UMONS Université de Mons

UCCRN edu | Urban Climate Change Research Network for Higher Education
Climate-Resilient Design, Planning and Governance of Cities

Faculty of Architecture and Urban Planning

Charleroi 7th Urban Design Climate Workshop | 27th October – 1st November 2024

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Table of participants

AFFILIATION	STUDENTS AND STAFF
UNIVERSITÉ GUSTAVE EIFFEL	Eva Lorentz, Abdelmalek MOSTEFAI, Corentin Renaud, Hilina Nebeyu Mulugeta, Arthur Bourgeois, Auguste Gbea, Ouldji Mohamed-amine, Coulibaly Bissi, Audrey Zeitoun, Valentine Pennec, Gédéon Magbonde, Aminata SARR, Hugo Mendes, Milila Mechedal, Khedidja Chetioui, Bouvry Sophie, Hadj Mohand, Mohamed Kchaou, Bruno Barocca, Margot Pellegrino, Angela Ruggiero
SORBONNE UNIVERSITE	Mariam Guerouani, Elouan Dubourg, Makowski Eli, Clémentine Sitoleux, Fayolle Océane, Macha le Pas, Anouchka Martin, Chantal Pacteau
AALBORG UNIVERSITET	Pauline Nun
UNIVERSITY COLLEGE DUBLIN	Lida Mercado Martín, Marley Kirkham, Gerald Mills
UNIVERSITAT INTERNACIONAL DE CATALUNYA	Georgina Treviño, Daniel Brito, Nor Jihane Touati, Christian Ninotta, Azadeh Shojaei, Adam Norrbom, Leke Frank Aderinola, Raquel Guidolin de Paula, Maria Isabel Galarza Leiva
UNIVERSITE DE MONS	Rebecca Guglielmino, Gabriele Sapienza, Mohammed Qasem, Chadi Mahfoud, Vincent Becue, Fabrice Sobszak, Noemie Lago, Sesil Koutra
UNIVERSITÀ DI PISA	Nicola Petrucco, Anna Maria
STICHTING IHE DELFT INSTITUTE FOR WATER EDUCATION	Deborah Dotta Correa
UNIVERSITÀ DI NAPOLI	Sara Tedesco, Mattia Leone

SOME WORDS ABOUT URBAN CLIMATE CHANGE RESILIENCE NETWORK

UCCRN_edu is an Erasmus+ cooperation partnership launched by world-leading Higher Education Institutions (HEIs) including members of the Urban Climate Change Research Network (UCCRN), consisting of an international consortium for the development of multidisciplinary knowledge-based actions on climate adaptation and mitigation from different perspectives (e.g. urban, societal, environmental, etc.).

The project aims to overcome existing gaps in education on climate-resilient urban planning and design strategies by establishing new synergies and collaboration with the leading research and teaching institutions and local actors, but also European and international educational networks with relevant precedent experiences on climate change strategies and tools to streamline the different actions in collaboration with local governments and communities.

During these years, the partnership developed educational and research alliances for training of future generations and fostering the knowledge transfer to hybrid and multidisciplinary new professionals of climate research, design, and policymaking. Crossing disciplines and diverse backgrounds and skills, the participants have integrated holistic visions and tools to identify different territorial problems related to the climate change challenges in multiple sectors and be part of integrated solutions and strategies promoted by the UCCRN_edu community in the fields of climate-resilient urban design, planning, governance, and adaptation.

Project Roadmap

- Integration of resilient strategies in the short and long term. Proposals for supporting planning and design solutions for mitigation and adaptation to reduce GHG emissions, increase flexibility, and reduce territorial vulnerabilities considering the local contexts, opportunities, limitations, and constraints that result in the greatest benefits and minimization of possible negative effects on site.
- Coordination of climate change adaptation strategies within the integration of related activities into different strategies and policies through multiscale approaches and assessment methods.
- Governance and knowledge networks through capacity-building and participation in city networks for climate action supporting planning horizons and implementation-related mechanisms.

The aforementioned dimensions have been developed via Urban Design Climate Workshops (UDCW) linking the different dimensions explored within practical activities in different European cities and particular concepts (e.g. zero-carbon, public spaces, zero-energy, etc.).

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1 INTRODUCTION

Figure 1: Multiple climate change impacts in cities ©https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts, Accessed: 02/12/2024

Climate change impacts are being felt across the globe (IPCC, 2022) affecting the built and the non-built environment in many different ways, including rising temperatures, sea level rise, droughts, flooding and more causing severe damage to its ecosystems and infrastructure. The effects have far-reaching implications including economic losses, displacement leading to climate refugees, being projected to worsen, and posing existential threats to species and humanity. As climate impacts intensify, illustrate the impacts in vulnerable territories.

The impacts of these rapid changes are already impacting and will continue to do so for the foreseeable future. Extreme weather events (storms, heatwaves, flooding, etc.) accounted for more than 80,000 human fatalities across Europe over the past 40 years, of which more than 80% were due to the heatwaves (European Environment Agency, 2024).

Additional growing risks include water scarcity and reductions in water quality, storms, wildfires, soil artificialization, biodiversity loss, and intensive pollution, which asks for local adaptation to increase the overall resilience of the urban ecosystems considering the inequalities both in the way that different population groups are affected by climate change and also in how they may benefit from any adaptation actions taken. Adaptation is required across all sectors and at all governance levels, with upscaling of local action urgently needed (European Environment Agency, 2023) to bring the gaps for incremental and anticipatory actions to meet the scales of climate change and other challenges (e.g. rapid and massive urbanization) including performance-based and resilient projects with coordinated and common actions at local and global levels on responding to international commitments or immediate crises (United Nations Environment Programme, 2024).

At an international scale, commitments towards climate urgency have been developed to jointly take actions against the combat of the climate challenges, such as the so-called Paris Agreement; under which Parties committed to hold the increase in the global average temperature to well below 2°C above preindustrial levels (United Nations Climate Change, 2015). At EU levels, and in line with this pathway, climate neutrality has been the cornerstone of the European Commission's Green Deal (European Parliament, 2019). In December 2020, the European Council aligned

the EU's 2030 climate objectives with the 2050 strategies by increasing the net reduction of GHG emissions by 55% by 2030 (compared to 1990) (European Environment Agency, 2022).

The fight against climate change will require deep changes in the Belgian energy system. It must therefore also be perceived as an opportunity for Belgium to reduce its energy dependency and increase the safety of its supplies. Belgium currently imports almost all its primary energy sources (oil, gas, coal, and uranium) and this puts the Belgian economy at the mercy of fluctuations in world raw material (Van Ypersele & Marbaix, 2004).

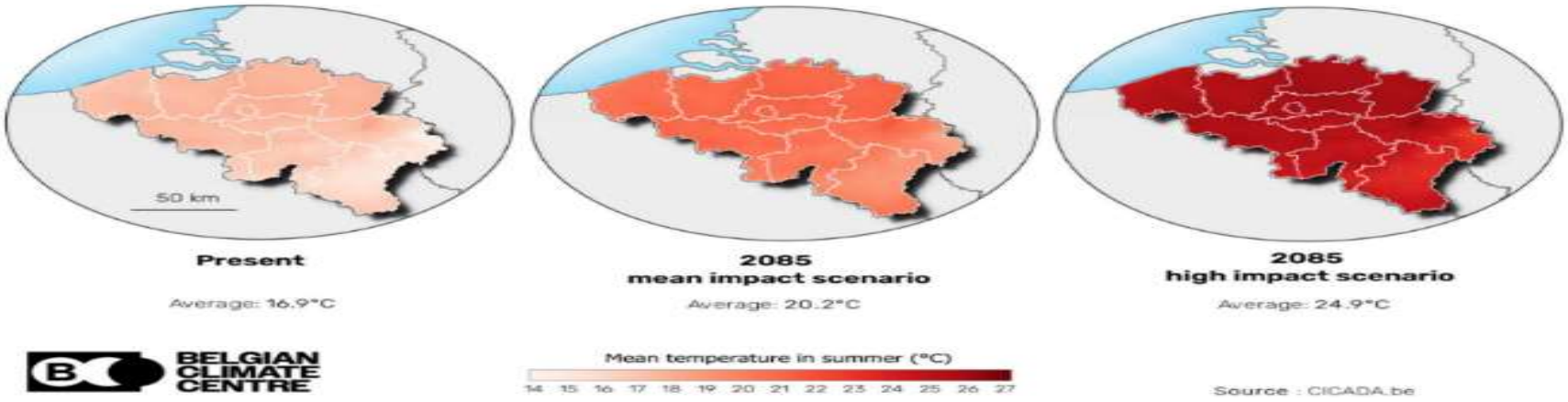


Figure 2. Climate change scenarios in Belgium, ©https://climat.be/doc/NAP_EN.pdf, Accessed: 02/12/2024

Beyond the first commitment under the Kyoto Protocol (United Nations, 1998), it is urgent that Belgium also develops a long-term political vision enabling it to reduce its greenhouse gas emissions by 80% between now and 2050. This long-term policy must include efforts in all sectors (industry, electricity production, households, and transport).

.elgium, from this perspective, Belgium adopted its second National Climate Plan (2009-2012) in 2008 (European Union, 2018), containing adaptation strategies stating that *"Belgium will assess the possibility of developing an adaptation plan based on the acquired experience".*

The Charleroi Urban Design Climate Workshop (UCDW), organized within the Erasmus+ KA220 action UCCRN_edu – Climate Resilient Design, Planning and Governance of Cities, will focus on the case of the Charleroi Porte Ouest, the rehabilitation strategies of the former industrial sites based on the Paola Vigano masterplan. Selected students from 9 European Higher education institution confronted within an area of multiple

complexities and challenges due to the intensive former industrialized activities, in which innovative climate-resilient concepts are needed to propose transformative pathways, integrating multi-hazard resilience linked to climate, volcanic and pollution risks with socio-economic and environmental co-benefits for local communities.

2 WHO WE ARE AND THE TEAM

Figure 3: Faculty of Architecture and Urban Planning Organization Team

The workshop is organized and hosted by the Faculty of Architecture and Urban Planning of the University of Mons and framed by the following academic and scientific staff:

- Prof. Vincent BECUE, Architect, Full Professor
- Dr. Noémie LAGO, Engineer of Urban Planning, Research and Teaching Associate
- Mr. Fabrice SOBCZAK, Architect, PhD candidate
- Dr. Sesil KOUTRA, Engineer of Urban Planning, Research and Teaching Associate

The supervising team was completed during the whole week of the workshop by the responsible partners of the consortium, Prof. Mattia LEONE, Prof. Gerald MILLS, Prof. William VEERBEEK, Prof. Margot PELLEGRINO, Prof. Bruno BARROCA and Prof. Chantal PACTEAU accompanied by the valuable administrative support of the Faculty and the contribution of the local actors and experts on the field, who offered significant insights to the participants.

3 OUTLINE OF THE 7TH UCCRN WORKSHOP IN CHARLEROI

3.1 Western Gate (Porte Ouest). Zone of Intervention

Charleroi is located in the province of Hainaut and the Sambre River flows through it. It is the administrative center of the administrative district of Charleroi, which covers 14 municipalities and has a total area of 554.55 km2. Charleroi, a major road and rail hub, has a population of approximately 200,000 (425,000 in its wider conurbation – the 5th biggest in Belgium – which stretches from Thuin to Sambreville). Consequently, it is the biggest municipality in Wallonia, the second biggest conurbation in Wallonia in population terms, and the third biggest municipality in Belgium.

The site of 'Porte-Ouest' ('Western Gate') mainly encompasses the municipalities of Marchienne-au-Pont and Monceau-sur-Sambre, situated to the west of Charleroi city center. The Western district is a land of many contrasts, as it connects the territory's most significant wooded and agricultural areas, most exceptional park, largest brownfield area, and river. The site is emblematic of both Charleroi's and Wallonia's industrial heritage and encompasses several scales, such as the Carsid steel plant grounds, the area of the urban periphery, and the surrounding territories, and is part of the vast transformation project of Wallonia's region. The Porte Ouest is first and foremost perceived through its built landscape. Viewed from outside the site and from the surrounding towns (Marchienne-au-Pont, Charleroi city center, Dampremy, etc.), the site is characterized by large historical and modern industrial features (chimneys, blast furnaces, water towers, etc.), which serve as landmarks in the landscape (Vigano, 2023).

The renewal of more than 100 hectares of brownfield areas, currently underway, aims to bring together various cutting-edge economic initiatives in a majestic post-industrial landscape. The challenge is to create an environment that considers industrial spaces in operation, the natural environment, and the urban fabric of surrounding neighborhoods. This can be accomplished by creating lively neighborhoods, introducing workplaces in the heart of the urban areas, and by developing large transportation infrastructures in the city (a station, highways, railroads, ports, etc.) that connect it to the rest of the world. Mainly made up of large industrial buildings and infrastructure, as well as a chain of slag heaps, this area is a key characteristic of the landscape of Charleroi. In addition to this, the transformation of former factories into cultural centers and the renewal of former town centers make this district one of the most dynamic and multicultural in the region.

The district occupies a very specific place in the structure of the city of Charleroi, delineated to the south by the Sambre River, to the north by the Charleroi-Brussels Canal, and to the west by the railway. In its historical context, Charleroi's first planning initiatives were the fortress constructions

in 1666 with strong and diverse potential markets leading to various economic activities, actively supported by government initiatives at the early beginning of the 18th century. Its strategic location at the point of convergence of coal and iron ore resources between the Sambre and Meuse Rivers incited important economic development. Thanks to iron, coal, and glass, the city grew gradually during the Industrial Revolution, when its vast industrial estates, road networks, and the plan of its city center took shape and its suburbs grew rapidly. Charleroi is a large European city, typical of the triumphant 19th century.

