as dominant for hinterland container transport.

Table 2: Modal Split of container transports from and to the Ruhr Area

Relation	Modal Split						
	Absolute (in 1.000 TEU)				In %		
	Rail	Truck	Barge	Total	Rail	Truck	Barge
Rotterdam	56.0	68.6	365.2	490	11%	14%	75%
All Seaports	265.3	163.7	541.5	971	27%	17%	56%
All regions	1,178.3	163.7	586.7	1,929	61%	8%	30%

Source: Federal Ministry of Transport (ed.): data set for the "2040 traffic forecast", own calculations.

2.4 Current Container Distribution Structures

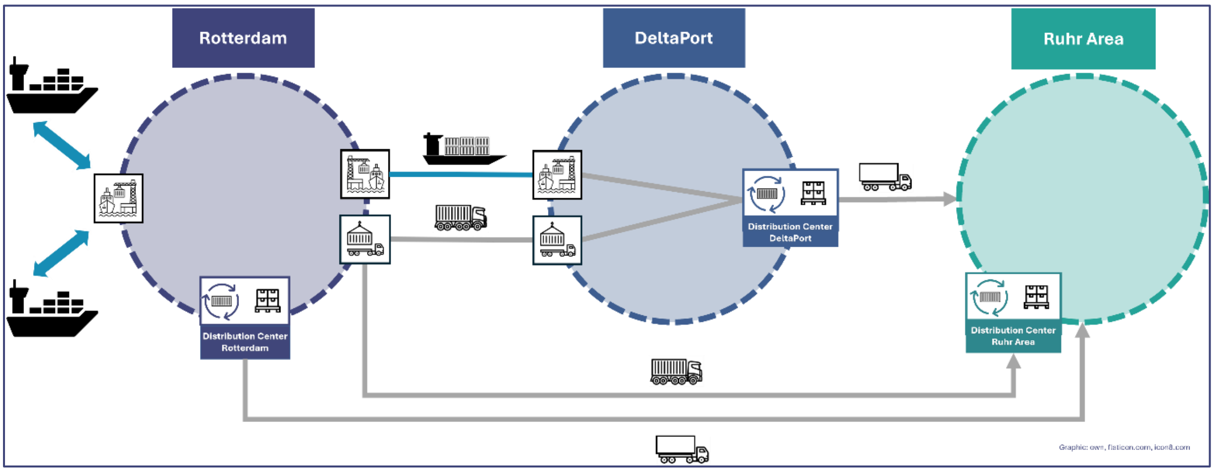
As noted in Section 2.3, truck transport remains at a high share for hinterland container transport overall. Particularly, the truck is dominant for time-sensitive and fragmented shipments. In addition to the advantages in terms of speed, this dominance can be explained by differences in container processing and transport modalities.

Full Container Load (FCL) containers remain sealed throughout the transport chain until delivery, whereas *Less than Container Load* (LCL) containers require intermediate processing at distribution centres (DCs), where shipments are consolidated, sorted, stored and prepared for onward or final delivery. This additional processing step typically favors truck transport for both the main leg and the final leg due to the greater flexibility of the truck and uninterrupted transport.

FCL containers are transported directly via truck or intermodal combinations[6] to the consignee. The transport chains for LCL containers are more complex. The following describes three typical transport chains for LCL containers between the Port of Rotterdam and the Ruhr region (see also Figure 2):

[5] Zeebrugge, Antwerp, Rotterdam, Amsterdam, Wilhelmshaven, Bremerhaven and Hamburg.
[6] Intermodal means a transport operation in which at least two different modes of transport are combined on a single route, with the goods remaining in the same loading unit throughout the entire journey. In most cases, rail and/or inland waterway transport carry out the main leg.

- **Transport Chain 1 - Early consolidation at port:** LCL shipments are consolidated and fully prepared for delivery at DCs near the Port of Rotterdam, then transported directly to the consignee via truck.
- **Transport Chain 2 - Late consolidation in destination region:** LCL containers are transported directly by truck to a DC in the Ruhr Area, where shipments are consolidated and sorted for final delivery, and then transported by truck. Given its strategically advantageous location, the Wesel region - centered around DeltaPort and its distribution centres - could serve as a regional consolidation hub.
- **Transport Chain 3 - Barge or rail transport:** LCL containers are transported by barge via the Rhine or rail to Emmelsum (DeltaPort), consolidated at a nearby DC and distributed to final destinations via truck.



Source: own illustration.

Figure 2: Typical LCL transport chains from Port of Rotterdam to the Ruhr Area

These three LCL transport chains reveal the advantage of truck transport in hinterland distribution. LCL shipments require intermediate consolidation at distribution centres, which is unavoidable regardless of transport mode. However, when barge or rail are used, additional transshipment and handling is needed, increasing complexity and transit time. Truck transport, by contrast, offers greater flexibility, and can access a denser network enabling direct connection to DCs and last-mile delivery. This explains the truck's dominant role in hinterland container transport, especially for LCL containers.

3. The Logistic Concept

3.1 Literature Review

Seaport competitiveness is widely recognized as depending substantially on the quality of the port's hinterland network and connectivity (e.g. Acciaro and McKinnon, 2013); Merk and Notteboom, 2015), with coordination among supply chain actors identified as a particular challenge (van der Horst and de Langen, 2008). For the Port of Rotterdam specifically, a substantial body of literature examines optimal and sustainable hinterland network structures (van der Horst and van der Lugt, 2011; Katowska et al., 2018), the economic feasibility of hub-and-spoke models for enhancing the modal split of barges in container transport (Pielage et al., 2007; Konings et al., 2013) and the development of synchromodal networks (Zhang and Pel, 2016; van Riessen et al. 2015).

