Circular City Ports Workbook 2 Building Blocks

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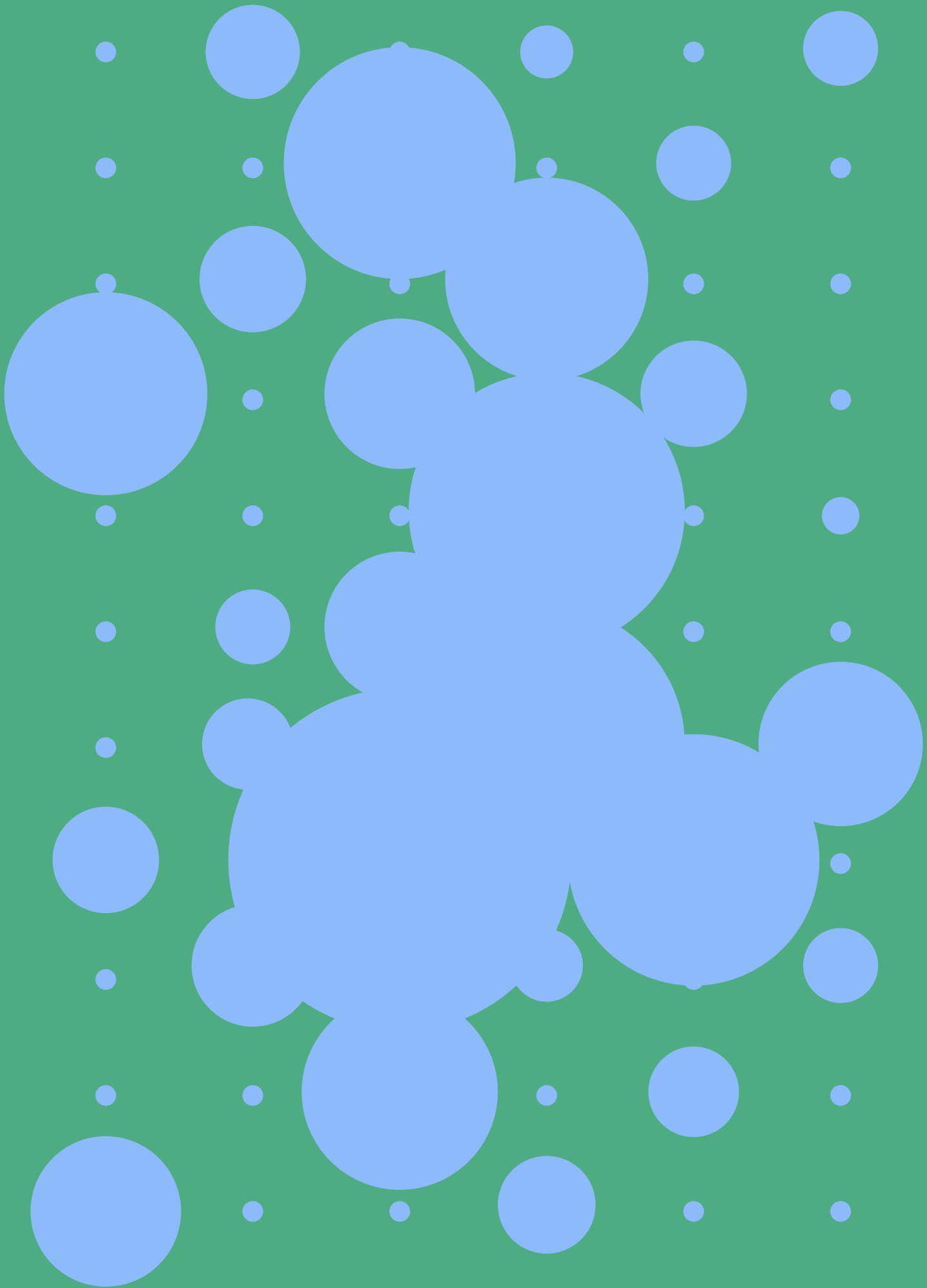
1010au and AWB

Circular Flanders/OVAM and Delta Atelier



1010au and AWB Circular Flanders/OVAM, Delta Atelier

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The Delta Atelier positions itself as an autonomous P2P knowledge and action platform including more than 50 actors coming from the Netherlands, Flanders, Brussels and, by extension, the regions of North Rhine-Westphalia and Nord-Pas-de-Calais. The platform bundles scattered knowledge and practical experience about the spatial impact of different transitions (mobility, energy, water, biodiversity, circular economy, agriculture, care) and organizes interaction between peers - both designers and policy makers and organizations as experts - so that they learn from each other and jointly formulate and realize new breakthroughs. The Delta Atelier sets out a program of debates, workshops, project initiations, design research, a physical workplace, exhibitions, virtual exchange (documentaries, podcast) and a community-driven online exchange platform.

The exploratory trajectory on Circular City Ports is framed within the Delta Atelier *Circular Ports* program and starts from the hypothesis that ports will play a crucial role in the transition towards circularity. It relies on an agenda of collective work programs and aims to start new transformation projects from unexpected coalitions. Within the Circular Ports program, the planning authorities are working together on: (i) a Circular Main Frame (scale XL) on the Delta as a whole; (ii) a regional test around the North Sea Port, counting on the cooperation between the provinces of East - and West Flanders and Zeeland (scale L); (iii) anew urban typology of so called city-ports (such as Antwerp Eilandje II or Rotterdam Makers District) as catalysts of a new manufacturing and circular economy (scale M), together with OVAM / Circular Flanders, 1010au and AWB; and (iv) a pilot for a circular building including logistical functions in the Merwe Vierhavens (scale S), pulled by the IABR and the municipality of Rotterdam together with the port authority in the context of Test Site M4H.

These different trajectories, each with their own coalitions, have met every six months to coordinate their independent tests. The support the Delta Atelier provides them is in the direction of setting up a renewed narrative for spatial transformation: if we start by linking the bits and pieces together, we might actually get closer to the living environment we collectively envision.

From documenting to desconstructing practices

So far, the exploratory research on Circular City Ports we conducted, which was articulated around workshops, interviews, and benchmarking, concludes with a somehow paradoxical statement: there is no single way of being circular. Circularity isn't easily replicable: what works somewhere might fail somewhere else. Furthermore, circularity targets can be multifarious: stretching from job creation to resource efficiency to ecological balance. Likewise, the changes circularity announces require not less than a systemic upheaval of our modern industrial system.

Such observation is no alibi for inaction. No matter how sweeping circularity appears now, we need to start somewhere, no matter where exactly along the value chain. Ports happen to be important switches in this globalized value chain. On the other hand, the multiple pathways City Ports can adopt to become circular keep on evolving, especially as City Ports themselves are subject to profound and rapid changes in their style of operations. But how to make this fuzzy concept operational without falling back to some sort of normative vagueness or intellectual laxity? If circularity refers to a concept with a fuzzy outline, it is nonetheless materialized, fixed as a practice.

This circular practice, born of distinct environments and endlessly reproduced, is steered by specific actors. These actors are locally anchored although their operation stretch across the entire Delta, and are organized in varied instances, who in turn innovate in different ways, from products to processes, from technologies to business models. If in the first phase of this research we focused on the isolated, innovative, and circular practices they had put into place, here we attempt their stylization. In social sciences, a stylized fact is a simplified presentation of an empirical finding. We started from the cases we had analyzed in the first phase of the research (around 11 ports, and 50 circular initiatives). We asked ourselves whether it was possible to identify similarities between them and across the ports, and eventually to distill initiatives that could be replicated elsewhere. We ended up identifying 8 building blocks that can be recognized across the Delta ports —from seaport to inland port to corridors as a linear system of ports.

Each building block represents a link in the total circular chain, and their interaction seems essential to further circularity. Although not all these blocks are necessarily found in all ports studied, they do capture the vibrancy of answers that ports and water-bound areas provide to their explicit circularity targets, an evolution that is often bound to the transition to a post-oil society.

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The following building blocks...

01 Capacity field
02 Island of urbanity
03 Canal cluster
04 Incubator
05 Local job generator
06 Urban trieur
07 Hinterland hub
08 Knowledge district

01 Capacity fields

01 Capacity fields

The diverse industrial and logistical areas located next to the waterways network hold a good potential for synergies. In the Capacity Fields we are next to the sea, with deeper waters, berths, facilities and operational techniques typical of coastal ports. They fulfil important hub functions for containerized cargo and the transhipment of goods (e.g. liquid and dry bulk) not exclusively directed to the regional economy. The “greening” of port activities and flows and the overall transition to a post-oil economy represents a potential competitive advantage for these areas. They have the infrastructural capacity to promote the growth of emerging industries focusing on Circular Economy and to enhance interactive development with coastal and shipping industries, as well as with the exiting (petro)chemical industries they might host.

● Observations - few existing cases

A quick geographical description

The capacity fields refer to large areas dedicated to industrial activities requiring generous surfaces. They are generally located downstream, at the mouth of the river or sometimes in reclaimed land, far from urban centres. They can be considered gateways to vast territories and massive flows, have significant land reserves and are home to a great proportion of national industrial and energy production -even though this might happen in a setting of slower growth.

Observed advantages and disadvantages

Their isolation and private access to facilities required by safety standards allow them to carry out activities that generate noise or odours. This physical distance is countered thanks to the many infrastructural investments that are made to connect these areas as effectively as possible to the landside by road, rail, and waterway networks. On the other hand, concessions are usually less expensive than in the vicinity of cities, and they cater to big installations. Furthermore, the physical colocation of companies makes viable to share services and facilities that can result in some form of industrial symbiosis. Unfortunately, their position in places where freshwater and seawater meet, means they are in the midst of a particularly rich and fragile biodiversity, which these capacity fields tend to ignore (e.g. irresponsible dredging) or damage (e.g. toxic spills) for the sake of their own operational efficiency.

Different situations analysed

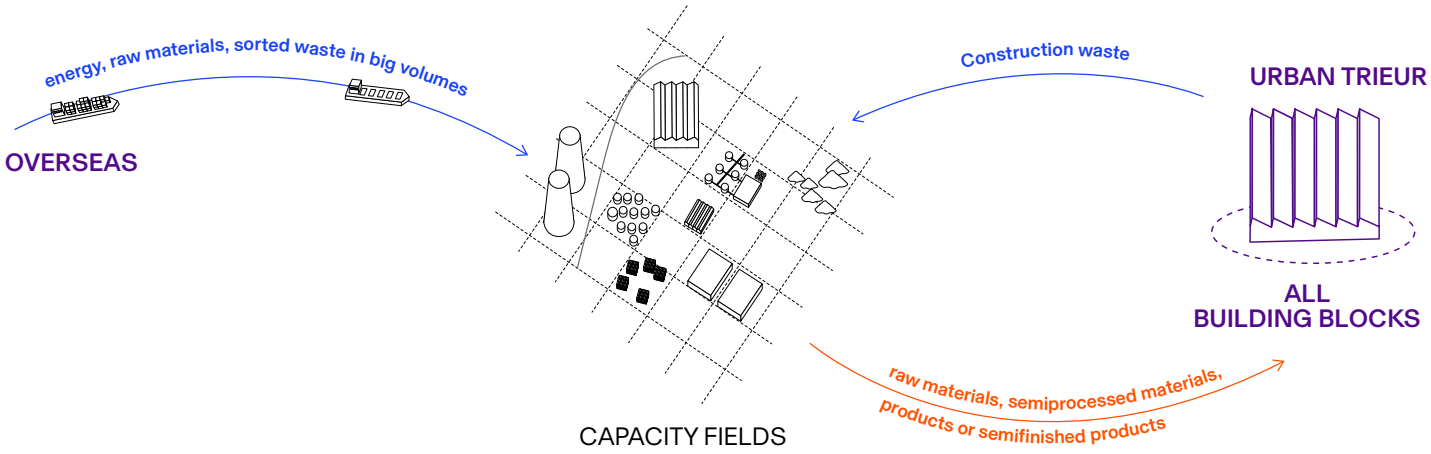
The comparative analysis shows that most of these industrial-logistical complexes are investing on a post-oil future, focusing on the (partial) reconversion of the petrochemical industry. Their logistical requirements also evolve, making some areas less profitable and even redundant. For example, in Antwerp, the port authority is currently reserving the Churchill Dock for an innovative project in terms of sustainability, energy transition, added value, enhancing employment… In the Port of Le Havre, the port's large land reserves are partly unexploited due to their environmental quality and the nationally imposed protection, what forces the port to adopt a strategy of densification of existing land rather than an expansionary strategy.

01 Capacity fields

Maasvlakte, Europoort and Botlek area in the Port of Rotterdam, Netherlands

Port of Le Havre, France

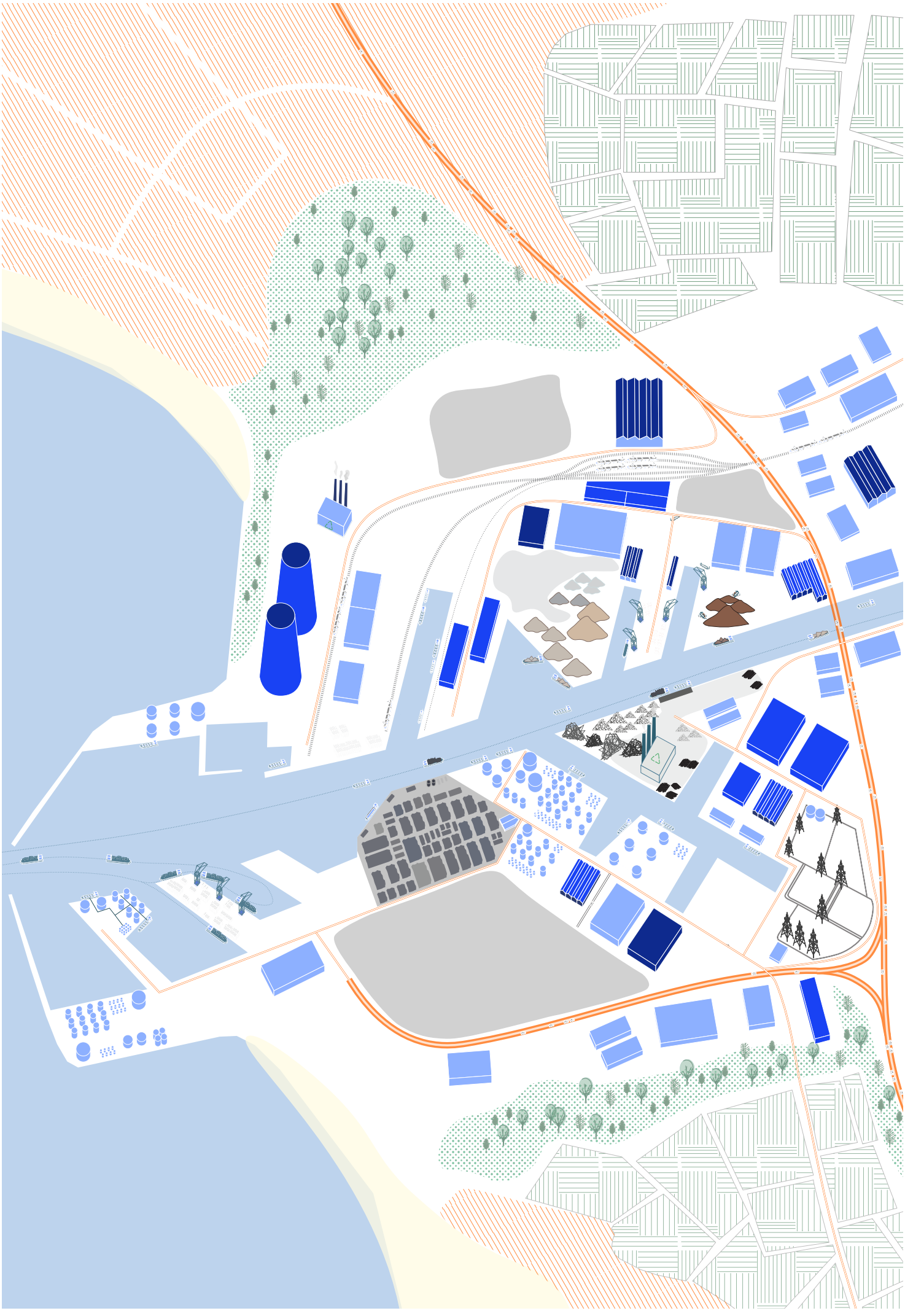
Port of Antwerp, Belgium



- **Analysis - the generic case: what activities can be found here?**

These large spaces articulate very diverse flows that circulate in big volumes. Retracing their path is a very complex exercise. Some of those flows come from local ports and are being gathered there, like in the case of waste collected in the "Urban Trieur" and being sorted out and either treated here or being dispatched somewhere else. Often those flows are related to the activities performed in the "Capacity Fields", like energy production, based around renewables (e.g. wind, biofuels or biogas) or petrol-based (e.g. gas and oil); maritime logistics (e.g. containerized cargo and bulk transhipment); or the (petro)chemical industry.

These flows of raw materials and (intermediate) products come from far away, in big vessels like tankers or container ships necessitating deep waters and large-scale infrastructure to dock. Frequently, these "Capacity Fields" operate as modal switches, and these flows continue their trip to other locations in smaller vessels, by train or on the road. Around this first industrial and logistical core, a crown of smaller logistics and industrial activities working in symbiosis with the big industries normally exists.



- **Towards more circularity: what are the ongoing initiatives?**

01 Rail intermodal container terminal: It allows a smooth transition between rail track, storage yard and gate operations, resulting in time efficiencies during the handling of containers. They are space intensive installations but crucial to establish the modal shift from the road to rail-based solutions (e.g. Green Express Network, EU).