A major industrial city of Wallonia, the territory of Charleroi would be deeply marked by industrialization, in terms of industrial facilities and of the density of its energy and transport infrastructure. The first industrial axis extended from West to East along the River Sambre and the coal load. It is along this axis that the railway tracks and main road arteries, as well as the canal that links Antwerp, Brussels, and Charleroi (ABC axis), were developed. After the merger of municipalities in 1977, Charleroi became the largest city of Wallonia in terms of the number of inhabitants. The industrial momentum ran out of steam, however. The coal mines closed and steel making came under strain.

Like all the cities that grew rich from heavy industry, Charleroi went through a slow economic decline and entered a crisis with a high unemployment rate. The slow flight of the well-to-do to green suburbs, the transformation of business activity, the displacement of trade to peripheral commercial centers, the sacrifice of urban spaces to the automobile, the obsolescence of construction sacrificed to property speculation, the many derelict industrial sites and brownfield areas – all these urban pathologies would fray its urban fabric.

The strategic geographical zone of the Porte Ouest (Western Gate), but also the numerous opportunities for brownfield remediation (soil artificialization, depollution, etc.) have been the incentives for the site selection. Additionally, the crossroads between the upper and lower Sambre Valley makes the site attractive with plenty of contrasts bringing together cutting-edge motivations with natural landscapes. The vast industrial areas undergoing reconversion constitute a reserve of land extension, with a surface equal to the historic city center, which will make it possible to connect the city center with the surroundings (Europan 15, 2015), but also its proximity to the city, and the presence of water offer plenty of possibilities to develop a balance between urban, economic, and societal considerations.

3.1.1 The “invariable” and “variable” of the landscape

The factory chimneys, blast furnace towers, walkways, and other monumental industrial elements were built on the former site spread over almost 200 hectares and have been etched onto the minds of the inhabitants of Charleroi.

The dimension of such know-how, closely linked to the social dimension through the toil of engineers and workers from generation to generation, has built up this heritage. No future museum could have such a lasting impression as the imposing edifice of the blast furnace. These elements have become landmarks in a similar way to monuments, such as the former belfry of the City Hall or, more recently, the tower at the Charleroi police headquarters, designed by the architect Jean Nouvel. Many reactions from citizens have been raised in defense of such heritage. The City of Charleroi has tasked a working group, made up of administrative representatives (city authorities, land planning, heritage, etc.), technicians and members of the "save blast furnace No. 4" support committee, with assessing the site's industrial heritage and the possibility of reintegrating these industrial remains. Blast furnace No. 4 (strategic site), 3 chimneys and 3 walkways have been defined as "invariable of the landscape" earmarked for conservation. However, other industrial constructions on the site, whether listed or not and referred to as "variables of the landscape" could also continue to feature as part of the landscape (the cooling tower - water tower (strategic site), changing rooms, halls, boundary walls, etc.) (

Figure 4 and

Figure 5).

In particular, the HF4 blast furnace is the last remaining furnace on the site. From an architectural perspective, it is a large metal structure with imposing shafts, staircases and frameworks. With its isolated position and role as a landmark in Charleroi's landscape, this structure evokes the image of an industrial cathedral. Aside from its symbolic and historical value, the HF4 is a highly visible beacon in the Charleroi region's landscape, one of the last witnesses to Wallonia's industrial evolution, one of Europe's most productive blast furnaces and, thanks to its surviving equipment, one of the last symbols of the hot-rolled steel industry. The Haut Fourneau, which has been kept in a state of controlled deterioration, serves as a landmark for a highly original public space, providing support for international cultural events with its unique stature in the area's scene and serving as a gateway to the "Boucle Noire"(Vigano, 2023).

Figure 4. HF4 Blast Furnace, Belgium
©https://www.bcd-urbex.com/hf4-blast-furnace-belgium/#google_vignette?
Accessed on 04/12/2024

Figure 5. Three Chimneys in Charleroi
©(Europan 15, 2015).

3.1.2 The slag heaps of Charleroi

Deindustrialization in Charleroi began in the ‘60s as a result of an important number of brownfields, including numerous slag heaps. In the 70s, to find solutions to the oil crisis, the Belgian government considered authorizing the exploitation of slag heaps as energy resources. Among the many battles waged by residents to protect the slag heaps from exploitation, the victory of the Martinet Neighborhood Committee is emblematic. They succeeded in making the site classified as a “natural site” to preserve biodiversity, being today places of nature, leisure, working-class memories, and craft productions, but also used for refugees of marginal practices, such as sheltering homeless people (Bianchi, 2023). Besides the ecologically valuable chain of slag heaps in and around the site, Porte Ouest retains several ecologically valuable areas featuring pioneering vegetation: these are derelict areas where young forests are growing. Pioneer species such as mosses, grasses, elder, and birch can be found growing on the old (semi-) terraced land and stony soils (Vigano, 2023).

3.1.3 The presence of the water

The site, at the confluence of the Sambre, Piéton, and Eau d’Heure Rivers, has historically been characterized by water (Figure 6). The floor of this wet valley was profoundly transformed during the industrial period. This included the creation of the Charleroi-Bruxelles canal in the Piéton Valley,

the raising of the ground level by several meters in response to flooding, the digging of a canal to connect the Sambre to the Charleroi-Bruxelles canal, and the progressive covering of several waterways, including the Piéton and Carabin. Apart from the Sambre River and the canal, water is invisible. The Eau d'Heure River is barely visible in the landscape, the Piéton runs through the site in underground pipes, the canal connecting the Sambre to the Brussels-Charleroi Canal has been filled in, and the ponds present at the beginning of the 20th century have largely disappeared. The canal and the Sambre's artificial banks are not particularly conducive to biodiversity. There is a major challenge to restore the visibility and place of water to redevelop ecological continuity (Vigano, 2023).

Figure 6: (a&b). The presence of water in Porte Ouest in Charleroi ©https://www.locationscout.net/locations/19320-charleroi/spots, Accessed

3.2 UCDW Scopes in Charleroi

The scope of the Master plan for Charleroi's Porte Ouest district primarily encompasses the former municipalities of Marchienne-au-Pont and Monceau-sur-Sambre, spread over an area of 8 km². The City of Charleroi has decided to focus specific attention on this area to improve the living environment for its inhabitants, which the development of industry has considerably degraded and then its departure.

The UCDW methodology focuses on sequential and iterative phases that lead to the development of the project through a multi-disciplinary and multi-scale approach. All phases of the methodology are implemented with the support of UCCRN multidisciplinary experts and urban stakeholders, defining an intervention model that combines knowledge-sharing and co-design actions with urban decision-makers and local communities together with the development of simulations based on computational design tools to control the main indicators that determine the performance of buildings and open spaces about climatic stress conditions.

In this collaborative project, a UCCRN workshop focused on territorial analysis was organized to integrate climate, resilience, and sustainability considerations into urban planning. The objective was to position the urban development of Charleroi Porte Ouest as a model for resource efficiency, circular economy, and energy resilience while reflecting local priorities and stakeholder viewpoints, and the territorial analysis. As a former industrialized area with an important decline and colonization of abandoned areas, Charleroi is particularly interesting for the emergence of new spatial values and the inclusion of specific aspects pertaining to the common (e.g. valorization of the historical heritage and new opportunities for urban renewal) (Bianchi, 2021).

For this Workshop, we have extracted three specific objectives from the Master Plan of Paola Vigano which will be explored by the students (Figure 7).

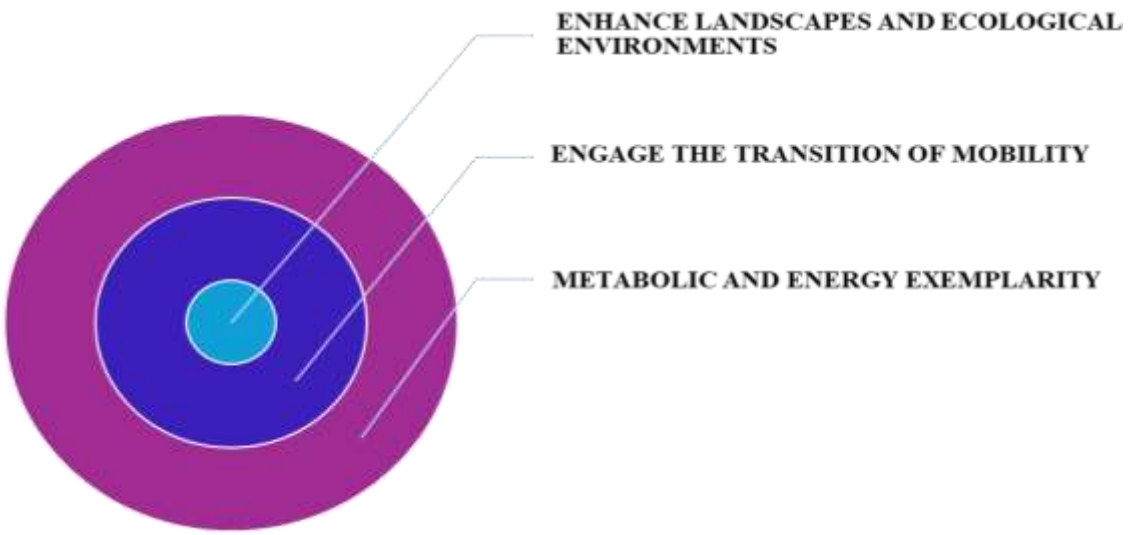


Figure 7. Three pillars of action for the 7th UDCW Charleroi (insights by ©Paola Vigano master plan)

In more details:

1. **Enhance landscapes and Ecological environments**. This axis aims to strengthen the quality and diversity of landscapes while preserving and revitalizing local ecosystems This axis aims to strengthen the quality and diversity of landscapes while preserving and revitalizing the local ecosystems specific to the Sambre Valley.. It focuses on promoting design and management strategies that integrate biodiversity, restore natural habitats, and foster a sustainable balance between urbanization and the environment in the context of industrialization from the Cleantech district. Emphasis is placed on the importance of creating resilient spaces that can adapt to the impacts of climate change while providing a healthy and attractive living and working environment.
2. **Engage the transition of Mobility**. This axis focuses on transforming mobility systems to address current environmental and societal challenges. It encourages the adoption of more sustainable modes of transport, such as active transportation, public transit, and low-emission vehicles. The goal is to reduce the carbon footprint of travel, improve air quality, and create inclusive transport networks that effectively serve the entire population locally and at the scale of the Charleroi Métropole project.

3. **Metabolic and energy exemplarity**. This aspect aims to position urban projects as models of resource management and energy efficiency. It involves designing infrastructures that minimize energy consumption and greenhouse gas emissions while maximizing the use of renewable resources. This axis advocates for a circular approach to the urban economy, where waste is minimized, materials are reused, and energy is managed responsibly to achieve exemplary metabolic and energy resilience while becoming an integrated component in the design of spaces for Charleroi's Porte Ouest.

The developed approach was based on the observed continuities and obstacles observed and analyzed and the analysis of the potential practices and possible scenarios around the site's future development getting through the experience, the previous studies and the fieldwork.

3.3 Timetable of the workshop

During the workshop week, different activities were organized and proposed to participants (students and staff). A detailed analysis of the scheduled work plan is provided in Table 1. After the participants' arrival on Saturday 26/10 and the welcome drink, on Sunday 27/10 the team organized a climate walk for the site observation and exploration of the opportunities and identification related to the brownfield redevelopment problems and constraints (e.g. preservation of industrial landmarks), protection of ecological corridors to cite some of them. The following days (Monday 28/10 to Thursday 31/10) were dedicated to teamwork and the progress evaluation by the teaching and research staff. Interesting contributions with local authorities and city actors completed the participants' insights with data and valuable information On Thursday afternoon, the multiplier event took place with keynote speakers of Belgian Climate Change Center following the final presentation of the main findings of the participants of the whole working week. On Friday, a city tour in the city of Mons was organized before the participants' departure.

Table 1. UDCW Schedule

When?	What?	Where?
Saturday 26/10	Arrival of participants, 18h Welcome meeting.	Meeting at **Mons**, hotel de ville, "Grand Place"
Sunday 27/10	14h00 Climate walk in Charleroi – Porte Ouest	Meeting at **Mons** train station (13h) or **Charleroi** train station (14h)
Monday 28/10	AM: 9h meeting with local authorities PM: Team working	8h: **Mons** central station, Train to Charleroi (8h15 departure, 8h49 arrival) 9h00 at "salle des fêtes" in Hotel de Ville, Place Vauban, 6000 **Charleroi** 13h30 at Maconnerie UMONS Campus in **Charleroi**.

