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CROSS ME IF YOU CAN

approach to CO2 through mobility in the areas of cross-border regions

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abstract

Cities are responsible for a great amount of CO2 emissions related to transportation (CBS). However, the greatest amount of CO2 is caused by private transport and is mainly associated with peri-urban (the peri-urban area is a common place to live for the natural environment and also near accessibility to city facilities) and rural areas due to the lack of public transport, proximities to Services of General Interest (SGI) and access to jobs. This problem is especially evident in the cross-border regions.

When zooming in on North-West Europe, more specific issues around transport, mobility and battling CO2 arise. The European railway network, which spreads across national borders, is a patchwork filled with gaps around those national borders. Considering that a large share of the European Union's territory consists of border regions and includes more than one-third of the EU's population, this fact is rather alarming (European Mobility Atlas, 2021). The spatial vision and strategy presented in this report will focus on the challenge of carbon emissions caused by the transport and mobility sector with a focus on cross-border and last-mile connectivity of peri-urban areas.

The region of Maas-Rijn is used as a case study. This project explores how the region can become a place where what is not in your direct vicinity, is still within reach in the next 30 years. In saying this, the project is not only referring to physical proximity to amenities, services and (infra) structures but also to the possibility of accessing job opportunities, education, social networks, communities and other intangible resources.

Based on our analysis, the relevant trends and values are identified for a region covering three different scales: Local scale within national borders, Cross-border scale, and Multi-nation/ European scale. Key findings emphasize the role of enhancement of short-distance transport trips, the reduction of motorized vehicle use of any kind by promoting development aimed at close proximity to physical and intangible resources and promoting the use of active/ non-motorized modes of transport of any kind. More medium and long-distance/ not daily movements will be replaced by the use of sustainable alternatives, such as EVs, optimized public transport networks and smart sharing systems.

Key words: mobility, CO2, cross-border, sustainable landuse, peri-urban

index

01
problem field

This chapter will provide a contextual framework for the challenge at hand: transport and mobility-related CO2 emissions. The chapter will start by introducing the context of this pressing issue, after which the problem will be analysed in more detail. This problem analysis ends with a visual overview of the identified problem, which will be used as a guide throughout the problem statement. Finally, the central research question and objectives of the project will be clearly stated.

1.1 problem context

Human action is at the forefront of the changing composition of the earth's atmosphere, and therefore the driver of future climate change development. The burning of fossil fuels is the largest contributor to increasing carbon dioxide emissions on a global scale (Hansen et al., 2013). After manufacturing, the transportation sector is the most significant contributor to CO2 emissions in the Netherlands, followed by agriculture and electricity (CBS, 2023). Figure 1 shows that among the carbon emissions associated with transportation, road transport is responsible for over 70 per cent, with more than 60 per cent consisting of emissions that can be associated with the use of cars. This tendency of domestic transport, including private motorized vehicles has been evident since the 1990s (fig. 2). Carbon emissions associated with the transport sector can be caused by a wide variety of challenges.

Page 6 will display an overview of the challenges related to transport on a European scale, focussing on the car sector, the railway network, the maritime sector and the aviation sector (fig. 3; fig. 4; fig. 5 & fig. 6).

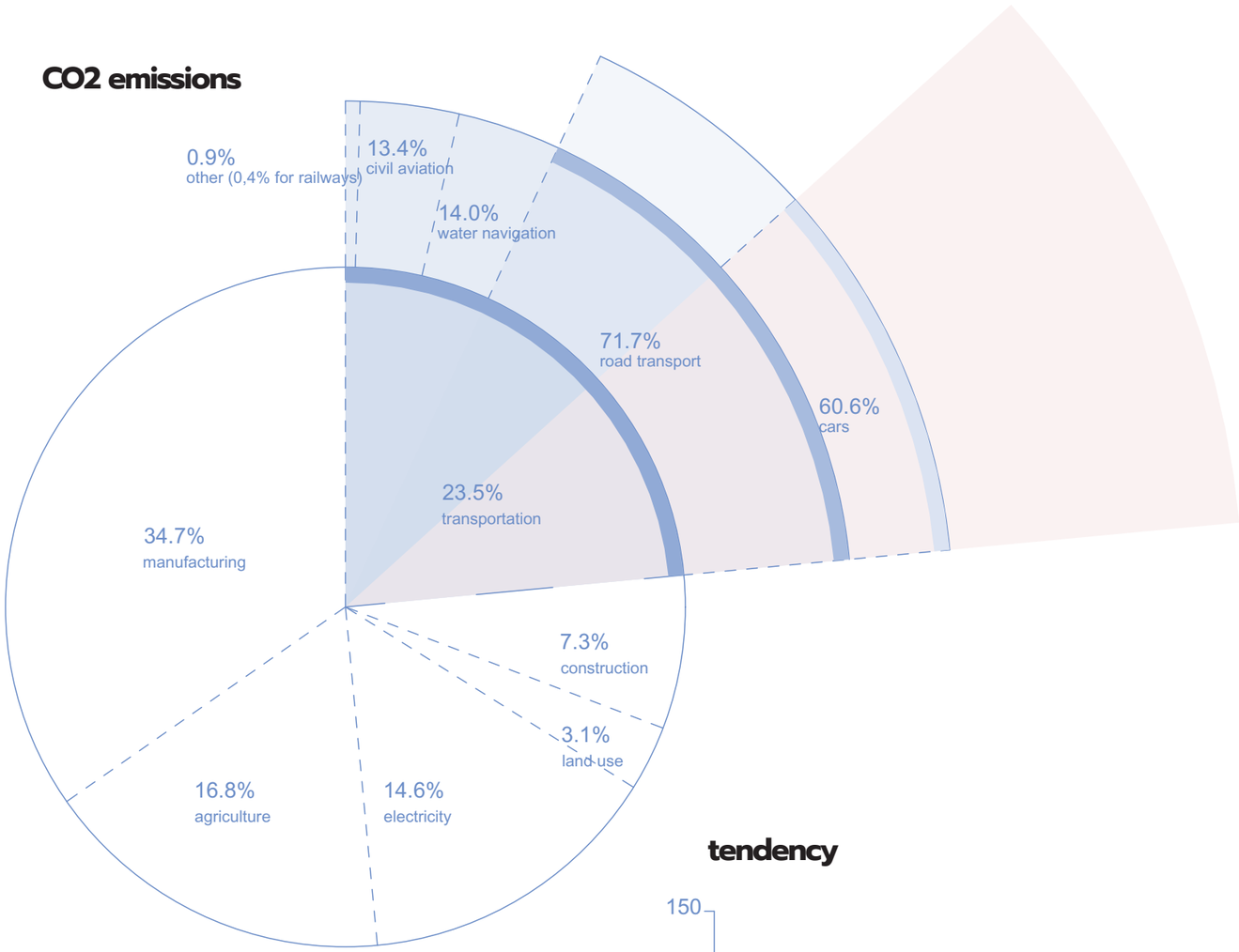


Figure 1. Share of CO2 emissions per sector, with focus on share of emissions within transport sector (Made by authors, 2024; adapted from CBS, 2023 & European Parliament, 2023).

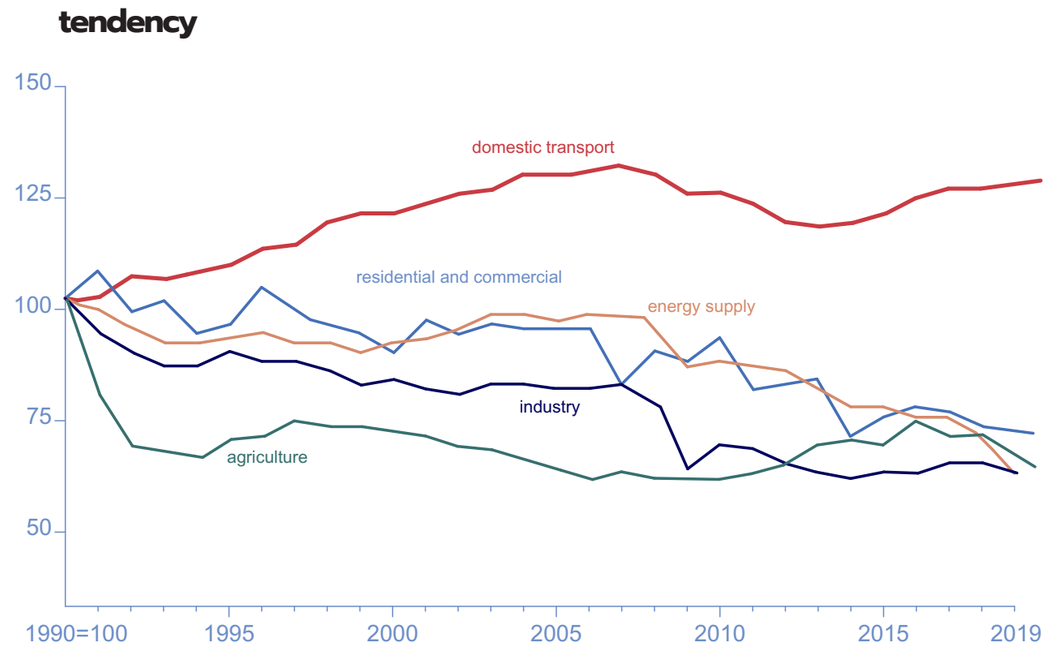


Figure 2. Changens in CO2 emissions per sectore since 1990 (Made by authors, 2024; adapted from EEA, 2022).

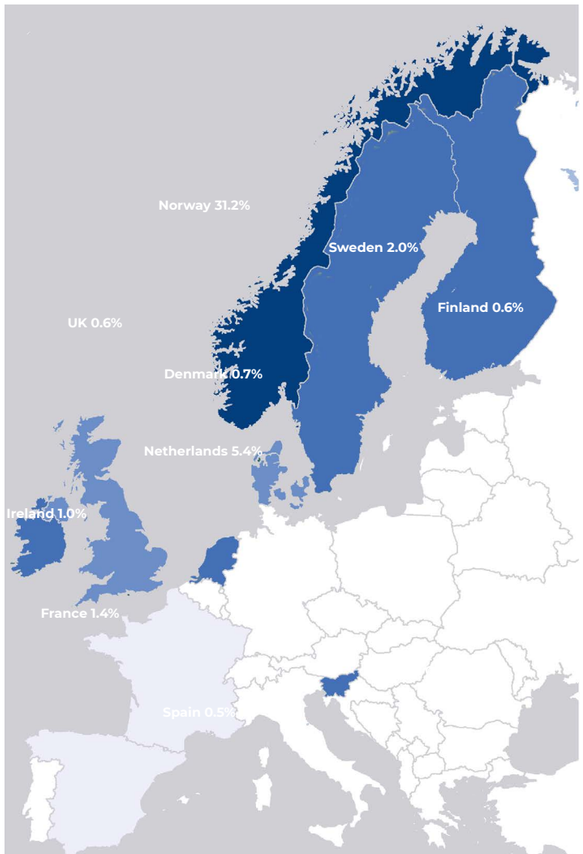


Figure 3. Discontinuation of diesel and gasoline engine sales and market share of electric cars in 2018 (Made by authors, 2024; adapted from Heinrich-Böll-Stiftung, 2021).

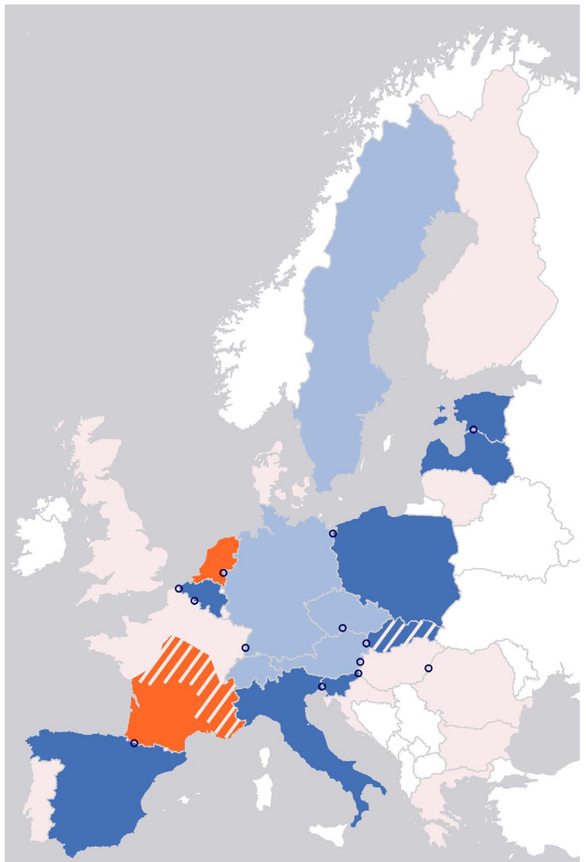


Figure 4. Examples of missing cross-border railway connections in the EU-28 and Switzerland, 2012-2020 & different electrification systems (Made by authors, 2024; adapted from Heinrich-Böll-Stiftung, 2021).

Figure 5. Map of European ports (Made by authors, 2024; adapted from Heinrich-Böll-Stiftung, 2021).

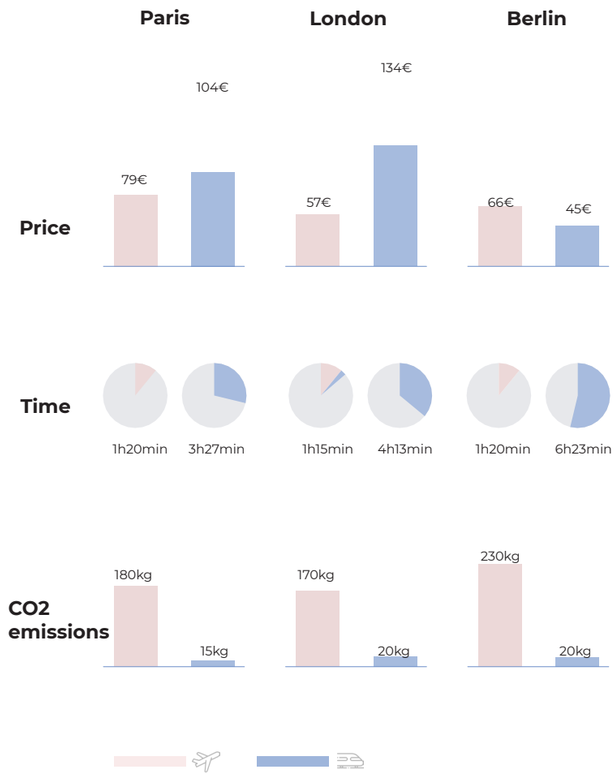


Figure 6. Comparison of ticket price by airplane and train, spent time, and CO2 emissions (Made by authors, 2024; adapted from NOS, 2023).

transformation of car sector

- About 13.8 million Europeans, representing 6.1% of total EU employment, work in the automotive sector.

- If European car manufacturers do not rise to the challenges, they will lose market share. US and Asia are leading the field.

Legend:

- by 2025
- by 2030
- by 2035
- by 2040

transformation of railway sector

- A well-connected cross-border railway system is the backbone of European transnational mobility.

- A core element of this EU policy is the introduction of a single EU-wide rail- way signaling system which goes under the name ‘Europe- an Rail and Traffic Management System (ERTMS)’.