The market potential for urban and short-range IWT has been quantified in the EU-funded Green Inland Ports[7] project by PLANCO Consulting. The study identifies substantial geographic markets for urban IWT services. 38.3 million inhabitants in EU27 reside in areas with potential for urban IWT services (PLANCO Consulting, 2024a). The results highlight that urban IWT, particularly in densely populated areas, represents a significant untapped market opportunity. In a related study conducted as part of the Green Inland Ports project, twenty good practice cases of urban and short-range IWT were analyzed, along with the factors contributing to their success (PLANCO Consulting, 2024b).

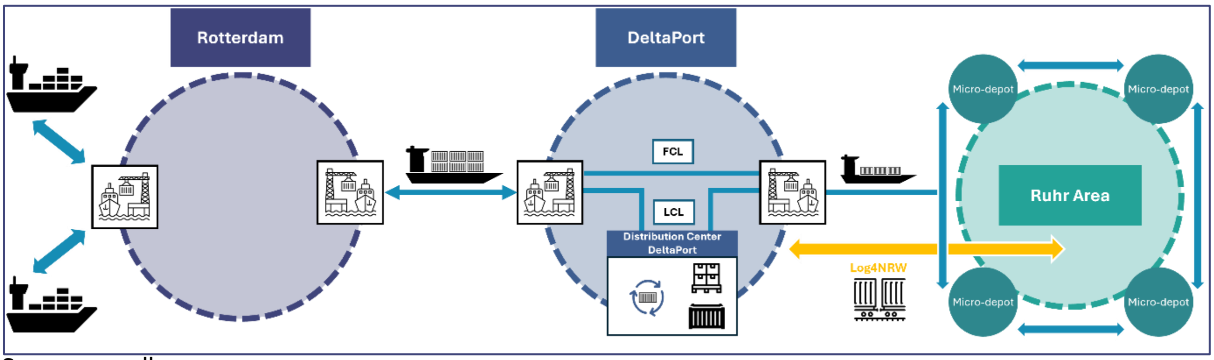
Four regionally focused research projects are of particular interest to the Logistic Concept elaborated in this deliverable as they address similar geographic areas and challenges. DeConTrans[8] ("Innovative concepts for a decentralized waterborne container transport", led by DST and partnered by DeltaPort) validates the feasibility of small, innovative inland vessels connecting decentralized transshipment points along the WGCN with Rhine ports. SpaCiH ("SmartPark City-Hubs and Virtual Infrastructure") is carried out by partners in the western Ruhr Area and Lower Rhine region, including DeltaPort. It develops an approach of a network of out-of-city hubs that are interconnected by barge and railway, with goods bundled and coordinated via a shared digital platform (Beckmann, 2023)[9]. iWALD ("Integral World And Local Delivery"), a third project, focuses on handling the final urban delivery of shipments that have been bundled to standardized small load units and vehicles[10]. Fourth, a two-part study funded by the Ministry of Transport of North Rhine-Westphalia identifies intermunicipal micro-depots as a promising solution for reducing urban congestion and emissions by consolidating parcel deliveries and enabling last-mile distribution with cargo bikes and other low-emission vehicles (Agiplan, 2019a; Agiplan, 2019b). The study further develops a practical implementation concept for shared micro-depots in the cities of Mönchengladbach, Krefeld and Neuss, providing a transferable blueprint for sustainable urban logistics.

Together, these four projects address distinct segments of the full transport chain – hinterland connectivity, consolidation and last-mile delivery. However, they are separate projects rather than an integrated system. What is missing is a single end-to-end concept combining each of them in coherent operational system, e.g., for B2C inbound container flows. This is the gap the Logistic Concept presented in the following addresses.

[7] See https://green-inland-ports.eu/.
[8] See https://www.dst-org.de/en/decontrans/. Several publications related to the DeConTrans project – such as Alias et al. (2021) - are mentioned on this website.
[9] See also https://www.hs-niederrhein.de/gemit/spacih-smart-park-city-hubs/.
[10] See https://globalhome-iwald.de/.

3.2 Description of the Logistic Concept

The Logistic Concept is an approach for sustainable hinterland networks and hubs. The Logistic Concept represents an alternative and complementary approach to conventional road-based hinterland transport, considering the full supply chain from the seaport to the consumer. It focuses on inbound B2C container flows which require consolidation prior to final delivery. Since road infrastructure in the Ruhr Area is affected by congestion and ageing infrastructure, IWT is fully integrated and road transport limited to last-mile distribution. Figure 3 illustrates three stages comprising the Logistic Concept.



Source: own illustration.

Figure 3: Description of the Logistic Concept

Main-haul: IWT from Port of Rotterdam to DeltaPort

After discharging containers filled with B2C shipments from the seagoing vessels, containers are transhipped onto barges for transport to DeltaPort via regular liner services. The hinterland hub DeltaPort is served currently by three departments per week. At the Port of Emmelsum, which comprises three container terminals, containers are exemplarily assumed to be handled at the Container Terminal in Emmelsum operated by Contargo. There, containers are transferred by truck shuttles to an adjacent distribution centre (DC).

Distribution-haul: From DeltaPort via the West-German canal network

In the DC, containers are stripped, shipments unpacked, sorted, stored and consolidated for last-mile delivery. Shipments are grouped by ZIP-codes to facilitate routing for last-mile delivery. They are packed onto Euro pallets and loaded into stackable container units, e.g. 20 ft, 40 ft. or 45 ft containers. The 45 ft. container is particularly efficient due to its Euro-pallet compatibility and can be considered as the preferred option.

Loaded containers are returned by truck shuttles[11] to the Contargo Container Terminal in the port of Emmelsum. After the transshipment onto dedicated vessels deployed specifically for the Logistic Concept, rather than on existing liner services, transport via the WGCN commences (see also Section 3.3). The vessel follows a circular route: from the Wesel-Datteln-Canal, the Dortmund-Ems-Canal, continuing to the Port of Dortmund and returning via the Rhine-Herne-Canal and the Rhine downstream to Emmelsum (DeltaPort) again. Along this route, several micro-depots are served.