When?	What?	Where?
Tuesday 29/10	Team working 14h: UCCRN training meeting	UMONS campus at **Mons** « Rosa Park »
Wednesday 30/10	Team working 10h: UCCRN training meeting	UMONS campus at **Mons** « Rosa Park »
Thursday 31/10	AM: Team working PM: Results presentation and multiplier event of the project	UMONS campus at **Charleroi** « maçonnerie »
Friday 01/11	11h00-12h30: City tour of Mons. Departure of participants	Meeting at **Mons** central train station

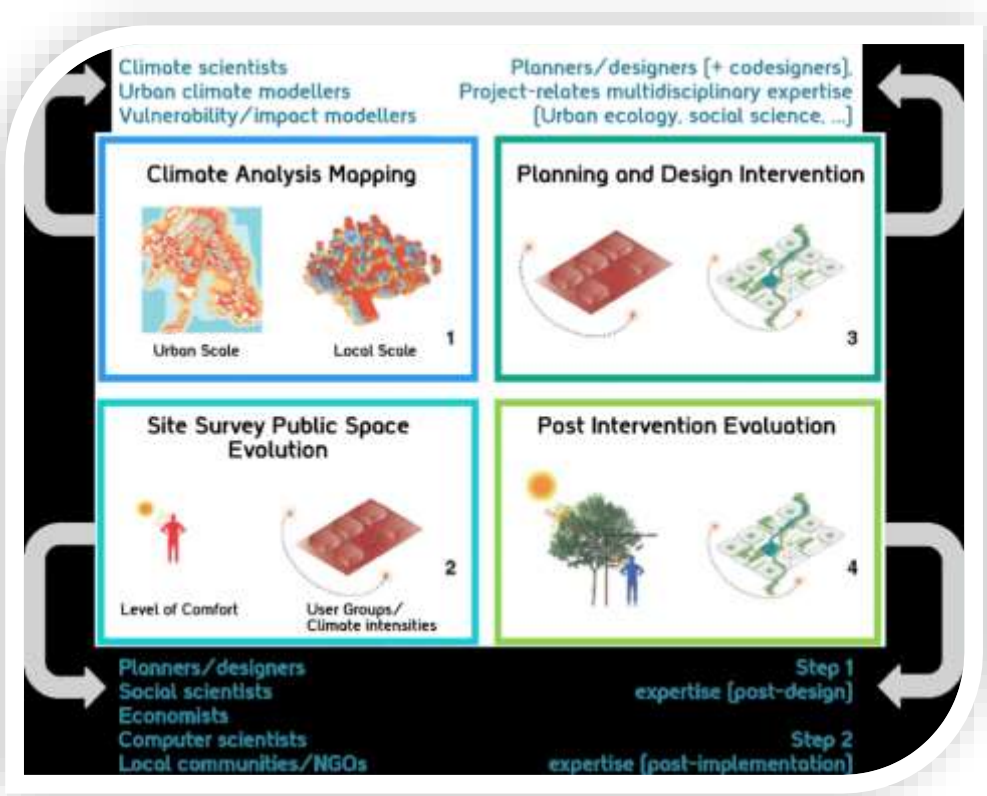


Figure 8: UCCRN methodological roadmap (UCCRN partnership)

4 METHODOLOGY. WORKSHOP STEPS

4.1 Adoption of the UCCRN principles and application of the developed methodological tools

In UCDW in Charleroi, we adapted the methodological approach developed during the UCCRN Erasmus+ toolkit to assess and improve the community plans for the brownfield remediation strategies (Figure 8), concretized in the following steps:

"Climate and microclimate analysis mapping" identifies urban areas most affected by extreme events and seasonal variations, including local climate projections, as preliminary project information. Historical climate data and Regional Climate Models (RCMs) are processed through simulation models integrated into different design tools: GIS systems for city/district-level analyses, providing as output urban heat hotspots and flood zones; parametric 3D modeling tools (Rhinoceros+-Grasshopper, GIS, etc.) assess technical solutions at the block/building scale, integrating climate-resilience aspects with other green building and environmental design criteria and benchmarks.

"Collaborative mapping and co-design" aims to assess the quality of urban spaces and combine climate-related considerations with the needs and expectations of local authorities, practitioners, and communities. Relevant local strategies and plans are critically analyzed to identify barriers and opportunities for integrating climate-resilient design principles. Residents, local administrations, neighborhood and category associations are engaged through collaborative mapping and co-design exercises to collectively develop a shared reading of the main critical aspects of the urban

system about environmental, functional-spatial, and socio-economic aspects. The synthesis of the results outlines a picture of shared needs and possible divergence elements between categories of stakeholders to integrate into the project.

"Planning and design" is based on a critical review of the information collected to identify synergies and tradeoffs that can be implemented in relation to the planning initiatives envisaged by the local authorities. Urban plans and building regulations define the limits within which to develop the most appropriate technical-design strategies and solutions to achieve the set of objectives. Zoning regulations and building codes frame the boundaries of the design and technical options to be assessed, and the most appropriate strategies targeted for future development. Visual tools link multiple factors orienting local policy and transformative actions; meta-design layouts support the production of innovative solutions addressing climate change impacts while increasing environmental quality in cities. Recurring design topics.

4.2 Methodological Steps of UCCRN Charleroi. Exploring the "how"

The UDCW methodology focuses on sequential and iterative phases that lead to the development of the project through a multi-disciplinary and multi-scale approach. All phases of the method are implemented with the support of UCCRN multidisciplinary experts and urban stakeholders, defining an intervention model that combines knowledge-sharing and co-design actions with urban decision-makers and local communities together with the development of simulations based on computational design tools to control the main indicators that determine the performance of buildings and open spaces about climatic stress conditions.

The masterplan envisioned a "rebuilding plan" in a dynamic environment of multiple projects to integrate remediation strategies. As Vigano argues in her studies (Vigano, n.d.) Porte Ouest's renewal is an ambitious initiative, whose objectives have been debated to emphasize economic growth and intensify its historical landscapes. In a 7-objective vision and several timeframes, the conceptions capture the expansion of the attractiveness and economic livability, the valuing of the cultural and historical heritage to provide a backdrop of the long history of the city and puts forward its cultural heritage system, to ***embark on the mobility transition*** and feature the accessibility to the gateway, to envision pollution remediation strategies as crucial instruments of regional redevelopment and promote decontamination priorities and to promote ***exemplary metabolic and energy performance*** replying to the decarbonization engagements for the 2050 horizon. Within the site and its surroundings, the master plan extends and accompanies the many projects for public spaces, mobility, the economy, culture, energy, etc. that are consistent with the transition.

By 2035-2050, Porte Ouest will be an attractive, inhabited part of the city, with its productive campuses and emblematic power plant, and mixed-use urban marina with the Phare Ouest as the centerpiece of the site, integrating productive activities on its southern edge, preserving and

showcasing the two major industries (Industeel and Riva Thy-Marcinelle) as well as supporting public spaces and major events (concerts, sporting and cultural events) around the HF4, one of the city's iconic structures

4.2.1 Icebreaking session

The first step of the methodological process included the icebreaking session, in which participants had their first virtual contact with each other. The organizational team presented the project, the scope, and the expected outcomes. The formulation of three groups was also taken place.

4.2.2 Climate Walk

The site observation and the climate walk took place on Sunday 26/10 (Figure 9). This first phase enabled the site to understand and the dynamics of its ecosystem along with a shared vision through its built (and non-built) landscapes and its characterization by large historical and modern industrial features and landmarks (e.g. chimneys, blast furnaces, cooling towers, etc.). This step would have been important for the study, debate, and development of realm scenarios and future design possibilities towards the site remediation, placing the broad perspectives to envision its new roles in the dynamics of ecological and social transition.

Figure 9. Climate Walk and site observations in the Port Ouest

4.2.3 Pillars of work and groups formulation

The observed approaches of the previous phase (and diagnosis) encountered the existing and potential practices, constraints, and perceptible qualities of the landscape and future perspectives were discussed along with the three groups proposed. Selected students from each of the 9 Higher Education Institutions partners of the project will join the UDCW to develop a multi-disciplinary planning and design-oriented proposal aimed at supporting plans for the 'clean' development of the "Porte Ouest" case study by 2050 based on the Masterplan by Studio Paola Vigano validated by the city of Charleroi and the Walloon Region in 2021.The aim will be to produce multi-scale design solutions supported by robust climate, environmental, and social analyses carried out in collaboration with government officials, design & planning practitioners and local communities, such as the Cleantech District. The student will conduct comprehensive urban analyses and propose sustainable and resilient solutions in line with the problematic of the energy crisis, and the challenges of the ecological and social transitions of the area.

UDCW output included detailed microclimate and urban analyses, linking climate-resiliency and sustainability with other local priorities expressed by stakeholders and other related data. In order to successfully tackle the multidisciplinary dimension of the urban climate challenge emerging from these objectives, the project involves an appropriate mix of complementary experience and expertise. To achieve this, our team divided tasks based on individual expertise into three sub-groups: renewable energy mix, metabolism and circularity, and passive and resilient measures, adopting an interdisciplinary approach. Each team member contributed their insights to ensure comprehensive coverage of the topic. The first sub-group focused on the energy mix, particularly by proposing energy-efficient technologies. The second addressed thermal aspects, with an emphasis on sustainable infrastructure design. The third sub-group examined metabolism and circularity.

Specific outputs were implemented according to sending HEIs' UCCRN_edu educational focus:

- Università degli Studi di Napoli Federico II – Italy: climate-resilient urban planning and design assessment methods and design support tools.
- Université Gustave Eiffel – France: urban infrastructure vulnerability and resilience assessment methods and tools.
- Sorbonne Université – France: urban ecology and biodiversity, Nature-Based Solutions.
- Aalborg Universitet – Denmark: urban governance and planning.
- University College Dublin – Ireland: urban climate science theoretical principles, assessment methods and simulation tools.
- Universitat Internacional de Catalunya – Spain: urban resilience assessment and co-design approaches.

- Université de Mons – Belgium: smart city planning, Net-Zero Energy district development; resilience and risk management in the urban project.
- Università di Pisa – Italy: environmental justice, policy-making and legislation.
- IHE Delft Institute for Water Education – Netherlands: sustainable and resilient urban water management and governance.

4.2.4 Community Engagement

City actors and other stakeholders with a particular interest in the area and the brownfield redevelopment. The findings indicate that implementing a circular economy model, which emphasizes resource reuse and waste reduction, could be highly beneficial for Charleroi. Key results include the potential integration of hydrogen and heat networks to meet energy demands, featuring a heat recovery system to reuse exhaust heat from nearby commercial facilities, a biomass boiler, and a water-to-air heat pump as a supplementary heat generation system leveraging the thermal energy potential from the river. It was recommended to connect these units to the existing and future heat networks, which would not only meet the heating demands of Porte Ouest but also supply heat to surrounding urban districts.

Another key recommendation is to prioritize community engagement to ensure that projects align with local needs. By promoting circular economy models focusing on renewable resources, and incorporating resilient infrastructure, urban projects in Charleroi could serve as a model for sustainable urban metabolism. Overall, the interdisciplinary approach allowed us to propose strategies that could position Charleroi as a leader in energy and metabolic resilience. Overall, more than 30 projects are planned for the forthcoming years (Figure 10).

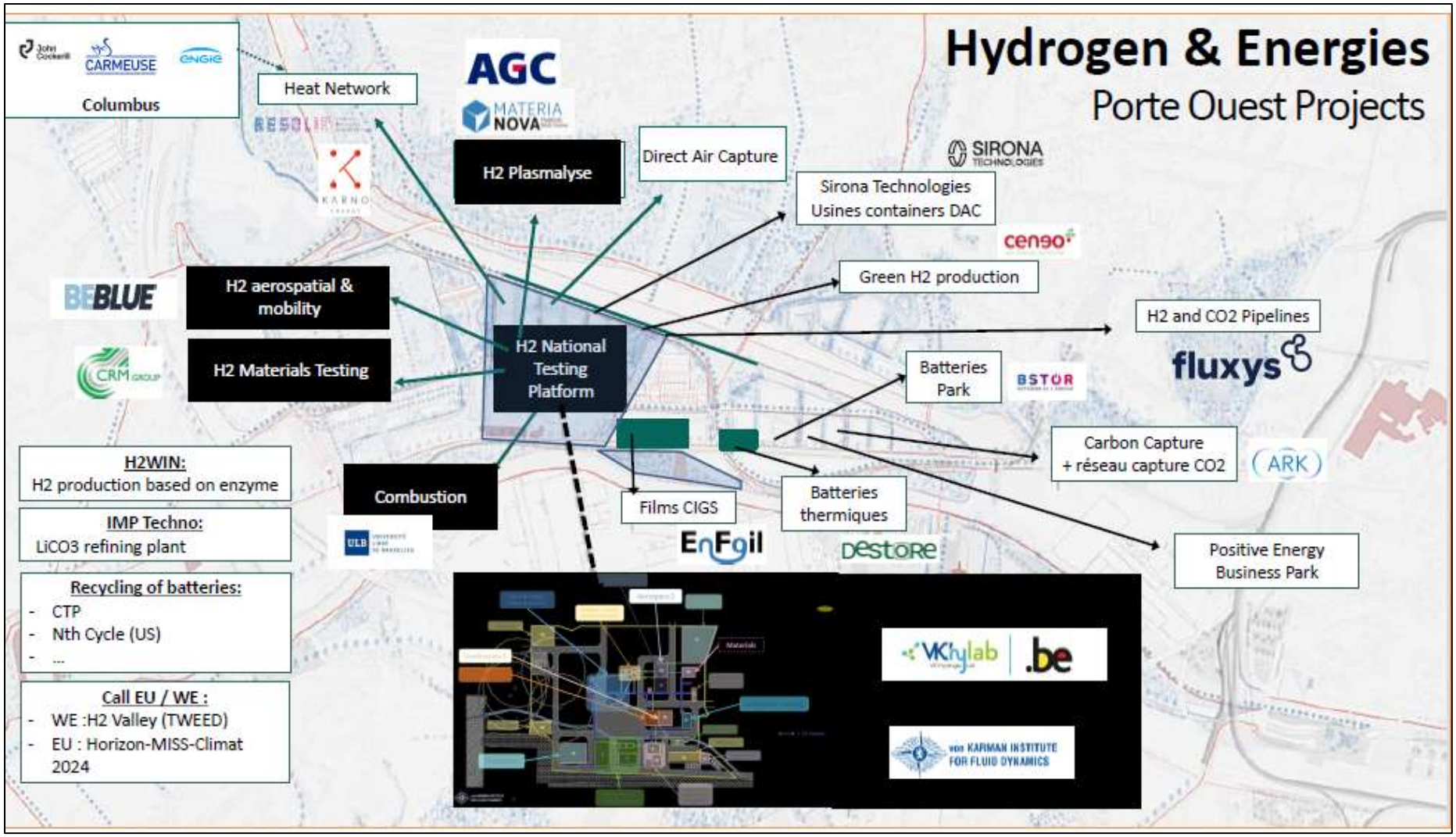


Figure 10. Planned projects in Western Gate of Charleroi (©Cleantech District, 2024)

5 PLANNING AND DESIGN OF STRATEGIES

5.1 Towards the ecological and green transitions

Problem statement:

- Presence of industrial wasteland
- Declining population
- Soil pollution with multiple troubles for natural ecosystems

Objective: *Climate-change adaptation based on natural solutions*

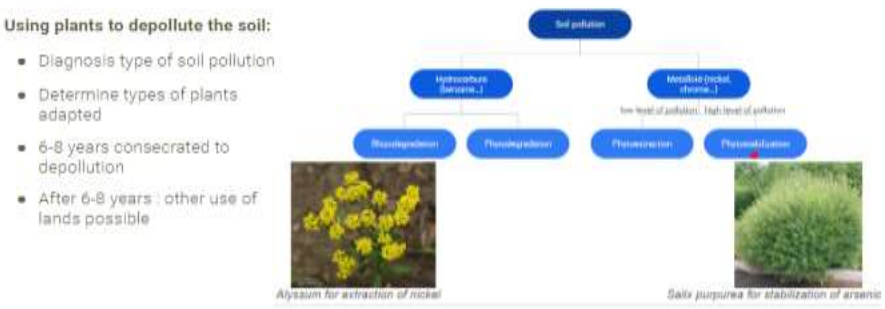
The primary objective was to eliminate pollution caused by previous industrial activities, addressing all components of the area, from the canal to the soil. The project involved students from Gustave Eiffel University, UMONS, and Sorbonne, including architects, engineers, landscape designers, and biologists. This interdisciplinary team allowed for large-scale work, integrating diverse skills ranging from urban greenery to art and urban design.