02 Sea litter collection platform: Around 20,000 T of waste are dumped in the North Sea yearly. Half of this volume corresponds to plastics (nets, ropes, rubber) that could be collected, sorted and recycled in (5).

03 Port sediment treatment plant: To guarantee enough water depths, large volumes of sludge and sediment are dredged and disposed of every year. The plant harvests and treats the residual water contained in those sediments for its later reuse, and processes the leftover dry-matter —nutrients are salvaged as fertilizers, and inert material reused in the construction sector (e.g. Amoras, Antwerp, BE).

04 Incinerator W2E: Those fragments of the sediments, sludge or sea litter that could not be recovered, are combusted or pyrolyzed, and energy is recovered from this process.

05 Plastics valorisation platform: While the textile industry expands due to the combined impact of demographic growth and the fast-fashion industry, the culture of natural fibres shrinks. Simultaneously, huge volumes of plastic are starting to be mechanically and chemically recycled, coming to substitute the natural fibres in textile production. The proximity of the (petro)chemical cluster represents a competitive advantage in technological and skill terms.

06 Metal-mining and recycling plant: Metal recycling is regarded as an essential industry and supported by the EU, an industry that is boosting thanks to the thickening of its chain: more and more companies start to collect and sort metals and e-waste inside cities. While a fragment of it stays in the urban market, these plants tend to focus on the more specialized and sophisticated side of recycling, as well as on those processes involving massive amounts (e.g. Umicore, Hoboken, BE).

07 Tidal park: Environmental concerns grow at the same pace as ports keep on reclaiming new land. The thread of sea level raising opens the door to regenerative and nature-based interventions that give more room to the water and buffer the risk. (e.g. New Nature in New Meuse River, Rotterdam, NL).

08 Seaweed biorefinery: It converts native seaweeds to CO2 neutral chemicals, third generation biofuels and bioenergy (e.g. Seaweed Biorefinery, Petten, NL).


Biomass (Wood, Straw, Waste)
Nutrients
Sand
Sediment
Sludge
Sea litter (Nets, ropes, cords, rubber, diverse plastics...)
Heat Power
Domestic and industrial plastic waste
Metal mining and recycling plant
Oil Products
Artificial Fibers (Acrylic, polyester)
Heat
Syngas
Biofuel for chemicals
Tidal Park
Biomass
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02 Island of urbanity

02 Island of urbanity

Regions can benefit from ports on their territory, at least if their ports perform well and are properly embedded in the regional economy. They can provide value added for the region, but they usually have relatively limited indirect economic effects due to the disconnection between flows of goods and materials, and high-value-added activities related to those goods, such as advanced services, innovation and knowledge-intensive employment. The Island of Urbanity comes to fill this gap. This building block is a hub of sorts for the creation of a regional community, and where the presence of a network of firms and institutions will support the linkages between throughput flows and locally available expertise. It increases the proximity and collaboration among firms, essential to build localized capabilities, support collective learning, and ensure competitiveness.

● Observations - few existing cases

A quick geographical description

This building block occupies a plot of relatively small size inside (or at least well-connected to) the port. In principle, it is located far from the rest of the city, because of the high environmental risk class of the industrial activities in the port, yet strongly connected to it through public transport.

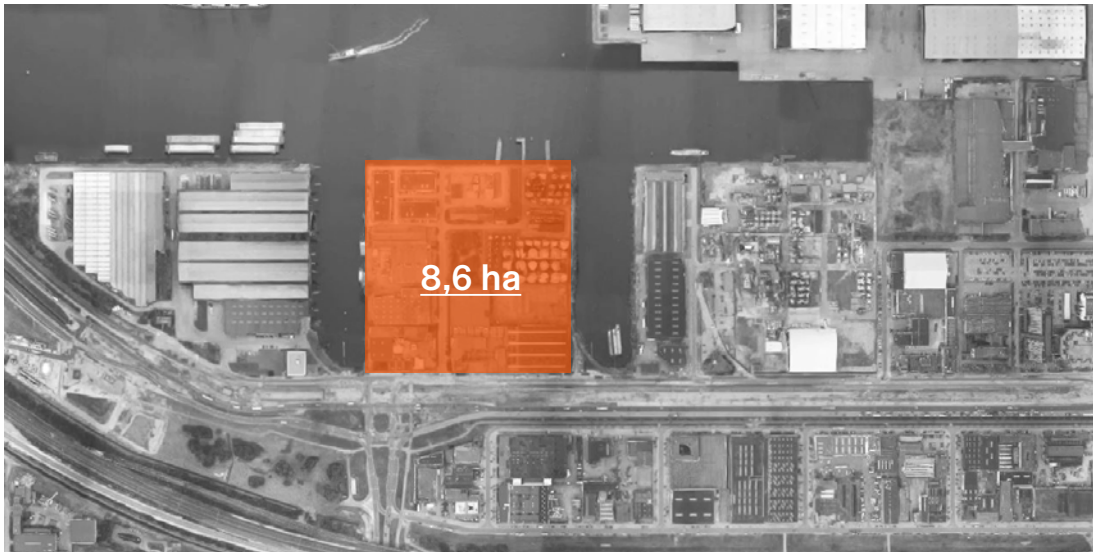
Observed advantages and disadvantages

The island of urbanity is a place of testing an experimentation, a platform for sharing and collaboration, and a hub where infrastructure (e.g. pipelines) and facilities (like convenient transport and storage of materials) are grouped and made accessible to companies as a way to fostering research and development.

Different situations analysed

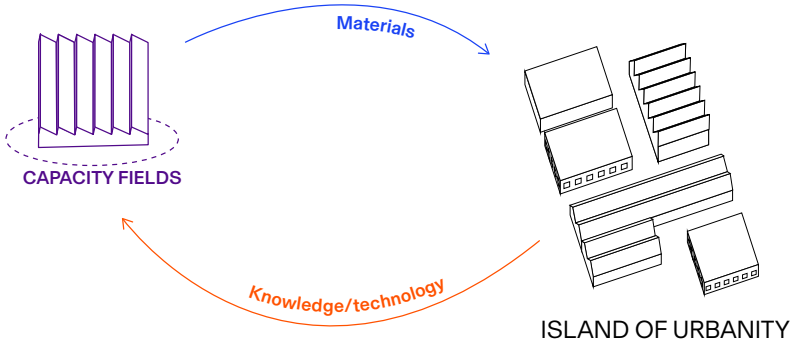
The comparative analysis shows a strong ecosystem of various industries and scales, next to the water and port large-scale infrastructures. Some islands of urbanity are not spatially connected to the rest of the port, while others are fully embedded into it. However, even when they work independently from the rest of the port, they stay well-connected to the residual flows and issues of the companies settled in the port.

Bio Base Europe Pilot Plant, North Sea Port, Gent BE



Prodock, Amsterdam, Netherland NL

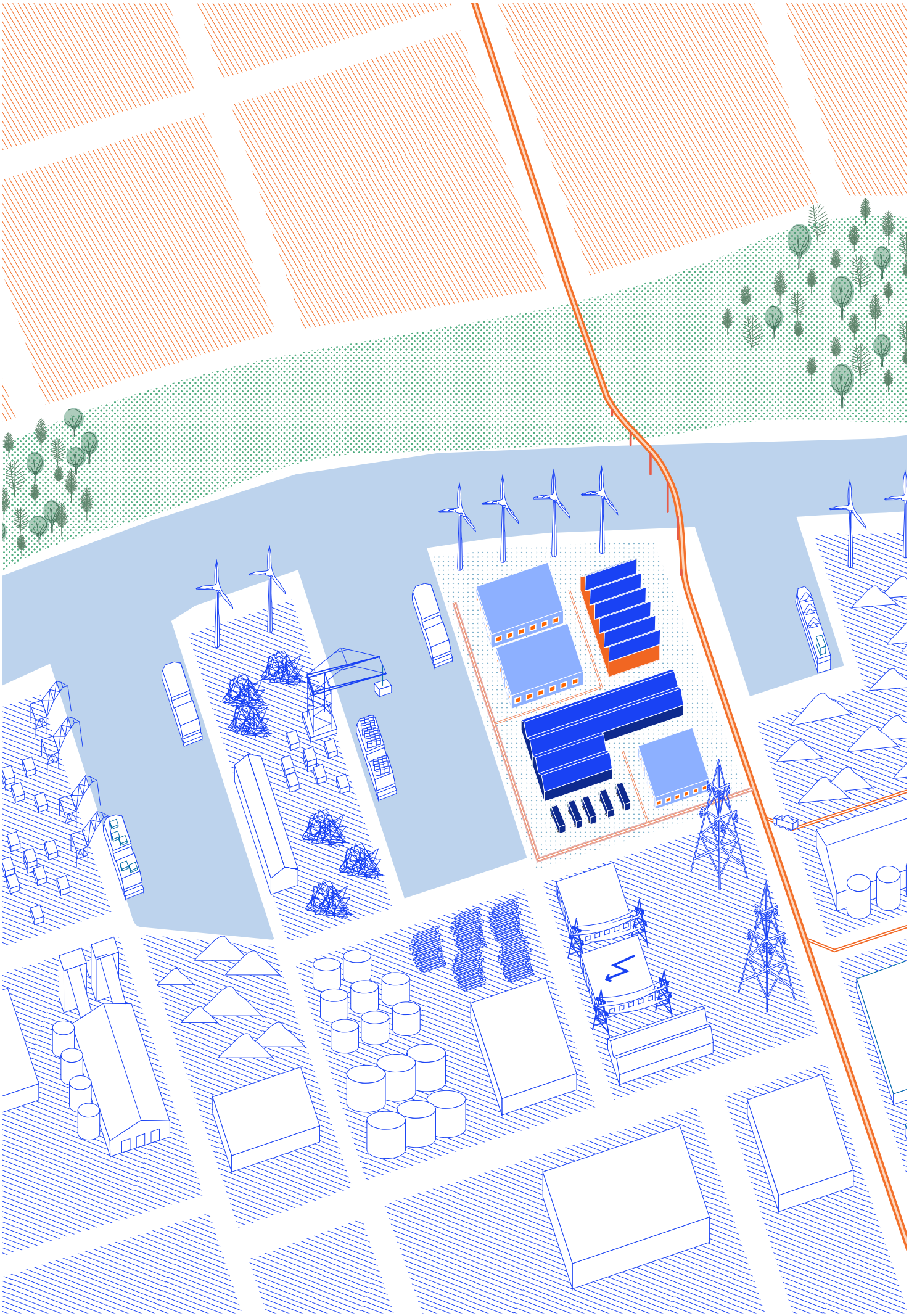
Plant One, Rotterdam, Netherland NL



- **Analysis - the generic case: what activities can be found here?**

The island of urbanity is a medium-scale area within the industrial port. It is a location appealing to pilot projects and test plants, sufficiently far from vulnerable areas to conduct all kinds of experiments and nearby the port companies. These can provide them with the (secondary) materials and imperfect questions that can eventually usher in innovation. For instance, they can extract nutrients or hydrocarbons from residual biomass and use it in many biotechnical processes.

Test plants are not only places for scaling-up and testing innovative industrial processes. They also offer labs and other technical infrastructure as well venues for meetings and conferences. Thus, the island of urbanity works as a hub for enterprises of different scale, stage of development and activities. It cooperates with the port authorities and entertains a close relationship with universities, other private and public instances, or specific private actors.



- **Towards more circularity: what are the ongoing initiatives?**

01 Provide space and infrastructure for smaller companies (spin-offs) to plug into, right in the middle of the large port companies, and in collaboration with the port authority, the university, other private companies (or a consortium of them). The facilities provided could range from very specific (high-tech) kind of equipment and measuring/testing devices to more open, demand driven (ad hoc), space and facilities like water access or large vacant structures.

02 Matchmaking between existing nearby industrial actors based in the port. It could start from industrial symbiosis (optional: an inventory of needs and by-products/waste flows). It anyhow requires places to test new processes leading to new linkages.

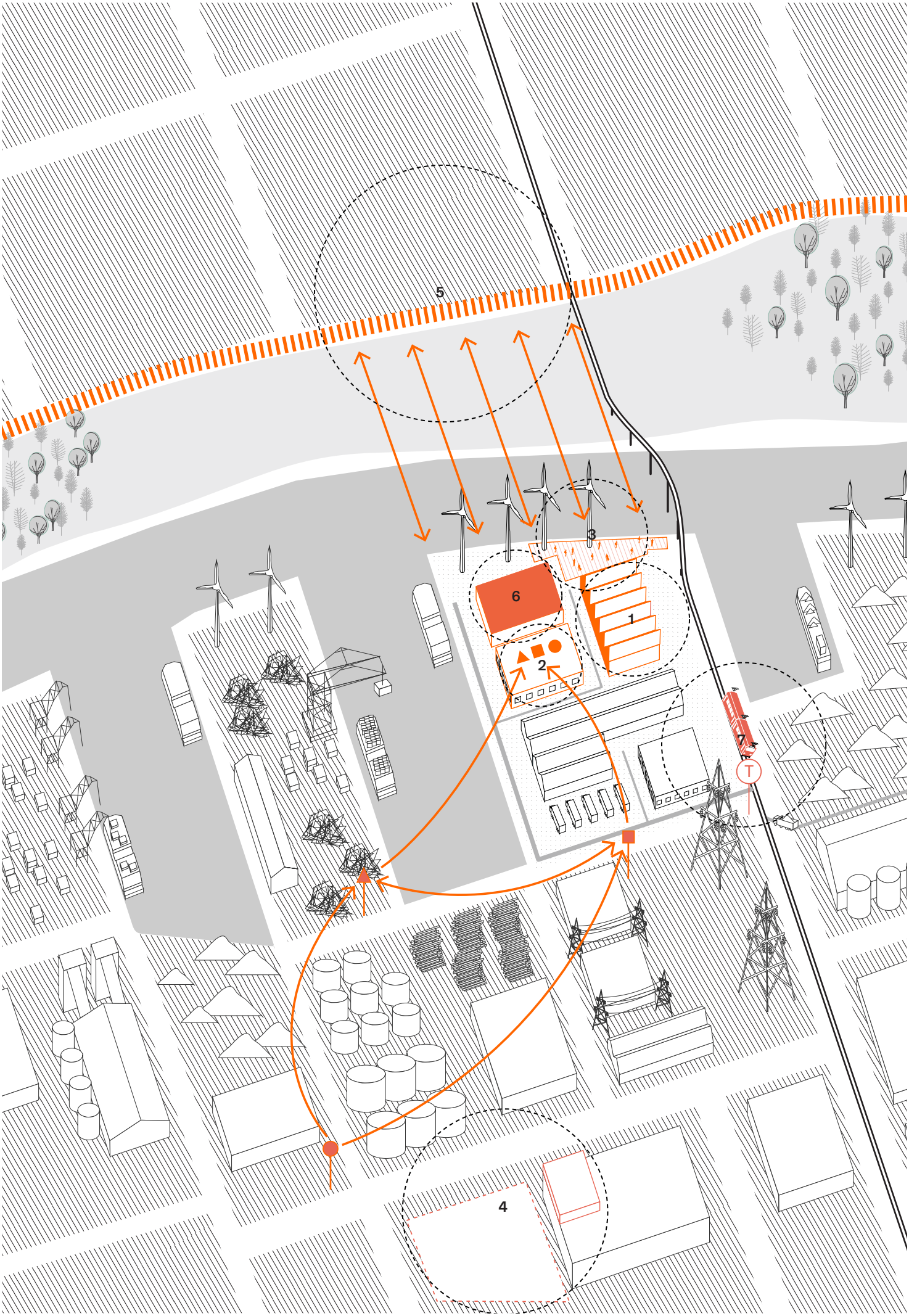
03 Orchestrate events around specific topics: Industrial ports and activities are hidden, unknown but very innovative and inspiring places.

04 Assist, match and provide place for future scale-ups to settle: They could either look for a premise inside other companies and join their site, infrastructure and production processes, or bigger port concessions could be subdivided into small and medium-size units.

05 These port areas, of an in-between scale, constitute key places to attach the working of small companies and start-ups to the wider network of the port authority (to other large-scale companies, to investors…), seeking synergies and encouraging specialization (e.g. Prodock, Amsterdam, NL).

06 Organise a neutral ground to test and interact with the regulatory framework: Sometimes it is difficult for companies to innovate and be busy with all the legislative paperwork at the same time, this is why 'umbrella' groupings providing collective environmental licenses work well. New industrial processes need new kind of legislations as well. This place could feed this necessary dialogue among instances and support innovation. Every test plant starts from a different configuration though: while Pilot One is a private company that guides companies through the legislative hurdles, Bio Base Europe is a more public institution that works ahead of desired changes, and in Prodock is the port authority envisioning products or business key to the port region.

07 Accessible public/collective transport: Innovation needs interaction. Industrial ports have a strategic advantage as they provide space with low environmental constraints. For smaller, start-up companies to reach such places, a good public transport service is vital to trigger new collaboration on local and international level.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03 Canal clusters

03 Canal clusters

A cluster is as an ideal type of institutional and economic structure involving collaboration among different actors and firms, normally operating within a discretely defined industry. The Canal Cluster is a specific type of economic agglomeration that can include firms in the maritime sector (from bunkering and shipping agencies, to ship or container repair and maintenance, or dredging) or any other industry - typically in the construction, recycling and food processing industries. A 'park manager' assures the development of synergies among those industries, also in terms of industrial symbiosis. It helps to interconnect firms active in similar or related sectors and those firms to knowledge-support organizations. Such cluster is located along a waterway, normally near a city. The waterway is often under-exploited.