Micro-depots and last-mile delivery

[11] Future operations may employ electric autonomous trucks, based on experience from MAGPIE Demonstration 6 "Green Autonomous Trucking".

Micro-depots are decentralized transhipment and storage hubs located in densely populated urban areas that enable sustainable last-mile logistics by cargo bikes and small vehicles, thereby reducing delivery distances while complementing existing logistics networks. Micro-depots can be operated in different organizational models, e.g. single-user or multi-user facilities (see Agiplan et al., 2019a), with CEP providers renting individual spaces. Ownership and operations may be managed by a public or private entity.

Within this approach, micro-depots are strategically positioned at the waterway or near to active ports, while also being located close to city centres and high-population-density areas. This reduces both main-leg transport and last-mile delivery distances. Micro-depots function as decentralized hubs within the MAGPIE hinterland logistics network to supply densely populated areas in the Ruhr Area with B2C-shipments.

At the micro-depot, containers are transhipped from the vessels and opened. ZIP-code consolidated shipments are stored temporarily, then packed onto the final-delivery vehicle. Depending on the distance and population density, cargo bikes serve short-distance routes, while transporters handle longer distances. To support sustainable urban logistics, electronically powered vehicles are prioritized. After unloading, empty containers are directly transhipped onto the vessel, which continues its circular route. To improve the economic feasibility of rolling out the Logistic Concept, reverse logistics flows should also be considered. Shipments from the Ruhr Area – such as B2C return shipments, waste, or other goods requiring consolidation - can be bundled at the micro-depot and transported back to the DC in DeltaPort. This back-haul utilization improves vessel capacity utilization, reduces empty return trips, and enhances economic viability.

As described above, the Logistic Concept integrates IWT into both traditional seaport hinterland transport networks and, in particular, into urban logistics. This exploits the potential of inland waterways, especially in densely populated areas, and shifts truck traffic to the last-mile, thereby reducing traffic congestion in metropolitan regions such as the Ruhr Area.

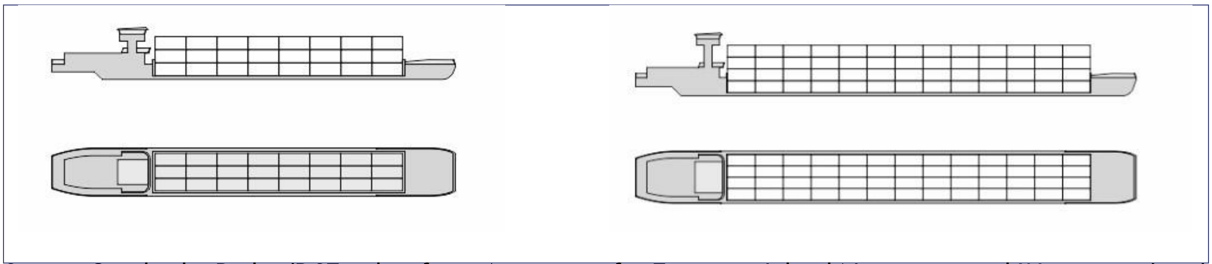
3.3 Vessel Concept and Loading Units

The considered sections of the WGCN are accessible to CEMT class V (Large Motor Vessel) and vessels of CEMT class IV (Europe Vessel) types illustrated in Figure 4. Due to bridge clearance restrictions[12], containers may be stacked in two layers when ballast water is used to increase the draft[13]. A Large Motor Vessel can carry up to 104 TEU, a Europe Type vessel carries 48 TEU.

Especially for the main-haul (i.e. Rotterdam-Emmelsum), the use of hydrogen-powered and semi-autonomous ships was also evaluated based on additional demonstrations conducted as part of the MAGPIE project, using the MS Letitia (operated by MTS) as a case study.

Europa Vessel (Johann Welker)	Large Motor Vessel

[12] See Table 4 in Annex for further restrictions such as locks and lock dimensions as well as bridge clearance height and draft.
[13] See Association for European Inland Navigation and Waterways (2011).



Source: Graphic by Dieker/DST, taken from: Association for European Inland Navigation and Waterways (2011): Suitability of Inland Waterways for Container Transport, p. 18.

Figure 4: Vessel Types

To enable efficient cargo handling across the network, standardized loading units are utilized. These ensure compatibility with handling equipment at warehouses, terminals logistics hubs. The standardization comprises two complementary systems: Euro pallets and standardized container units (20 ft, 40 ft or 45 ft), while the 45 ft. pallet-wide container is designed for Euro pallets to achieve volume efficiency. The optimal container choice depends on cargo volume and container availability.

3.4 Analytical Methods and Site Identification for Micro-Depots

3.4.1 Criteria and Site Assessment Scheme

The following site analysis applies an analytical methodology to identify suitable micro-depot locations within the WGCN. The framework systematically evaluates geographic, logistical and infrastructural criteria to assess location feasibility, incorporating analytical elements from two earlier studies that examine the assessment of transhipment points in the WGCN (see Alias et al., 2023; Beckmann, 2023).