Legend:

- missing cross-borders
- non-electrified
- 25kv, 50Hz AC
- 15kv, 16.7 Hz AC
- 3kv DC
- 1.5kv DC
- 25kv, 50Hz AC + 1.5kv DC
- 3kv DC + 25kv, 50Hz AC

transformation of maritime sector

- The majority of operations in Europe pass through the ports of Rotterdam, Antwerp and Hamburg.

- Maritime transport is the most important, most efficient, but also dirtiest way of shipping goods. Not covered by the Paris Agreement.

- Over 90%t of world trade and 94% of developing country trade is handled by maritime shipping.

Legend:

1. Rotterdam: 14.5 mil containers
2. Antwerp: 11 mil containers
2. Hamburg: 8.8 mil containers

transformation of aviation sector

- Currently, sector is responsible for 5-8% of global climate impact. If unmitigated, will double by 2050 and will be responsible for 1/4 of the global carbon budget under 1.5 degree scenario.

- There are no solutions on the horizon to effectively green aviation, the only way to reduce aviation’s emissions is to reduce air traffic.

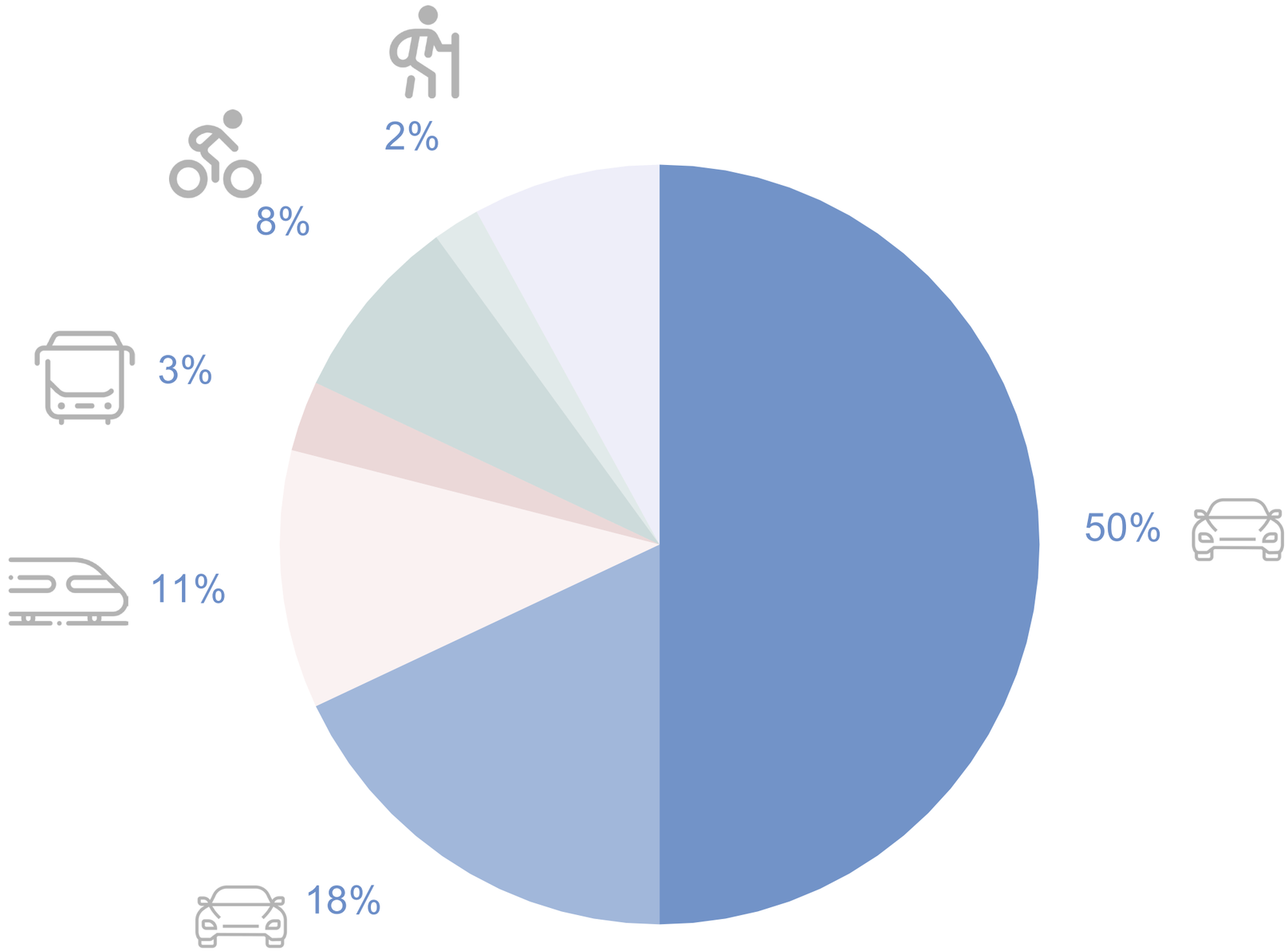
- A key demand is to stop aviation’s regulatory advantages over more sustainable forms of transport and eliminate its tax exemptions.

Legend:

- by 2025
- by 2030
- by 2035
- by 2040

transport in the Netherlands

When further zooming in on the causes of CO2 emissions in the Netherlands, figure 3 clearly shows a trend towards the use of private motorized vehicles, since 68 per cent of kilometres is travelled by car, either as passenger or driver. This might seem rather unexpected, considering the Netherlands is a country where biking is popular, however, this fact further underlines the problem of transport-related CO2 emissions.



13140km travelled per person per year, per mode of transport

Figure 7. 13140 km travelled per person per year, per mode of transport (made by authors, 2024; adapted from Ministry of Infrastructure and Water Management, 2023).

1.2 problem analysis

After providing the general context for transport-related CO2 emissions in North-West Europe and the Netherlands, it is evident that the use of private motorized vehicles is presenting a challenge for reducing CO2 emissions. This next section will dive deeper into the analysis of this challenge within the scope of the Netherlands and its direct borders. The aim of this section is to analyse where the challenge of CO2 emissions related to mobility and transport is most apparent within the Dutch context.

First, it is important to acknowledge the variety of settlement typologies present in the Netherlands and determine whether the settlement type impacts the modes of transport used and therefore the related CO2 emissions. Figure 8 clearly shows a discrepancy between urban areas and peri-urban/ rural areas. The use of public transport is lower in peri-urban and rural areas compared to the urban, whereas the use of the car is considerably higher. This can have a considerable negative effect on the level of accessibility in places and therefore contribute to CO2 emissions associated with the use of private motorized vehicles.

Furthermore, figure 9 visually represents the notion that places on borders experience fewer benefits from neighbouring places, as the border can function as a barrier to accessing amenities, services and other benefits. Border areas can therefore also experience a lack of accessibility and contribute to more CO2 emissions related to the use of private motorized vehicles.

The following sub-sections will uncover the dynamics at play in the mobility and transport sector in the Netherlands and the related CO2 emissions, especially considering the peri-urban and border areas. First, evidence will be presented regarding the accessibility to both public transport and amenities to understand which places might lack accessibility to services and amenities in the Netherlands. Next, the possible consequences of this lack of accessibility will be explained, including the intensity of road network use, the use of private motorized vehicles and the associated CO2 emissions from vehicles. Finally, an analysis of a selection of relevant conditions will be presented that can impact the accessibility of places in border regions of the Netherlands, including language, the number of commuters and population decline.

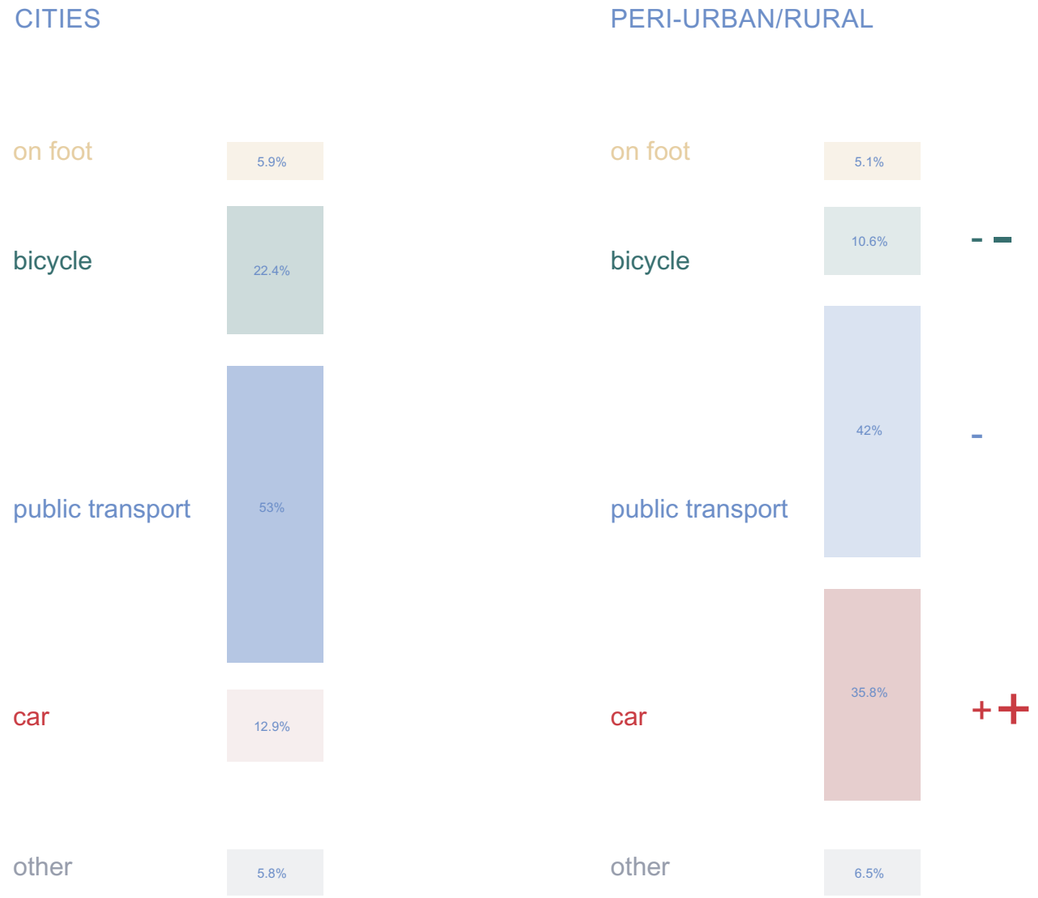


Figure 8. Share of transport modes in cities and peri-urban/ rural areas (made by authors, 2024; adapted from Heinrich-Böll-Stiftung, 2021).

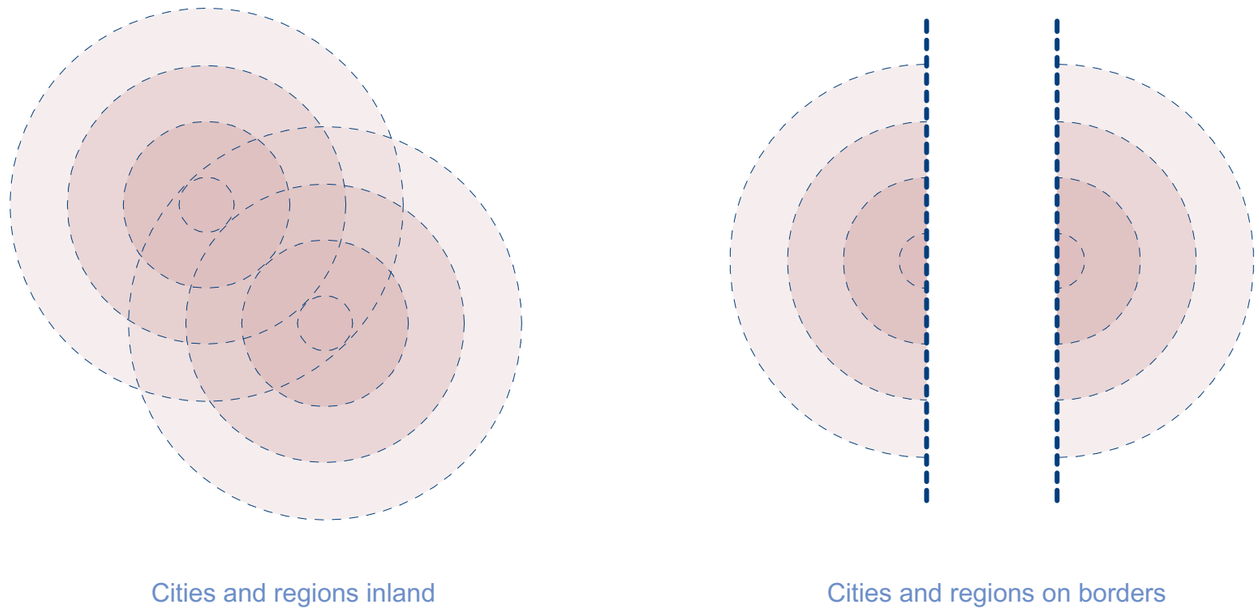


Figure 9. Agglomeration benefits of cities and regions inland and on borders (made by authors, 2024; adapted from Marlet et al., 2014).

evidence:
accessibility to public transport

This map (fig. 10) shows whether public transport stops are in reach within 400 meters walking from any given building. From this analysis, we can establish a difference between urban, peri-urban, and rural areas. The urban centres present a much higher rate of access to public transport than the non-urban areas.