● Observations - few existing cases

A quick geographical description

This building block is characterized by its strategic position: close to the city, along the waterway and having access to logistical infrastructure. It is thus very accessible from major urban economic centres and located next to the passage of port flows too via the canal.

Observed advantages and disadvantages

Despite the spatial advantages of these Canal Clusters, the waterway is often underused. The same applies to old railway infrastructure. And while many, diverse companies are in permanent cohabitation, few synergies are created between them.

Moreover, the proximity to residential areas is a real opportunity to develop activities that could be beneficial to both the residential and industrial milieus, not less in terms of energy and material flows. Once again, this potential is hardly exploited.

Different situations analysed

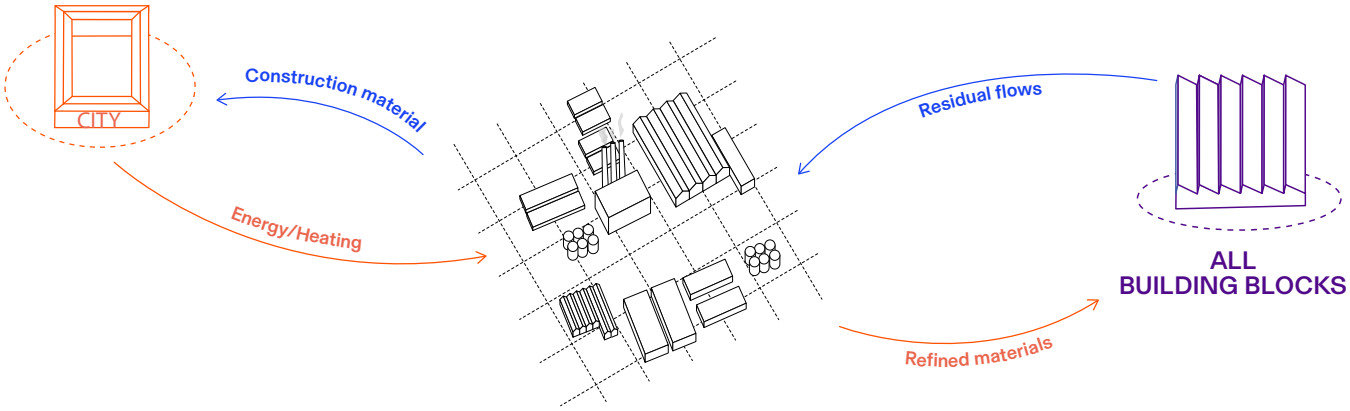
The comparative analysis of three clusters in different port contexts, casts light on the workings of this building block. The cluster might be inside or outside the port area (e.g. Kanaalkant is outside, while the other two are inside a port area). Its management can be trusted to the Port Authority or to some other consortium (e.g. North Sea Port is managed by a cross-border group integrated by the Zeeland Seaports and the Port of Ghent; Kanaalkant is managed by province of Antwerp, POM and Economic Network of Albertkanaal).

A perimeter around the cluster might be established, allowing a common management and communication. An area manager might have been appointed in order to smoothen coordination among the different parties and start new projects. In all cases, a specific InfoPoint helps companies to find their way through to sustainable transition, for instance by guiding them to specific funds that will allow the companies to shift to renewable energy resources, reusable water and alternative solutions to road transport.

Area manager Kanaalkant, Albert Kanaal, Antwerpen

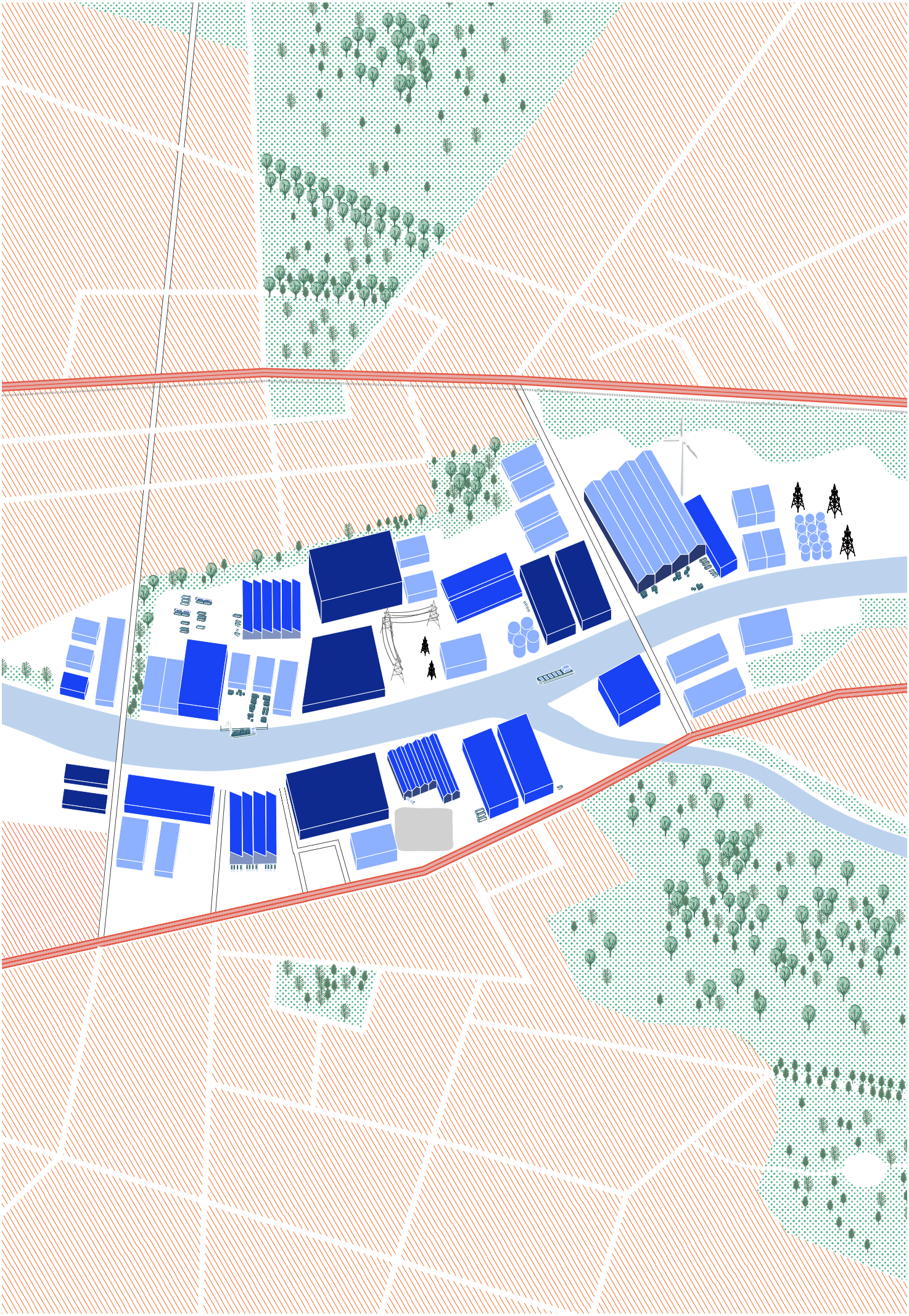
North Sea Port, Ghent

Laeken Port - Brussels



- **Analysis - the generic case: what activities can be found here?**

The activities fall into several categories. The first includes activities near the canal, mostly linked to transhipment platforms (e.g. recycling centres, concrete mixing plants, building materials, food manufacturers, pharmaceutical products, chemical industries). The second category takes advantage of the large available surfaces, plugged into a well-connected road network, and brings together activities that are grafted around the existing core (e.g. services to companies and industries, logistics services, suppliers of industrial or construction equipment, or wholesalers). A third category, much less present but none the least a job-intensive one, consists of private training centres or training as part of the industrial activity. The challenge remains as to how can a link be created between these activities and their environment, enriching each other.



- Towards more circularity: what are the ongoing initiatives?

01 Regional Material Bank: High-value separation and repurposing of construction and demolition residual flows (e.g. Stockholm Royal Seaport Building Logistics Center, SW)

02 Incinerator W2E: Small scale installation for those fragments of the construction and demolition streams hard to recycle or reuse.

03 Large recycling plant: Intended for mixed construction waste (wood, windows, plaster, isolation, concrete, and electric and electronic equipment). New materials and components can result (Sharp Skips Construction and Demolition Waste Processing Plant, London, UK).

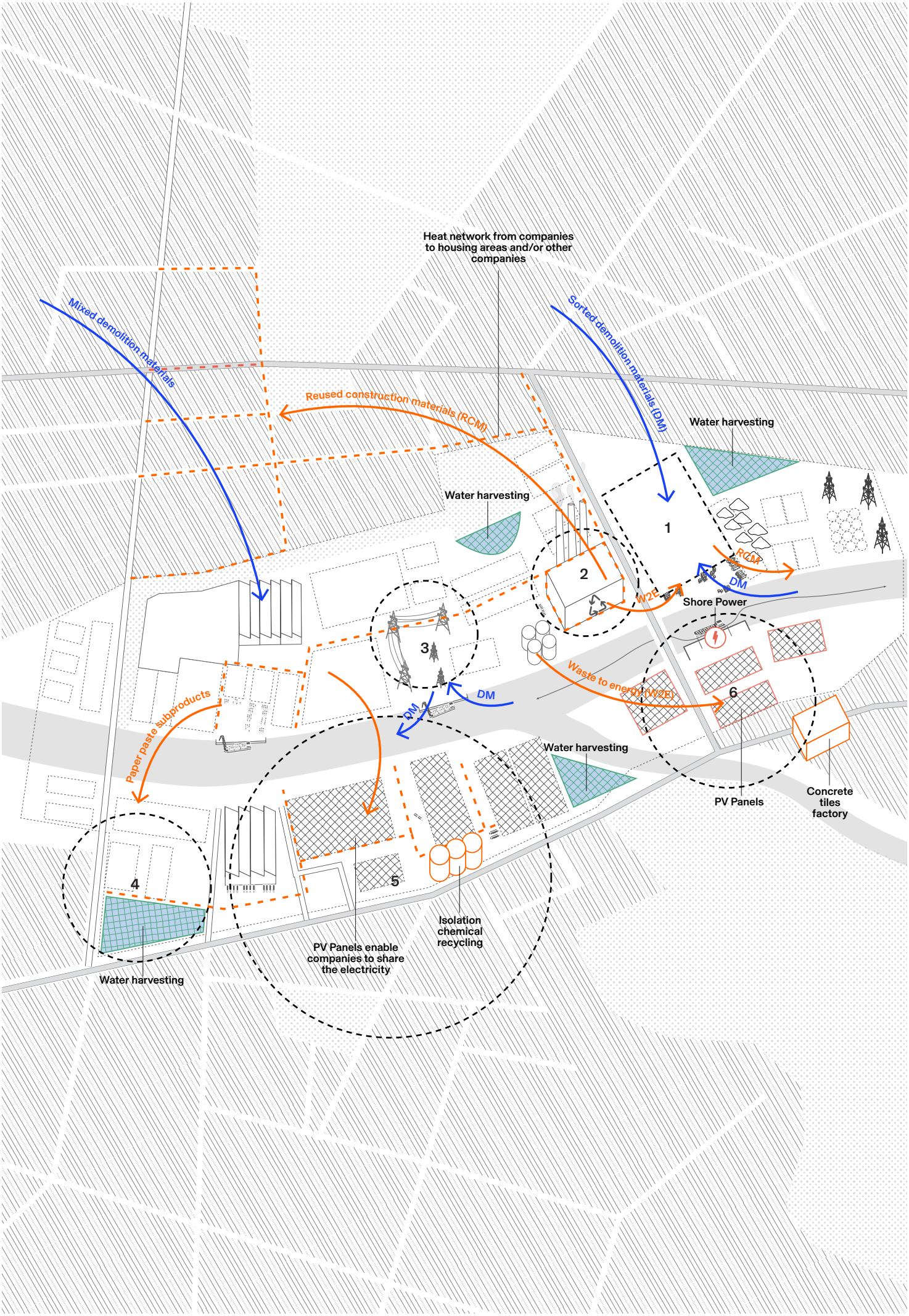
04 Paper paste sub products facility: The sorted paper and cardboard (and eventually textiles and wood) coming from (3), which are high fibre, can be used in new biodegradable plastics.

05 Chemical recycling plant: Some recycling can be carried out on-site, but often the waste must be sent to an offsite recycling company for processing. This is the case with plastic waste. The process of chemical recycling changes the chemical structure of the polymer and converts into chemical building blocks including monomers that are then used again as a raw material in chemical processes. It covers processes such as gasification, pyrolysis, solvolysis, and depolymerization, and reduces the use of fossil feedstock. Some test plants exist dedicated to Polystyrene and PVC (RecoVynil) chemical recycling.

06 Concrete tiles factory: Treatments in the CDW produce aggregates of diverse sizes, the fines fraction of which is rarely used as secondary raw material for concrete production because of the high-water absorption and impurities content. Inside this cluster, recycled sands together with by-products or waste (wood, slags, foundry sands, etc.) coming from the other companies in the cluster, could be valorised in the fabrication of new tiles.

07 Mixing renewable and shared energy resources: At all scales and in all locations, solutions are sought for diversifying the energy mix in favour of renewables and low-carbon conversion technologies for electricity, heating and cooling.

08 Water harvesting: Longer drought periods and soaring water demands coming from agriculture oblige us to look for alternative ways to manage our water reserves, locally harvesting rainwater and reusing it whenever possible.


Heat network from companies to housing areas and/or other companies
Mixed demolition materials
Reused construction materials (RCM)
Sorted demolition materials (DM)
Water harvesting
Water harvesting
1
2
3
RCM
DM
W2T
Shore Power
Waste to energy (W2E)
DM
DM
6
Paper paste subproducts
Water harvesting
PV Panels
Concrete tiles factory
4
5
Isolation chemical recycling
PV Panels enable companies to share the electricity
Water harvesting

04 Incubator

04 Incubator

For the sustained success of the port ecosystem, it is essential to understand every stage of its development to help it to evolve over time as well as to catch up with breakthroughs that are difficult to anticipate. The Incubator is used to refer to those innovative enterprises which can fill the gap between innovative small companies (niches) and the big-scale industrial and logistics setting characteristic of ports. The Incubator consists of a mix of diverse firms, combining established companies, (specialized) services and start-ups. They offer financial and organization support to early-stage start-ups and early grown-ups to help them to upscale and adapt to the global concurrence that partly governs the port ecosystem and provide adapted infrastructure to them (e.g. testing centres and labs).

- Observations - few existing cases

A quick geographical description

This building block finds its habitat within the city port, and away from any housing developments because of nuisances like noise and emissions it generates. The area is often publicly accessible, and its success depends on the visibility of companies, along with their physical and organizational proximity.

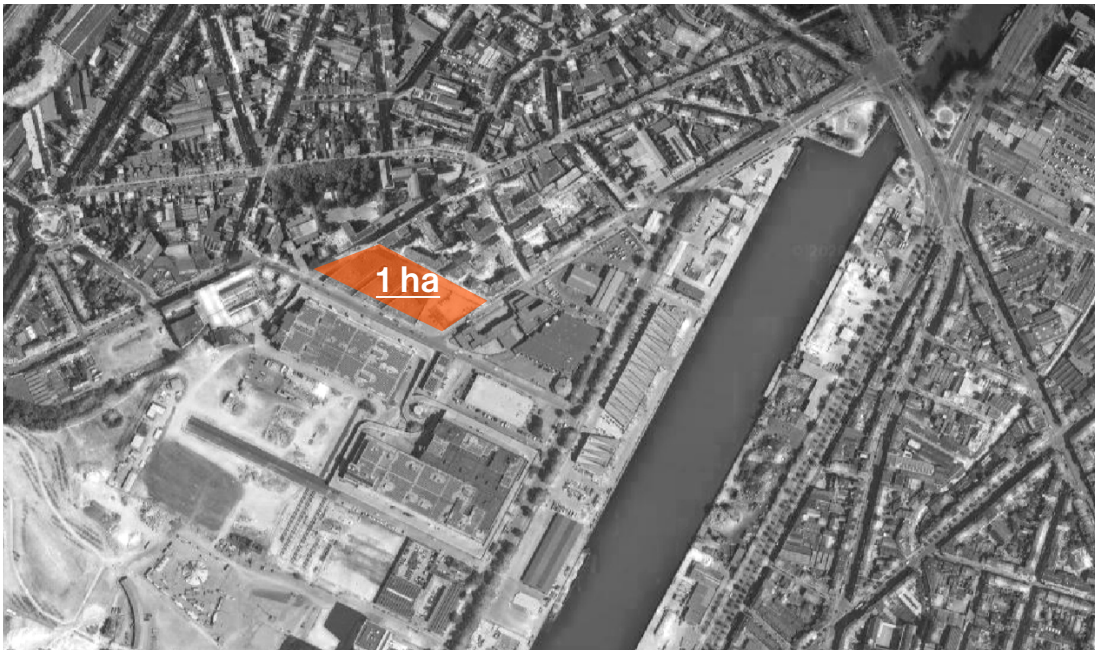
Observed advantages and disadvantages

The proximity to other companies in other (un) related sectors can usher in new opportunities for cluster creation in the port ecosystem. In those cases, incubators can play a role as switches among sectors or furthering functional specialization.