Potential micro-depot sites are evaluated against a predefined set of criteria derived from infrastructure and suprastructure requirements. The criteria are organized into the following main categories:

- **Waterway and Road Accessibility:** Sites must have direct access to the inland waterways, i.e. the WGCN, and adequate road connectivity, including supraregional networks (federal highway, autobahn). Public transport accessibility is considered a secondary factor relevant for workforce connectivity.
- **Port infrastructure, suprastructure and handling equipment**: The availability of quay walls, paved surfaces, and cargo-handling equipments (cranes, reachstackers) is a key criterion and serves as a proxy for estimating the expenditures for site development.
- **Proximity to markets:** For B2C distribution, population density is assessed within the defined isochrones: up to 5 km for cargo bikes and up to 20 km for conventional vehicles (vans, truck). Proximity to existing logistics centres or CEP providers is also considered.
- **Site size and expansion potential:** sufficient space is required for transshipment, (short-term) container storage and micro-depot facilities. A minimum of 1,000 sqm is considered necessary, with attention to expansion potential.
- **Land-use designation:** Sites must be designated as industrial and commercial areas - ideally, as special port zones - in municipal land-use and development plans. This ensures compliance with regulations including noise emissions, particularly relevant in urban contexts.

A site's suitability is assessed using a three-point scale (0, 1, or 2 points) for each criterion. Particularly relevant criteria - such as port infrastructure and cargo-handling equipment, are weighted by a factor of two (see Table 5 in Annex).

3.4.2 Data

For the analysis different data sources are used:

- Spatial and planning data derived from satellite imagery, municipal geoportals and municipal planning documents, and publicly available port operator information.
- Waterway infrastructure from the Electronical Waterway Information System (elektronisches Wasserstraßeninformationssystem, ELWIS), provided by the Federal Waterways and Shipping Agency,
- Demographic data based on 100x100 m census grid population data publishes by the Federal Statistical Office and the State Statistical Offices (Statistische Ämter des Bundes und der Länder, 2024).
- Qualitative input gathered through stakeholder interviews, amongst others with the Ruhr Regional Association (Regionalverband Ruhr).

3.4.3 Identification and Site Selection

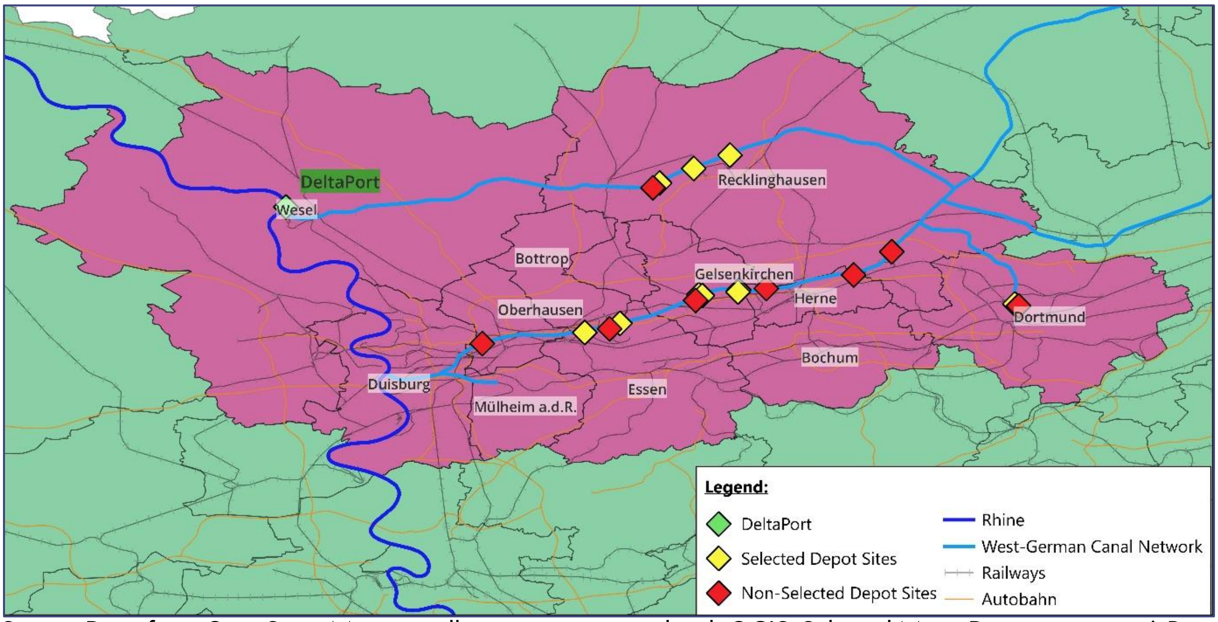
Micro-depot sites were identified through systematic screening of satellite imagery and ELWIS data, the latter providing information on active and inactive inland port sites along the WGCN.

These sites were differentiated according to their site characteristics into three categories:

- Existing active ports and transshipment sites,
- Brownfields, primarily former mining-related transshipment sites,
- Greenfields.

Due to the absence of any port-related infrastructure, developing sites in Greenfields would be not economically feasible. Similarly, brownfields require extensive remediation - for example, due to contaminated soil - are prohibitively costly and were either excluded or assigned lower priority. Consequently, active ports offer best conditions, but typically face space constraints.

A total of 18 sites were examined in detail, of which 9 were active port areas and 9 were brownfields (see Figure 5). The eight best-assessed sites were selected as the most promising micro-depot sites (highlighted in red in Figure 5). Six of these are located along the Rhine-Herne-Canal, reflecting the regions high population density. Site selection also prioritized geographic dispersion to minimize service area overlaps.



Source: Data from OpenStreetMap, own illustration composed with QGIS. Selected Micro-Depot sites are: 1) Port Dorsten / Marl (active); 2) CTD Dortmund (active); 3) Port of Castrop-Rauxel (active); 4) Port Friedrich der Grosse (inactive); 5) Port of Wanne-West (active); 6) Port of Gelsenkirchen (active); 7) Port of Essen (active); 8) Port Zeche Concordia (inactive).

Figure 5: Assessed Micro-Depot Sites

Together with DeltaPort, approximately 4 million residents live within a 20-kilometer radius of the selected micro-depots, demonstrating substantial market potential.