The landscape design group worked across multiple levels – climatic, hydrological, and artistic-cultural – to develop a deep and multidimensional understanding of the area. This preliminary work laid the foundation for the design group, which developed a proposal for the revitalization of the industrial zone. The project envisioned the creation of a large public space, designed as a “green lung” to connect various citizen-oriented areas through green corridors, squares, and recreational spaces. Additionally, the proposal addressed the challenge of reconnecting areas divided by the main canal, which extends to the Brussels waterway.

Particular attention was given to addressing key environmental and urban challenges in the area, including the presence of industrial wasteland, soil pollution, and invasive species like Reynoutria japonica, which harm the local ecosystem. The proposal focused on eliminating these issues to improve biodiversity and enhance human use of the land. Furthermore, it tackled the lack of intra-site connections and continuity between ecosystems, creating pathways and green corridors to connect fragmented spaces. The revitalization also sought to address the area's declining population and limited urban life by reimagining spaces for public use and interaction.

Another distinctive feature of the area is a large existing mural. The proposal included extending the mural and bringing art to other buildings in the area, aiming to create a more vibrant and colorful environment. Finally, alongside the existing high-speed road, a parallel cycling and pedestrian path was proposed, designed to connect with the newly constructed bridge and promote sustainable mobility.

Particular strategies suggested in this axis are:



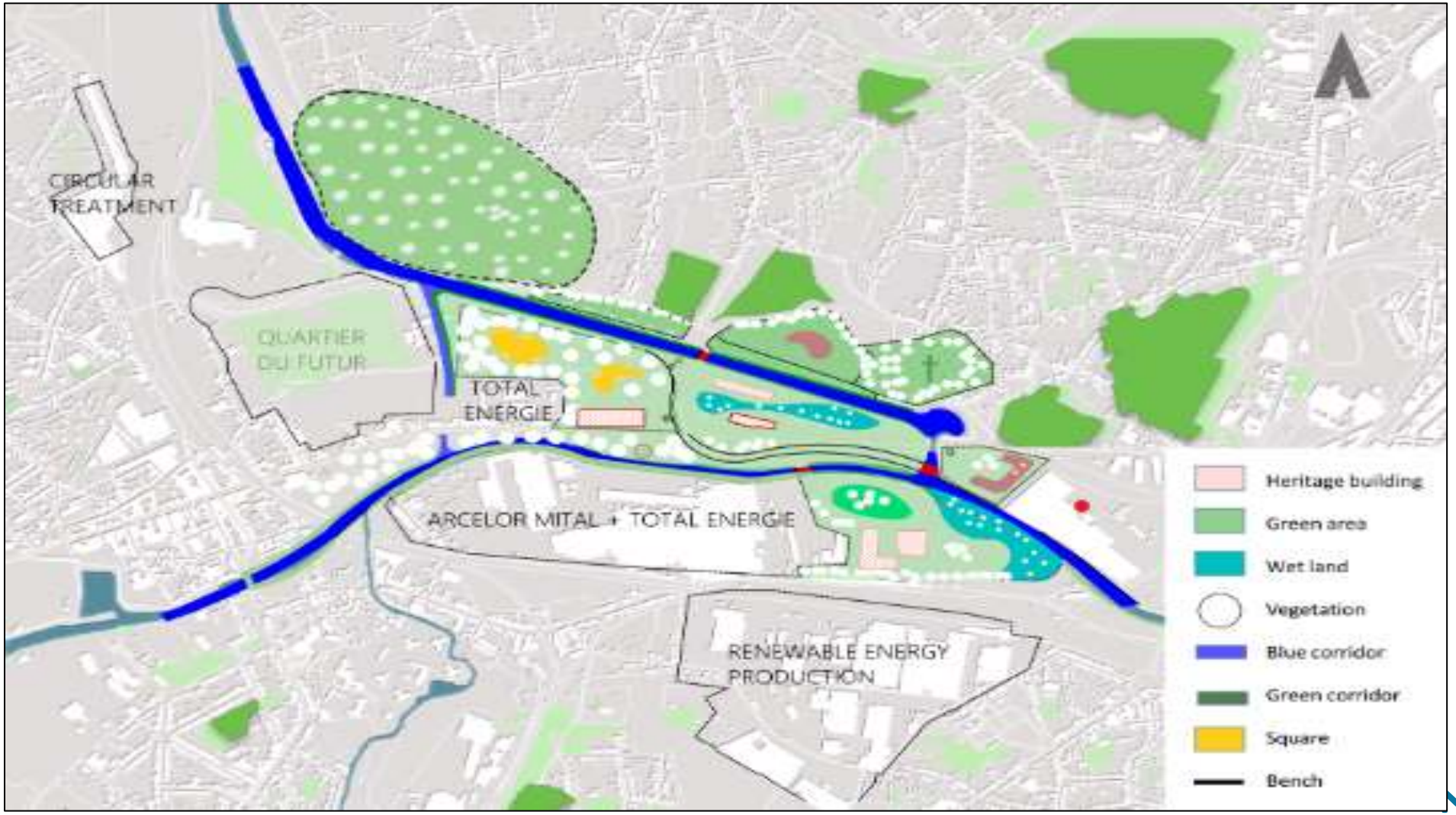


Figure 11. Suggestion of 'Porte Ouest' masterplan based on nature-based solutions

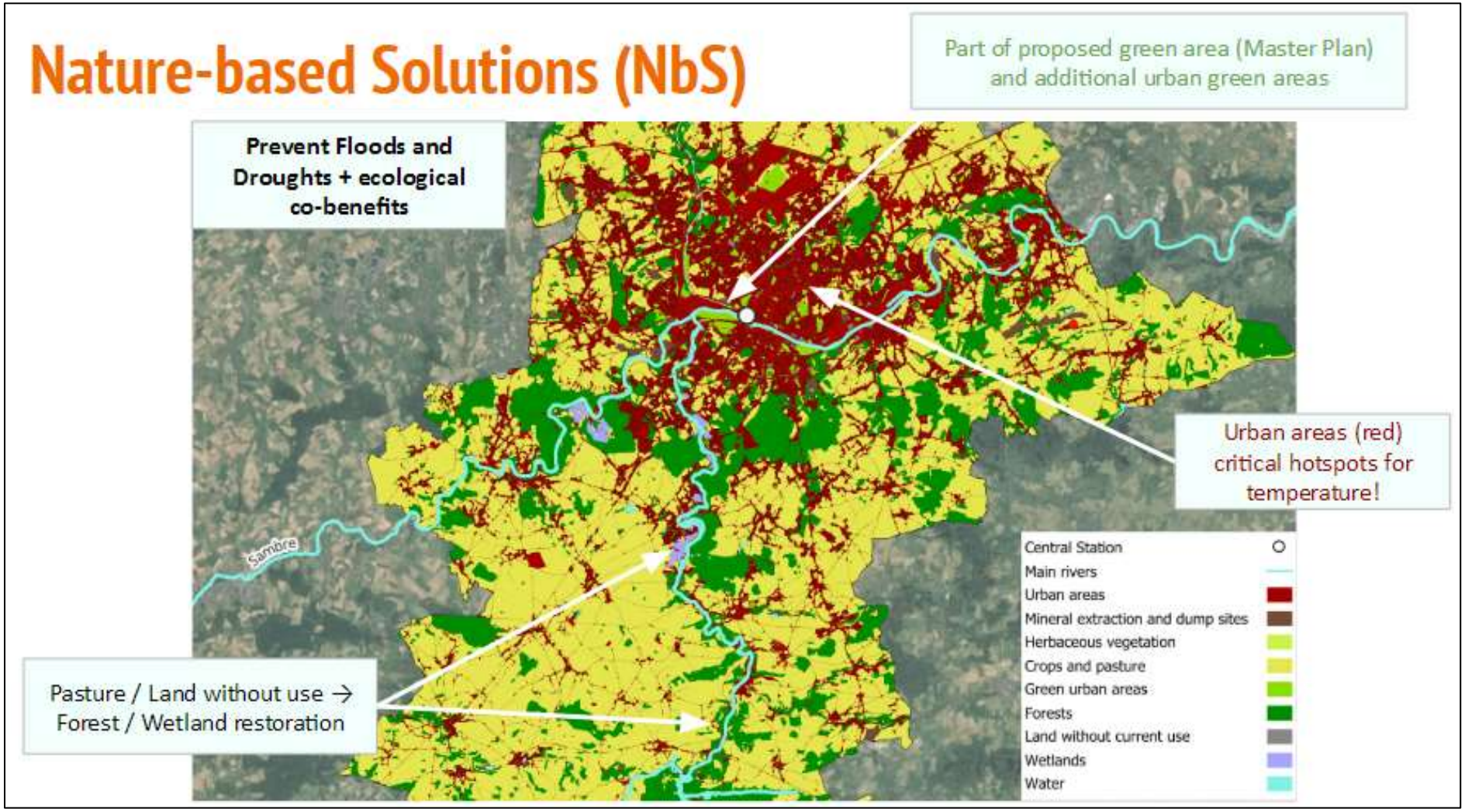


Figure 12. Nature-based solutions and proposals in the studied area

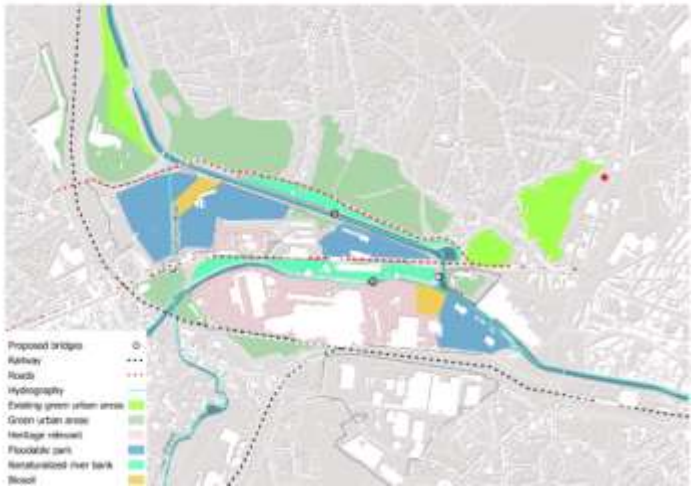
Problem statement: **How can the landscape and ecological environment in Porte Ouest be enhanced?**

- Climate-related risks: rising temperatures, floods, droughts, etc. resulting in social and territorial vulnerabilities
- Biodiversity
- Lack of continuity between the different areas in Porte Ouest

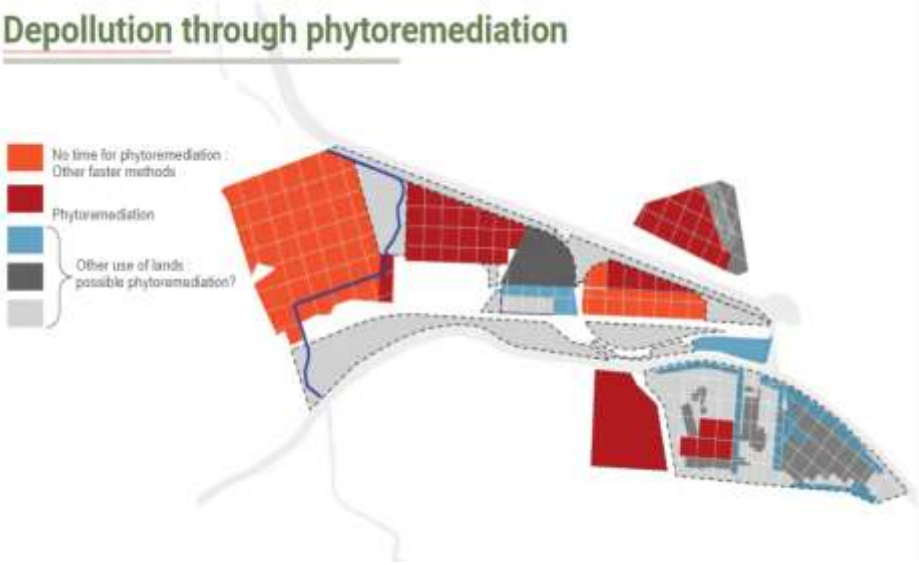
Objective: *Replying to the three abovementioned challenges, this group aimed at:*

- Mitigation and adaptation to climate change effects
- Preserve the actual biodiversity and implement new adapting technologies for soil depollution
- Bring back life to this industrialized area (human and other potential natural species)