Different situations analysed

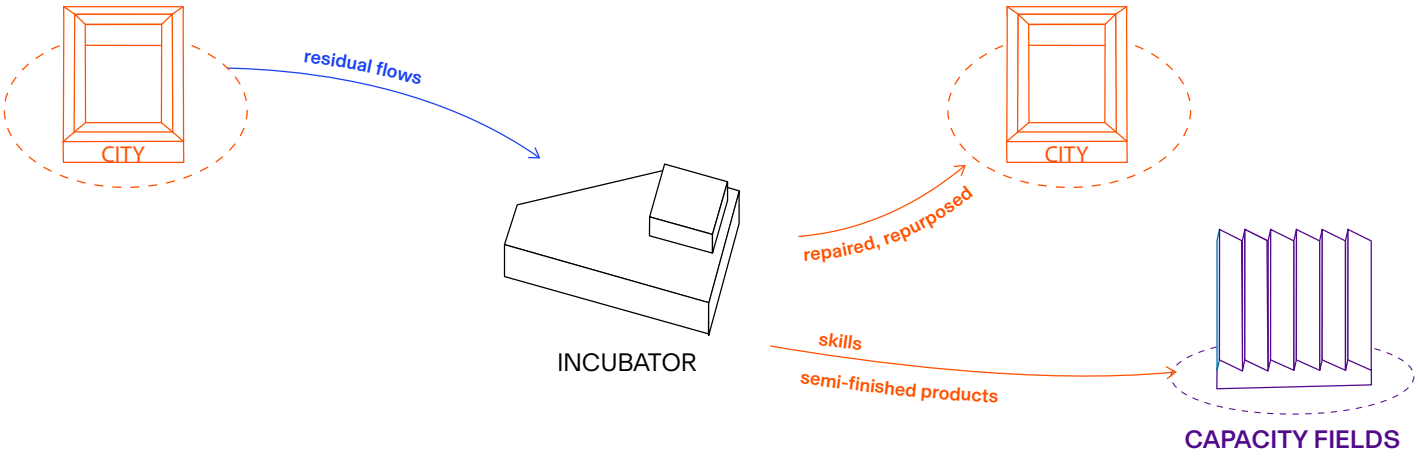
The differences between the incubator types are noteworthy. Where they are lighter and linked primarily to urban manufacture and circularity, as is the case of Greenbizz in Brussels, the incubator is less concerned with port-related developments. In the other cases, the physical and organizational proximity of the incubator to the port ecosystem, as in the case of Eilandje - Steenborgerweert in Antwerp or Bluebridge in Ostend, makes them an ideal place to further innovation in some of the specialisms located there (e.g. mechanical equipment for oil infrastructure, underwater reparation of vessels, interactions between waves and man-made structures).

Innovatice City Port (ISH), Antwerp: Asiadok-Westkaai will see its vacant structures being redeveloped as testing spaces



Greenbizz, Brussels

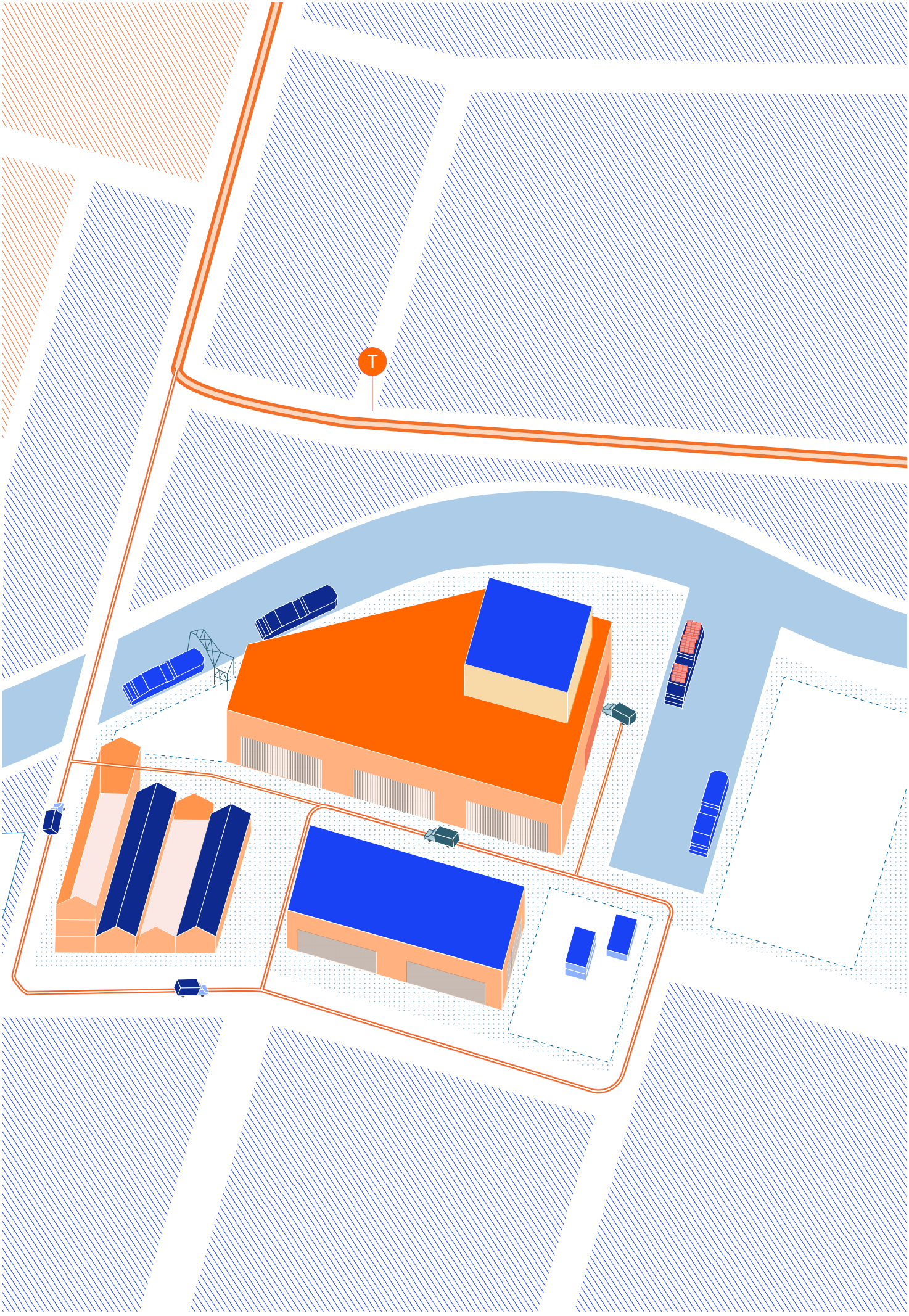
Bluebridge Science Park, Ostend



- **Analysis - the generic case: what activities can be found here?**

Traditional port activities are moving away from the port, leaving big vacant spaces and buildings behind. This offers an opportunity for those growing and not yet established companies, attracted by these large spaces and a cheap market price. Indeed, a successful incubator depends on a combination of different features: large vacant spaces (between 1ha and 8 ha) to store the flows and accommodate growing enterprises, a permissive environmental legislation for testing and a good public transport connection to the city.

Those vacant buildings and plots offer enough room for the colocation of experimental activities next to small administration offices and large warehouses. Other factors influencing the success of an incubator is its proximity and synergy with other companies operating with the same industry. For instance, research done in the incubator can interact with on the ground maritime activities like logistics and shipping, material storage and life cycle analysis, or reparation/repurposing companies.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- Towards more circularity: what are the ongoing initiatives?

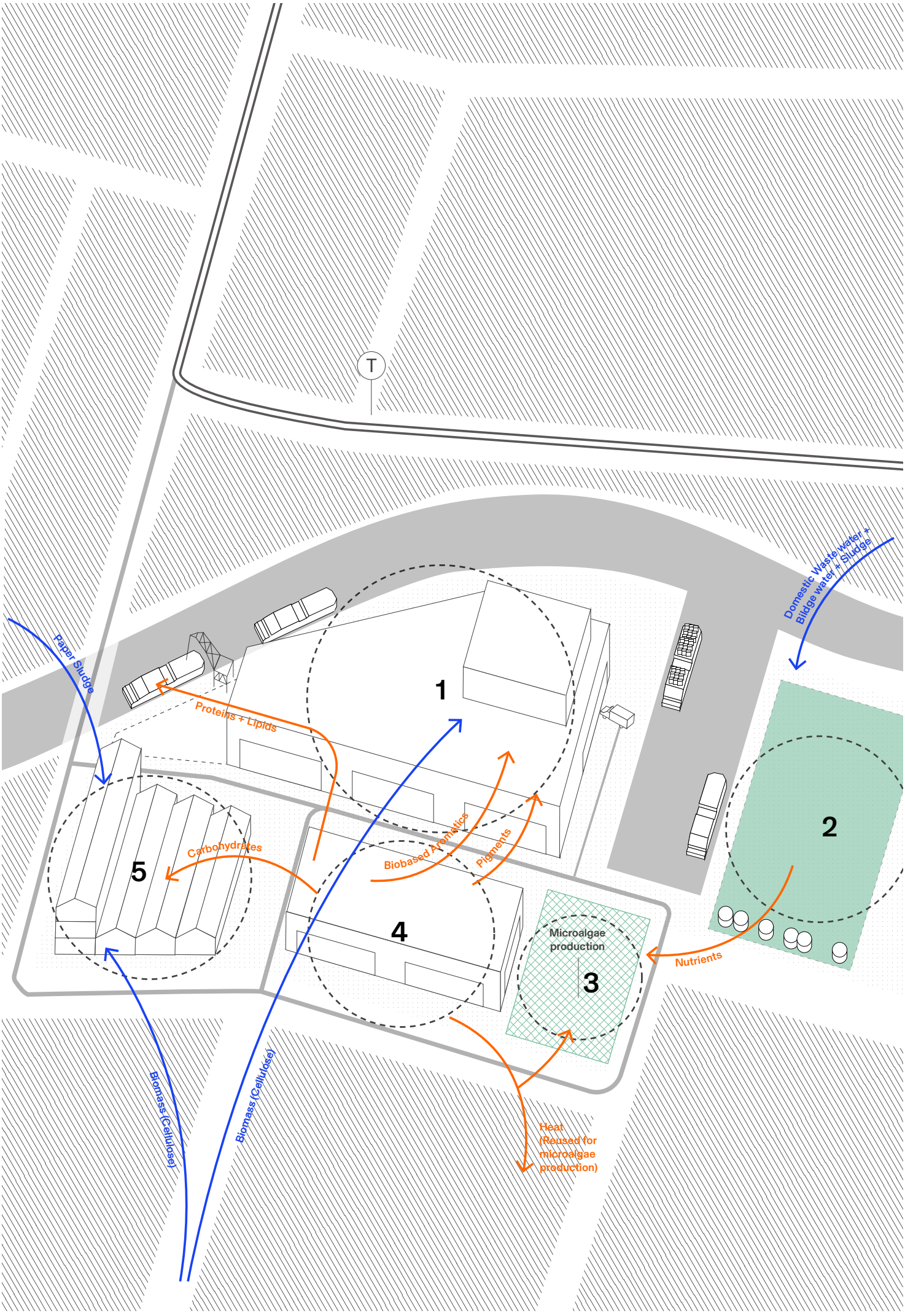
01 Laboratory: Facility for testing biobased coatings, personal care products and biodegradable packaging produced from the recovery of the residual flows (e.g. proteins and lipids) and intermediary products (e.g. pigments, biobased aromatics) originated in (4).

02 Waste-water treatment plant: Land or fuel-based sludge valorisation, including the nutrient recovery —phosphate and nitrogen in the form of ammonia (e.g. Milano San Rocco, Milan, IT).

03 Microalgae cultivation: Microalgae uses industrial refusals as inputs (wastewater, CO2, and desalination plant rejects) and results in a large product basket with energy-derived (biodiesel, methane, ethanol and hydrogen) and non-energy derived (nutraceutical, fertilizers, animal feed and other bulk chemicals) products. They use less land than other, particularly in the case of a production system or bioreactor based on flat panels. Algae cultivation enjoys a better growth yield and lipid content than crops (e.g. Proviron, Ostend, BE).

04 Microalgae refinery: A biorefinery is the best way to valorise algal biomass. In order to work effectively, it needs to include co-products next to the oil extracted in the first place, like alcohols, alkanes and residual biomass that can be used as fertilizer or biogas. To make sense of the algal biorefinery concept, there is a need to establish a proper connection between the various input and output streams (e.g. Ecoduna Algal Biorefinery, Bruck an der Leitha, AT).

05 Bioplastics testing lab: Algae serve as an excellent feedstock for plastic production thanks to its high content of carbohydrates and hydrocarbons. These chemicals can be converted into bioplastics to replace oil-based plastics. Bioplastics produced from microalgae have similar characteristics to oil-based plastics and thus can be “dropped in” to existing infrastructure and applications. Furthermore, microalgae-derived bioplastics can also be biodegradable, which also makes them environment-friendly (e.g. GreenBridge, Ostend, BE).


T
Paper Sludge
Proteins + Lipids
1
Domestic Waste water + Bildge water + Sludge
2
Carbohydrates
5
Biobased Aromatics
Pigments
4
Microalgae production
3
Nutrients
Biomass (Cellulose)
Biomass (Cellulose)
Heat (Reused for microalgae production)

05 Local job generator

05 Local job generator

At the interface between port and city, often occupying structures that were left behind by the continuous up-scaling of the logistical activities in the port, new pools of skilled workforce see the light. The jobs in these Local Job Generators take both advantage of the nearby passing material streams and the maritime skills that might remain -linked for instance to ship repair or the work with wood or metal. They sometimes develop synergies with the nearby neighbourhoods in terms of job placement and training (e.g. food processing, furniture making) as well as in the type of products that can be handled locally, like repurposed textiles or electronics. And sometimes they operate as autonomous zones, entertaining relationships with areas well beyond the close-by neighbourhoods.

● Observations - few existing cases

A quick geographical description

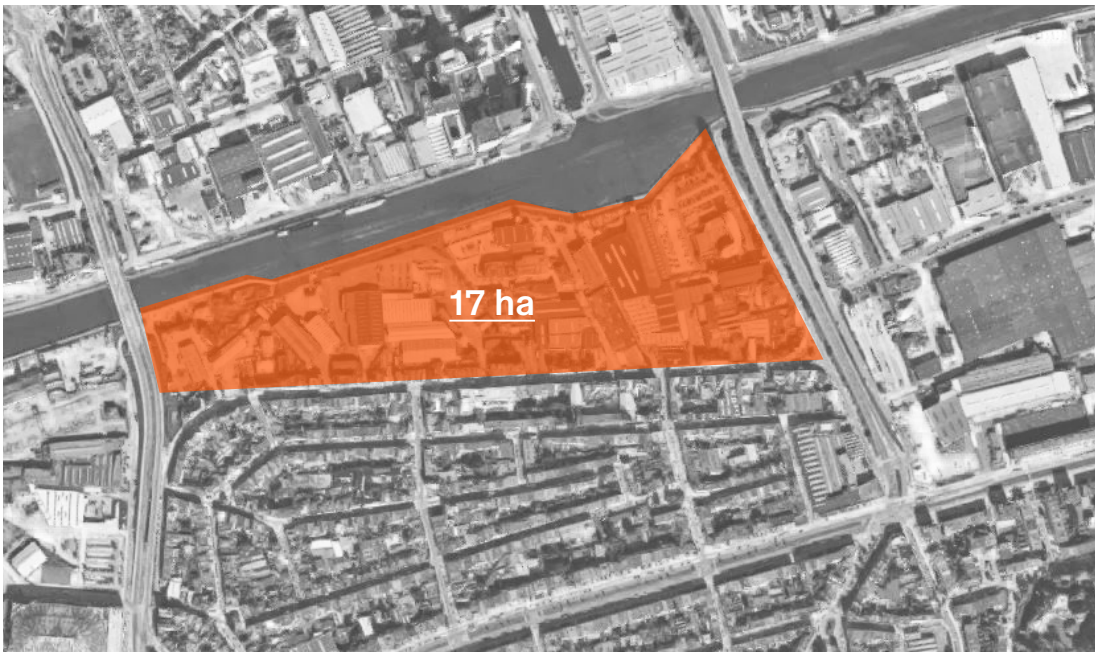
The port-related activities have always been a major pillar to urban economies and an important job provider. Before the port scaled up and left the city, the populated districts surrounding it could rely on a continuous demand for mariners, stevedores, coopers, shipwrights, merchants, and related crafts. They became places of arrival, attracting newcomers in search of a better life. Some of this know-how has stayed in the same place, preserved in the operations of specific companies, and some of these districts continue to function as places of arrival.

Observed advantages and disadvantages

The good connection between the old port and the adjacent neighbourhoods makes this building block a good attractive pole for new investors and entrepreneurs, especially for labour intensive activities that do not require vast spaces or sophisticated infrastructure. Furthermore, publicly funded programs exist both for renovating the 19th century urban legacy and for generate jobs for the often shortly trained and/or long-term unemployed people inhabiting those places of arrival. Despite its spatial advantages linked to mixed use and the existence of waterways, they are often under-exploited.