3.5 Implementation within LOG4NRW

Beyond its standalone application, the Logistic Concept outlined previously gains relevance through its integration in existing logistics chains and networks, which can also serve as a vehicle for its rollout. Given DeltaPort's role as important hinterland and regional logistics hub, it is well positioned to anchor this integration. This integration is aimed to be realized through LOG4NRW.

LOG4NRW is a comprehensive initiative designed to shift freight from road to rail and inland waterways. LOG4NRW has multiple objectives: creating a synchromodal and resilient transport network, reducing transport-related emissions, relieving congested road infrastructure across North Rhine-Westphalia, and addressing acute truck driver shortages.

LOG4NRW is aimed to be implemented through successive phases, each building on the capabilities of the previous stage. The first phase, operational since late 2023, establishes a rail shuttle connecting DeltaPort (Emmelsum), Duisport (Duisburg-Walsum), CTD Dortmund and Kreuztal (Container Terminal Kreisbahn Siegen-Wittgenstein), operated by Duisport. This rail backbone provides reliable, high-capacity connectivity across the region.

The second phase strengthens inland waterway integration by introducing synchromodal barge services between DeltaPort (Emmelsum), Duisport and Dortmund. These services enable flexible modal selection based on shipment characteristics and network conditions, optimizing costs, sustainability and supply chain resilience.

The third and final phase extends LOG4NRW to last-mile logistics, directly embodying the Logistic Concept. Micro-depots are established at active ports and reactivated port sites along the WGCN, creating distributed urban consolidation points. This phase completes the integration of IWT into sustainable B2C distribution networks.

Whether the roll out in the third phase – and with it, the Logistic Concept – can be realized as intended depends critically on its economic and technical feasibility. Therefore, Section 4 assesses the economic performance and technical challenges of the Logistic Concept. These results provide guidance for its further development within the framework of LOG4NRW and to inform general pathways for its implementation at other locations.

4. Feasibility Assessment

This section assesses the economic, technical and operational feasibility of implementing the Logistic Concept into the supply chains of courier, express and parcel (CEP) service providers. The assessment is based on qualitative insights gained through stakeholder consultations with shipping companies, terminal operators and logistics service providers, complemented by a quantitative analysis.

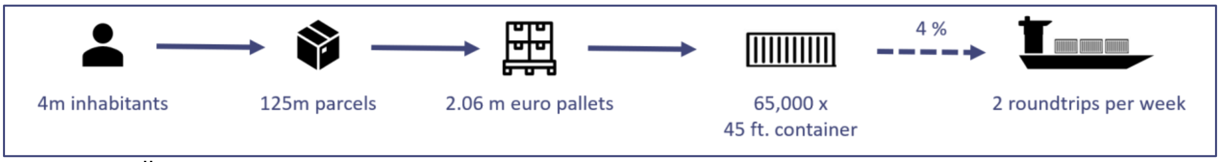
In order to assess the economic feasibility and specifically to evaluate the competitiveness of IWT relative to truck transport, the Logistic Concept is modelled within the *PLANCO Synculator*. The PLANCO Synculator is a simulation tool for synchromodal and multimodal mode-choice, developed by PLANCO within in the MAGPIE[14], and can be accessed online via https://planco-synculator.com/.[15]

4.1 Market Potential

According to the latest statistics published by the German Parcel and Express Association (BPEX), Germany recorded 2.57 billion B2C shipments in 2024 (BPEX, 2025). This corresponds to an average of 31 shipments per capita annually.

With a population of approximately 4 million inhabitants within the 20km-catchment area of the selected micro-depots, this area generates a volume of 125 million B2C shipments per year. If loaded into 40-foot containers, this would amount to approximately 87,000 containers.

Assuming that the Logistic Concept is rolled out using a dedicated Large Motor Vessel operating two roundtrips per week, capable of accommodating 30 45 ft containers in two layers, the maximum annual transport capacity amounts to around 3,000 containers. Consequently, a market penetration rate of around 5 % of the catchment areas total B2C shipment volume would be necessary to achieve full capacity utilization of the vessel.



Source: own illustration.

Figure 6: Estimated market potential in the catchment area

Moreover, BPEX forecasts indicate a continued growth in B2C shipments until 2030. This would increase market potential and may further push the economic feasibility of the model.

4.2 Economic Feasibility

The economic feasibility of the Logistic Concept must be evaluated across three distinct but interrelated dimensions: transport costs, transit times and investments. Transport costs and transit times are derived from modelling the Logistic Concept within the PLANCO

[14] See Deliverable 6.6 Demonstration report synchro-modal hinterland logistic.
[15] As of the time of this peer review, the PLANCO Synculator is not freely accessible to the public. A password is required to access the PLANCO Synculator. For more information, please contact mw@planco.de.

Synculator, developed by PLANCO Consulting in the context of MAGPIE D6.6 (PLANCO Consulting, 2026).

4.2.1 Transport Costs and Transit Times

The following transport costs analysis evaluates the Logistic Concept modelled within the PLANCO Synculator. The analysis covers the complete logistics chain from the Port of Rotterdam, through DeltaPort – including consolidation and preparation of shipments at a nearby DC – to micro-depots along the WGCN, concluding last-mile delivery. To assess the competitiveness of IWT for this purpose, results are compared across IWT and road transport scenarios[16]. Table 3 presents the results, i.e. transport costs[17], while Figure 7 shows a graphical illustration of the calculated route.