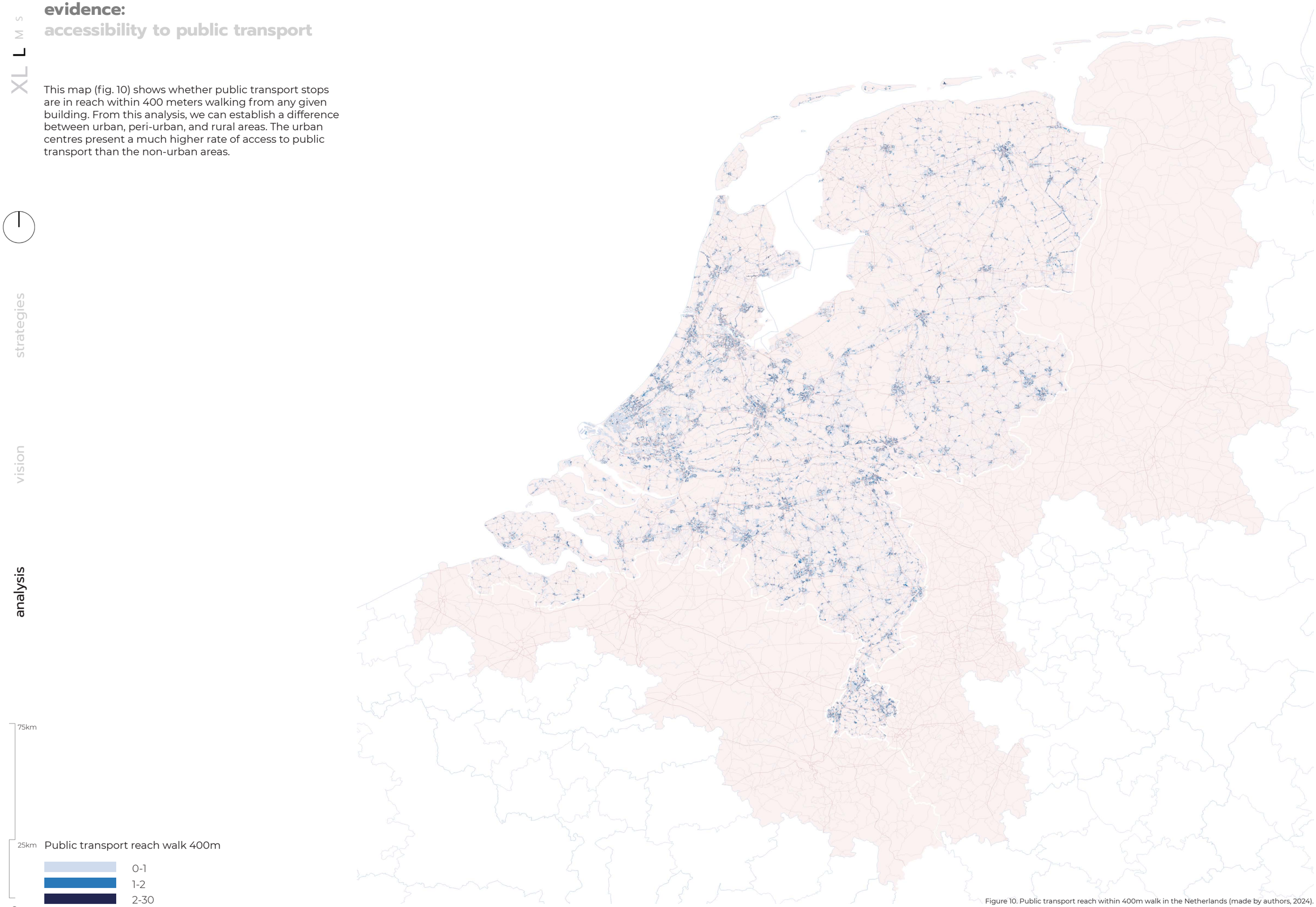


Figure 10. Public transport reach within 400m walk in the Netherlands (made by authors, 2024).

evidence:
accessibility to amenities

Figure 11 presents a spatial overview of where amenities are located and further emphasizes that there is an obvious discrepancy between the urban, peri-urban and rural areas. Amenities are clustered in the urban centres. and much more dispersed outside the urban areas.

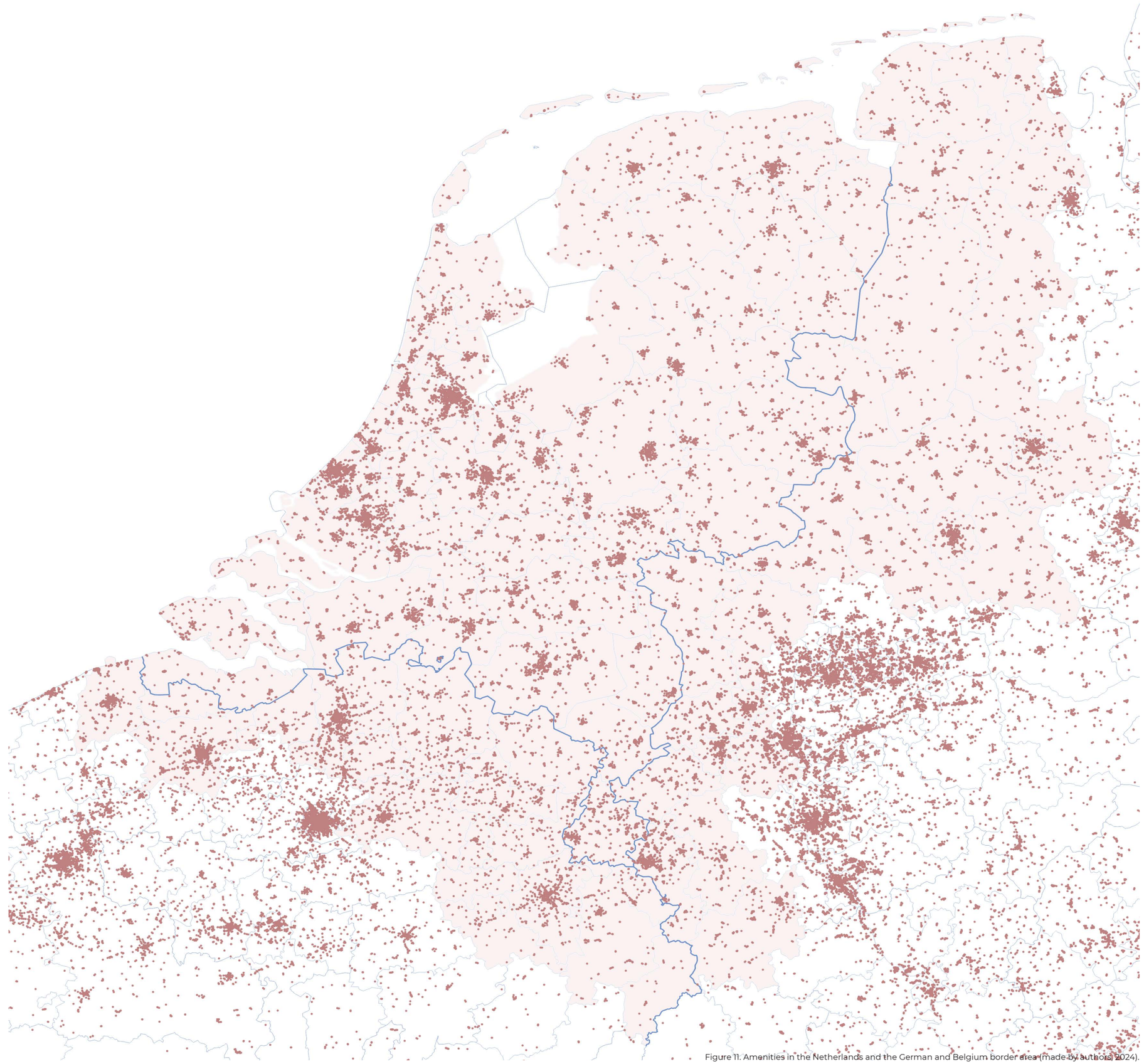


Figure 11. Amenities in the Netherlands and the German and Belgium border area (made by authors, 2024).

consequences:
road accessibility

The relative lack of amenities in peri-urban and rural areas and the limited access to public transport have consequences for the need for and modal choice of transport. Figure 12 presents the intensity with which the road infrastructure is used. A significant number of peri-urban and rural areas experience a high-intensity use of the road network.

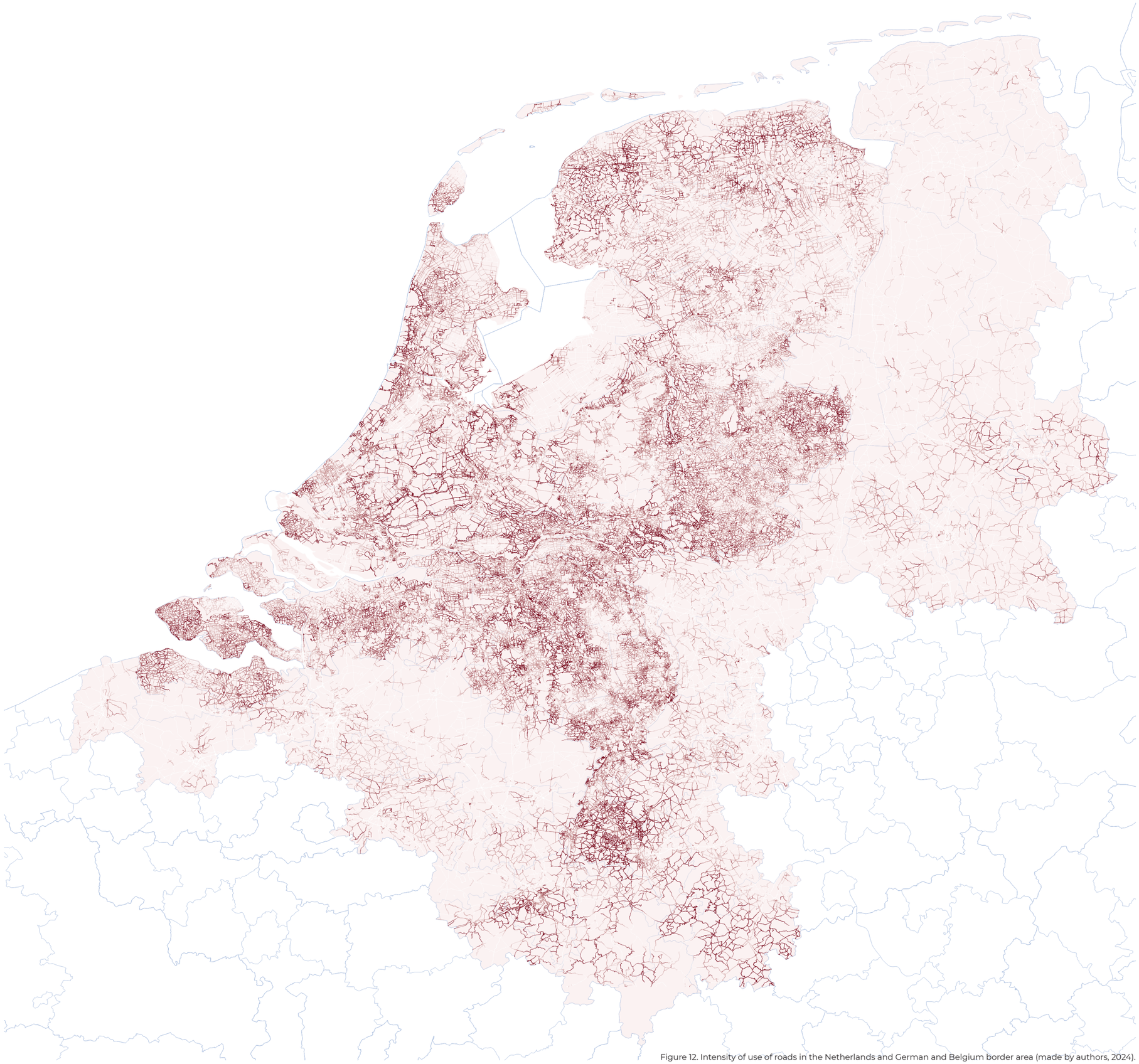


Figure 12. Intensity of use of roads in the Netherlands and German and Belgium border area (made by authors, 2024).

consequences:
higher use of motorized private transport

This high-intensity use of the network is confirmed by the number of passenger cars per capita (fig. 13). Especially in the border areas a relatively high number of cars per capita can be observed.

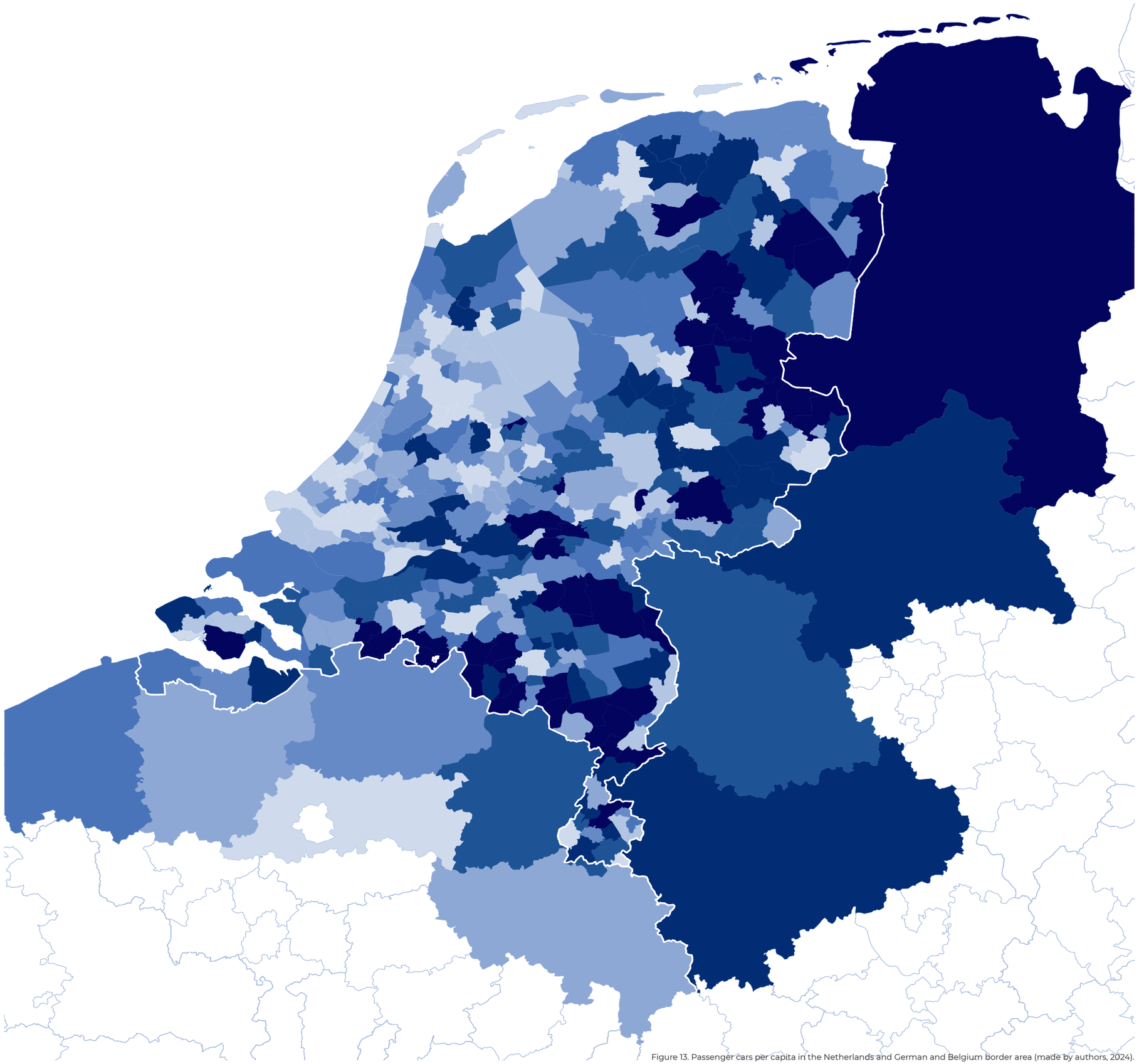


Figure 13. Passenger cars per capita in the Netherlands and German and Belgium border area (made by authors, 2024).

consequence:
higher CO2 emissions from vehicles per capita

Another consequence of the lack of accessibility to amenities and public transport is the CO2 emissions associated with the use of vehicles. Figure 14 presents a great variety of vehicle-related CO2 emissions throughout the Netherlands and its border regions.