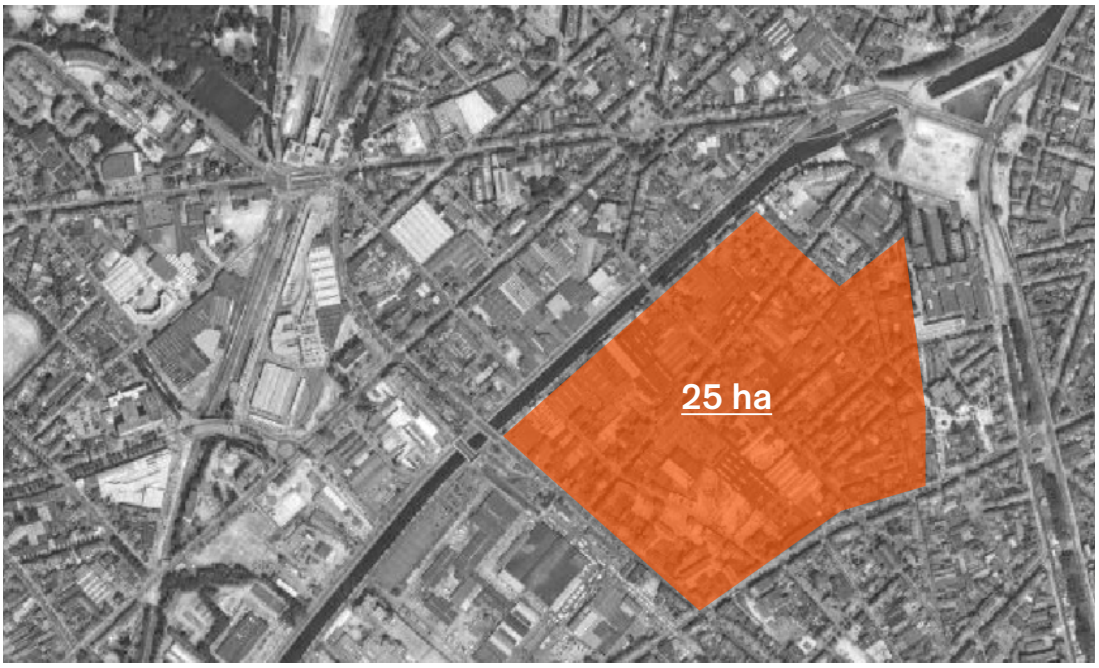
Different situations analysed

This building block can manifest into different scales: sometimes it involves an entire neighbourhood, creating synergies between the local economy, the community networks, and the port, while some others it works self-sufficiently, concentrating its activities within a single plot. In contrast to the Islands of Urbanity or the Incubator, this building block is located inside the city, or straddling the port and the city. Additionally, contrary to the Knowledge District, this building block is people-driven instead of technology-driven, aiming to train and employ as many people as possible. Some case-studies, as Westpractice within the M4H in Rotterdam, have been able to foster a high-end professional work environment while helping people coming from low socio-economic or educational backgrounds to enter the labour market.

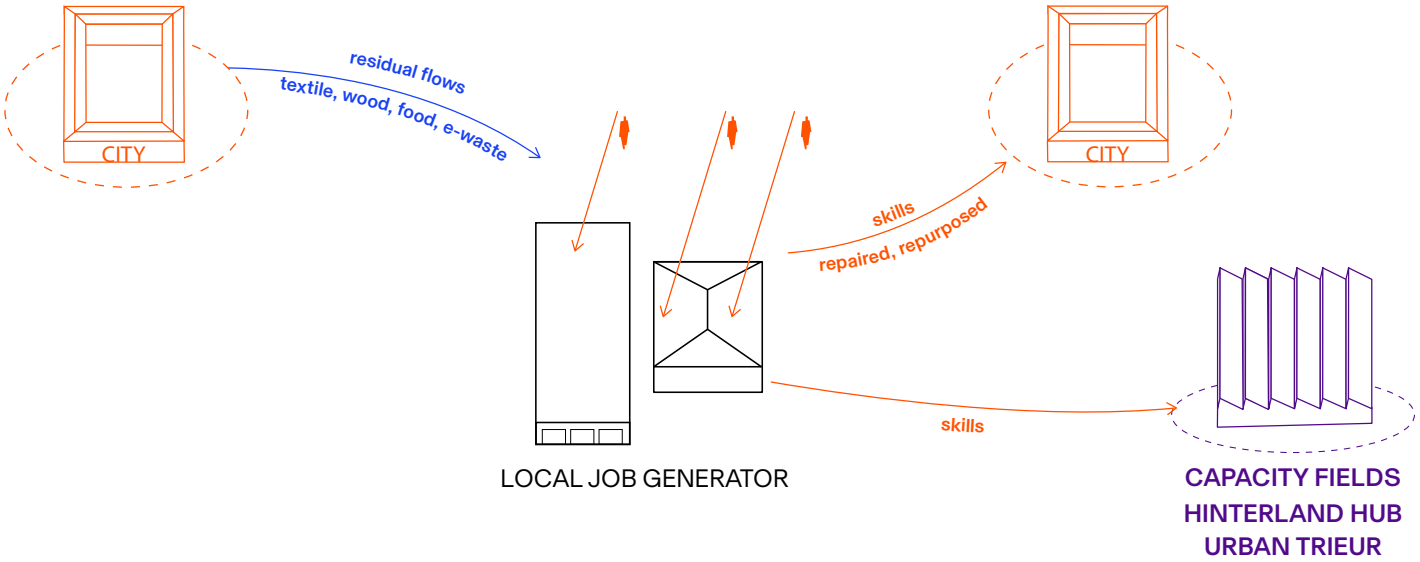


Former container area along Merksemsteenweg in Deurne, Antwerp

M4H Makers district, Rotterdam: big industries leaving the port area make room to companies like Buurman or Westpractice, straddling between the port and the residential district for training and making.



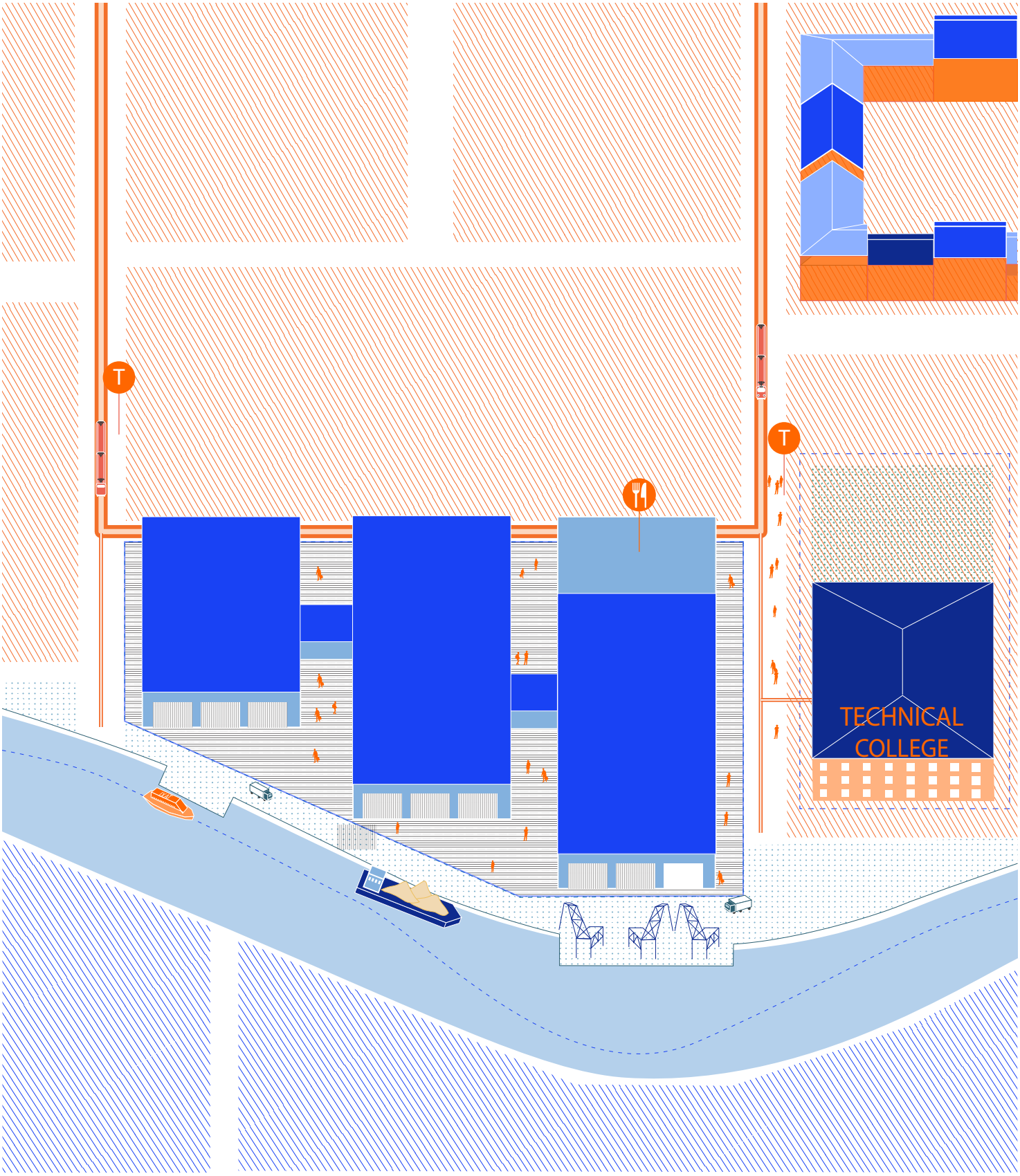
Heyvaert district, Brussels: an area undergoing transformation from old metal and (auto) mechanical workshops and warehouses to small scale experiments in circularity like Recy-K, Circularium or Fab Labs.



- **Analysis - the generic case: what activities can be found here?**

The local job generator takes different forms. It can be organized inside a parcel or be part of a wider neighbourhood. In this last case, the building block might be used as an urban regeneration tool, attracting enterprises and residents to the vacant spaces left by economic stagnation once the port left the area in search of bigger docks, deeper waters or looser environmental constraints.

Eventually, some of those activities will keep a lint to the port economy and will work as “stitches” between the port and the urban dynamics. They often include makers activities and tend to “mine” the urban zone in search of secondary materials like textile, wood, electronics or construction leftovers for either reuse or to upcycle them.


T
T
TECHNICAL
COLLEGE

- Towards more circularity: what are the ongoing initiatives?

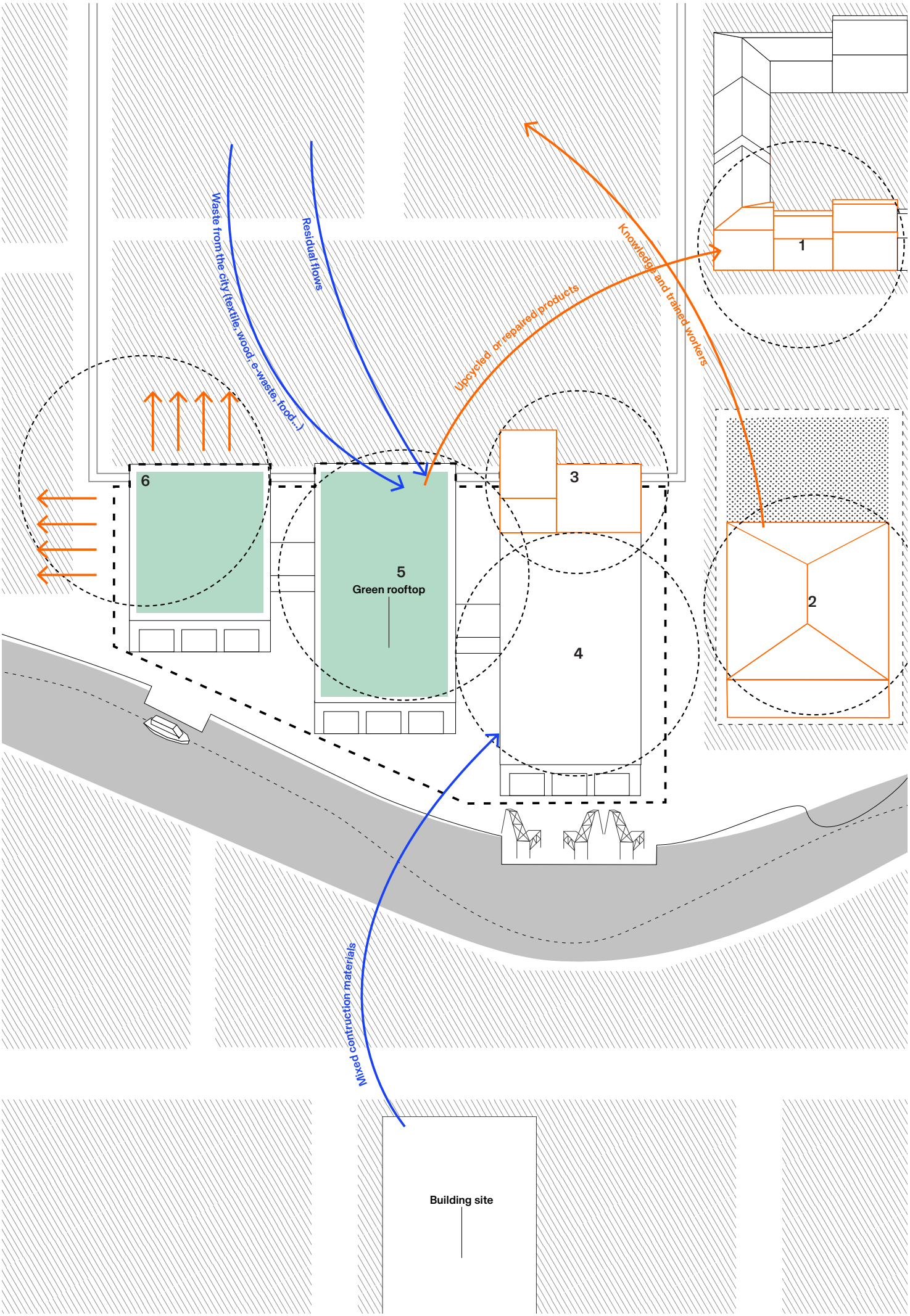
01 New retail spaces for reused products that help to increase the visibility and appealing of used items. This type of commercial offer exists for garments, books and high-end electronics (like smartphones or tablets), as well as through online platforms. Creating a physical place for display and exchange will lower the barriers that currently prevent a wider public from opting for those used or repurposed goods. A location nearby an old port area can sometimes provide bigger surfaces at affordable rents (e.g. NDSM-Werk, Amsterdam, NL).

02 The opportunities for employment that the circular economy offers depend to a large extend on the training and re-skilling of workers, to adapt to shifting markets and changing demands for knowledge and skills that range from waste management to digitalization and creative industries (e.g. CF2D, Brussels, BE).

03 A local job generator needs to integrate other facilities than the ones directly attached to job creation and performance, which range from nursery homes to restaurants to last mile logistics (cargo velo….). They help creating the right conditions and activate the area throughout the day.

04 Marketplace for salvaged materials (bank of materials), provided with local refurbishing services. Mechanical recycling of small-size components could be made onsite, but some processes releasing hazardous substances should be avoided given the proximity of residential quarters (e.g. BUURMAN, Rotterdam, NL).

05 Workshop for upcycling used consumer items (garments, furniture…) or repairing and repurposing a fraction of e-waste (domestic appliances and other discarded electronics, from computers to phones), possibly complemented with typical FabLab equipment, like a 3D-printer and other computer-controlled machinery (TechShop Leroy Merlin, Lille, FR).


Waste from the city (textile, wood, e-waste, food...)
Residual flows
Upcycled or repaired products
Knowledge and trained workers
Mixed contruction materials
1
2
3
4
5
Green rooftop
6
Building site

06 Urban trieur

06 Urban trieur

Port areas, because of their easy logistical access and the existence of ample surfaces for large volumes of products and wastes, have traditionally attracted a mix of recycling and distribution firms. The Urban Trieur hosts activities ranging from the distribution of products directed to the urban economy (from construction materials to consumer items) to the handling of wastes (collection, storage and sorting), and even their treatment on site (involving repair and recycling). These fast-growing activities claim their strategic position next to the urban markets and residual streams. Its size is modest, implying that it can only handle relatively small volume at once while relaying on other locations along the port corridor for consolidating and eventually treating them further.

- Observations - few existing cases

A quick geographical description

As its name suggests, the Urban Trieur has the particularity of being functionally linked to the urban core, while taking advantage of vast port areas and the canal as a means of transport.

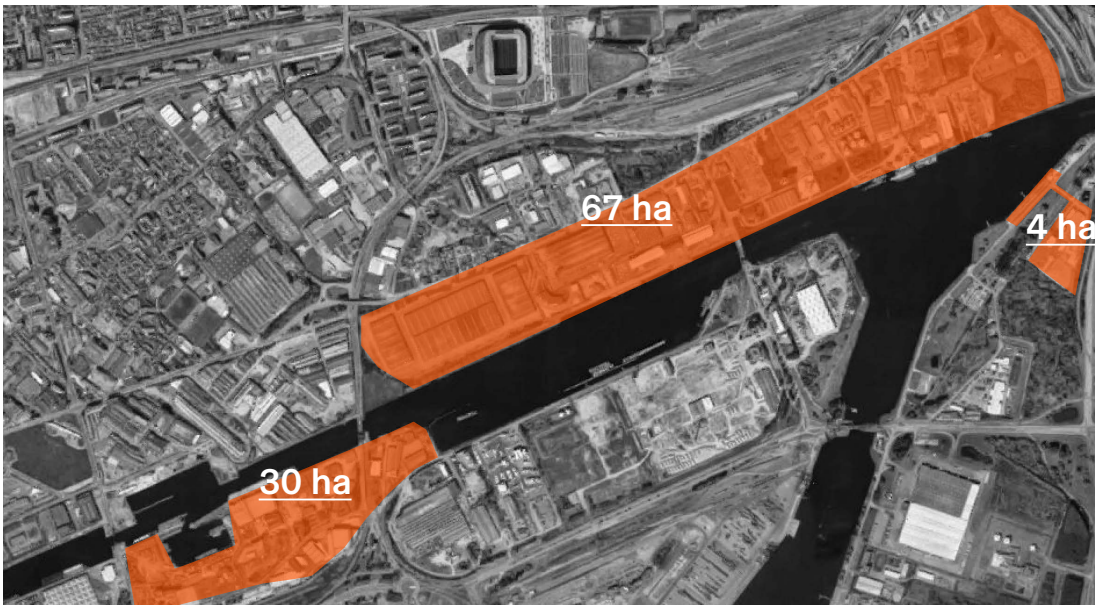
Observed advantages and disadvantages

Its strategic position makes the Urban Trieur a crucial link in the waste management chain: mining the diverse wastes originated in the city to then dispatch them for further treatment or disposal along the port corridor. It is necessary that authorities become aware of the importance of conserving such spaces in urban areas, both from a logistical point of view and from a circular one, as reusing a fragment of those wastes in new local products will depend on the continuity of their operations on the sites they occupy at present. Although the Urban Trieur relies mostly on transport by water, as a sustainable and competitive enough transport mode, many companies operating inside this building block have no choice but to still shift now and then to the road to reduce costs and pay the higher land rents to be able to stay even. In addition, restrictions on the transport of waste by water are often a barrier to the further development of this sustainable alternative.