Table 3: Results of the Simulation Tool

Transport Leg	Inland Waterway Transport		Truck	
	Transport Costs (€/TEU)*1	Transit Time (in h)*2	Transport Costs (€/ TEU)*1	Transit Time (in h)*2
Main-Haul: Rotterdam-Emmelsum	€185	73	€610	4
Truck-Shuttle: Emmelsum-nearby Distribution Centre	€95	1.5	-	-
Distribution-Haul (supply of selected Micro-Depots)	€200	27	€350	4.5
Total	**€480**	**101.5**	**€960**	**8.5**

Source: Own calculations based on modelling the Logistic Concept within the PLANCO Synculator (PLANCO, 2026). The calculations are based on several assumptions. For example, it was assumed that there were no water level restrictions (i.e. low water) at the time of the query and that the assumed utilization rate for all modes of transport was 70%. *1 Transport Costs per TEU include costs for handling and transhipment. *2 Transit time includes handling times, waiting times at seaport (especially relevant for barges) and breaks.

The total costs for the IWT-based supply chain amount to €480/TEU, compared to €960/TEU for road transport. This confirms that IWT is competitive regarding pure transport and handling costs. The advantage is particularly pronounced on the main-haul leg Rotterdam-Emmelsum (€185/TEU[18] vs. €610/TEU), where IWT outperforms road transport due to the economies of scale of Jowi-type vessels.

In addition, one should note that there are costs associated with unloading the shipments from the container and handling them at the distribution centre, as well as for consolidating the shipments for distribution haul and for last-mile delivery. These monetary and time costs are assumed to be the same for both scenarios, IWT and truck transport. The PLANCO Synculator calculates €240 per TEU for unloading, warehousing, and consolidation, as well as approximately €200 for the last-mile delivery of the packages. These costs are for the sake of clarity not listed in Table 3.

[16] The road transport scenario includes a direct truck from the Port of Rotterdam to the DC nearby DeltaPort.
[17] The reported figures represent actual transport costs, exclusive of taxes, as calculated within the PLANCO Synculator, not market prices or freight rates charged to customers.
[18] Here, costs for the truck shuttle from the port of Emmelsum to the nearby Distribution Centre are not included. Moreover, consolidation costs are not considered, as we assume the processes for both analysed transport chains are identical.

In addition to the transportation cost savings, the IWT also offers advantages in terms of CO_2 emissions. On the main-haul, IWT emits 42 kg of CO_2, while a conventionally engined truck emits 141 kg of CO_2.

However, the analysis reveals a substantial difference in transit times. While truck transport completes the entire supply chain in 8.5 hours[19], the IWT-based transport chain requires up to 100 hours, with the IWT leg from Rotterdam to Emmelsum alone (including transhipment and waiting time at seaports) accounting for 73 hours, posing considerable challenges for time-sensitive delivery networks and modern e-commerce logistics.

Conclusively, the results reveal a trade-off between cost efficiency and travel time. While IWT demonstrates to be competitive and even offers a cost advantage, it faces significant limitations regard transit time, which poses substantial challenges for time-sensitive supply transport chains and for modern e-commerce logistics. Given the nature of B2C shipments and current consumer purchasing behaviour – particularly expectations for next-day or same-day delivery – the transit time advantage of truck transport should not be underestimated. These time-delivery capabilities may outweigh IWT's cost savings.

4.2.2 Technological Developments and Future Competitiveness

In addition to current cost and time factors, technological developments such as hydrogen powered vessels, semi-autonomous inland navigation and the electrification of road transport will play a decisive role in the competitiveness of IWT. These developments are examined below, drawing on the experiences and results of MAGPIE demonstrations.

The MS Letitia (operated by HTS Group) can be powered emission-free using hydrogen fuel cells and interchangeable tank containers. However, according to the operator's assessment, hydrogen-only propulsion is not competitive yet with conventional propulsion systems due to both high Capex and high Opex. Nevertheless, the future use of hydrogen-powered vessels holds potential for increasing the sustainability of the Logistic Concept, especially when production, bunker infrastructure and hydrogen supply scales up with higher demand.

Furthermore, semi-automated and remote-controlled navigation can increase the competitiveness of IWT by reducing Opex with respect to crew costs. To assess the savings achieved through semi-autonomous navigation, the most recent cost and valuation estimates for the German Federal Infrastructure Plan (*Bundesverkehrswegeplan*) were considered (TTS et al., 2024). According to these estimates, replacing five captains on board with one captain on shore reduces annual personnel costs for the vessel types considered by 36.7 % to 38.7 %. These potential savings by (semi-)autonomous inland navigation are not merely theoretical: in a successful demonstration, the MS Letitia autonomously navigated to several terminals in the Port of Rotterdam and performed various manoeuvres, such as docking and undocking as well as sailing through the port and along the river (see MAGPIE Deliverables D5.5 and D5.6).

However, to fully assess the long-term competitiveness of IWT, developments in competing modes of transport must be taken into account. Road transport with Battery Electric Vehicles (BEV) is advancing more rapidly towards zero emissions than IWT. By 2040, more than three quarters of all trucks are assumed to be electric (TTS et al., 2024). Although the current list prices for electric trucks are significantly higher than those for trucks with conventionally engined trucks, economies of scale in production are expected to lead to lower unit costs. As a result, it can be assumed that the prices will continue to converge, making electric trucks more attractive (see also Tol et al., 2022). At the same time, operating costs are likely to be

[19] The time required to consolidate the shipments was not considered here.

lower, as electric trucks require less maintenance and, at least at short term, benefit from incentives such as exemptions from road tolls.

Therefore, the PLANCO Synculator (see D6.6) enables to choose for electric trucks. The costs for operating the main-haul leg (Port of Rotterdam – Port of Emmelsum) with an electric truck amount to approximately 560€, which is 8 % lower than the cost of operating a diesel truck on this route (see Table 3). This calculation shows that, under the given assumptions[20], electric trucks can already achieve lower operating costs despite their currently higher upfront costs, and can thus be competitive with conventional trucks. This, in turn, has implications for the competition between IWT and road transport.