Overall landscape proposal



Depollution through phytoremediation



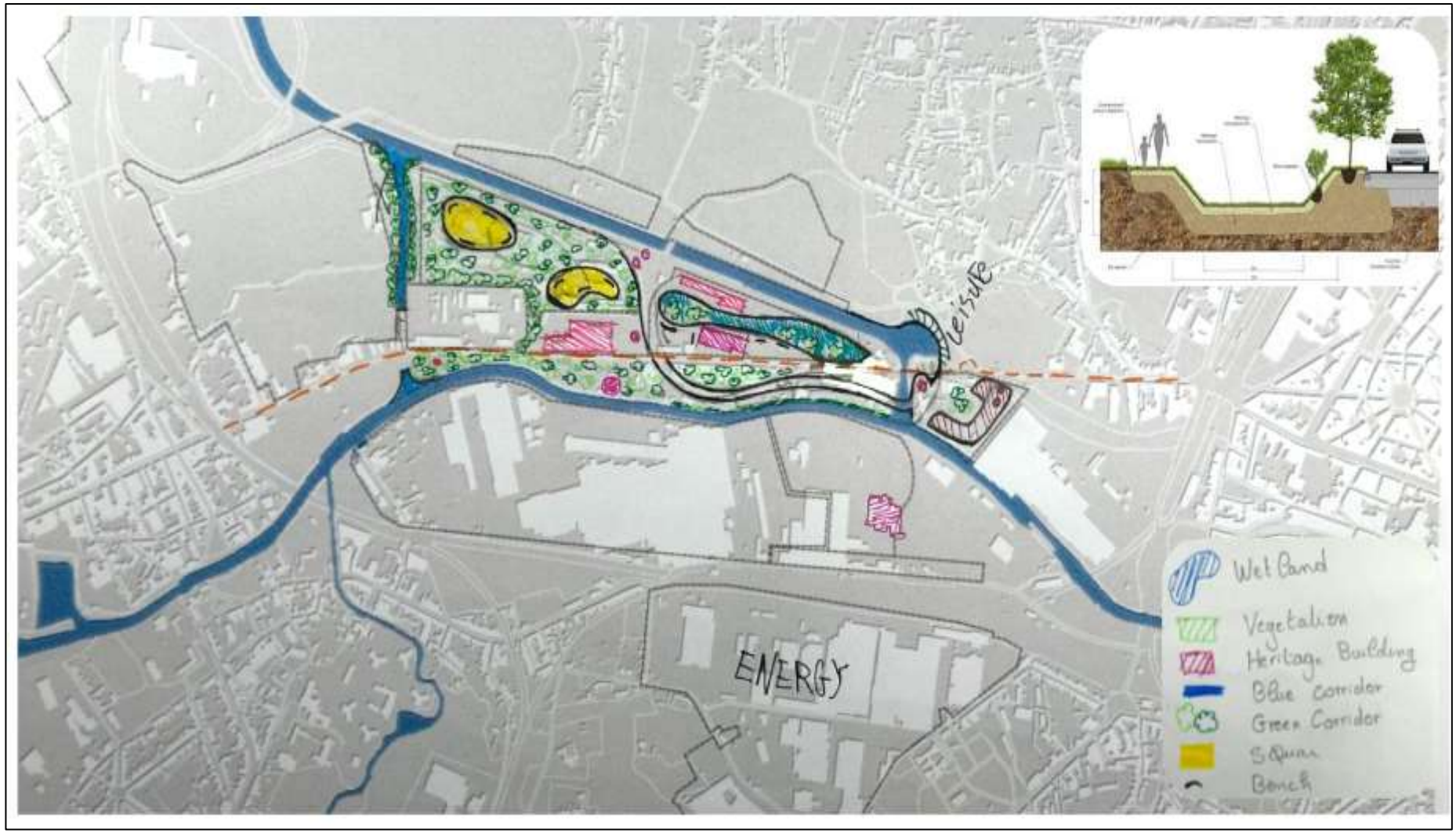


Figure 13. Suggestion of 'Porte Ouest' masterplan based on landscape and ecological environment strategies

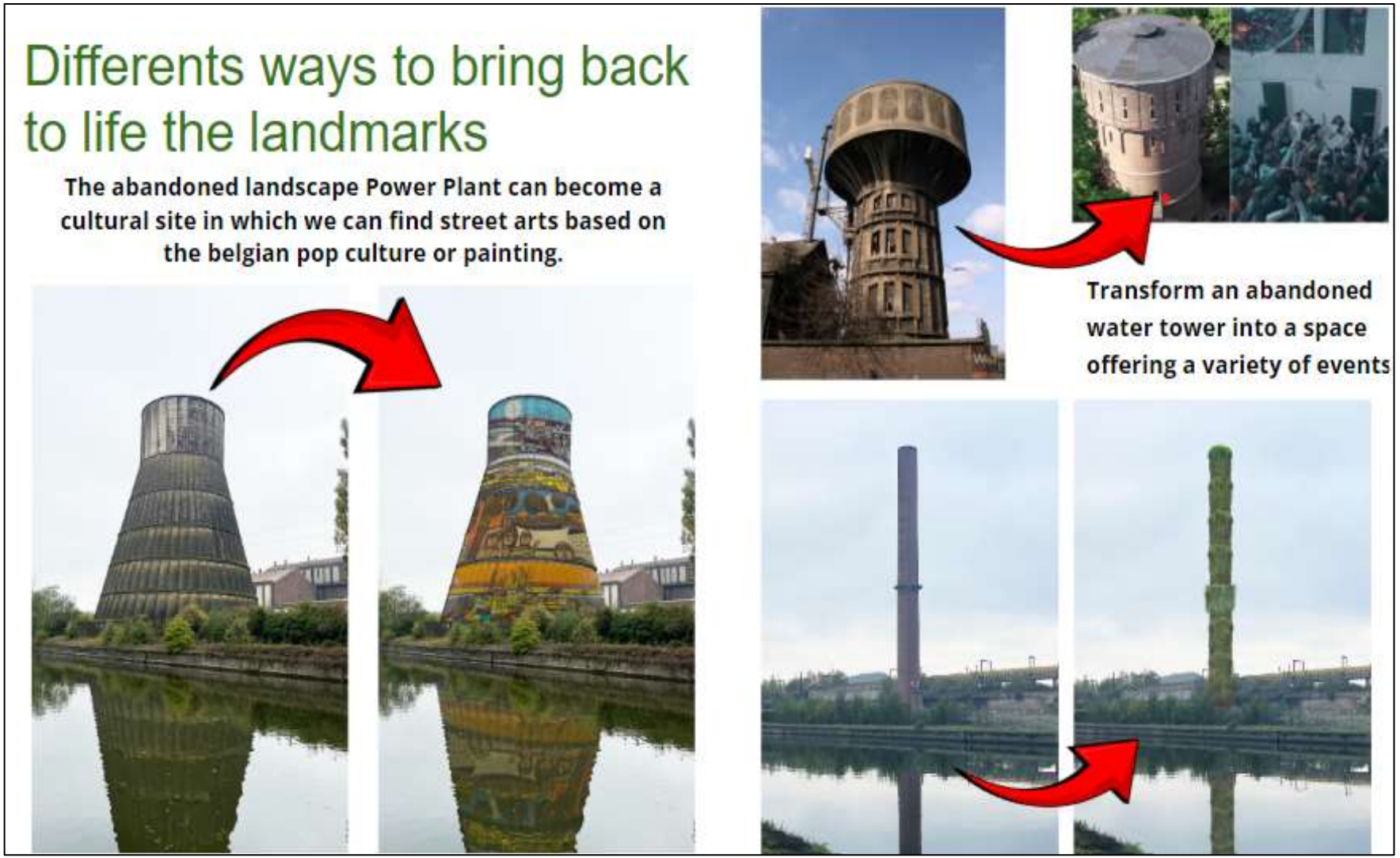


Figure 14. Remediation of cultural landmarks of the Porte Ouest case study

2.1Context of Biodiversity

It has been noticed the absence of precise database and inventory the biodiversity proper for Charleroi.
This analyse is made out of observation from the site visit and the LifeWatch report 2022
Actual Flora
And so we can say :

- Presence of invasive species : Reynoutria japonica
- From the most important species present on the site of the Porte Ouest : Argousier and Lycium barbarum (PCDN Charleroi)
- The very small proportion of Tree broadleaved,Monospecific grassland with graminoid…etc. In conclusion, Natural Material Surfaces with less than 10% vegetation

Sources : Fédération Wallonie-Bruxelles (FWB) - LifeWatch - Ecotopes 2022 (2023-10-31)

Actual Fauna :
Upon the site visit we could observe many species of birds, for exemple ducks, we also conclude from the fishing spots and the presence of small mammals and birds that some small fishes lives or pass by the canal.

The Industrial stamp of the area makes it not propice for animals proliferation.

Figure 15. On-site biodiversity observations

Problem statement: **How to engage the transition of mobility?**

Objective: *The aims of this group are:*

- Development of sustainable transport modes
- Reduction of commuting time
- Reconnections with Sambre River
- Bring life back to the site of 'Porte Ouest'