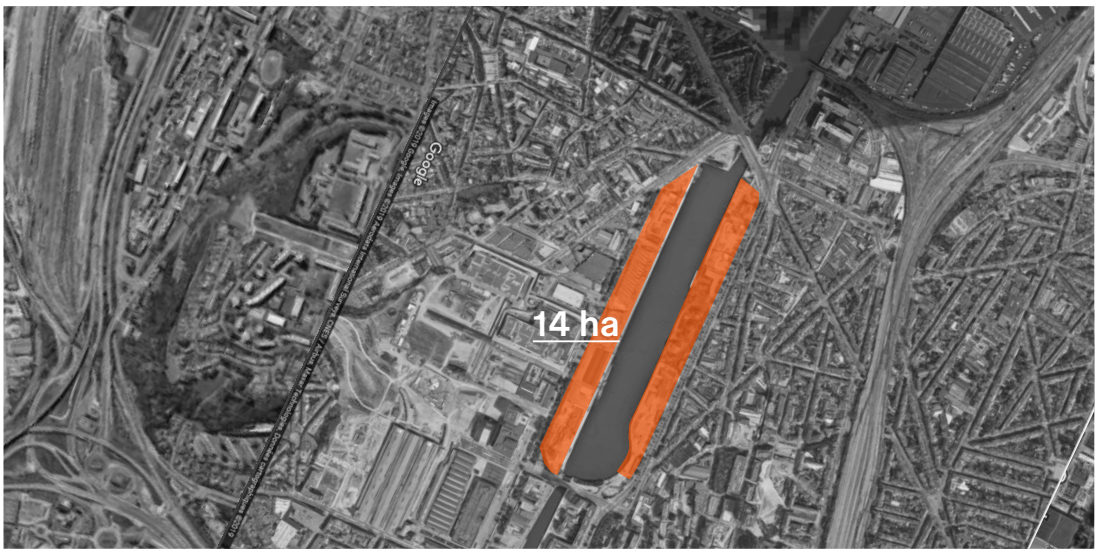
Different situations analysed

The most representative example is undeniably the case of the Vergote Basin in the port of Brussels. Positioned next to the canal and the city, this basin boasts industrial activities such as sorting, collection, and storage of used materials, but also fabrication of concrete, whose location there is justified by the imperative to be nearby construction sites. The Vergote basin constitutes a real hub for construction and demolition materials, which constitute an important flow in terms of volume and weight circulating through the Brussels port and the region.

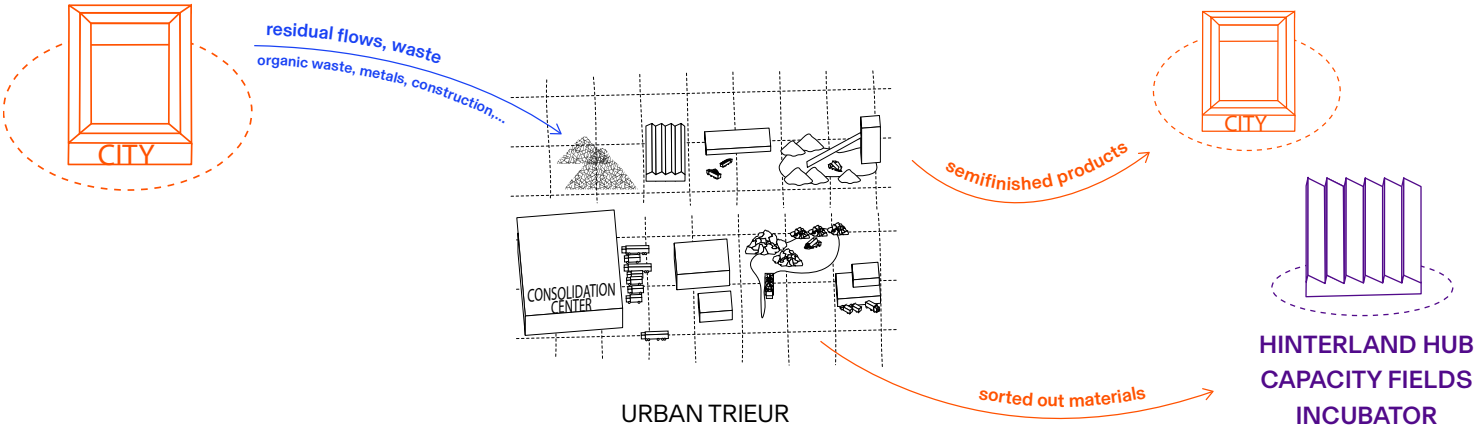
Boer groep recylcing solution (textile), D



Valle Bereult neighbourhood with SEVEDE, Veolia, Cemex, etc. in Le Havre, France



Vergote Basin with Suez environnement, Mpro, Interbeton etc. in Brussels

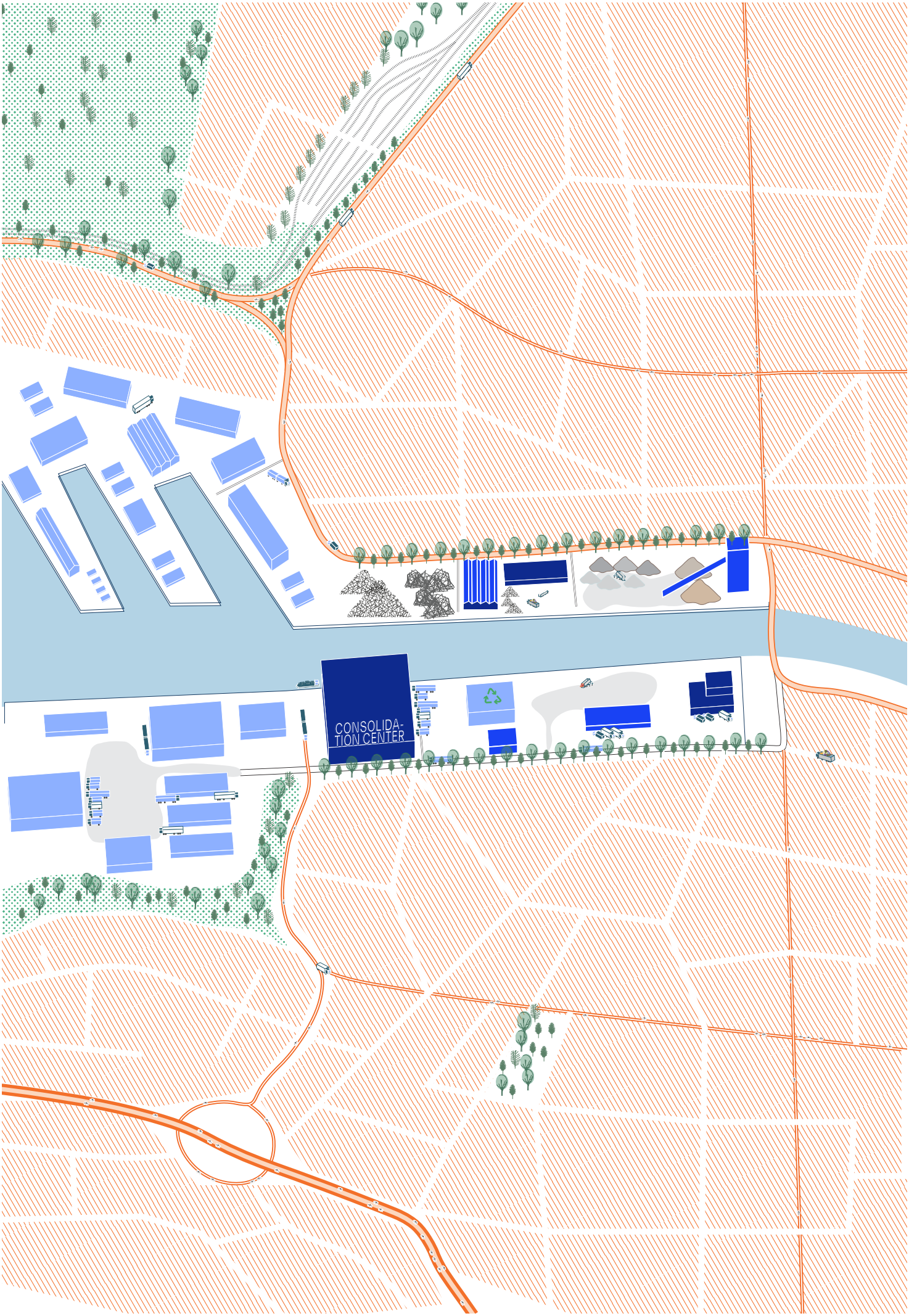


- **Analysis - the generic case: what activities can be found here?**

The main activities found here are related to industry and logistics, necessary for the treatment of urban waste and mostly linked to the supply of building materials. These activities use the waterways as much as possible to deliver the products as close as possible to their destination in the city centre. Conversely, waste from the urban centre passes through the Urban Trieur where it is sorted, stored, revalorized or compacted if necessary before sending it back to the city if recovery has been possible onsite or, failing that, to more distant treatment areas.

The proximity to the city is crucial in two ways: it allows to collect residual flows separately, thus keeping as long as possible their latent value (e.g. mixed organic waste does not enjoy the same reuse possibilities than when it is separated from early on into coffee grounds, citrus peels, other pulp-rich fruit, etc.); and the handling time is also reduced, as aspect that might be important in some flows (e.g. the fabrication of concrete, or the fermentation time of some biota). The fact that this building block might attract some activities that are labour intensive, some of them requiring specific skills that are learned while performing them (e.g. removing metallic elements from textile like zippers and buttons), implies a potential for job creation in the neighbouring districts. Often, this building block develops jointly with the Local Job Generator one: while the secondary flows might be grouped and sorted in the port itself, their manipulation might involve nearby workshops, especially for those items with a higher added value (e.g. textiles, electronics, packaging).

Conversely, activities linked to the distribution and handling of goods, whether bulk (e.g. sand, cement, fuel) or palletized (e.g. bottled good, building materials) ones, might be less labour intensive thanks to the many technological progress it has experienced lately (e.g. Internet of Things, unmanned and electricity-propelled ships, semi-automatic loading equipment) but due to its multiplication and long supply chains is equally important for the creation of jobs. In the Urban Trieur goods arrive preferably by water, are temporarily stored on the quays, and then timely distributed to the rest of the city. These services often include return or reverse logistics that allow residual goods and wastes to be collected on the way and be brought back to the quays, aiming to limit trips.


CONSOLIDA-
TION CENTER

- Towards more circularity: what are the ongoing initiatives?

01 Training centre: Training for new jobs in the recycling sector.

02 Vacant spaces: Spaces to be shared between several actors for temporary storage for example (e.g. BC architects, brick project, BE).

03 Vertical densification: New second floor to sort and salvage smaller waste, like electrical and electronic waste. These activities are labour intensive and are normally endowed with higher added value (e.g. Stevens and co, Brussels, BE).

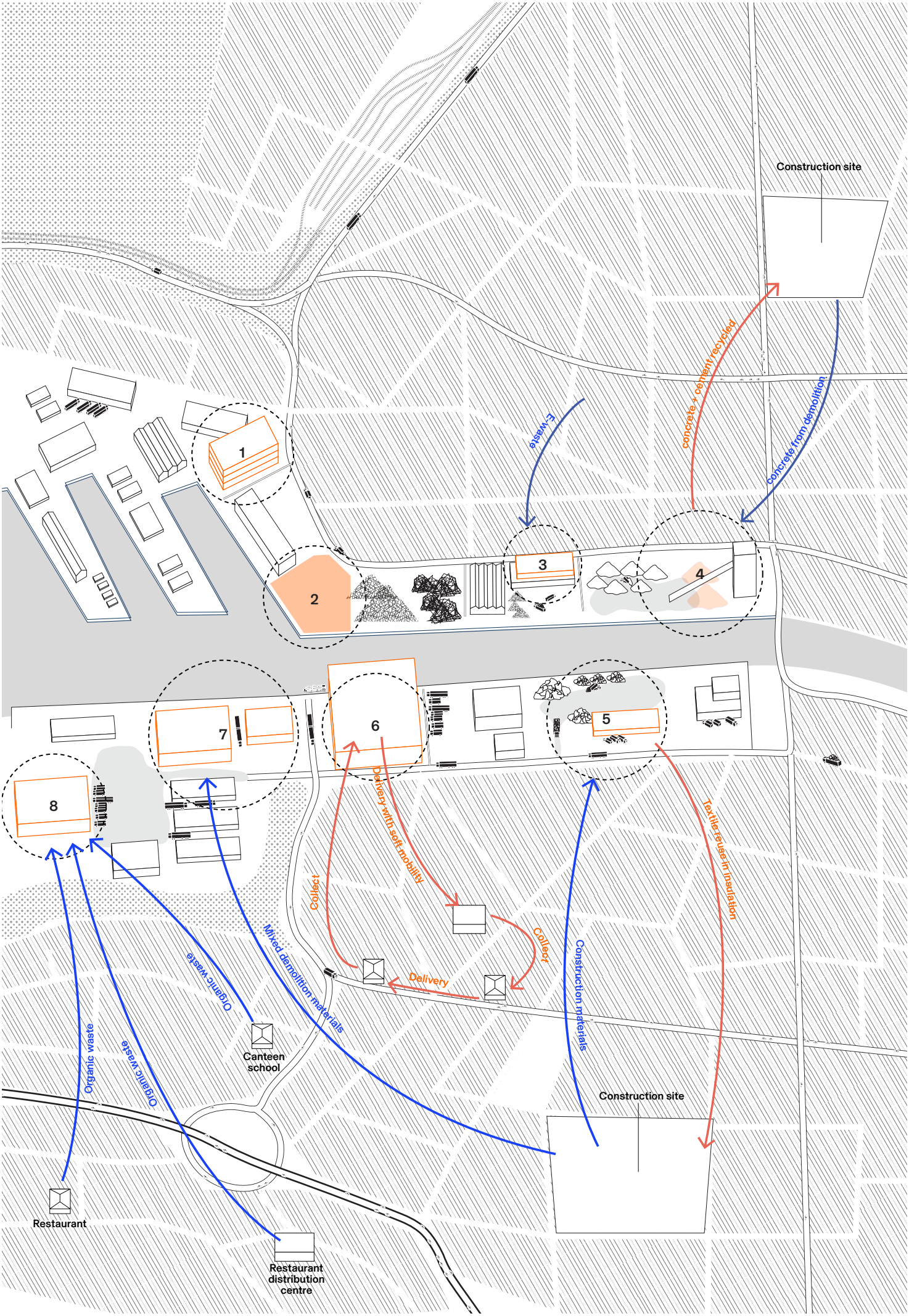
04 Concrete plant: Storage of concrete from the construction and demolition sites and reintroduction of it into the manufacturing process of new concrete.

05 Textile sorting: Research unit in collaboration with the training centre to find new ways to recycle combined textiles (e.g. Boer group, Dordrecht, NL).

06 Consolidation centre: This type of platforms helps to group all (reverse) logistics of the construction sector in a couple of places strategically located in the region and along the waterways. From there on, materials are being distributed to the individual sites, and waste collected and brought back to the CCC. It helps to reduce logistics-related road transport (by clustering deliveries), and to optimize the normally limited space available for construction sites in dense urban areas (e.g. Royal Dock, Stockholm, SW). The consolidation centre can also be used as a platform for retrieving flow data passing through it (e.g. CMDU, Lille, FR).

07 Building materials bank: Provide a space where it is possible to store, sort, and resell building materials to individuals or companies and consider a lab for the recovery of second-hand materials (e.g. Mpro, Brussels, BE).

08 Biomaterials lab: Recovery of organic waste to make new products and process biomass-derived intermediaries (e.g. Groencollect, Rotterdam, NL).


Construction site
1
2
3
4
E-waste
concrete + cement recycled
concrete from demolition
5
6
7
8
Delivery with soft mobility
Collect
Collect
Delivery
Textile reuse in insulation
Construction materials
Mixed demolition materials
Organic waste
Organic waste
Organic waste
Canteen
school
Restaurant
Restaurant
distribution
centre
Construction site

07 Hinterland Hub

07 Hinterland Hub

The Hinterland Hub exemplifies best the numerous possibilities that the redesign of global value chains holds for ports, by combining traditional maritime activities like the handling of commodities with activities in other economic sectors, e.g. in energy or agriculture. On one hand, this Hub can operate as a transhipment point for goods and raw materials coming from the port and being further distributed across its hinterland, and perhaps further processed or customized in order to capture some of their added value. On the other, it can operate as a specialized location in the agri-food sector, capable of revaluing organic waste flows and feedstock coming from the nearby agricultural areas for the generation of energy (e.g. green biorefinery) and the production of new biobased materials (e.g. bioplastic from cellulose, bio-construction materials, etc.).