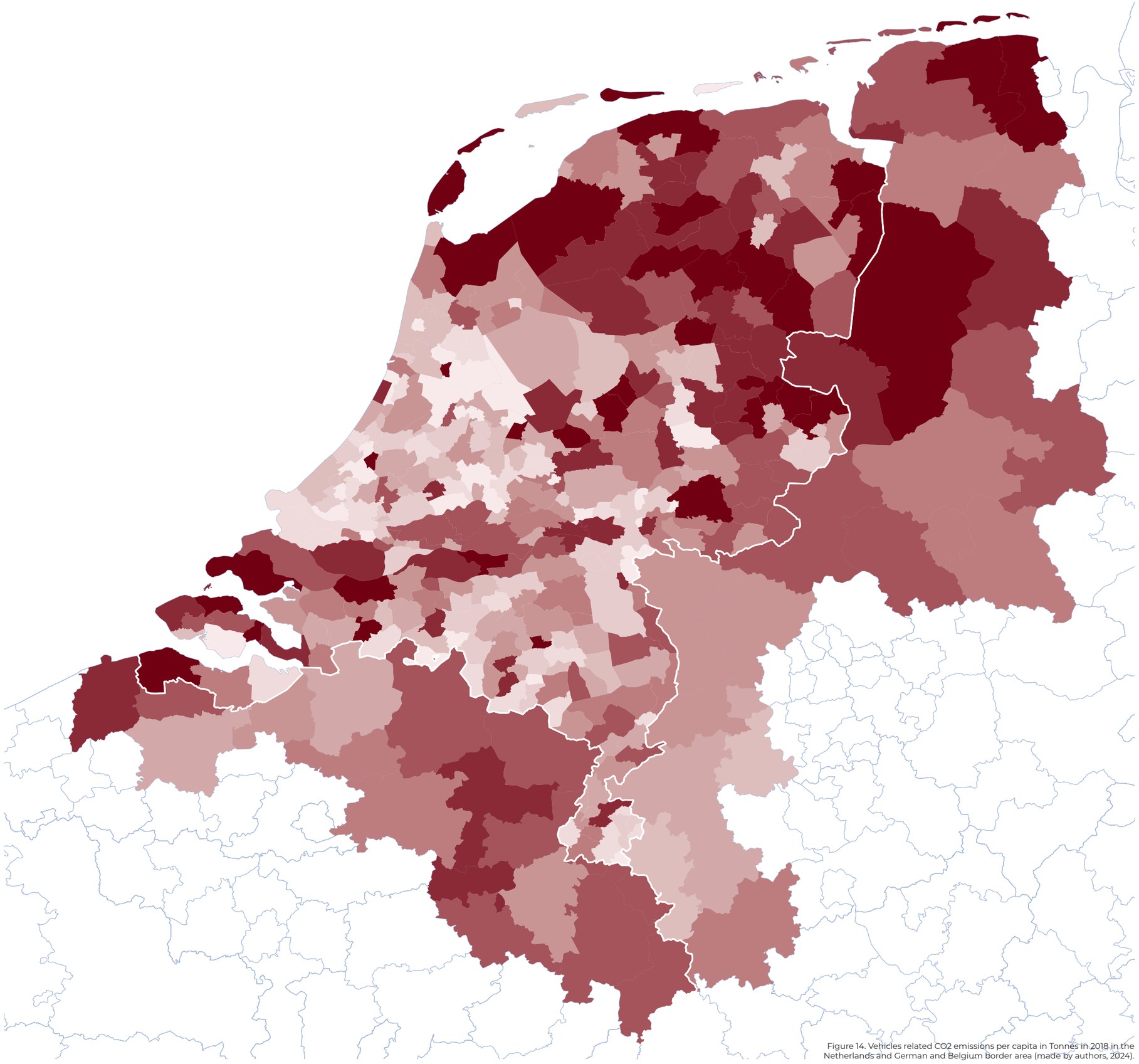


Figure 14. Vehicles related CO2 emissions per capita in Tonnes in 2018 in the Netherlands and German and Belgium border area (made by authors, 2024).

condition:
cross-border commuters

After exploring the issue of CO2 emissions related to motorized vehicles as a result of a lack of access to amenities and public transport, which seems to be more pressing in cross-border and peri-urban and rural areas, some relevant conditions will be explored to get a better understanding of the dynamic that is at play in these areas. Figure 15 shows the difference in job opportunities when considering the opportunities across borders. This can potentially explain the level of cross-border commuters between the Netherlands, Germany and Belgium (fig. 16). This condition of high levels of cross-border commuting provides further relevance for the CO2 issue at hand.

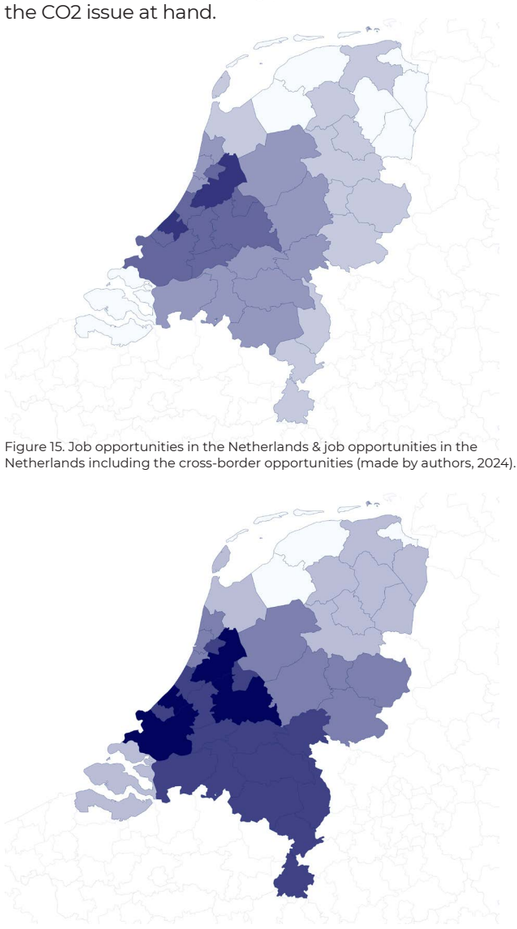


Figure 15. Job opportunities in the Netherlands & job opportunities in the Netherlands including the cross-border opportunities (made by authors, 2024).

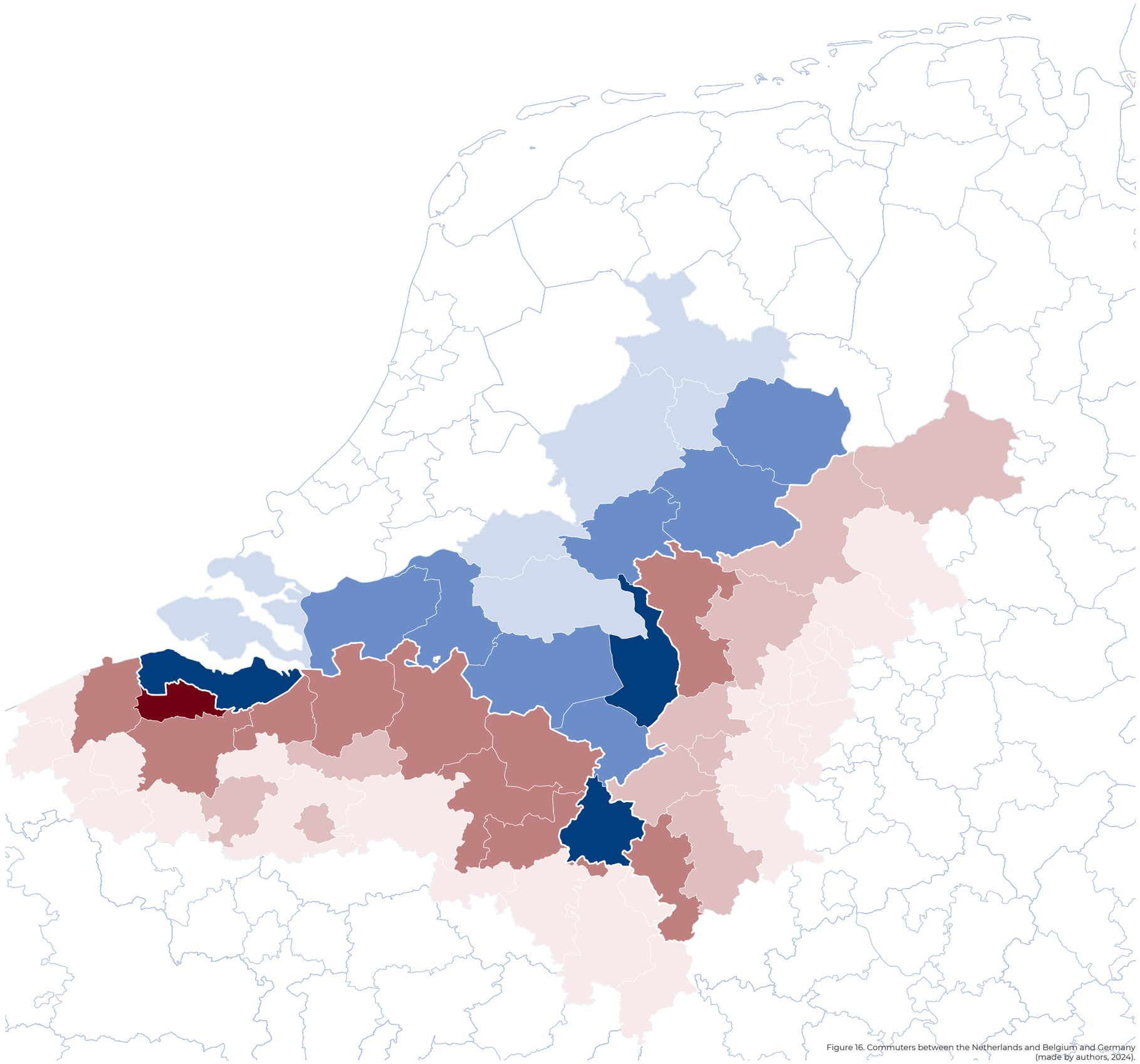


Figure 16. Commuters between the Netherlands and Belgium and Germany (made by authors, 2024).

condition:
population decline

Another relevant condition is the measure of population decline in the Netherlands (fig. 17). Population decline can potentially result in less investment in public transport infrastructure as the investment might serve a growing area elsewhere more.

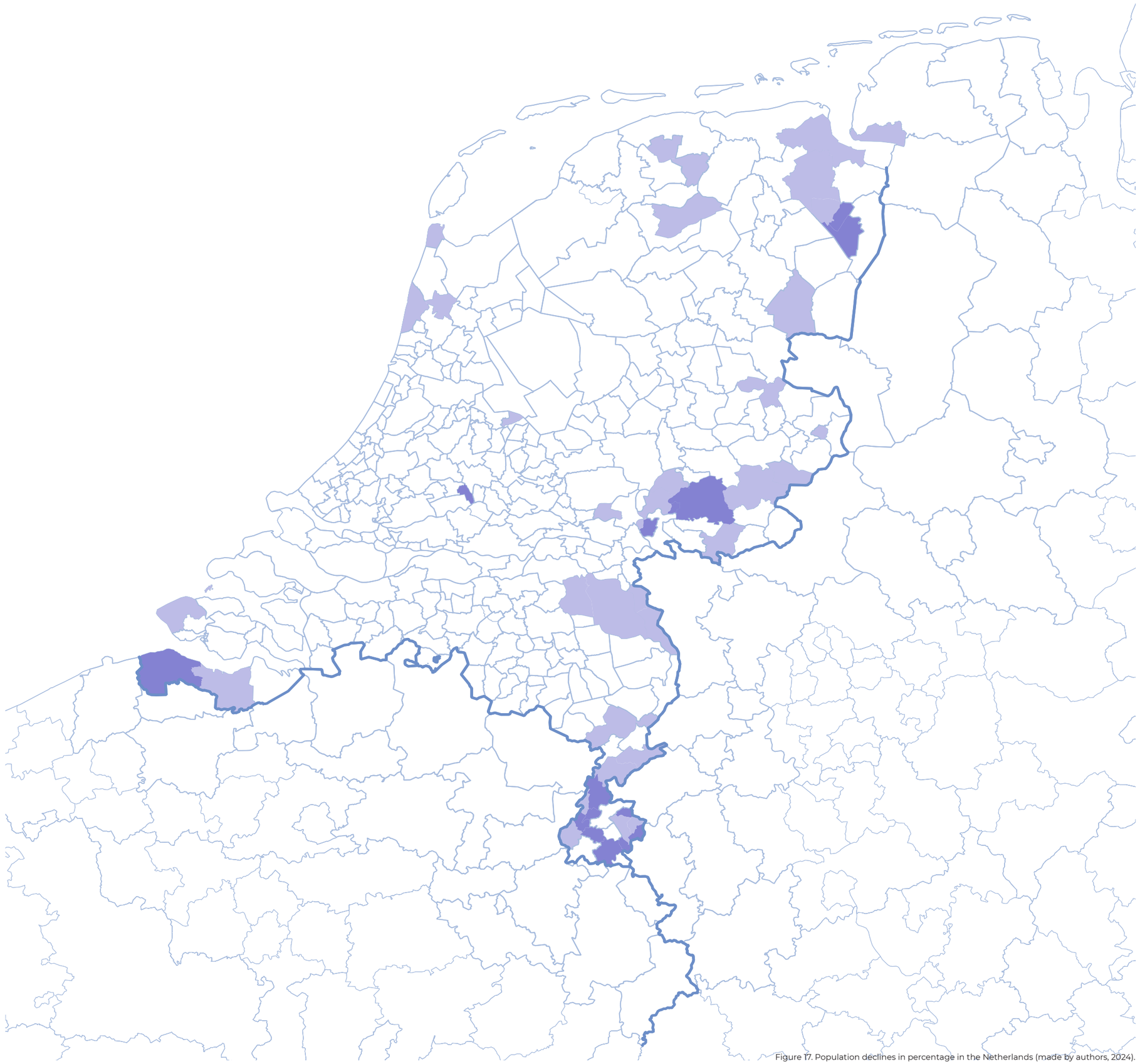


Figure 17. Population declines in percentage in the Netherlands (made by authors, 2024).

condition:
language

Finally, the languages spoken in the Netherlands and its border regions with Germany and Belgium are an important condition when it comes to accessibility in cross-border regions, as language can present a barrier in terms of bureaucratic matters. Figure 18 presents an overview of the spoken languages.