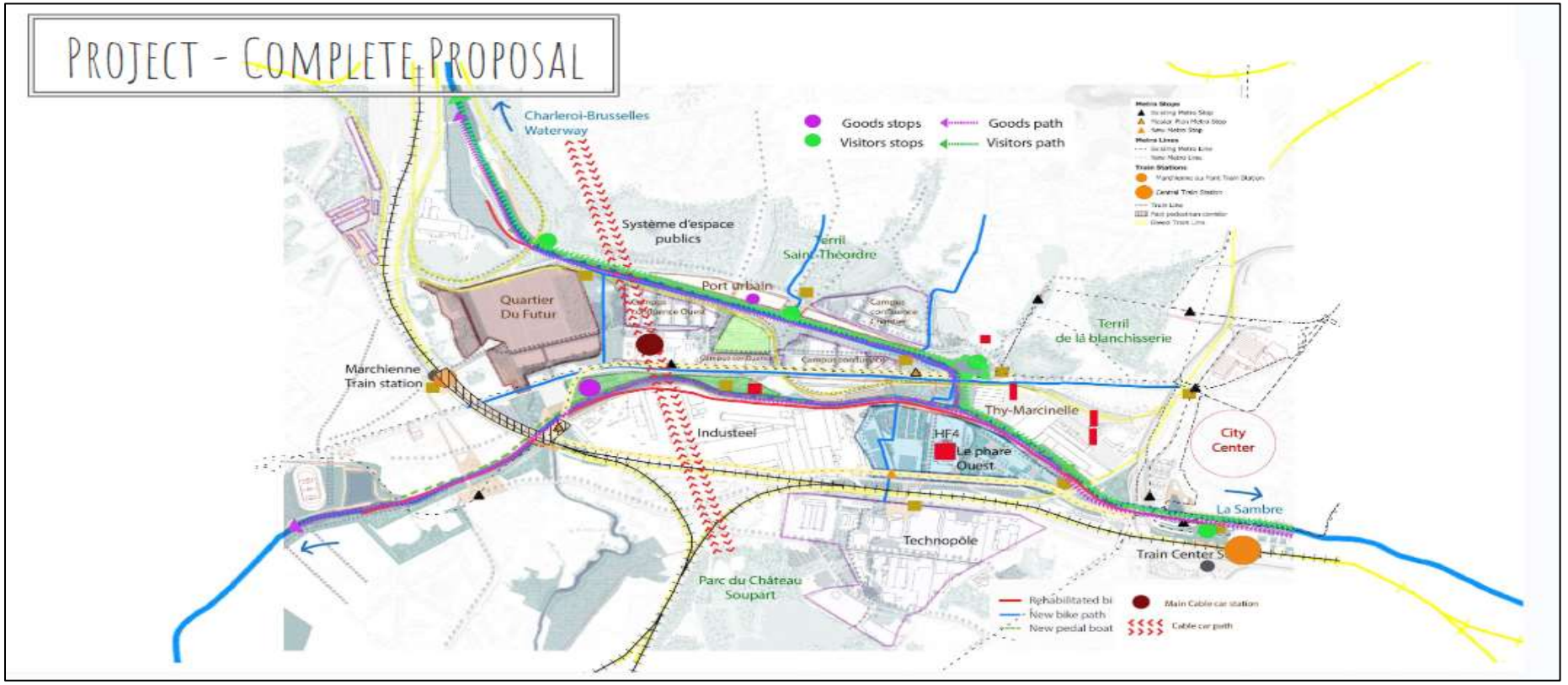


Figure 16. Proposed actions on mobility strategies in Porte Ouest

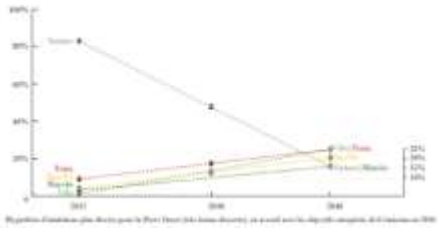
… In more details

3- Cable Car System

4- Car

Shuttle

Navya Army, transbus.org



Car free site within campus confluence

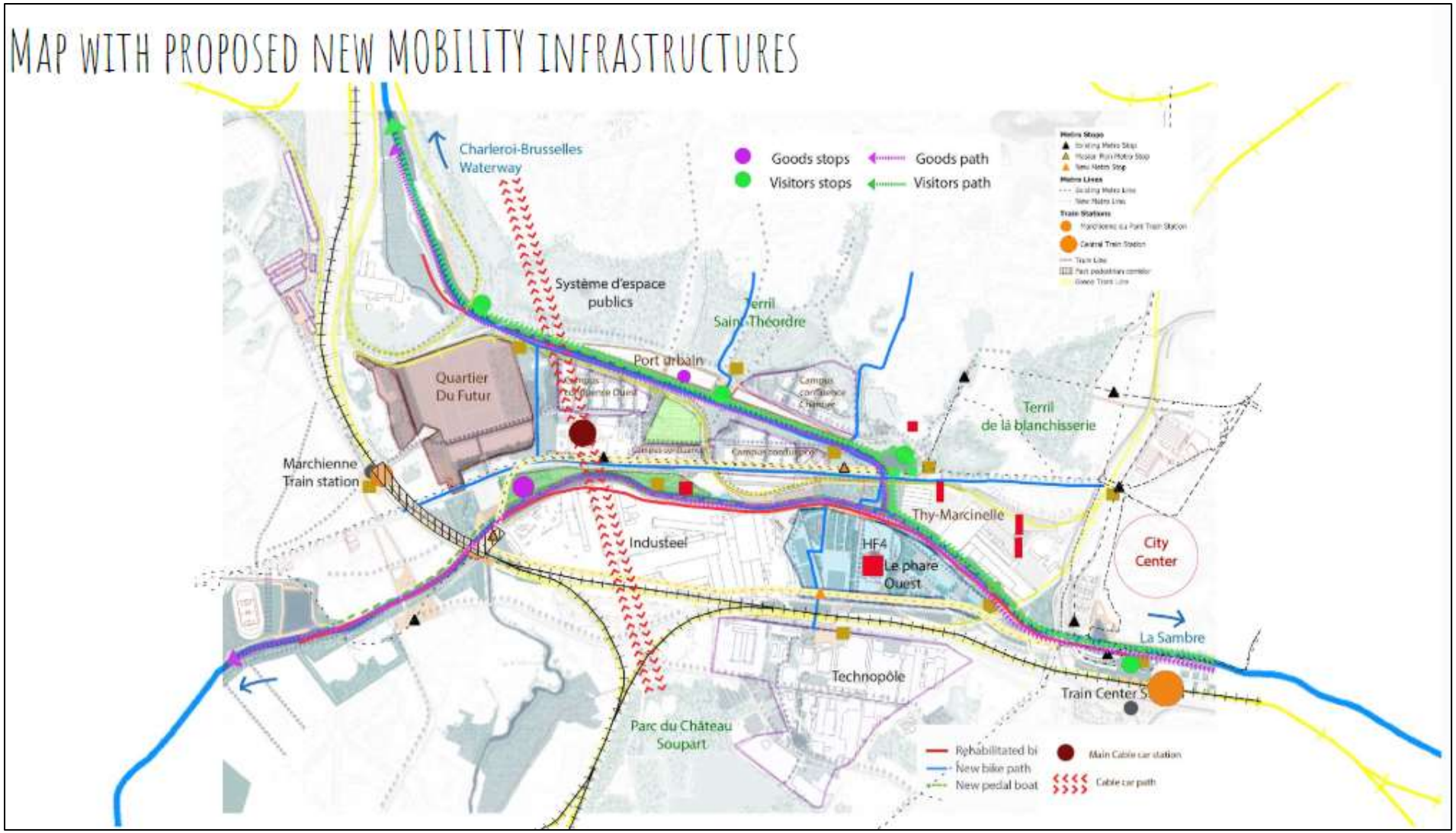
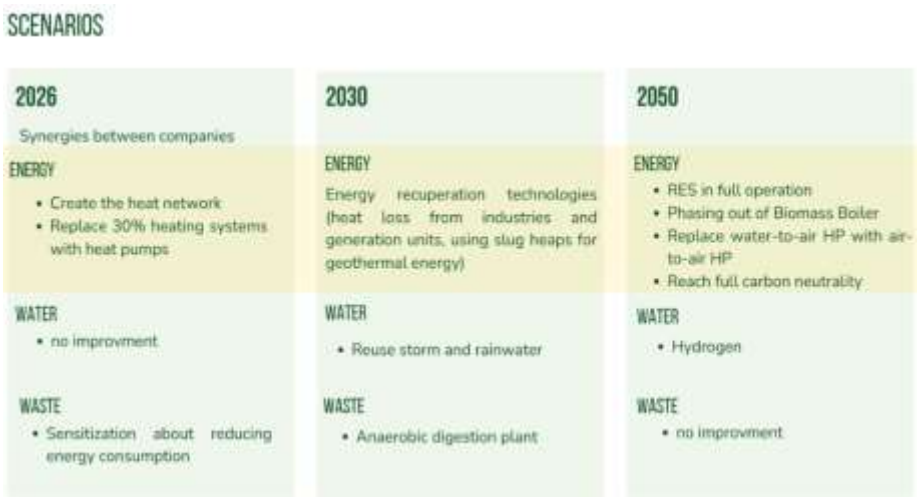


Figure 17. Proposed actions on mobility infrastructure in Porte Ouest

Problem statement: **Establishment of an integrated, circular energy system for Charleroi, building resilience through local resource use and industrial cooperation.**

Objectives:



3 WAYS OF THINKING:

- → **Adaptation to the needs**
- → **Spatial Structure**
- → **Resilient Energetic Metabolism**

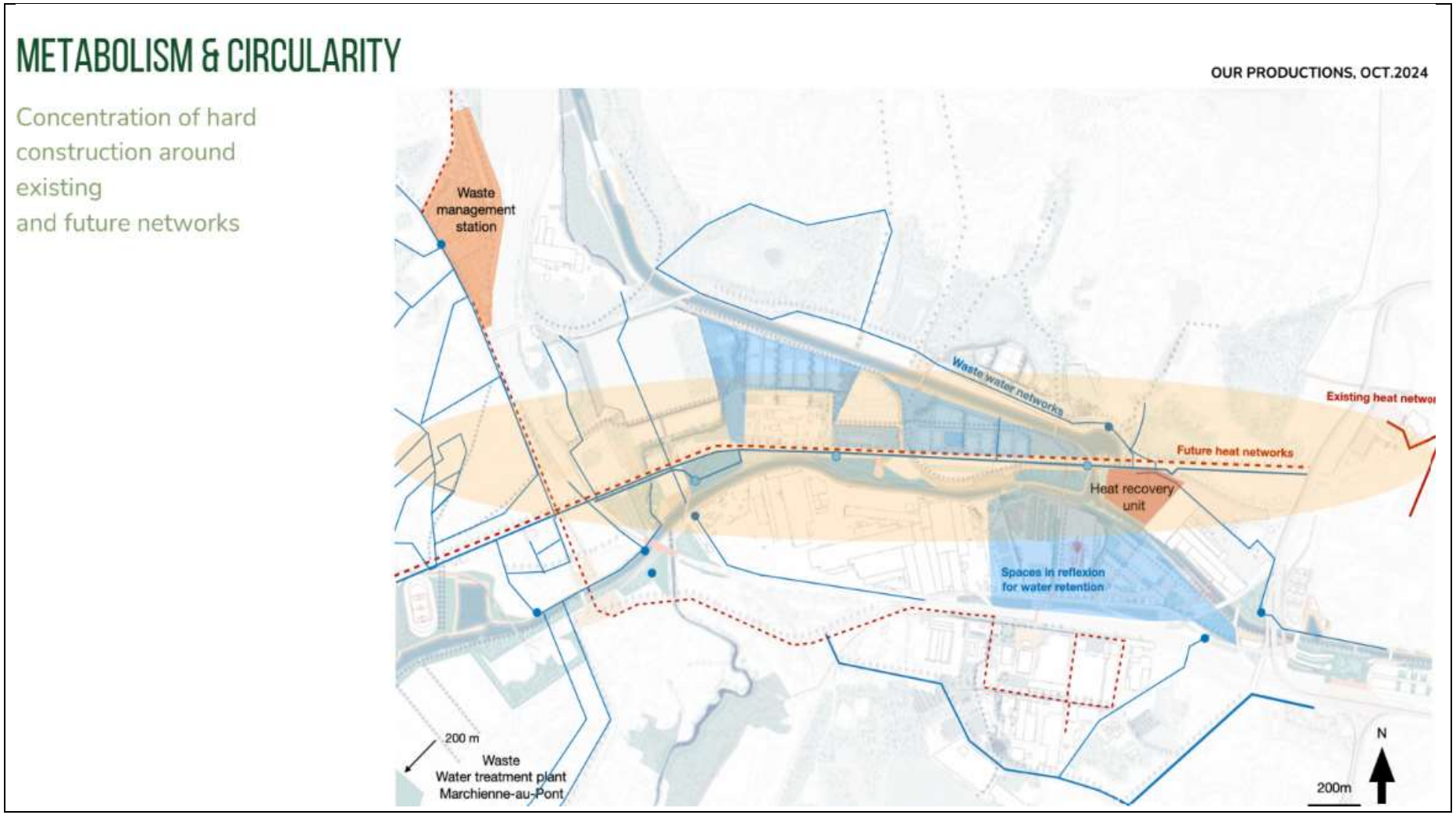


Figure 18. Axis of metabolism and circularity. Concentration of hard constructions around existing (and future) networks of the studied area

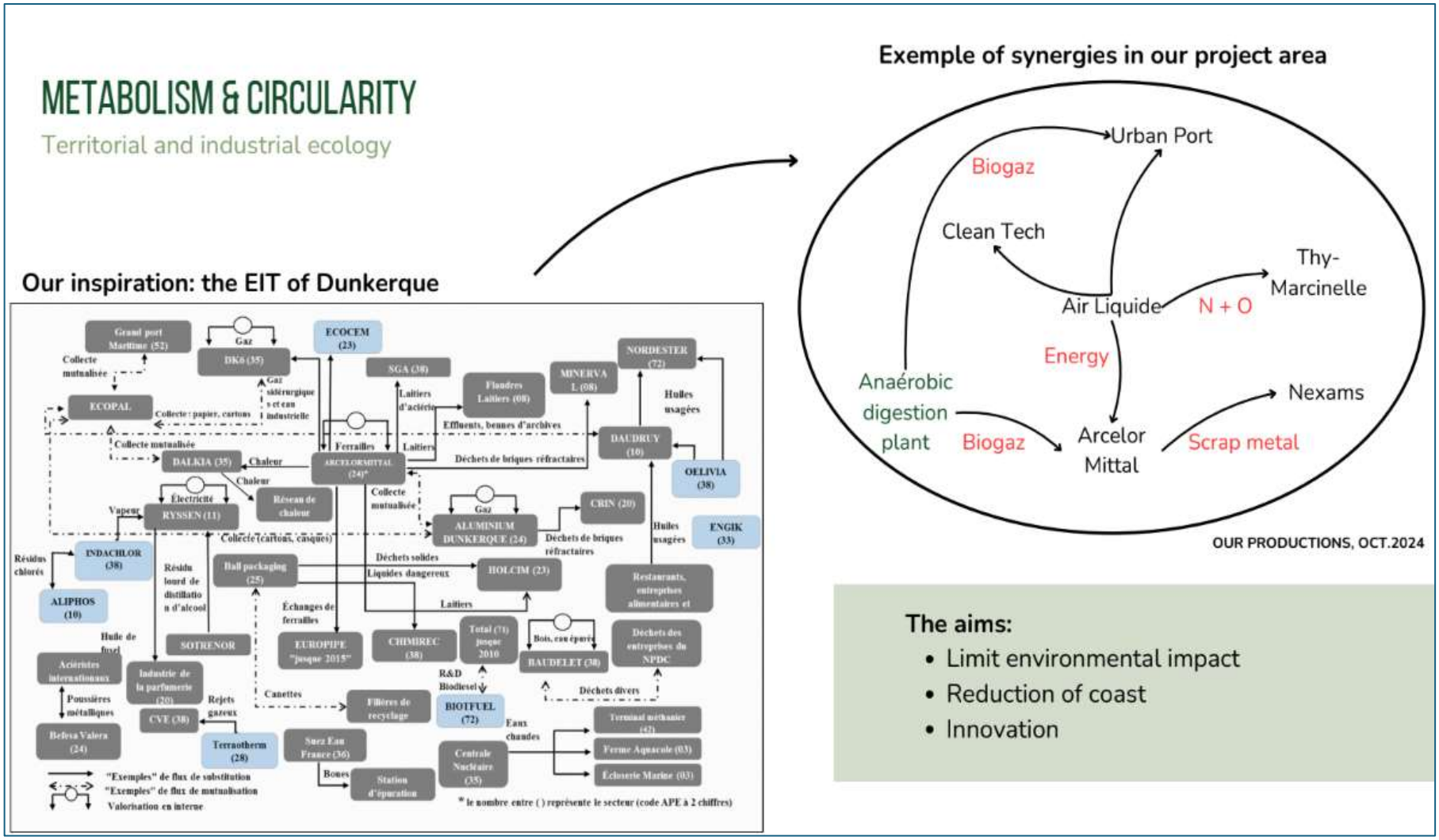


Figure 19. Axis of metabolism and circularity. Territorial and industrial ecology