● Observations - few existing cases

A quick geographical description

In the hinterland of many ports, industrial activities are located along waterways that use transhipment docks, of private or collective use. Not far from agricultural areas and sometimes partially urbanized areas, these activities, which are clearly related to water, benefit from trade flows between seaports and inland ports.

Observed advantages and disadvantages

These hubs benefit from the internal market, thanks to their connection to canals as well as major road infrastructures. Their rural isolation allows them to carry out activities that generate noise or odours, while staying close to biological feedstocks.

Different situations analysed

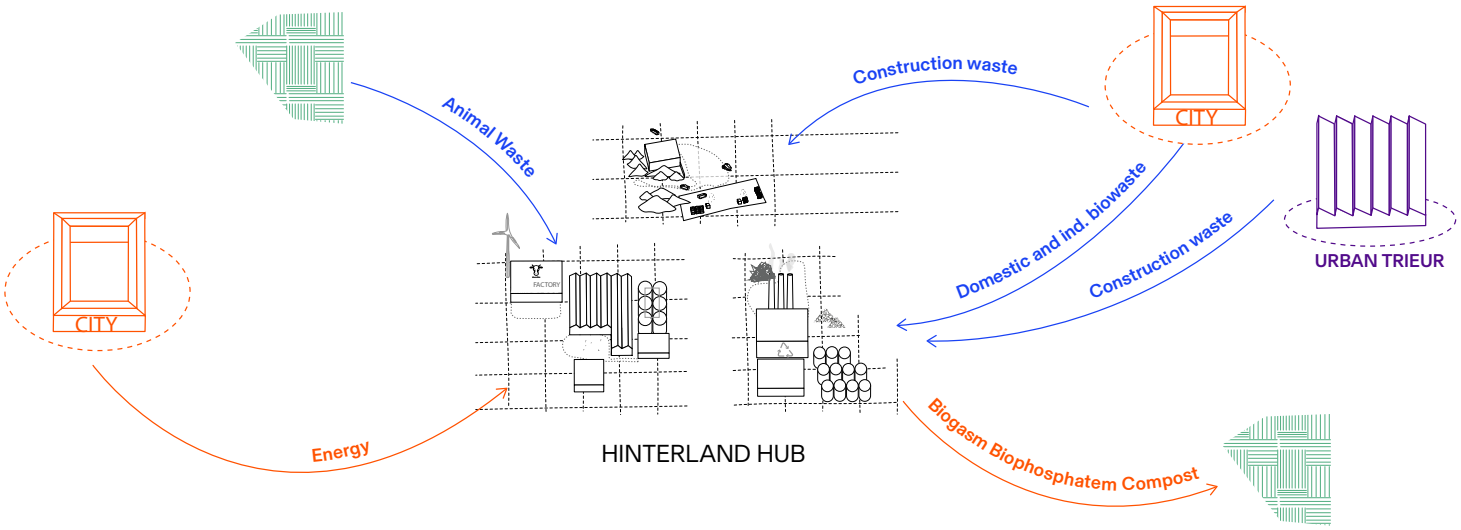
These Hinterland Hubs have been strongly influenced by the original landscape characteristics. For example, the presence of large flat areas in the armpit of some meanders has been a key factor for the establishment of large industrial units, such as refineries or automobile manufacturing units. In the case of the Le Havre-Paris axis, the proximity of the port and of the Seine has been decisive for the oil industry, supplying crude oil by sea, hydrocarbons by river, and using the water of the Seine in the cooling part of some of those industrial processes.

On the negative side, hazardous discharges originated mainly in the (petro)chemical industries, paper mills and treatment plants, end up eventually in the Seine. Or the will to control and assure navigation leads to abusive dredging and a sophisticated hydraulic system of locks and pumps that continuously threaten the regenerative capacity of the Seine valley.

Brick factory and resale in the hinterland of the North Sea Port, along the Escaut

Farming industry, construction materials... in the hinterland of Antwerpen Port, along Albert Canal

Aggregates quarry of Cemex company and its transhipment platform implanted along the Seine, between Le Havre and Rouen

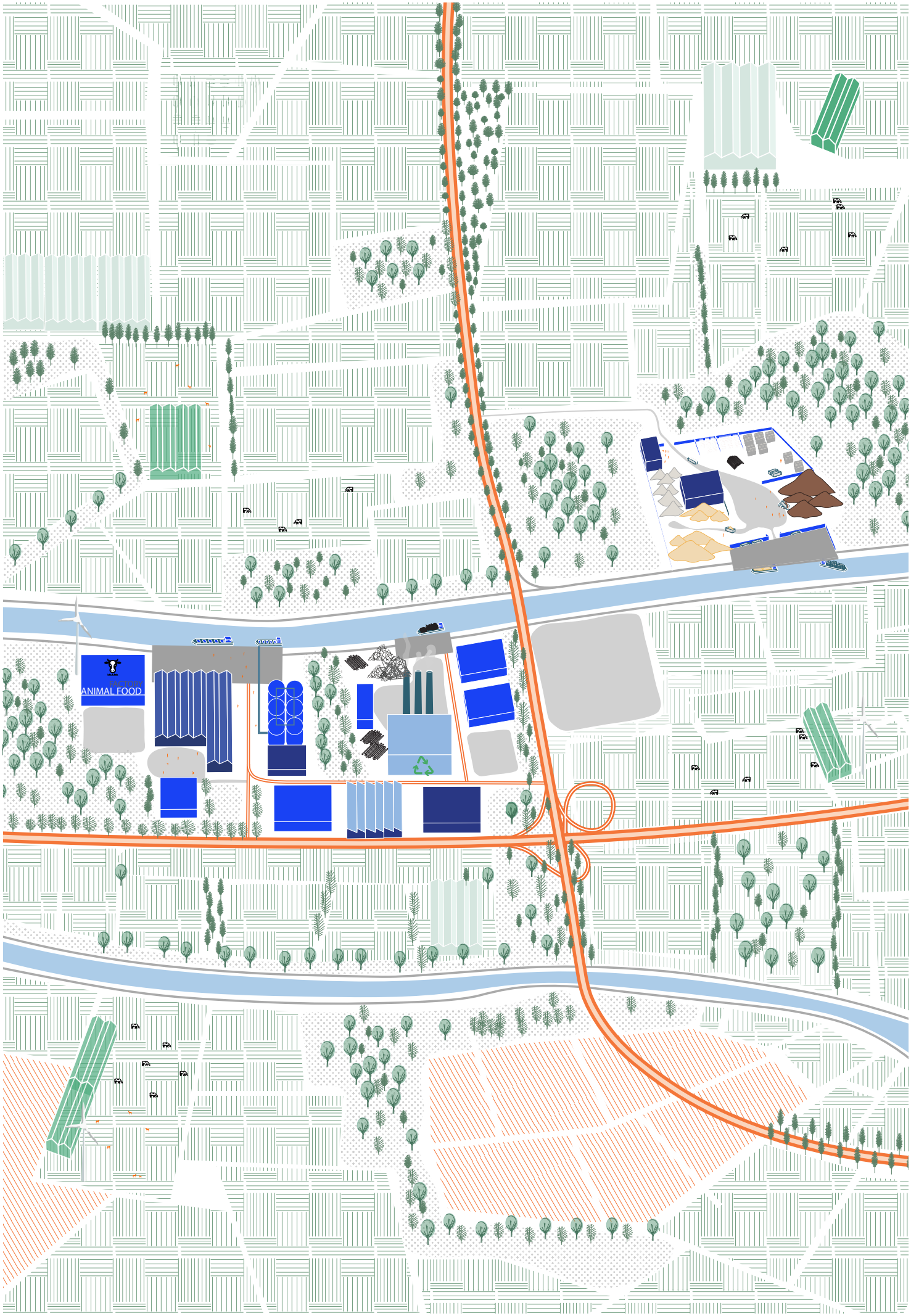


- **Analysis - the generic case: what activities can be found here?**

The flows collected in the Hinterland Hub come from upstream or downstream ports, feeding onto the industrial installations and distribution facilities that are located along the waterway.

We might find companies specialized in stripping containers and customizing the intermediate products therein transported (e.g. Nike Logistics Campus), recycling plants collecting wastes from nearby cities, construction companies, chemical industries (for the fabrication of pesticides and fertilizers) and feed for livestock or food processing ones.

Many of those industries still rely on feedstock supplied locally though: from inert materials like sand to biomass, or even (renewable) energy. This diversity reveals to which extent this building block constitutes an important link in the supply chain, connecting distinct flows and know-how, but also the missing synergies that could be still unleashed in them, beneficial to the regional economy as a whole.


ANIMAL FOOD

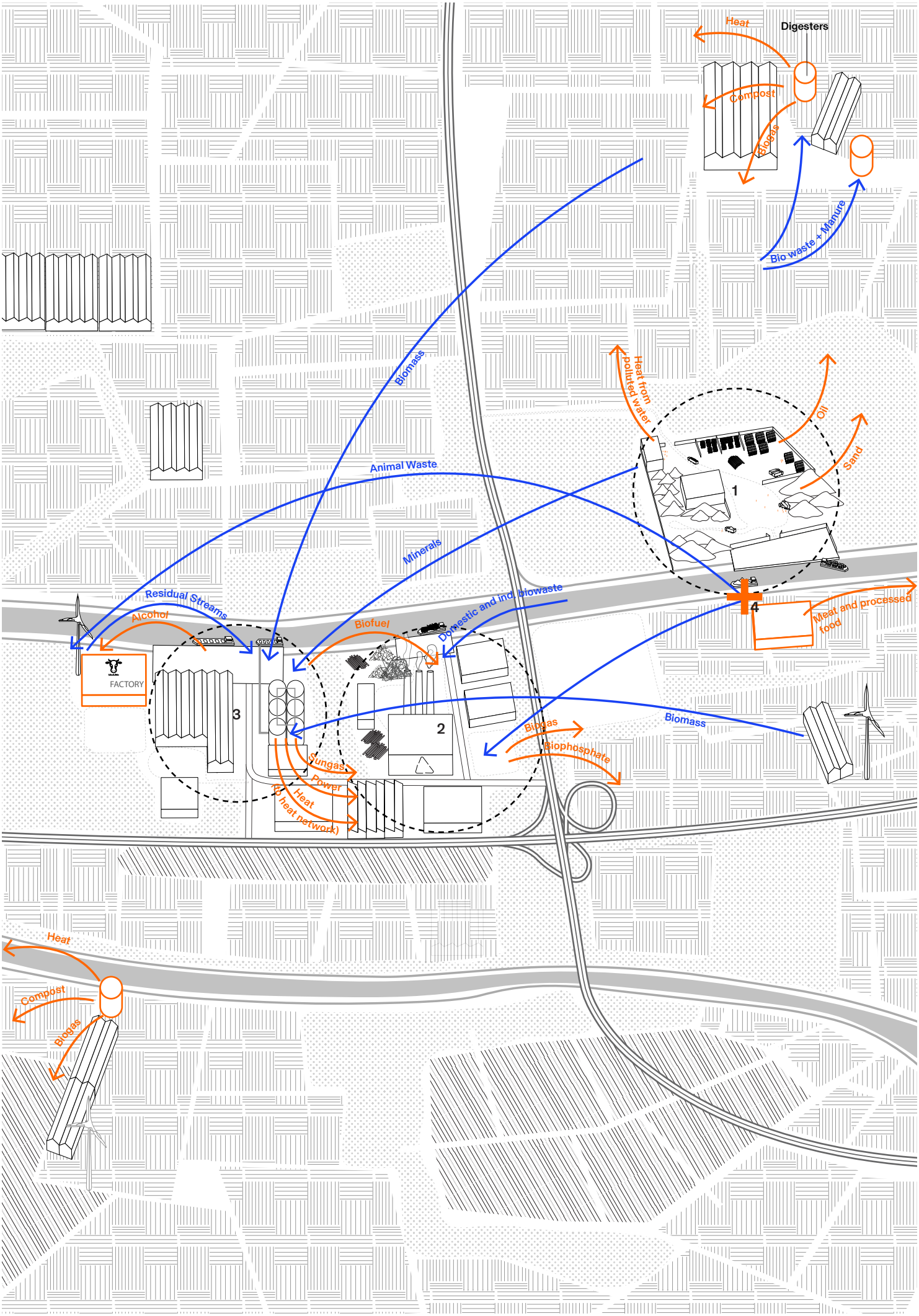
- Towards more circularity: what are the ongoing initiatives?

01 Sludge, sediment, and bilge water treatment plant: The plant would offer a diverse range of biological treatments adapted to the water and solid residues types. Biological treatment produces essentially no waste oil, can degrade organic pollutants to low concentrations, and operating costs are relatively low —which is compensated by the increased spatial demands and sophisticated skills it requires (e.g. SUEZ).

02 Incinerator and cogeneration plant from biogas: The biogas cogeneration plant allows the simultaneous production of renewable electricity (CHP or cogeneration) and heat (hot water or steam). It could benefit from its integration into the regional agricultural structure, helping to mutualise infrastructures and generating local added value (e.g. Agrogas & Wärme GmbH & Co KG, Malstedt, DE).

03 Biorefinery of imported biomass: Organic and food waste is collected from slaughterhouses, foodservice companies, supermarkets, etc. and processed into gas or fuel, next to a digestate than can be used as biofuel. Moreover, some of the residual materials generated in the process can be exploited as fertilizers for agriculture (e.g. Vion Ecoson BV, Son, NL).

04 Transhipment platform: Such facilities are fundamental in order to diversify the type of activities ports perform, reaching out to other economic sectors like energy or agriculture. Moreover, the existence of these platforms could stimulate the modal shift in the distribution of agricultural produce and processed food towards the city. On the opposite direction, reverse logistics could handle organic waste originated in the city back to the biorefinery or the cogeneration plant.


Digesters
Heat
Compost
Biogas
Bio waste + Manure
Biomass
Heat from Polluted water
Oil
Sand
Animal Waste
Minerals
1
4
Meat and processed food
Residual Streams
Alcohol
Biofuel
Domestic and ind. biowaste
FACTORY
3
2
Biogas
Biophosphate
Biomass
Syngas
Power
Heat
(to heat network)
Heat
Compost
Biogas

08 Knowledge District

08 Knowledge District

Regional economic benefits could be stimulated by innovation and high-value-added activities. The Knowledge Districts are the breeding ground for start-ups busy with breakthroughs in fields such as the life-cycle environmental impact (also of vessels), autonomous shipping, Internet of Things, biochemicals and energy diversification (incl. in transport). They are characterized by the involvement of University research institutes and typically support new ventures originated within them. They depend on funds that are necessary for linking public and private stakeholders in a cooperative network integrating cross-sector activities, as well as to support local applied tests and pilot projects.

● Observations - few existing cases

A quick geographical description

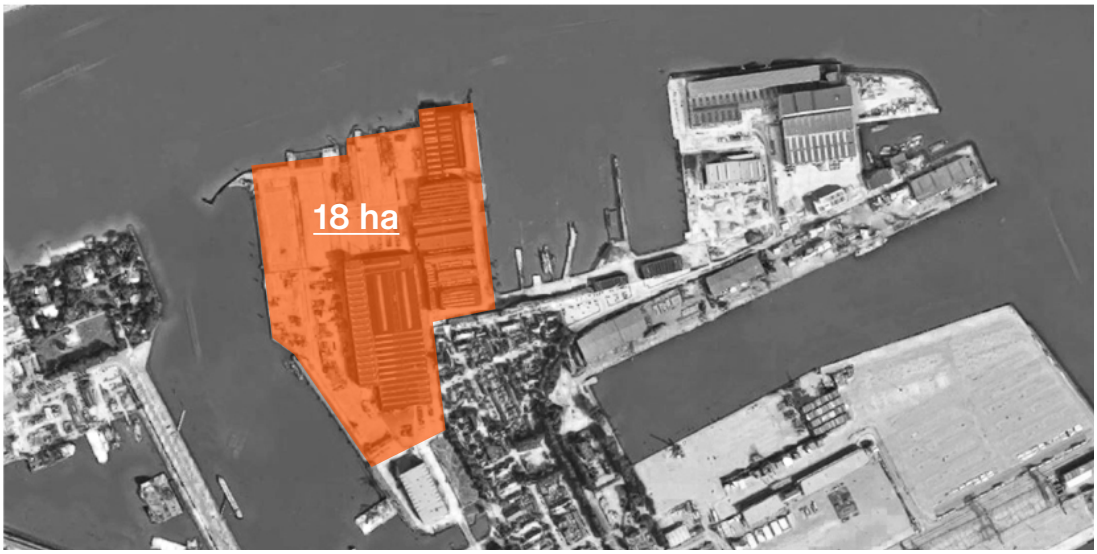
The Knowledge District is in a well-connected area of the city port, closer by the city than the Island of Urbanity or the Incubator building blocks. Such a typology represents a shift compared to the isolated and self-sufficient research centres that used to dominate in the past. Nowadays, this building block is more and more functionally mixed, accessible (thanks to recent micromobility solutions), and generously planted.