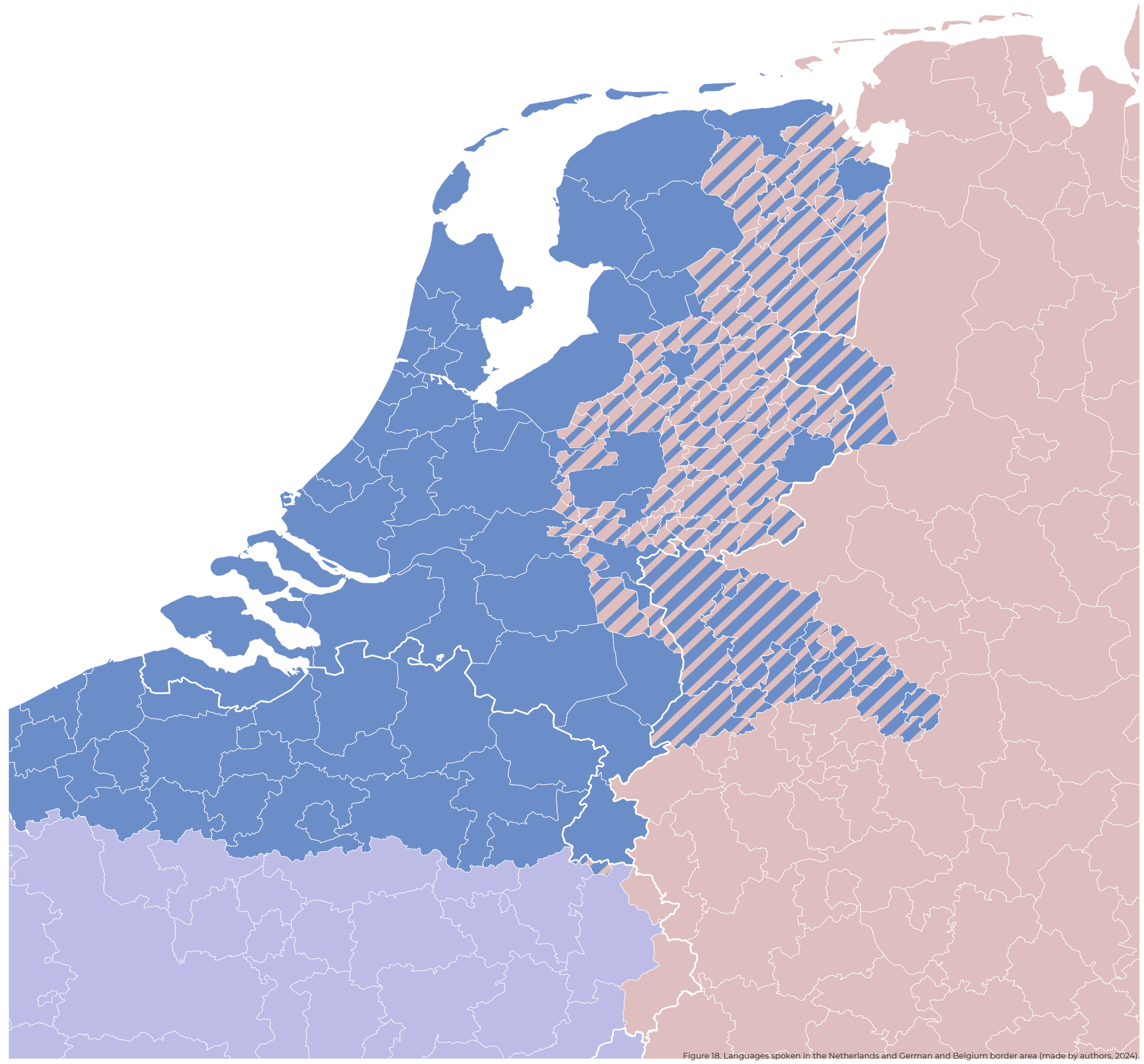


Figure 18. Languages spoken in the Netherlands and German and Belgium border area (made by authors, 2024).

summary problem

After analysing the problem of accessibility to amenities and public transport, the negative consequences of transport-related CO2 emissions and the conditions that can have an impact on this dynamic in cross-border areas, figure 19 presents a visual overview of the summary of this analysis. The interdependence of the evidence, consequences and conditions is highly relevant in this scheme.

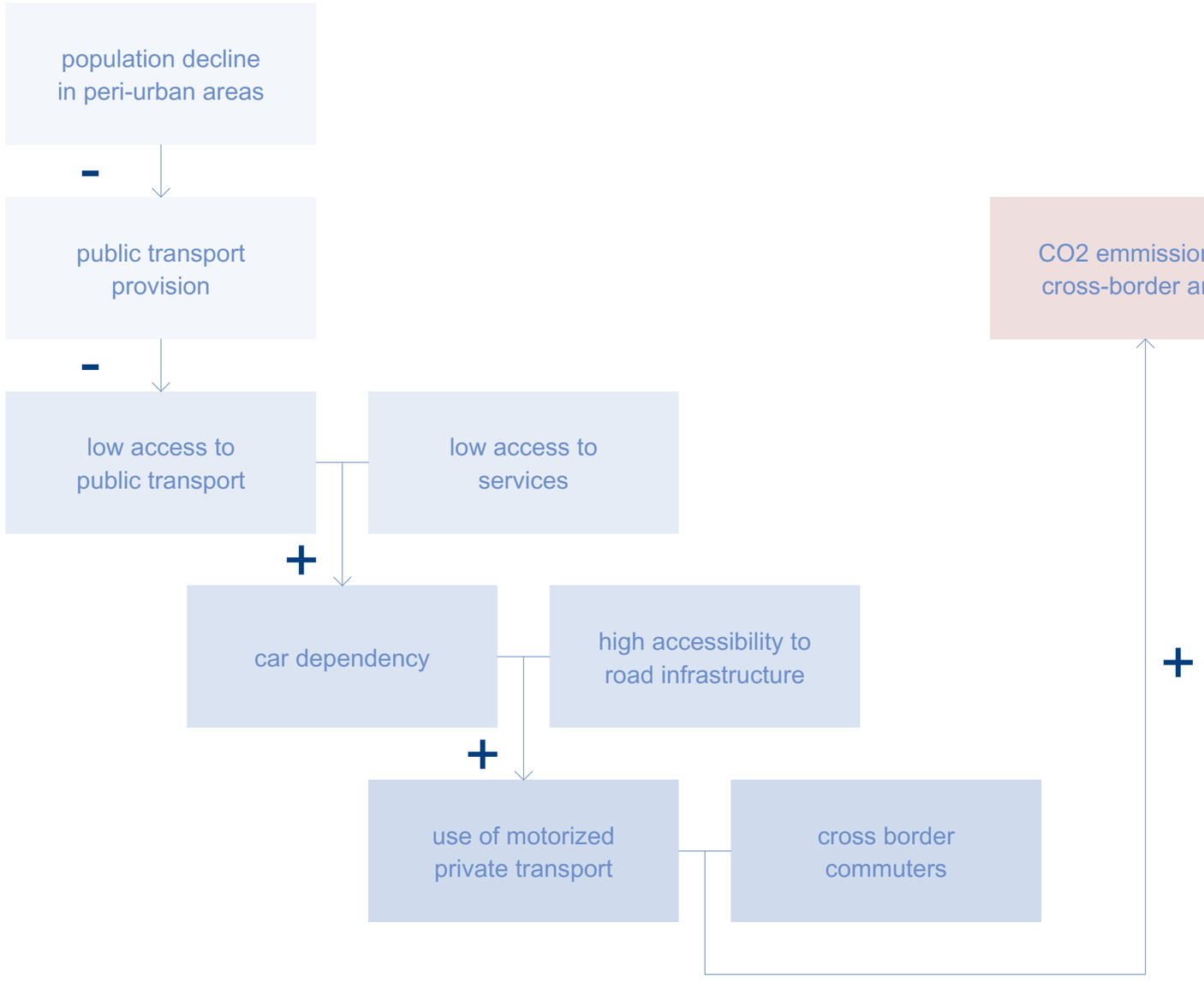


Figure 19. Visual summary of the different components of the problem analysis (made by authors, 2024).

spatial context of problem

Establishing and summarizing the problem around transport-related CO2 emissions in the Dutch context has uncovered the relevance of cross-border and peri-urban areas. Based on the analysis, these areas are more vulnerable due to the lack of accessibility to amenities and sustainable (public) modes of transport.

The next step is to identify more specific areas in which the identified problem is most prevalent. Figure 20 shows a first draft of overlapping the hand-drawn versions of various elements of the analysis. At first glance, the regions along the border seem to deal with multiple factors. The remainder of this section will elaborate on this.

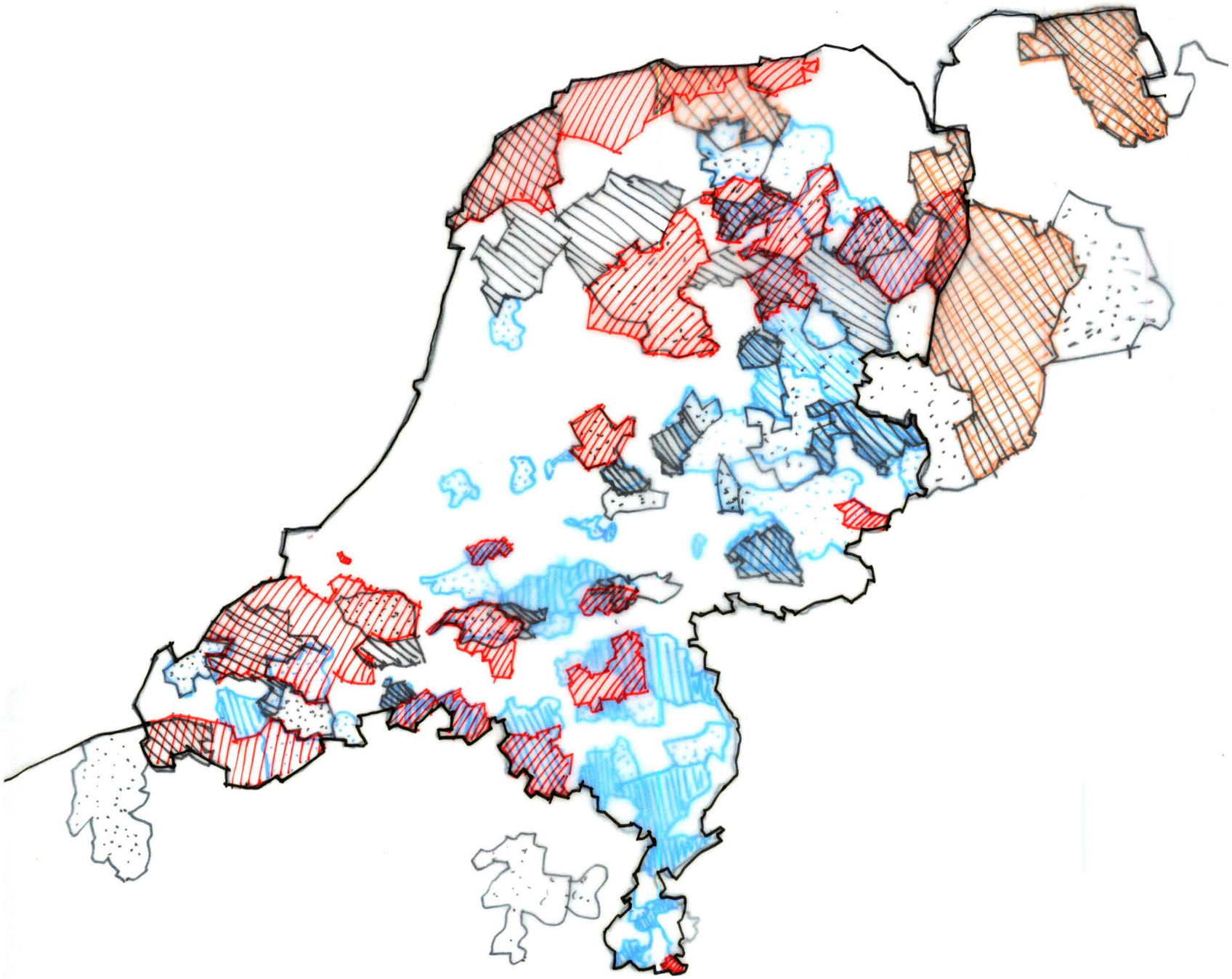


Figure 20. Hand drawn overlap of various elements of the problem analysis (made by authors).

cross-borders regions

To establish a more specific area of interest, an existing classification of the cross-border regions around the Dutch and German and Belgium border is shown in figure 21. The Euregions can potentially provide a specific, already existing, administrative region, for which a vision and strategy can be developed.

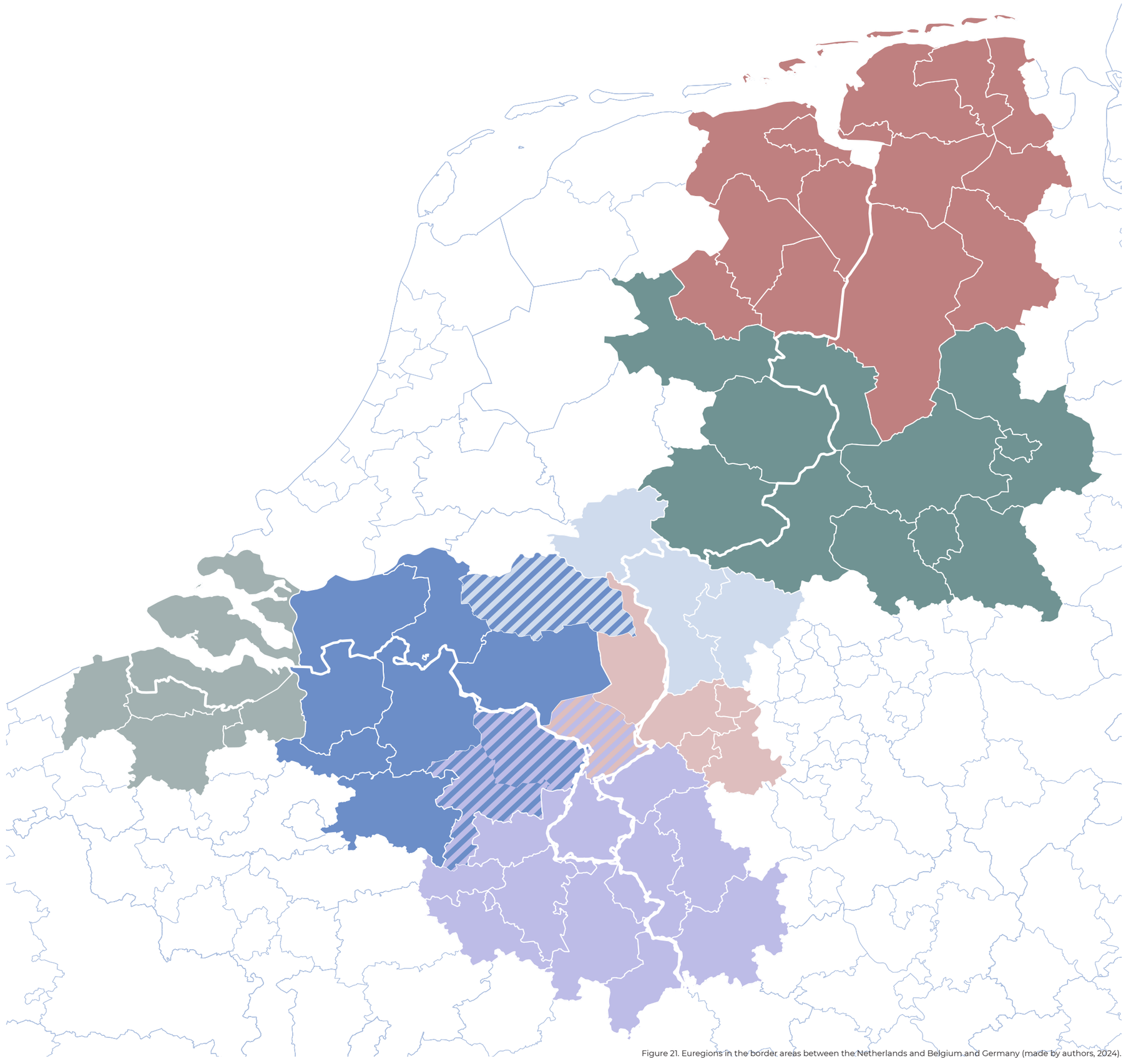
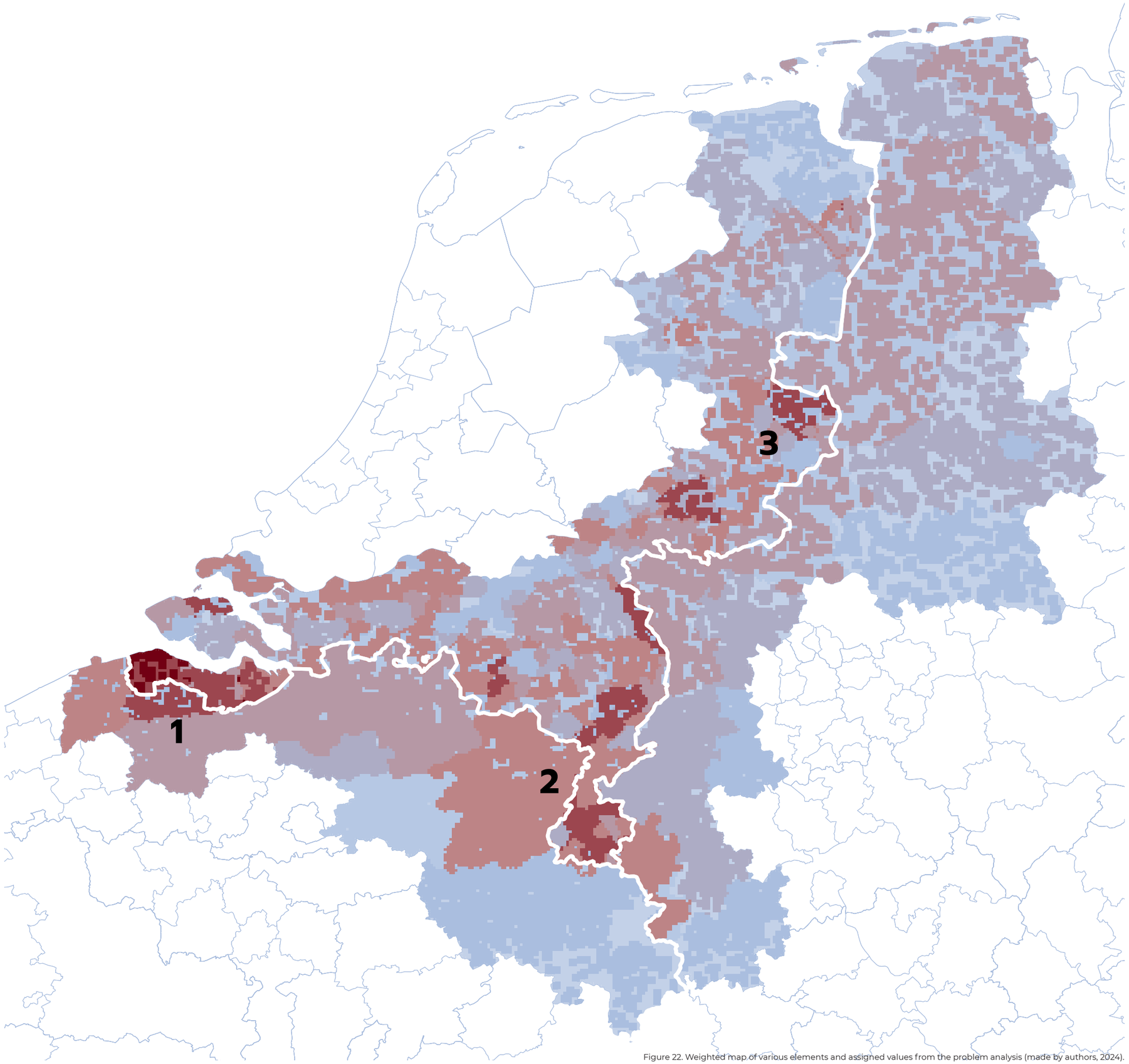