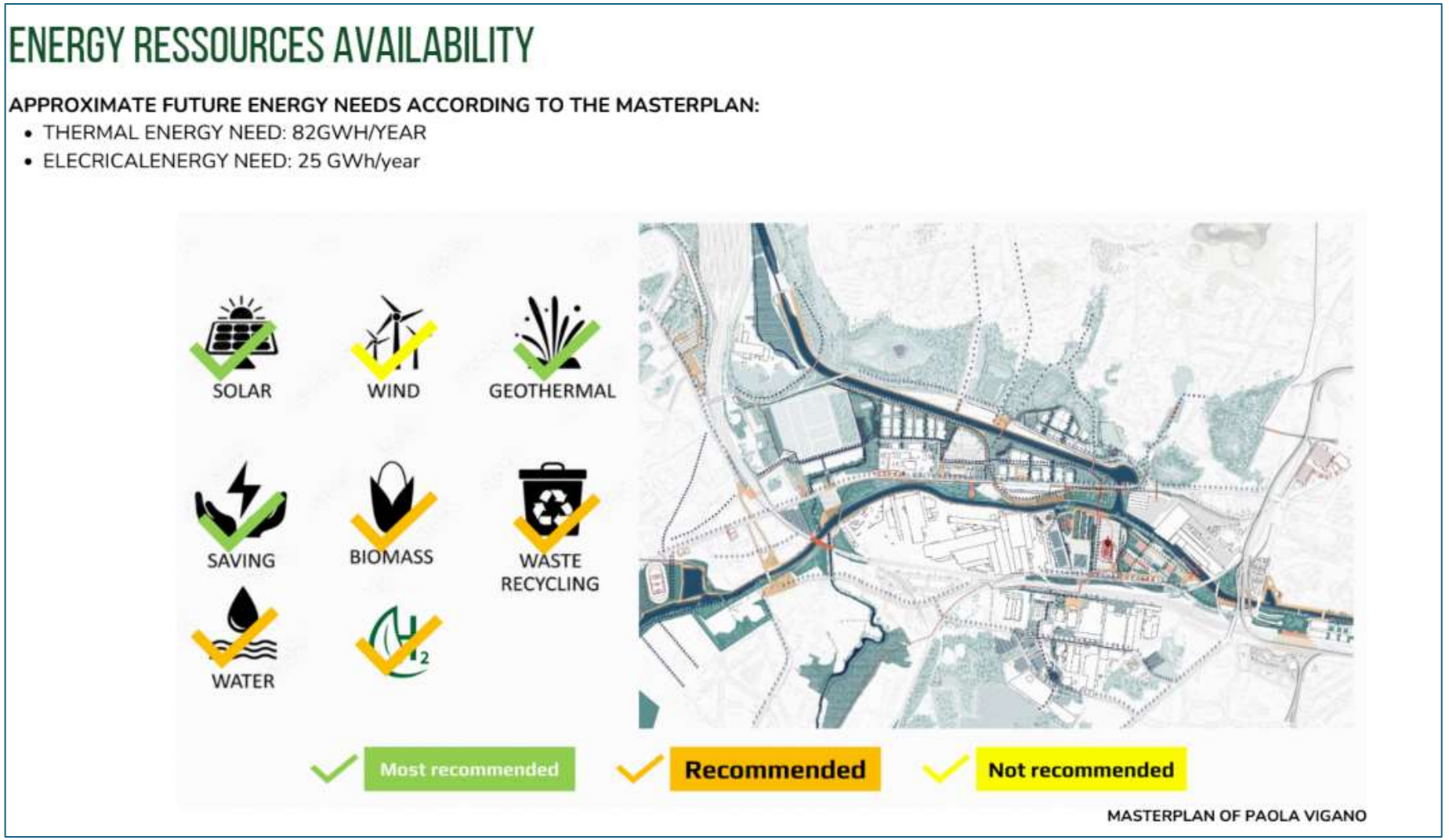


Figure 20. Energy resources availability & approximate future energy needs according to P. Vigano's Masterplan