Source: Graphics generated with the PLANCO Synculator (PLANCO, 2026). The green dots represent the Micro-Depots, the dark-red line represents the main-haul with a Jowi-type vessel, the red line shows the circular route through the WGCN with a Europe-type vessel.

Figure 7: Graph generated by the PLANCO Synculator tool showing the IWT-based route.

4.2.3 Capital Investments

A successful rollout of the Logistic Concept requires capital investments for port infrastructure and site preparation, micro-depot facilities, handling equipment, last-mile delivery fleet, vessels, digital infrastructure and integrating the logistics chain into existing IT systems.

Port infrastructure and site preparation:
Port infrastructure and site preparation represent foundational investments that vary significantly depending on site conditions. Active ports with existing quay walls and mooring facilities require less investments than brownfields with ageing port infrastructure and/or contaminated soil.

Micro-depot facilities
Physical facilities for micro-depot operations include storage buildings for short-term parcel storage and consolidation, administrative and operational facilities such as small offices and staff areas, as well as areas for waste management. Agiplan et al. (2019b) estimate the setup costs for a 370 sqm micro-depot at €250,000.

Cargo Handling Equipment

[20] The cost calculation based on several assumptions, such as a list price of €300,000 per electric truck, energy consumption of 120 kWh per 100 kilometers, and an electricity price of €0.3 per kWh. Moreover, the electric truck is exempted from any carbon tax or road toll, which may be adjusted when the share of electric trucks increase. In addition, it is assumed that there will be no additional time costs associated with charging the truck on this route.

If no cargo handling equipment is available, reachstackers or smaller mobile cranes are required. Since gantry cranes cost several million euros, used reach stackers are a suitable alternative and can be purchased for about €50,000-€250,000 (Alias et al., 2021).

Last-mile delivery fleet
The size and the composition of the last-mile delivery fleet depend on service area density and parcel volumes. The prices for electric cargo bike solutions are ranging from €10,000-€25,000, for light electric vehicles and electric vans €30,000-€70,000[21]. To ensure sustainable last-mile delivery, the fleet is electronically powered. Consequently, costs for charging infrastructure should be considered.

Vessels
Purchasing used vessels of the Johann Welker type (built in 2000 or later) can cost between €1.5-€3 million, a Large Motor Vessel between €2-€4 million[22]. To minimize business risk and remain flexible, the first step should be to charter an inland waterway vessel.

Integration into existing logistics networks
Parcel and express delivery service providers have established efficient networks in the Ruhr Area, achieving economies of scale. Adopting micro-depots and IWT into the transport chain requires capital investments for CEP providers, even if micro-depots are multi-user facilities owned and operated by other private or public entities. Costs arise from IT system integration, platform modifications, and routing optimization. Additionally, CEP providers must restructure distribution strategies to leverage the new network.

Capital investments across the mentioned categories are substantial but manageable through phased implementation and strategic financing, especially for micro-depot sites at active ports. Public co-financing through EU or German infrastructure and mobility programs can reduce the financial burden on both private operators as well as CEP providers. Therefore, a phased implementation beginning with active port sites, supported by public funding, represents a viable pathway for rolling out the Logistic Concept.

4.3 Operational and Technical Feasibility

Beyond capital requirements, the feasibility of the Logistic Concept depends on how CEP providers can integrate micro-depots operationally and technically into their existing networks.

First, it must be clarified how CEP providers would integrate the approach of the Logistic Concept into their existing distribution centre networks. One option is to use a decentralized and external distribution centre, such as the Rhenus Warehouse, which is in the immediate vicinity of the Port of Emmelsum. This decentralized solution appeals to CEP providers without nearby locations. Conversely, CEP providers with nearby locations (e.g., Amazon, GLS, UPS) may leverage their own DC infrastructure.

For providers integrating MAGPIE either solution – whether via the external DC or via their own network – the routing decision becomes critical. CEP providers must then decide whether to route containers through the DC by truck, or through the IWT and micro-depot network.

[21] Price data are based on own market research and represent current offer prices. Cargo bike prices were collected for the Urban Arrow XL and ONO Motion models. Light commercial vehicle prices were compiled for the Renault Kangoo, VW Caddy Cargo Maxi, Mercedes-Benz Sprinter, and Ford E-Transit.
[22] This price data is based on own research and represents current offer prices only. For example, we searched www.pcshipbrokers.com.

This routing decision depends on IWT reliability and costs, time-sensitivity of shipments as well as granular demand forecasts for the micro-depots in the Ruhr Area.

However, using an external DC introduces operational dependencies and constraints. CEP providers would lose direct control over consolidation processes and full data accessibility. Moreover, the CEP providers become dependent on the operational reliability of the external DC operator. These factors may make the external DC solution less attractive for large, established CEP providers (Amazon, DHL), while potentially remaining viable for smaller providers without existing infrastructure in the region.

From a technical perspective, the integration process poses a core risk. Harmonizing the micro-depot network into an established system requires extensive API and middleware development e.g. to consolidate different data sources (barge tracking, container tracking, depot operations).

Moreover, the two networks operate under different conditions. The micro-depot network must consider (external) IWT scheduling, manual handling at the micro-depot, and variable transit times. IWT delays caused by locks and low water levels on the Rhine - as experienced in summer 2026 - affect predictability and the supply of the micro-depots.

Ultimately, the feasibility of rolling out the Logistic Concept depends not only on organizational and technical integration, but also on external factors related to inland waterway infrastructure.

5. Conclusion and Outlook

The *Logistic Concept for Sustainable Hinterland Networks and Hubs* presented in this deliverable is developed to address congestion and ease pressure on the road infrastructure on the freight corridor between the Port of Rotterdam and the Ruhr Area by integrating IWT into B2C last-mile delivery networks. The Logistic Concept proposes a three-stage system: main-haul via IWT from Rotterdam to DeltaPort, where shipments are consolidated, distribution via the West-German canal network to decentralized micro-depots, and last-mile delivery using cargo bikes or (electrical) vehicles.