Figure 21. Euregions in the border areas between the Netherlands and Belgium and Germany (made by authors, 2024).

weighted map

The cross-border Euregions provide an outline for exploring in which area the transport-related CO2 emissions due to a lack of accessibility are most pressing. Figure 22 presents an analysis in which a value was assigned to various parameters to uncover areas of interest. Three rather clear areas arise from this analysis, one of which will be selected. Chapter 3 will present an exploration of the selected area of interest for the vision and strategy-making process.



75km
25km

Weight parameters and values

Peri-urban: 2
CO2 cars emission PC: 2
Average train distance: 2
Commuters: 1.7
Cars per capita: 1.5
Population decline: 1.5

Figure 22. Weighted map of various elements and assigned values from the problem analysis (made by authors, 2024).

systemic section
current situation

To finalize the problem analysis carried out in this chapter, figure 23 presents a systemic section on the dynamics of mobility and transport-related CO2 emissions. The section includes a focus on the difference between different types of areas in a cross-border context.

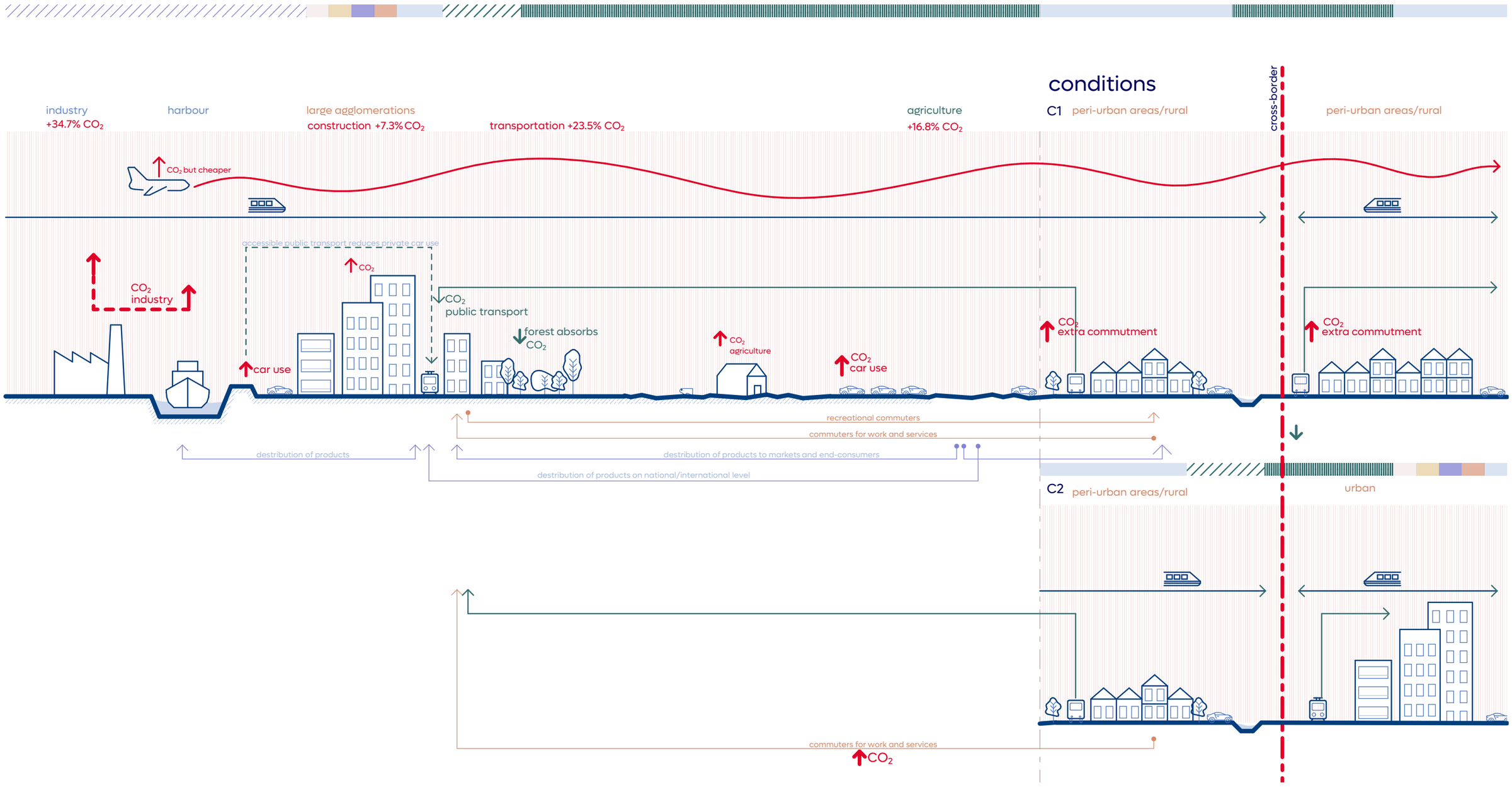


Figure 23. Systemic section of the current situation around transport related CO2 emissions in a cross-border, peri-urban context (made by authors, 2024).

1.3 problem statement

The free movement of people, goods, capital, and services as established in the Treaty of the Functioning of the European Union (European Parliament, 2023), gave way to the invention and development of contemporary modes of transport. However, the duplicity of this trend of mobility and transport development is becoming more apparent every day as fossil fuel consumption and greenhouse gas emissions keep increasing at an alarming rate (Heinrich-Böll-Stiftung, 2021). Nowadays, the transport and mobility sector is responsible for nearly a quarter of the total carbon emissions in Europe. Carbon emissions caused by transport have increased by 33,5% between 1990 and 2019 (Europees Parlement, 2019). Mobility by road infrastructure is causing the largest share of carbon emissions, roughly 72%. The current situation and expectations for Carbon emission reduction are nowhere near the 90% reduction by 2050 as proposed in the European Green Deal (Ibid.). Therefore, the challenge around carbon emissions caused by the transport and mobility sector in Europe is one of great significance.

Although cities are responsible for a great amount of CO2 emissions related to transportation (CBS) the greatest amount of CO2 is caused by private transport and is mainly associated with peri-urban and rural areas due to the lack of public transport, proximities to Services of General Interest and access to jobs. When zooming in on North-West Europe specifically, more specific issues around transport, mobility and battling carbon emissions arise. The European railway network, which spreads across national borders, is a patchwork filled with gaps around those national borders. This results in the limited use of railways in a cross-border context (Heinrich-Böll-Stiftung, 2021) and further increases the CO2 emissions associated with the use of private motorized vehicles. Considering that a large share of the European Union's territory consists of border regions and includes more than one-third of the EU's population (Ibid.), the current availability of sustainable transport and accessibility to a variety of amenities, services and opportunities is rather alarming.

Therefore, the spatial vision and strategy presented in this report, named Cross Me If You Can (CMIYC), will address the challenge of mobility and transport-related CO2 emissions in a peri-urban, cross-border context, especially caused by the use of privatized vehicles, due to the lack of equal accessibility.

The spatial vision and strategy presented in this report, named Cross Me If You Can, will address the challenge of mobility and transport-related CO2 emissions in a peri-urban, cross-border context, especially caused by the use of privatized vehicles, due to the lack of equal accessibility.

1.4 research question & aim

In order to address the challenge of reducing carbon emissions associated with the use of private motorized vehicles, a central research question was formulated to guide the design of the CMIYC vision and strategy:

"What strategies can foster a more socially and environmentally sustainable future approach to mobility in which access to amenities and opportunities for peri-urban areas in a cross-border context is prioritized, whilst also fostering affordable and sustainable international accessibility?"

This central question is accompanied by a set of objectives that the CMIYC spatial vision and strategy aims to meet:

- A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rhein region, by the European Green Deal.

- High-quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport.

- Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport.

The objectives for the CMIYC project align specifically with three Sustainable Development Goals (SDG's) adopted by United Nations in 2015. Based on an overview KnowSDGs Platform (n.d.) an overview of each of these

Goal 9: Industry, innovation and infrastructure

Target 9.1: Develop quality, reliable, sustainable and resilient infrastructure, including regional and transborder infrastructure, to support economic development and human well-being, with a focus on affordable and equitable access for all.

Indicators:
9.1.1 Proportion of the rural population who live within 2 km of an all-season road.
9.1.2 Passenger and freight volumes, by mode of transport

Goal 11: Sustainable cities and communities

Target 11.2: By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.

Target 11.6: By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.

Target 11.8: Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning.

Indicators:
11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities.
11.6.1 Proportion of municipal solid waste collected and managed in controlled facilities out of total municipal waste generated, by cities.
11.6.2 Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted).
11.8 Number of countries that have national urban policies or regional development plans that (a) respond to population dynamics; (b) ensure balanced territorial development; and (c) increase local fiscal space.

Goal 13: Climate action

Target 13.1: Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries

Target 13.2: Integrate climate change measures into national policies, strategies and plannin

Indicators:
13.1.1 Number of deaths, missing persons and directly affected persons attributed to disasters per 100,000 population.
13.1.2 Number of countries that adopt and implement national disaster risk reduction strategies in line with the Sendai Framework for Disaster Risk Reduction 2015-2030.
13.1.3 Proportion of local governments that adopt and implement local disaster risk reduction strategies in line with national disaster risk reduction strategies.

By implementing sustainable urban planning practices, investing in innovative transportation infrastructure, and promoting renewable energy solutions, our project aims to create a more resilient and livable metropolitan area. Through our efforts, we contribute to SDG 11 by improving access to affordable and sustainable transport system, enhancing urban resilience, and promoting inclusive and sustainable urbanization. Moreover, we address SDG 9 with focus on developing advanced infrastructure and fostering innovation supports progress by promoting inclusive and sustainable industrialization and fostering technological innovation. Furthermore, our commitment to reducing CO2 emissions and mitigating climate change through reduction of these emissions directly contributes to SDG 13 by aligning with global efforts to combat climate change and its impacts. By addressing these SDGs, our project seeks to create positive impact that benefit both current and future generations.

02
theory&methodology

This chapter aims to provide a theoretical and methodological framework for the remainder of the project. First, an overview of the relevant concepts from the literature will be presented, which will be followed by the conceptual framework that will serve as a guideline throughout the project. The final section will set out the approach and methods that will be used to answer the central research question and meet the established objectives.

2.1 theoretical framework

This framework serves as a conceptual underpinning for the vision and strategy that is proposed in the CMIYC Report, to reduce CO2 emissions related to private motorized vehicles in cross-border regions. The framework consists of a discussion of five highly relevant concepts, some of which include working definitions that will be maintained throughout the whole report.

Sustainable development

Large-scale phenomena of industrialization and development over the past decades have resulted in considerable positive effects, such as increased life expectancies, more widespread implementation of democratic elections and increased food production. However, these positive effects also undeniably come with detrimental consequences to the environmental quality of the earth and social and economic aspects of the lives of future generations (Lozano, 2008). The concept of sustainable development, defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987), was first established as such in the Brundtland Report in 1987. This working definition of sustainable development will be maintained throughout the Cross Me If You Can spatial vision and strategy. The concept of sustainable development essentially arose in response to the concerns regarding the negative effects of the global trends of industrialization and development.

Adding onto the definition of sustainable development, the concept rests on three intrinsically linked conceptual underpinnings: environmental sustainability, economic sustainability and social sustainability (Basiago, 1998). These aspects are highly relevant in the Cross Me If You Can vision and strategy as they form the guidelines for a more generally sustainable approach to accessibility.