Observed advantages and disadvantages

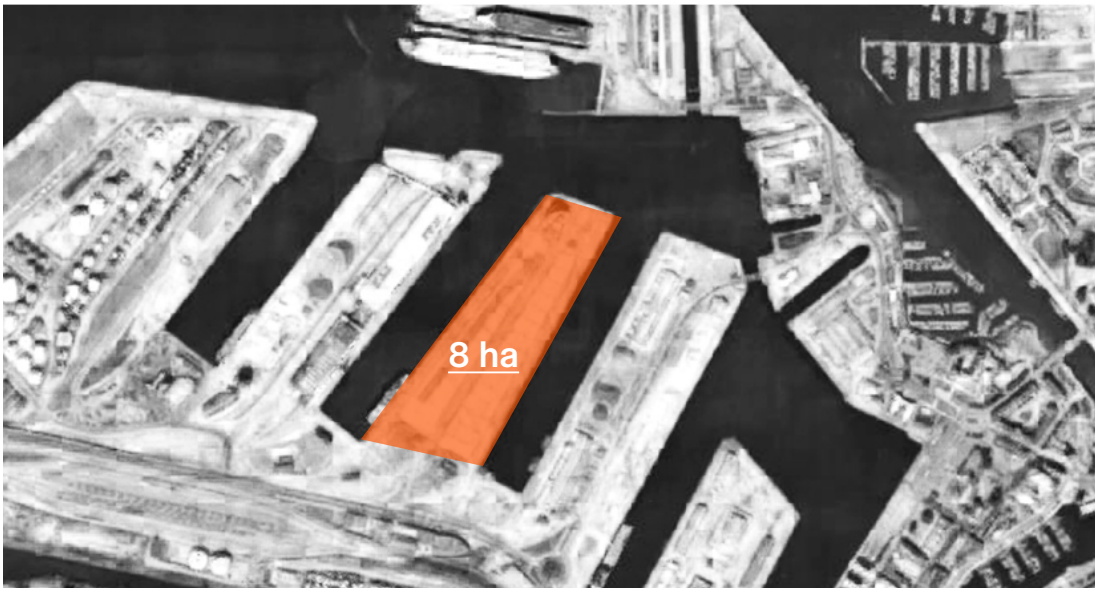
In a few cases, the Knowledge District has been used as a regeneration tool by some port authorities. The advantages to locate it in the port area derive from the existence of vacant spaces (often with low market value) and the window of opportunity that is created by occupying them to train a new workforce and test new technologies. Also, its proximity to the water allows it to invest in waterborne transport.

Different situations analysed

The comparative analysis shows a diverse number of Knowledge Districts. The diversity of scales at which it can be realized is probably the most striking feature. Also, it is possible to observe its spatial relation with the other enterprises located in the area: sometimes the knowledge district is placed at the centre of the industrial ecosystem, some others it is further away and surrounded by green fields.

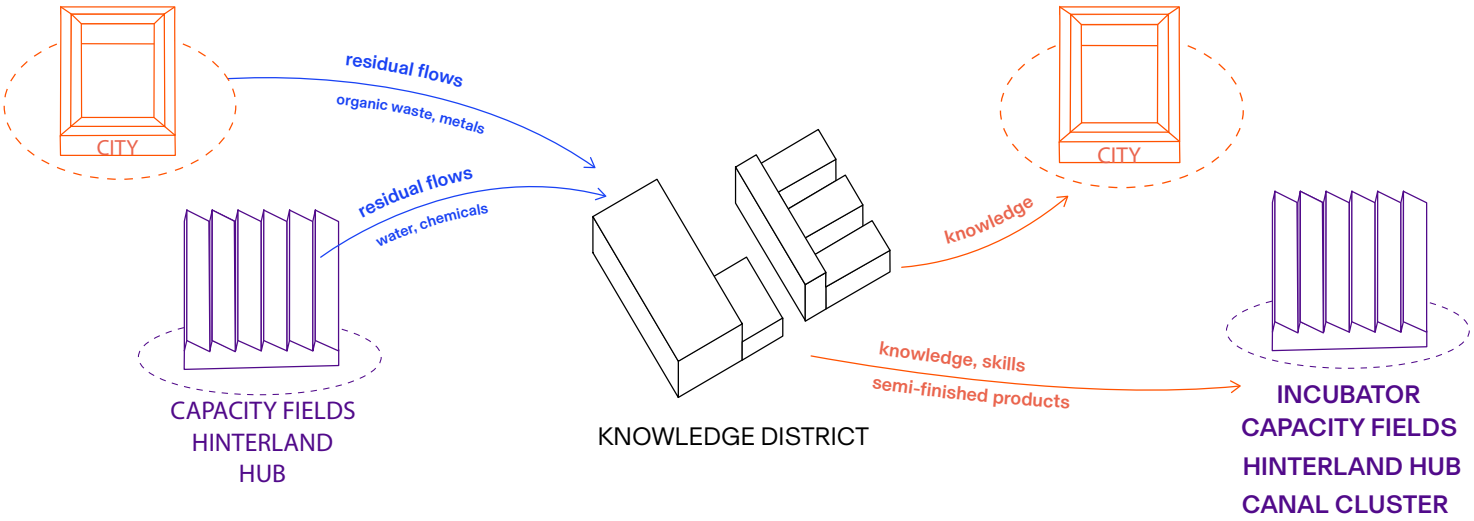


RDM Campus, Rotterdam, The Netherlands



Euraénergie is a project site bringing together university campuses, laboratories, companies and specialists from the energy sector, Port of Dunkirk, France

Duurzaamheidsfabriekm, Dordrecht

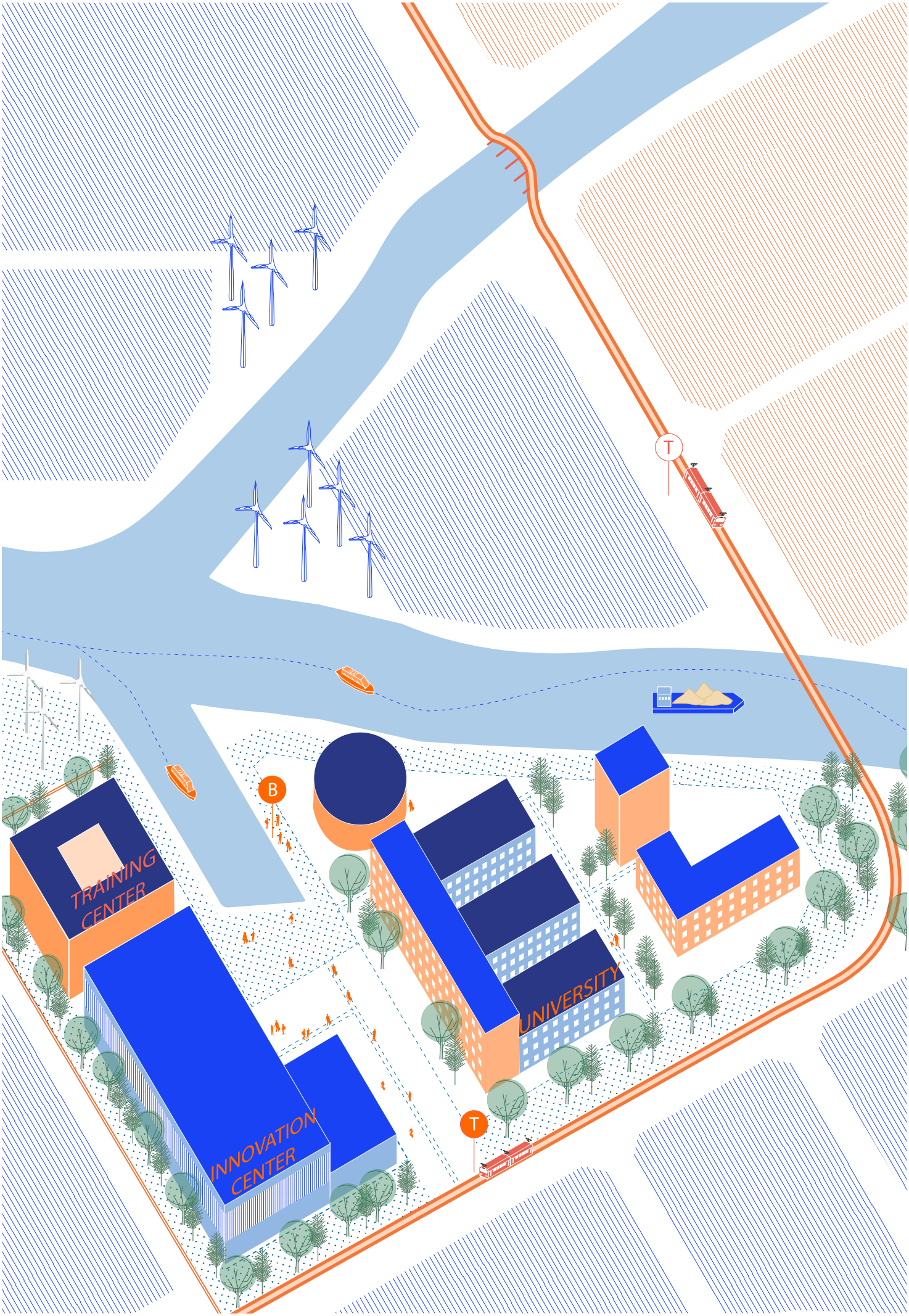


- **Analysis - the generic case: what activities can be found here?**

Knowledge Districts are places where innovative companies work in collaboration with institutions, such as universities or research centres. They normally grow in areas left behind by the continuous upscaling of the port, yet close to the city centre, creating opportunities for an innovative maritime ecosystem. Indeed, since traditional port companies move farther away from the city and closer to the new terminals, new port-related activities find their way to the city-port and develop here their perfect habitat.

The proximity of the city centre is key for the existence of educational institutes and financial services, helping smaller industries with fully equipped spaces, services, and infrastructures. Additionally, the enterprises have access to a pool of students who can acquire new skills on parallel to their standard education.

The companies attached to a Knowledge District work normally inside the same (sub)sector (e.g. the blue economy) or can be even recruited to join forces inside a specific research line (e.g. the impact of digitalization and robotics on port economies). It is assumed that the mix of activities and enterprises will accelerate innovation and support cross-pollination between the business community, students, and researchers.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TRAINING CENTER
UNIVERSITY
INNOVATION CENTER
T

- Towards more circularity: what are the ongoing initiatives?

01 Business incubator: Dedicated to companies and start-ups innovating in the maritime and blue growth sector and supported by university instances (e.g. Greenbridge Science Park, Ostend, BE).

02 Docking station: Electrical vehicles (cars, bikes, scooters) can be charged onsite and their batteries used as temporary storage for electricity generated by PV panels and the wind turbines.

03 Maritime School: Offering continuous education and postgraduate programmes in Autonomous Maritime Systems and Life Cycle Assesment (e.g. ENSM Le Havre, FR).

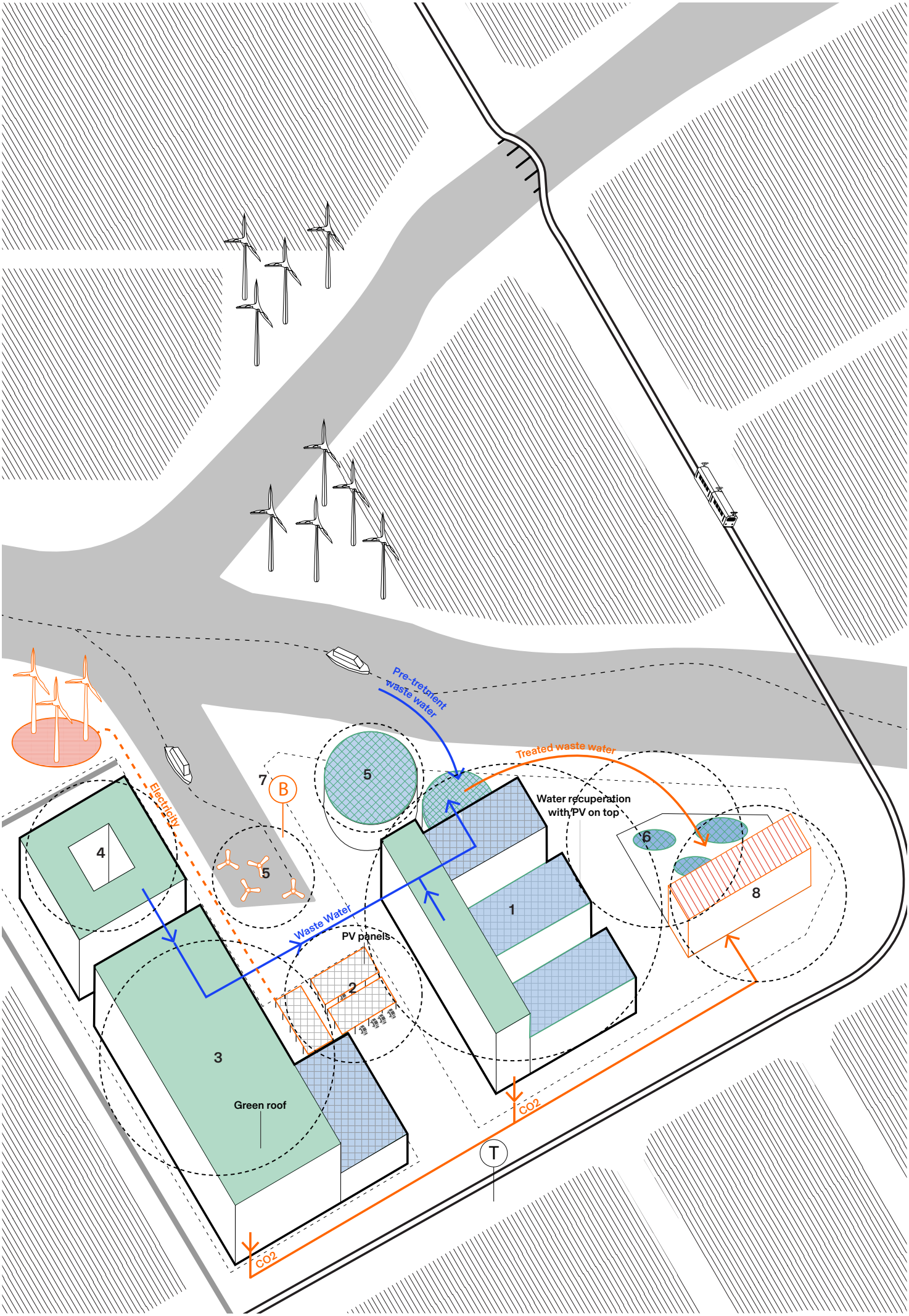
04 Technical education: Technical knowledge is key for the constitution of testbeds for innovation, and in this case, it could provide specialized training in Circular Economy and Energy Transition (e.g. CNFPT - INSET Dunkirk, FR).

05 Onsite energy tests: The water movements inside the dock and the wave tank next to it are used to try out prototypes to exploit tidal and wave energy (e.g. Hydrex, Antwerp, BE).

06 Outdoor and indoor Aquaculture Facility: Crustaceans like shrimps, molluscs and fish species are grown locally as food and as feedstock for small-scale tests of new bioproducts like coatings (e.g. RODAX IMPEX SRL, Bucarest, RO).

07 Water taxi: The Knowledge District is reachable by water from the nearby locations (e.g. RDM Watertaxi, Rotterdam, NL).

08 Vertical aquaponics greenhouse: Locally generated waste water is treated onsite and residual nutrients and CO2 coming from the buildings are used in a vertical aquaponics system that allows to feed the onsite canteen and test out new plant-fish combinations (e.g. BioMakery, Koningshoeven, NL).


Pre-treatment waste water
Treated waste water
Water recuperation with PV on top
Electricity
Waste Water
PV panels
Green roof
CO2
CO2
1
2
3
4
5
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B
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In the present context of highly globalized global value chains governing growth and development, the design and establishment of ecosystems reaching beyond conventional geographic borders (from the single company to the port) seems key in order to create and capture value. The building blocks contained here constitute a first attempt to identify which elements could integrate the complex and continuously adapting assemblages that port areas will need to become in order to stay the economic engines they are today. This first speculation takes the form of a corridor along which a series of differentiated milieus cohabit and establish synergies in order to work as a whole. Such synergies can involve:

. sharing infrastructure and other facilities

. developing technological innovations that can optimize the circulation and use of resources

. valuing specific streams and sub products

. diversifying the energy mix in favour of renewables and low-carbon conversion technologies for electricity, heating, and cooling

. combining traditional port activities like the handling of commodities with activities in other economic sectors, e.g. in energy or agriculture

The final question is whether cities and ports have the capabilities to foster the creation of such supply chain ecosystems (overlapping concepts as port clusters or hinterland chains), which geographically are much more widely dispersed and functionally more complex.

On the other hand, neither port nor city authorities can afford to operate as stand-alone entities and should rather be open to new models of governance and cooperation that offer opportunities for ecosystems creation both inside and outside port-related localized clusters. Such ecosystems work as increasing returns accelerator for every company located therein, and as extension for the entire urban region (whose population and economic size are the major reason for sustaining such a corridor). Most importantly, such assemblages seem more resilient when facing global volatility, and that is all the more true since the reshoring and reindustrialization policy that the EU has pushed for the last decade, starts to grow roots, and will possibly contribute to stabilize intra-corridor industrial and logistical relationships.

Outside those ecosystems, the upheaval of our modern industrial system that circularity announces will not be realized. Or will only happen in spread out niches and places, without attaining the redesign of the entire system. Ports are important switches in the globalized value chain, and often they host the installations of a (petro)chemical industry whose significance is increasingly contested. Sticking to every port alone, despite their diversity, will not bring us far. It is their physical interconnection what constitutes a real opportunity for the creation of functional synergies and industrial symbiosis. A post-oil society needs to rely on the whole assemblage and go beyond end-of-pipe solutions. This is perhaps the most important lesson we learned so far: a strategy to further circularity in city-ports needs to proceed from the port-corridor on.

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