From the perspective of market potential, the feasibility of rolling out the Logistic Concept appears promising. Within the catchment area of selected micro-depot sites, a volume of around 125 million B2C shipments is generated annually. Just 5% of these shipments would be enough to achieve high utilization of a barge service with two roundtrips per week.

Furthermore, the economic competitiveness of IWT is tested by modelling the Logistic Concept within the PLANCO Synculator (see D6.6). The results show that waterborne transport - as assumed by the Logistic Concept - can compete with truck transport on the specified routes, purely from the perspective of transport costs (€480/TEU vs. €960€/TEU).

However, the overall feasibility of rolling out the Logistic Concept depends not only on pure transportation costs but also on other factors. The feasibility analysis reveals critical challenges, particularly regarding the integration of the proposed model into existing logistics systems, longer transit times that may conflict with consumer expectations for rapid delivery, the operational reliability of IWT itself, and the substantial capital investment required to establish the micro-depot network. These investments must compete with the structural cost advantage of incumbent CEP providers that operate already-amortized infrastructure.

To tackle these challenges, adequate storage and handling capacities need to be established at the hinterland hub to ensure rapid order fulfilment and timely delivery to end customers. In order to reduce time-related disadvantages compared to truck transport, transit times along the main-haul leg (from the seaport to the hinterland hub) and the distribution-haul leg (from the hinterland hub to the micro-depots) need to be optimized. This could be achieved, for example, by increasing the frequency of barge services and by perfectly coordinating the transshipment and delivery processes at the micro-depots, so that shipments are transferred directly from the container to the delivery vehicle and dispatched with minimal intermediate storage.

In addition, general framework conditions can improve the economic feasibility. Rising road congestion, road tolls, and continued growth in B2C shipment volumes would strengthen the case for the Logistic Concept. At the same time, technological developments must be considered: (semi-)autonomous inland navigation reduces crew costs and makes IWT more cost-efficient and thus more competitive, while the ongoing transition from diesel-powered to electric trucks narrows the sustainability of IWT and its cost competitiveness – particularly as long as electric trucks remain exempt from tolls and other charges or taxes.

Conclusively, these results suggest that the feasibility of rolling out the Logistic Concept depends on three interrelated factors:

- the competitiveness of IWT relative to truck transport (costs and time);
- the extent to which IWT and the micro-depots can successfully be integrated into the existing structures of CEP providers;
- and the way the necessary infrastructure for micro-depots is financed.

Economic feasibility is therefore closely linked to public funding. Even in the absence of such initial funding, the Logistic Concept can still prove viable as a niche solution for corridors where IWT offers clear operational advantages. Such pilots would allow CEP providers to gain valuable operational experience with IWT-based distribution, laying the basis for a wider rollout to other corridors.

The findings of this deliverable provide guidance for the further development of the Logistic Concept within the framework of LOG4NRW, which positions DeltaPort as a hinterland hub, and offer a realistic pathway toward the concept's implementation. Beyond this specific case, the results are also transferable to other regions aiming to establish innovative waterborne transport solutions. In doing so, this deliverable supports the broader EU objective of shifting freight from road to more sustainable modes such as rail and inland waterways.

6. Annex

Table 4: Maximal Drafts, Locks and Bridge Clearance Heights

Inland Waterway	Relevant sections	Locks	Bridge clearance height	Max. load draft (in m)
Wesel-Datteln Canal	km 0 - 60	6 (Length 220m, Width 11,45m)	Railway Bridge Friedrichsfeld: 4,98m (km 3,81)	2.8m
Rhine-Herne Canal	km 0 - 45,6	5 (Length 190m, Width 11,45m)	Bridge Bladenhorst: 4,58m (km 39,65)	2.6m (km 0-24,53); 2.5m (km >24,53)
Dortmund-Ems Canal	km 0 - 21,4	1 (Length: 190m, Width: 11,45m)	Schwieringhauser Bridge: 5,02m (km 6,61)	2.8m

Source: ELWIS (2026).

Table 5: Criteria and Site Assessment Scheme

Criterion	Weight	0 Points	1 Point	2 Points
Land Designation	2	No Information / Residential Area / Conservation Area / Agricultural Land	Commercial Area / Industrial Area	Port Area / Freight Handling Port
Waterway Access	2	No	Possible via development / Access through adjacent port operator	Yes, direct access
Site Availability	2	Already in use (e.g., by port operator)	Vacant	For sale / Listing available
Port-Related Infrastructure, suprastructure and handling equipment	2	No	Partial (e.g., quay wall)	Yes, port infrastructure available including cargo handling equipment
Consumer Market (proximity and population density)	2	The 4 locations with the largest population within 20 kilometers.	In-between	The 4 locations with the lowest population within 20 kilometers.
Business Market	2	Close to industrial / commercial area, but no major B2B consumers within 10 km	Major B2B consumers in the vicinity (>5 km but < 10 km)	Major B2B consumers nearby (DHL, Amazon, etc.) (< 5 km)
Development Costs	2	High	Medium	Low
Road Access	2	No	Possible via development / Narrow access	Yes, direct access
Land Size	1	< 1,000 sqm	<= 1,000 sqm but < 5,000 sqm	>= 5,000 sqm
Expansion Potential	1	No	Possibly	Yes, additional space available
Distance to Residential Areas	1	Distance: < 200 m	Distance: >= 200 m and < 500 m	Distance: >= 500 m
Highway Access	1	Distance: > 5 km	Distance: > 2 km and <= 5 km	Distance: <= 2 km
Railway Access	1	No	Decommissioned / Planned	Yes

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