Sustainable transport

The concept of sustainable transport, following from the concept of sustainable development, has received major attention in literature. The broadest definition of the concept encompasses several elements, including environmental issues, the depletion of natural resources, and social and economic welfare (Zhou et al., 2020). A broad definition that not only includes the environmental sustainability aspect of transport but also the social and economic elements results in a base for finding integrated solutions that incorporate all elements that play a part in the transport sector (Ibid.). The CMIYC report favours a more practical working definition to guide the vision and strategy-making process. Therefore, sustainable transport will be defined as: "low- and zero-emission, energy-efficient, and affordable modes of transport, including electric and alternative-fuel vehicles, as well as domestic fuels." (Office of Energy Efficiency & Renewable Energy, n.d.).

Cross-border cooperation

The need for cross-border cooperation can arise as a consequence of the mutual interests of border regions, a relevant geographical or economic interdependence between the border regions or a joint political effort, amongst other things (Sousa, 2013). In this report, a rather broad working definition of the concept of cross-border cooperation will be maintained: "any type of concerted action between public and/or private institutions of the border regions of two (or more) states, driven by geographical, economic, cultural/identity, political/leadership factors, to reinforce the (good) neighbourhood relations, solve common problems or managing jointly resources between communities through any co-operation mechanisms available." (Sousa, 2013, p.5). The extent of cross-border cooperation for a region is highly dependent on economic, cultural, political, historical and geographical factors.

Cross-border cooperation is highly relevant to the CMIYC project, especially in terms of its potential for reducing CO2 emissions in the border regions. In most EU border regions, accessibility, for instance in terms of the use of public transport, in a cross-border context is still considered a major barrier (Medeiros, 2019). Increasing the quantity and quality of cross-border cooperation can result in improved low-emission transport accessibility and therefore help reduce CO2 emissions. A possible organizational structure to aid in this transition is the Euregions, which are highly relevant in the EU cross-border space and have the potential to shape processes of cooperative governance in these border regions (Noferini et al., 2020).

Land use & mobility

The interconnectedness of land use patterns and mobility networks is highly relevant for the CMIYC project, as land use, including population density, accessibility to public transport and the presence and diversity of services and amenities highly affect both modal choice and car ownership (Dargay & Hanly, 2004). The use of slow and public modes of transportation is considerably lower in peri-urban and rural areas, compared to urban centres, whereas the use of cars is considerably higher. This phenomenon can be partially explained by the built environments in these respective areas (De Vos, 2015). Areas with lower density and diversity of buildings, amenities and services, such as peri-urban and rural areas, on average deal with increased average distances. This discourages the use of slow modes of transportation. Therefore, these areas are often more car-oriented, resulting in fewer opportunities for using public transportation modes (Ibid). Reimagining the built environment and land use patterns can therefore help reduce the negative effects, such as CO2 emissions, of the use of private motorized vehicles (Dargay, 2004; De Vos, 2015).

Mobility-oriented spatial development

A variety of concepts arose in response to the importance of land use patterns on modal choice and the use of private motorized vehicles, including the 15-minute city and Transit Oriented Development (TOD) (De Vos, 2015).

The concept of the 15-minute city can be understood as a city in which "residents will be able to enjoy a higher quality of life where they will be able to effectively fulfil six essential urban social functions to sustain a decent urban life. Those include (a) living, (b) working, (c) commerce, (d) healthcare, (e) education and (f) entertainment." (Moreno et al., 2021, p.100). To realise accessibility to this set of functions within a period of 15 minutes, the urban fabric will have to be designed in such a way that proximity, diversity and density are prioritized (Moreno et al., 2021). In a more peri-urban context, this concept can be translated to a 30-minute radius, to reflect the reality of less density and proximity in non-urban areas. However, this will ultimately still reduce the need for travel, therefore contributing to reducing CO2 emissions.

TOD essentially revolves around the idea to structure settlements around existing or new transit nodes, and in doing so reduce the need for private motorized vehicles, by improving accessibility to sustainable (public) transport (Ibraeva et al., 2020). TOD is similar to the notion of the 15-minute city, as it presents another example of a concept that builds upon the relationship between land use patterns settlement structures and mobility. Both concepts are highly relevant to CMIYC's mission to reduce car-use-related CO2 emissions in cross-border regions.

Smart Mobility transition

The transition to 'Smart Mobility', in which emerging technologies including a wide variety of business-to-customer applications, automated vehicles and other technologies, will reshape the way the current mobility network is designed and functions (Docherty et al., 2018). According to literature, this transition consists of future or already existing components, such as Mobility as a Service (MaaS), 'intelligent' infrastructures and electrified vehicles that make use of a smart energy grid (Ibid). The most relevant question the Smart Mobility transition poses in the CMIYC project, similar to any other socio-technical transition, is how to manage this transition in a just manner. Especially in terms of differentiating between the urban, the peri-urban and the rural. Research indicates that different types of areas can benefit from the implementation of smart mobility, although the advantages might differ per area based on context (Porru et al., 2020). Therefore, for the sustainable future of mobility, it is crucial for all governmental levels to consider all future traveller's needs, not just those in urban areas. The CMIYC vision and strategy will consider the just application of Smart Mobility interventions.

2.2 conceptual framework

After providing a theoretical framework for the CMIYC project, figure 24 presents the conceptual framework for the project. The framework shows the conceptual underpinning of the CMIYC project, where the middle section represents CMIYC's approach to sustainable development with regards to reducing transport-related CO2 emissions. The framework is based on both the problem analysis and relevant theoretical notions. To illustrate, the sustainable development approach for cross-border accessibility is based on the notion of mobility-oriented spatial development.

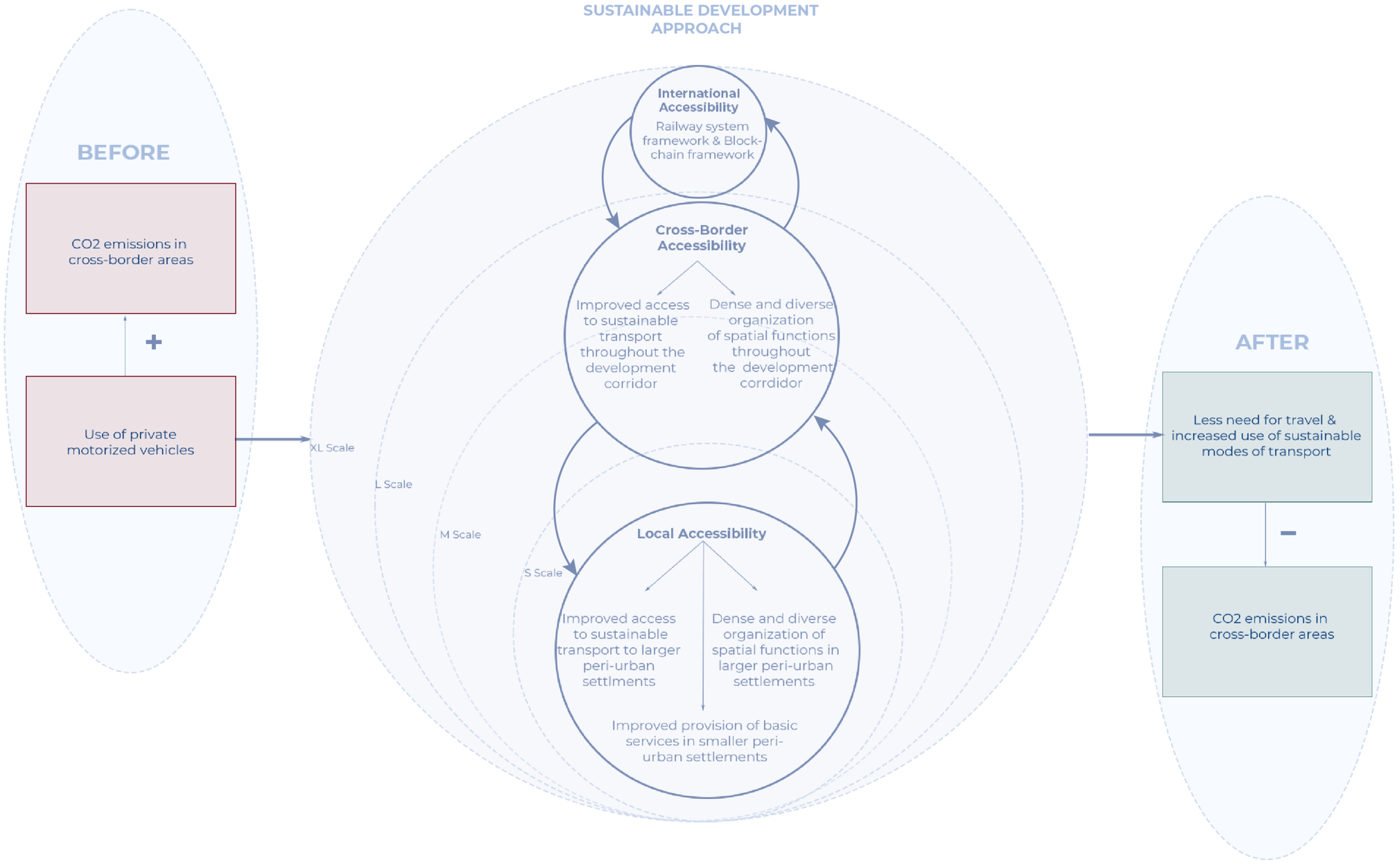


Figure 24. Conceptual framework (made by authors, 2024).

2.3 through the scale approach

Before discussing the methodology in the following section, it is relevant to create an overview of the variety of scales that are relevant to this project. Mobility, transport and the provision of amenities and services are not a set of isolated networks on a small scale but rather stretch across and beyond national borders. Therefore, the CMIYC project and its three main elements, work with a clear overview of 4 scales (fig. 25).

XL refers to a scale that stretches beyond the Netherlands and its bordering countries, it takes into account multiple countries within the European Union.

L refers to the cross-border Euregions (fig. 21), which, unlike the other scales, is only used for analysis purposes throughout the project.

M refers to the area of interest, this will be on the scale of a specific Euregion, which will be established in chapter 3.

S refers to the smallest scale which will consist of a maximum of a few settlements within the area of interest.

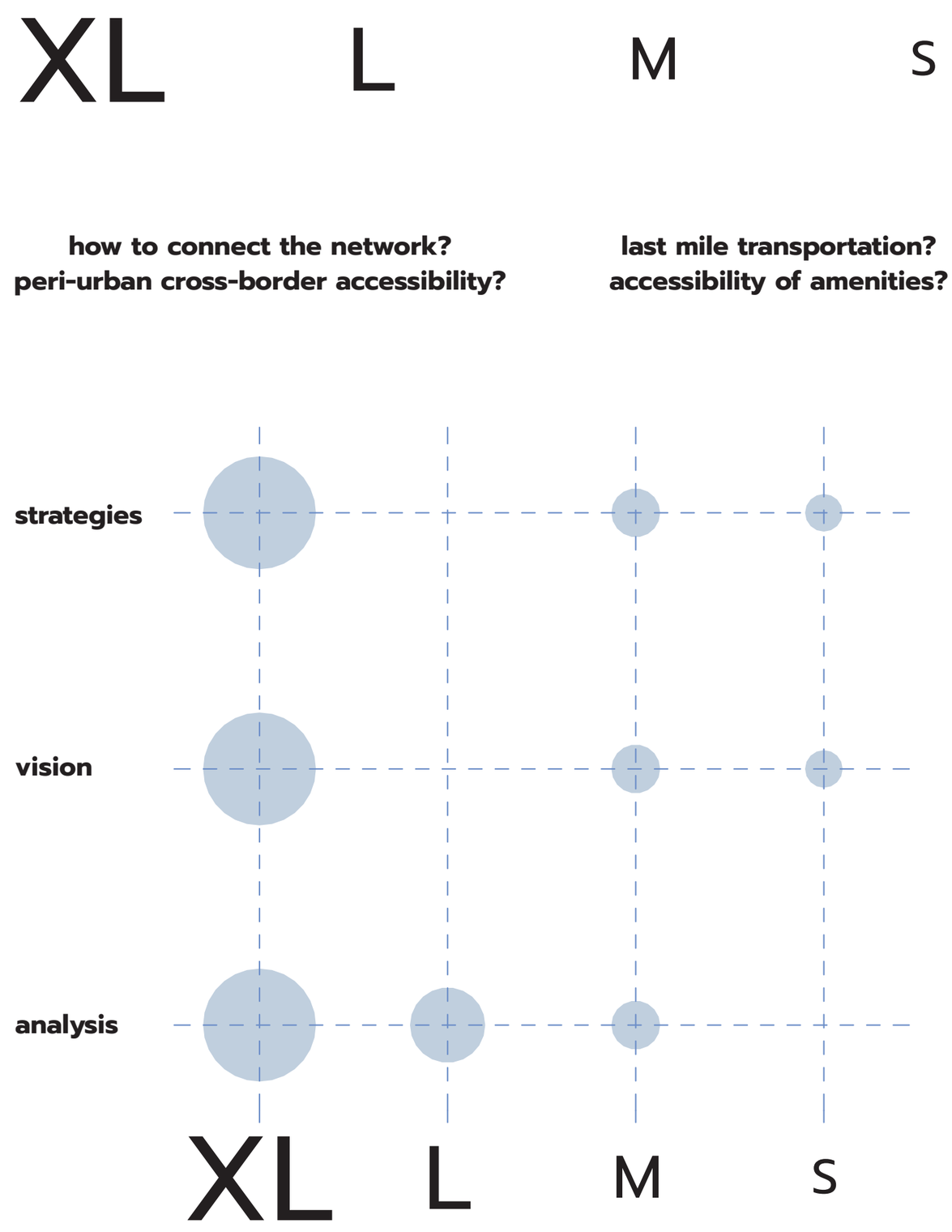


Figure 25. Scale approach for the CMIYC project (made by authors, 2024).

2.4 methodological framework

The methodology framework presented in Figure 26 shows an overview of the steps that will be taken in the CMIYC project, to go from context to final application of strategy. The steps are connected to several components that will be produced with each step and used to arrive at the following step. Furthermore, the specific methods that are used throughout the project are listed under the 'theory & methodology' step. This framework will serve as a guide for the research, planning and design process throughout the project.