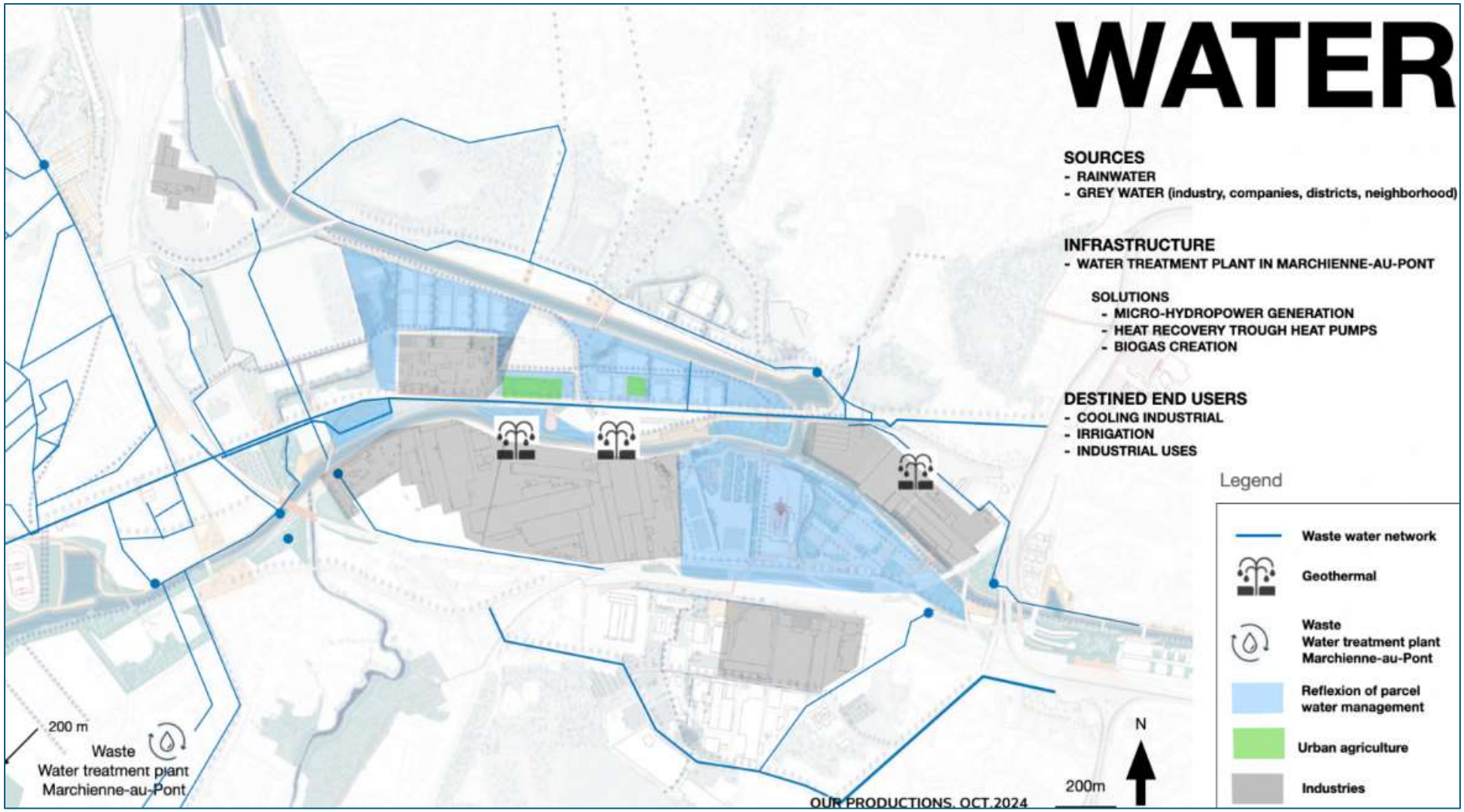


Figure 21. Proposals and strategies for water management

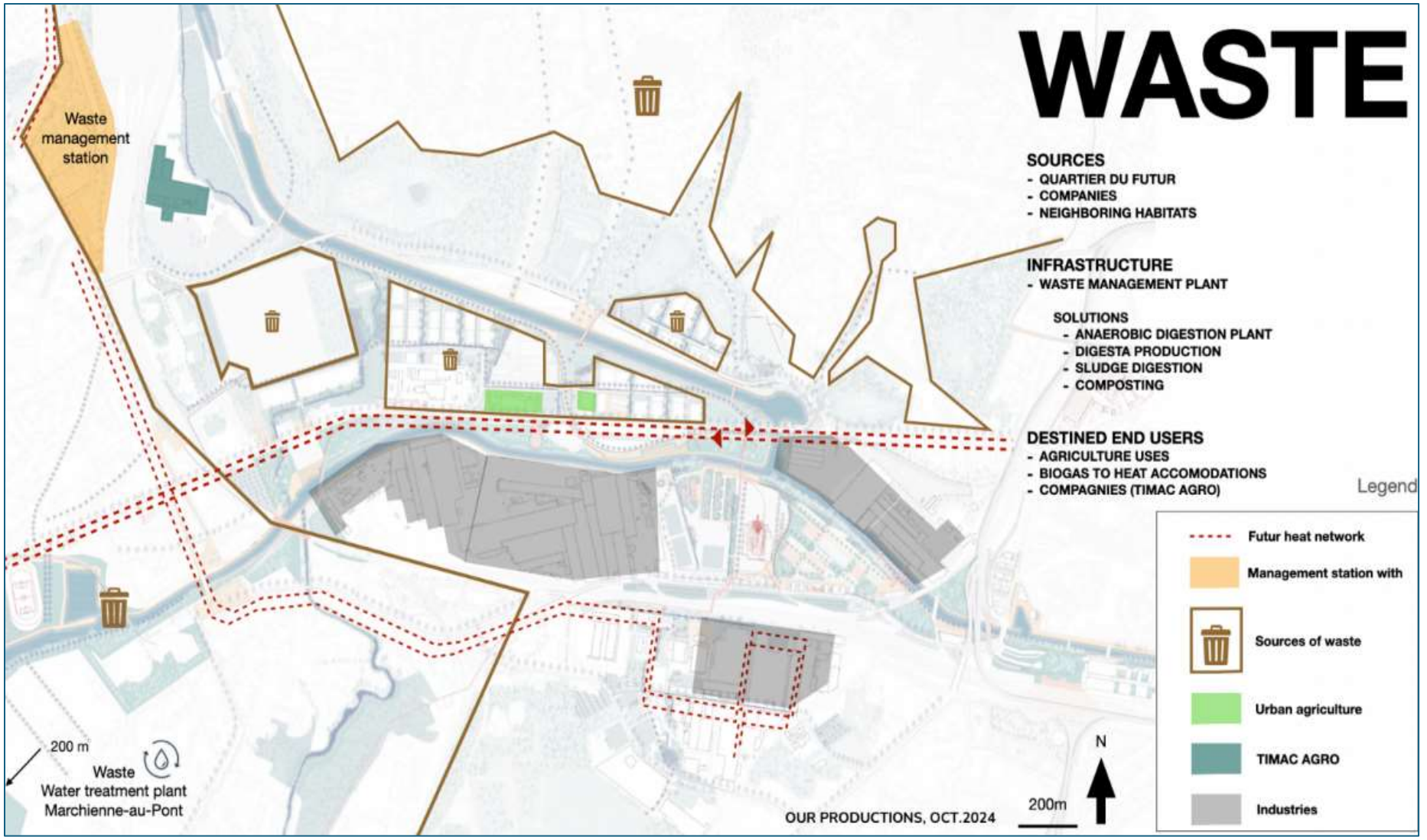


Figure 22. Proposals and strategies for waste management

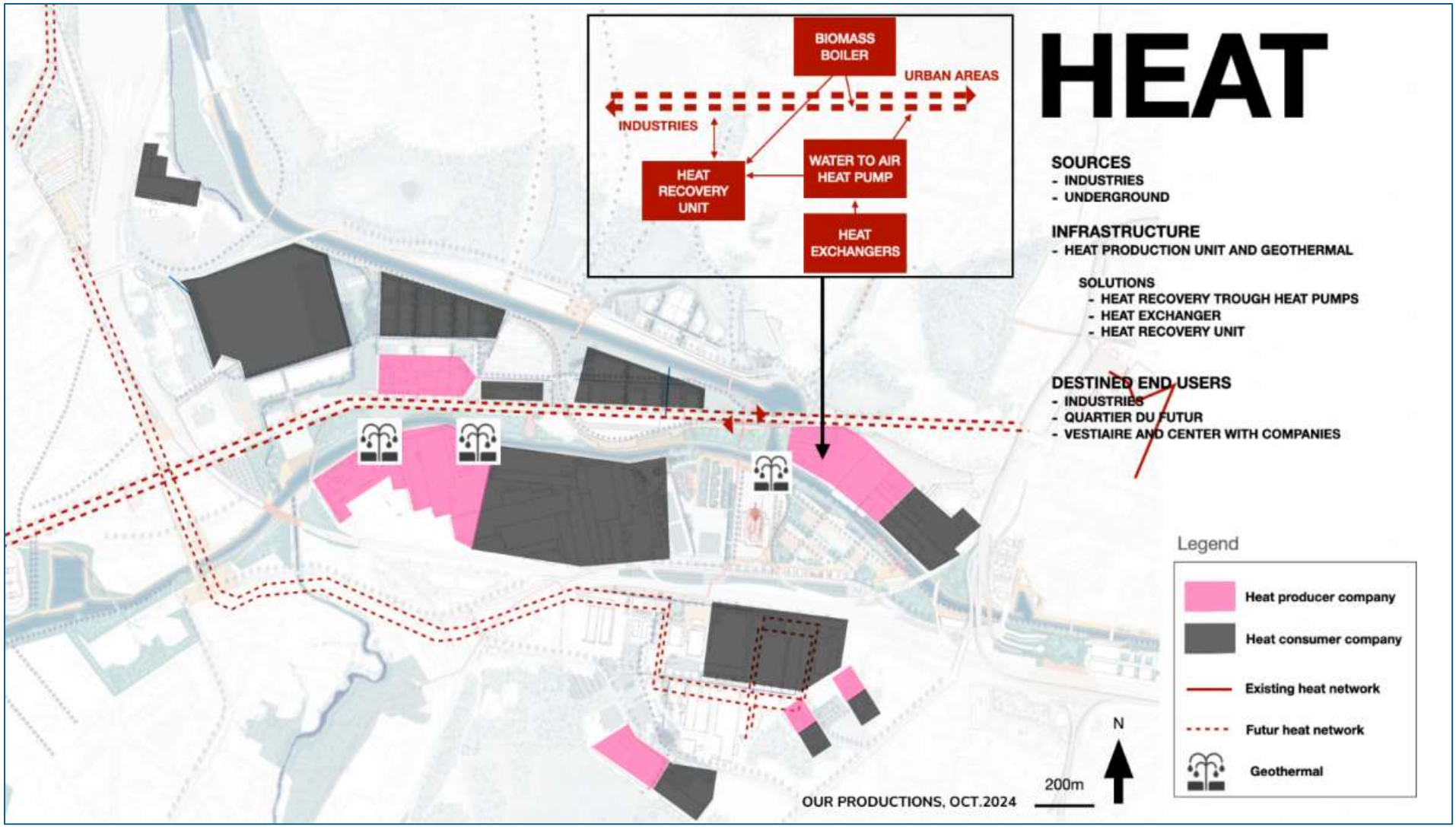


Figure 23. Proposals and strategies for heat management

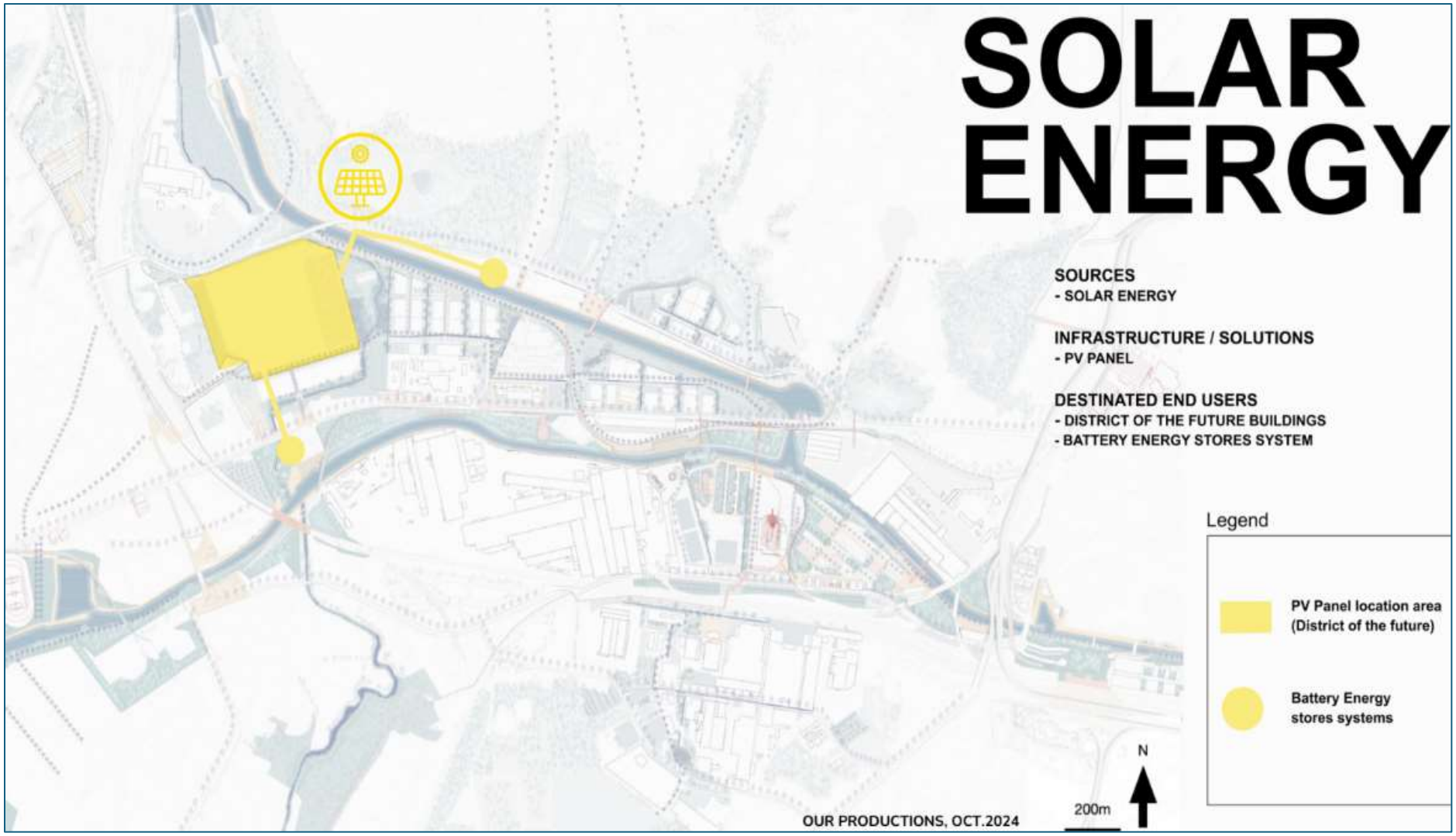


Figure 24. Solar energy management. Proposals and strategies for Porte Ouest

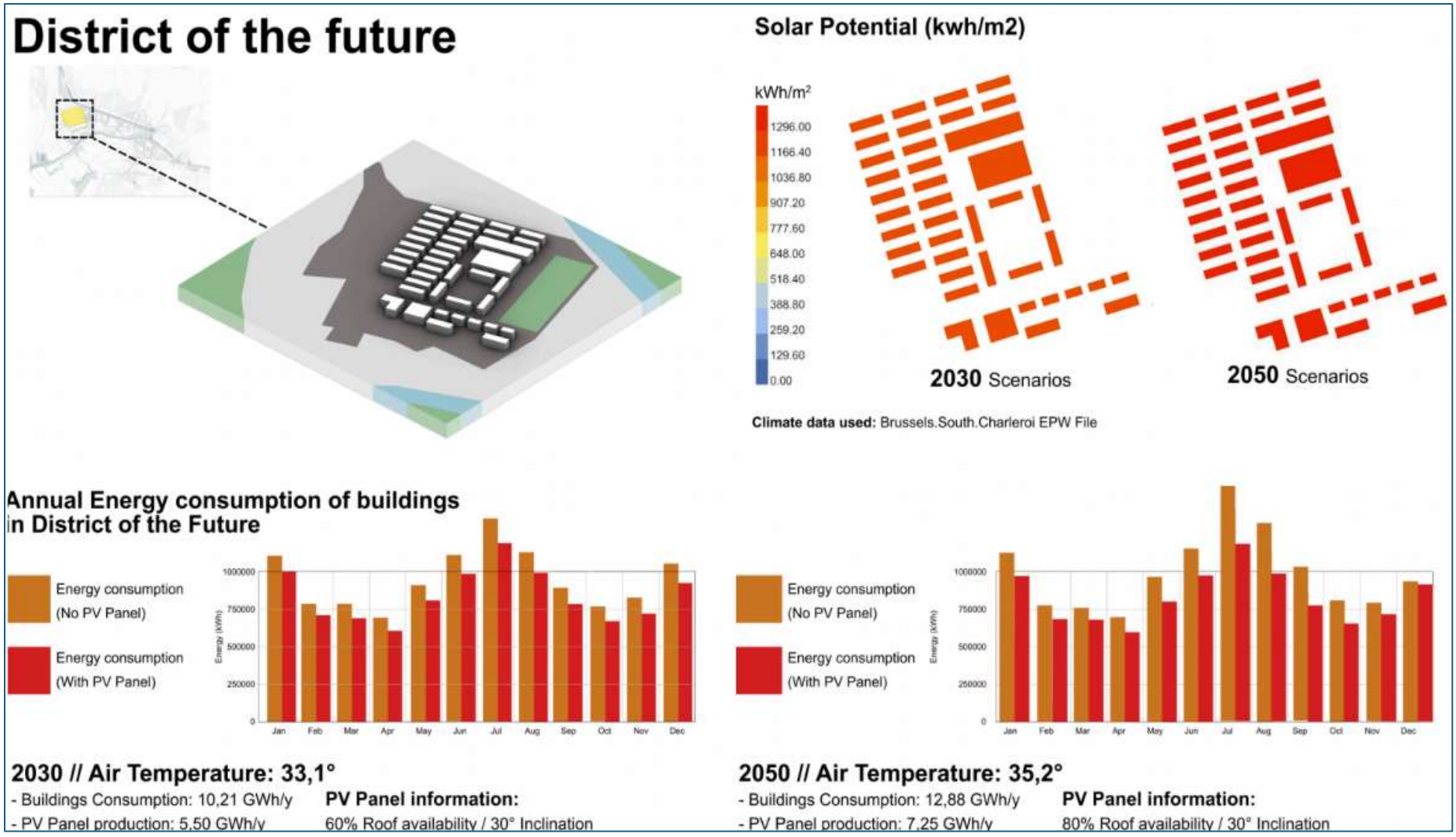


Figure 25. Synthesis of energy management strategies in the Port Ouest

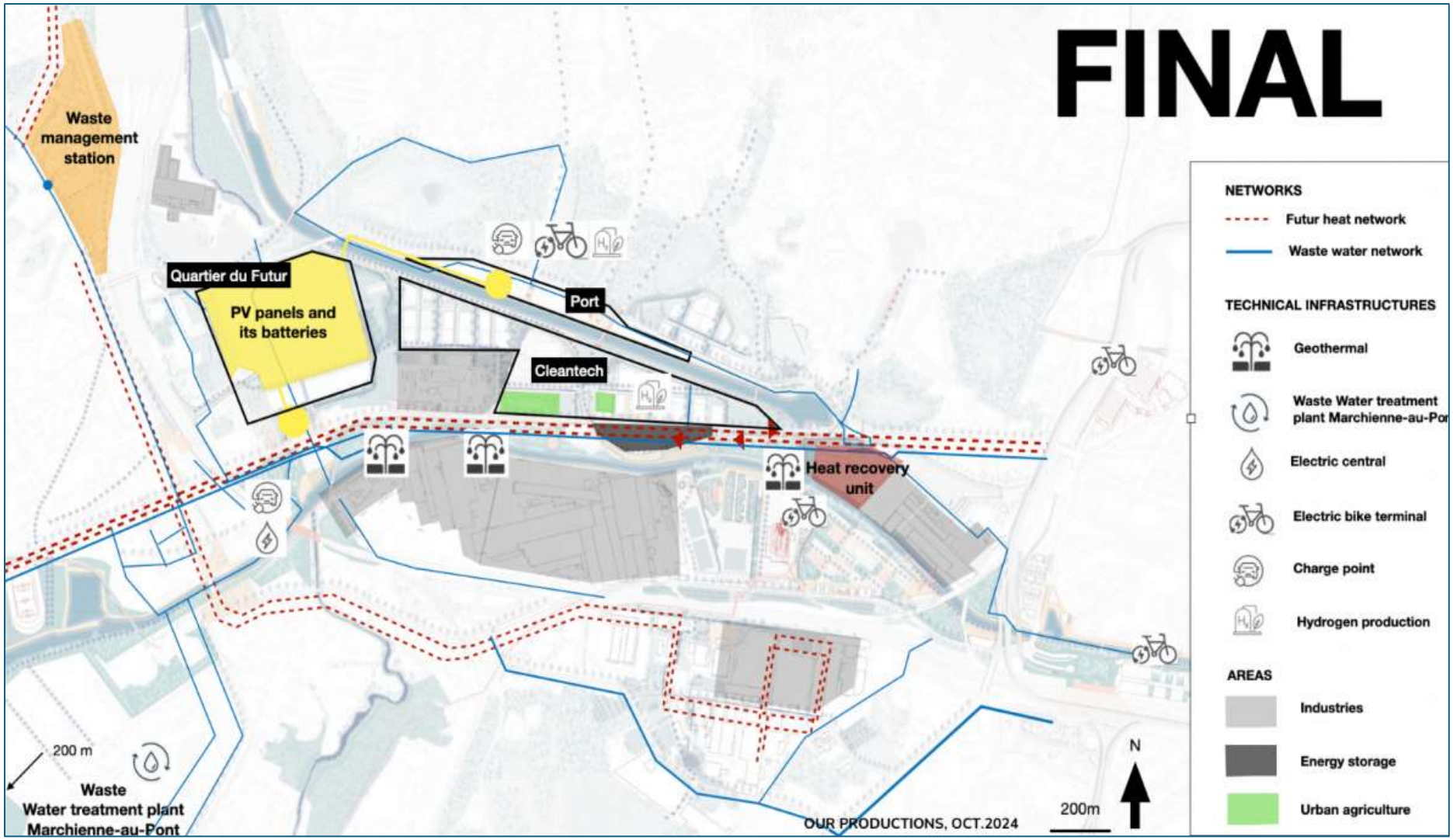


Figure 26. Global perspectives of the energy management initiatives in Porte Ouest

6 SUMMARY AND REFLECTIONS

Among the different challenges faced by participants was dealing with the complexity of the site particularities. Given the scope of the work and the limited time available, the project focuses on a multidimensional strategic analysis of three of the seven pillars of the master plan proposed by Paola Vigano for Charleroi's redevelopment; energy transition, landscape and nature-based solutions, and mobility challenges. Overall, it was a very short time to tackle a project with so many complexities.

From the perspective of the organization and given the scope of the work, the coordination team analyzed and considered the previous experiences of the precedent workshops, and the lessons learned and evaluated them by the needs of complementary ambitions including the previously developed design/planning tools, etc. enabling rich discussions and exchanges between the participants and city actors, nonetheless, the topic analysis required a different set of tools linking design/planning decisions for the cartographical analysis and the various calculations (e.g. energy strategies and management).

Another important challenge during the workshop's week has been as well the development of effective teamwork and the related aspects of communication and crossing disciplines and skillsets to ensure balance and create coherent groups working effectively on the different (or similar as was the case of landscape/environment groups, split in three sub-groups). Moreover, making sure that all of the teams work in a coordinated process and focus on the overall project goals required oversights. During the week, a time at the end of the workday was dedicated to progress analysis from each of the teams (and with all the groups when this was possible) and the staff team (organizers and academic staff from the other partners) to calibrate and re-arrange the work, when needed. However, it has been clear that these types of engagements among the teams occur throughout the workday so that miscommunications do not lead to divergence from the tasks. Probably, a structure with more achievable and smaller goals would have allowed the participants not to be overwhelmed by the proposed tasks.

The workload required by the participants over the working week was considerable with limited time and data available. Given the novelty of the work and the multidisciplinary backgrounds, the solid foundations of the working leadership were sometimes under questioning. At the same time, the invited city actors did not have the opportunity to follow the students' activities regularly apart from the early beginning of the workshop. Nonetheless, different conferences connected to the three work pillars were organized aiming to provide participants with insights into the design solutions and knowledge of the local context, such as:

- District CleanTech, Industrialising innovation for a sustainable transition to address the climate emergency, Mrs. Margaux Monforti

- IGRETEC, Water Energy Nexus, Mrs. Alice Brognaux
- Charleroi Bouwmeester, Porte Ouest Masterplan. Planification évolutive d'un parc métropolitan, Mr. Arthur Hardy

Finally, regarding the organization of the multiplier event, only two keynote speakers (Dr. Etienne Hannon, Belgian Climate Centre and Prof. Jeffrey Raven, New York Institute of Technology) were invited to share their experiences, which was not sufficient to expand the networking for future synergies and project continuity.

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