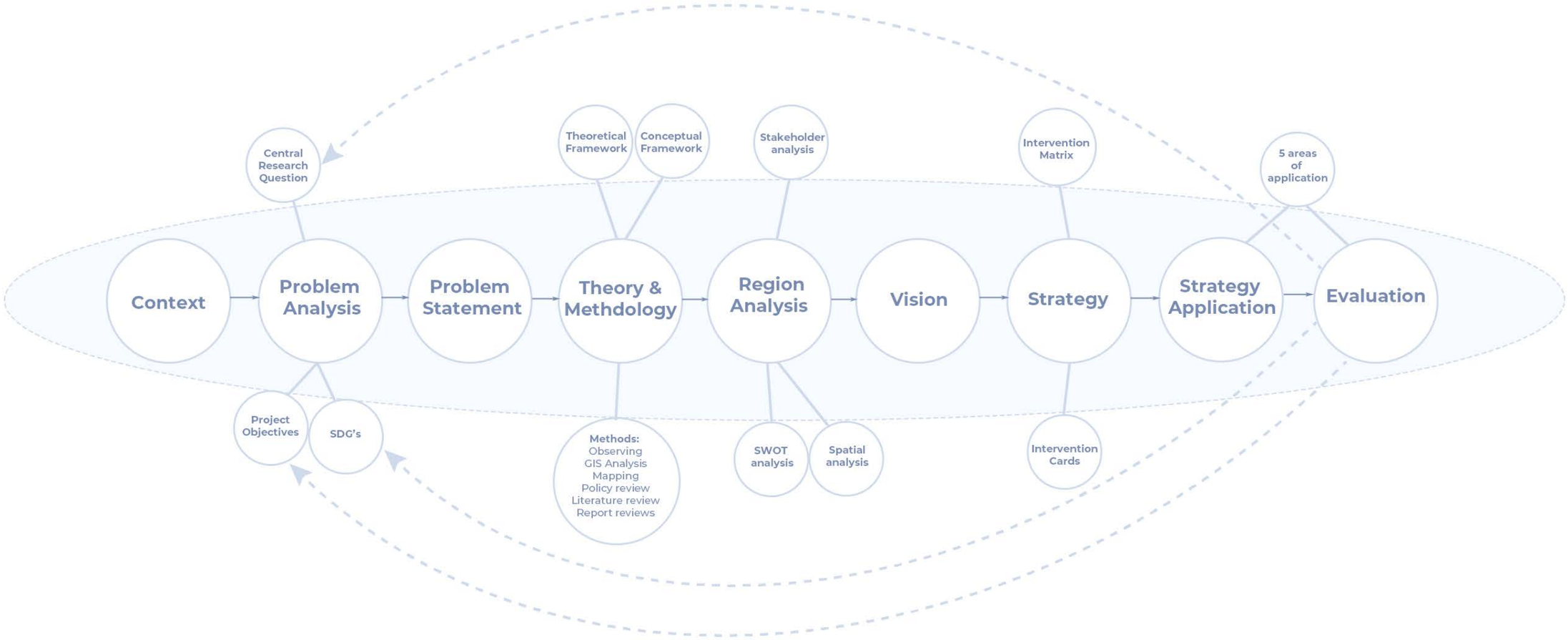


Figure 26. Methodology framework (made by authors, 2024).

03
Maas-Rhein

This chapter will first select the final area of interest, followed by an in-depth analysis of this Euregion to help guide the vision-making. The analysis will include a spatial element, an analysis of stakeholders and an overview of the strengths, weaknesses, opportunities and threats that shape the area.

3.1 region selection

The weighted map (fig. 22) presented in Chapter 1 showed three potential areas of interest. Out of these areas, one presented the most interesting case due to a combination of factors: the Maas-Rhein Euregion (fig. 27). Not only are the problem analysis parameters very prevalent in the Maas-Rhein region, but the cross-border conditions also underline the relevance of this area even further. The vision and strategy in the CMIYC project will be developed for the Maas-Rhein region, both on the scale of the full region (M scale) and for smaller scale areas within the region (S scale).

75km

25km

Weight parameters and values

Peri-urban: 2
CO2 cars emission PC: 2
Average train distance: 2
Commuters: 1.7
Cars per capita: 1.5
Population decline: 1.5

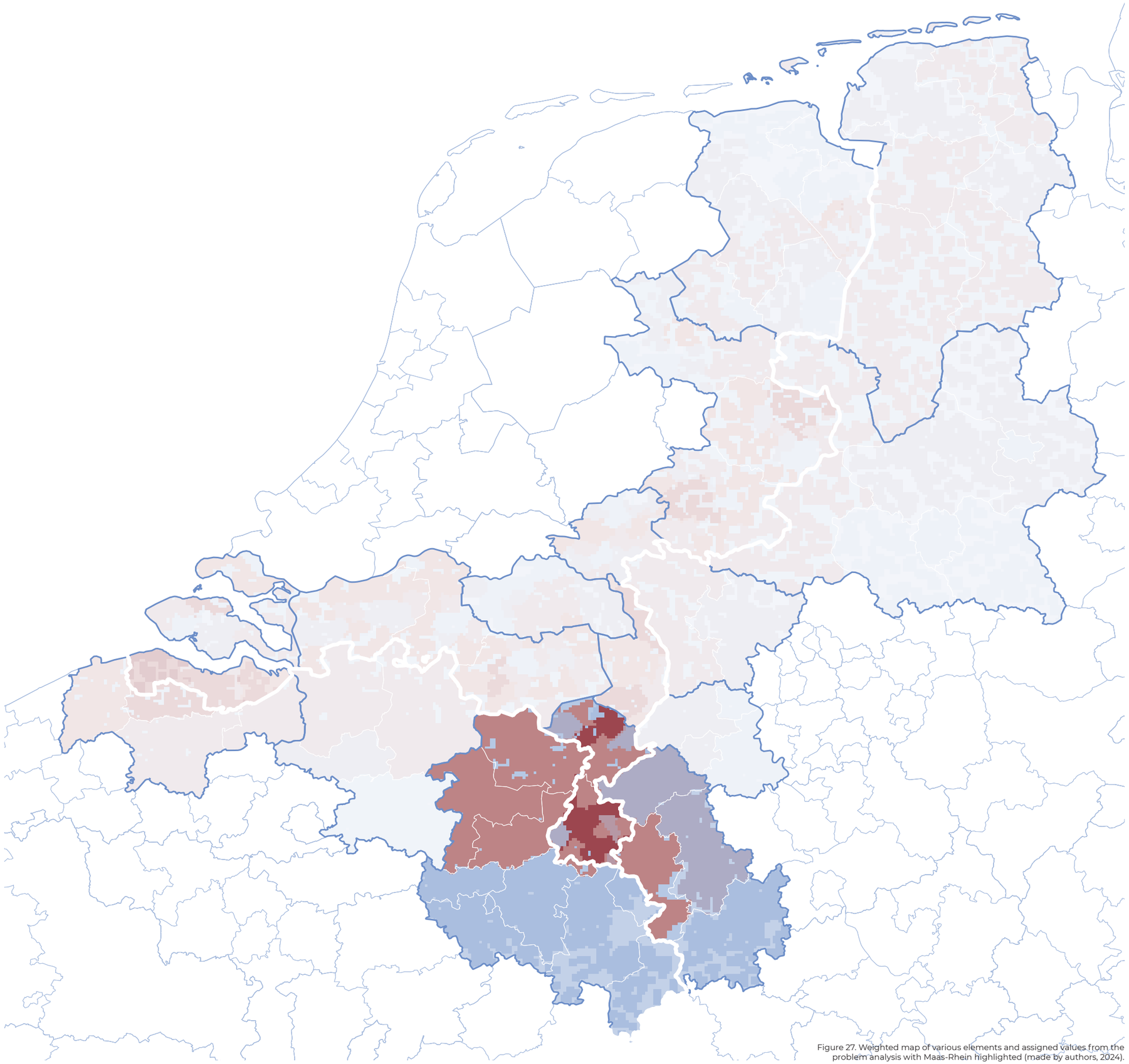


Figure 27. Weighted map of various elements and assigned values from the problem analysis with Maas-Rhein highlighted (made by authors, 2024).

3.2 spatial analysis

Maas-Rhein

Figure 28 presents an overview of spatial conditions in the Maas-Rhein region. This map will be used to inform the vision-making process, especially since these spatial conditions are highly relevant for the potential development of the transport and mobility network.

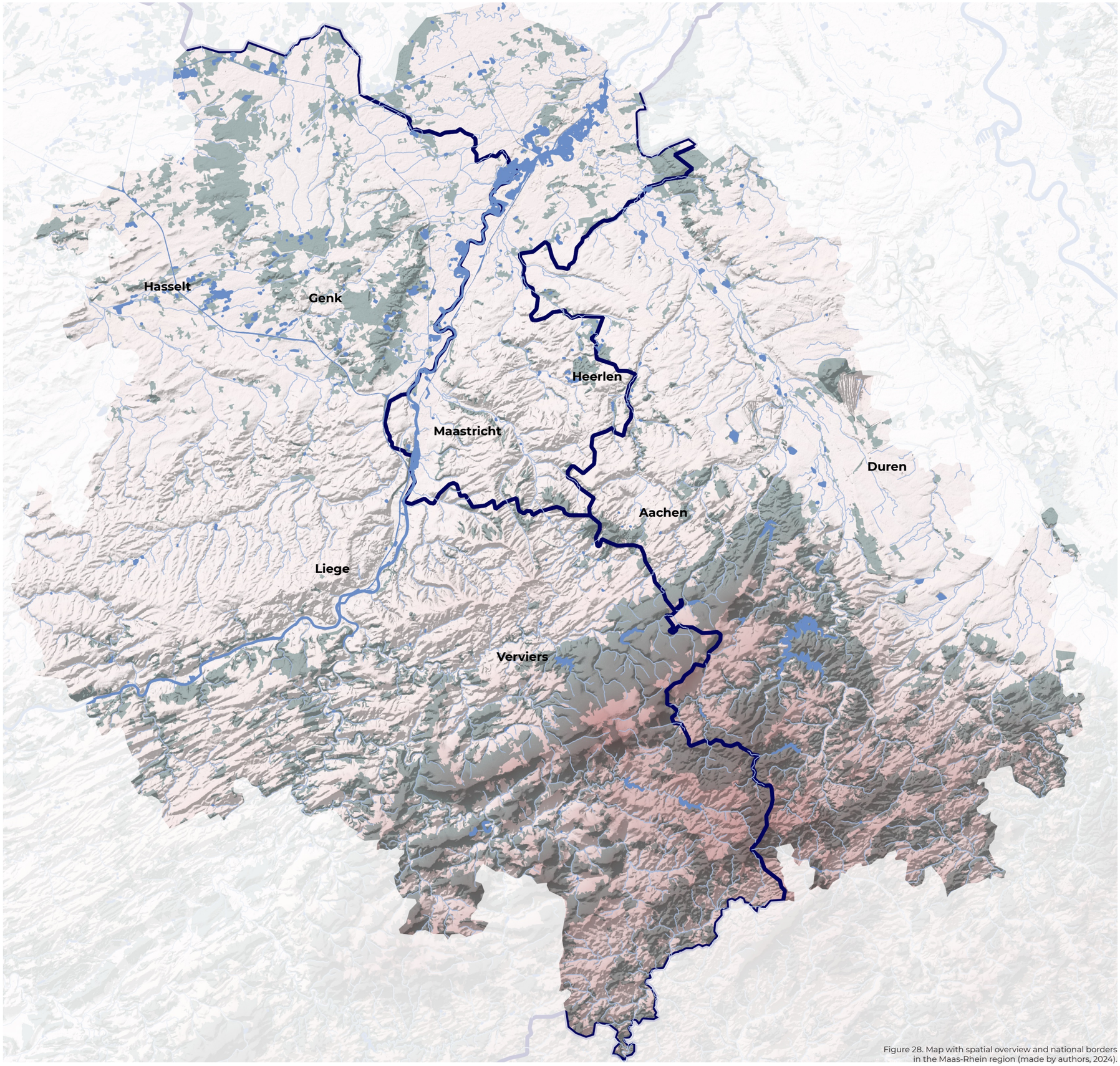


Figure 28. Map with spatial overview and national borders in the Maas-Rhein region (made by authors, 2024).

train conditions

Another important condition is that of the railway network (fig. 29). Although the network is quite extensive, there are some clear gaps. This map can help identify missing links and help establish new corridors.

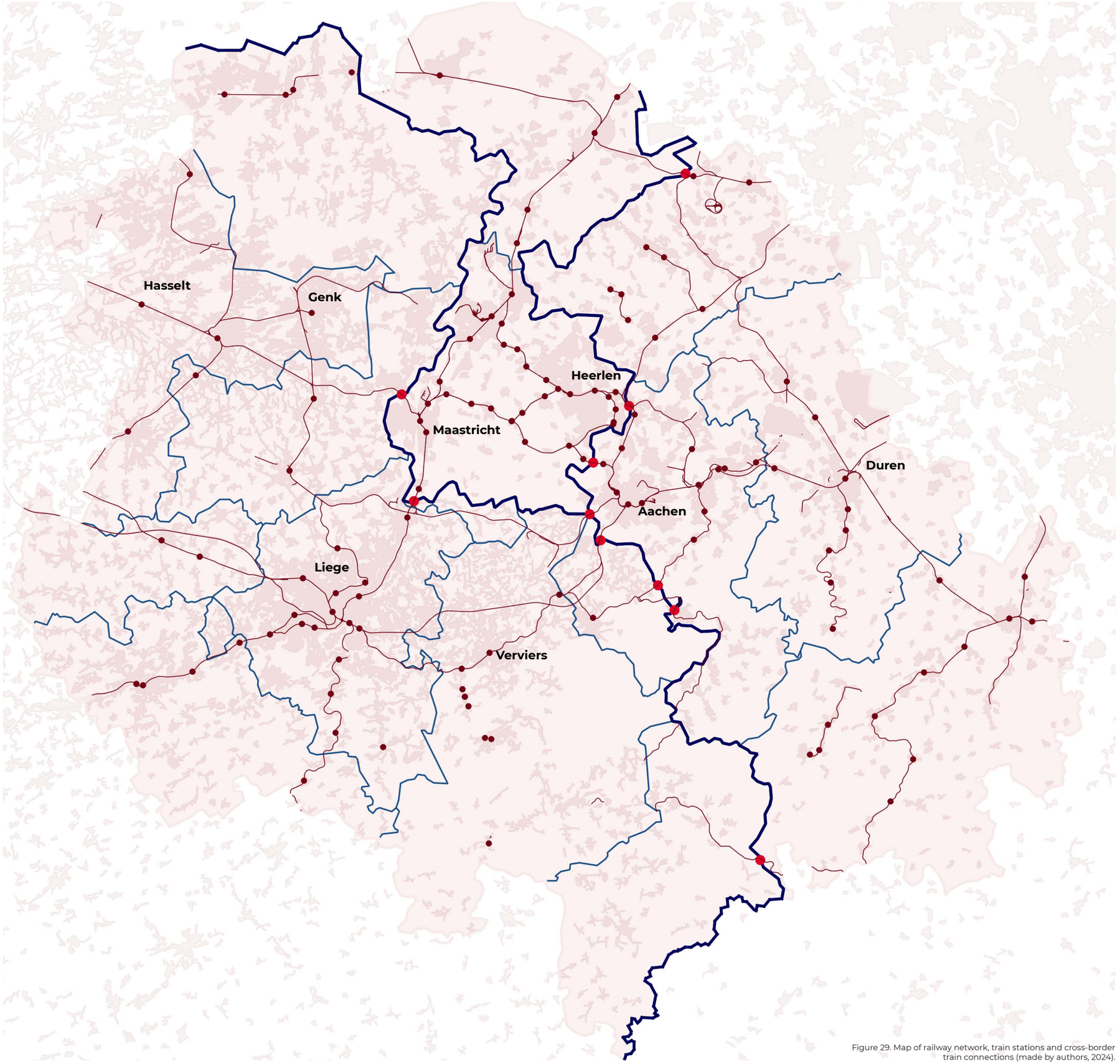


Figure 29. Map of railway network, train stations and cross-border train connections (made by authors, 2024).

bus conditions

The next part of the spatial analysis of the Maas-Rhein consists of the bus conditions in the region (fig. 30). Similar to the railway network, it is rather extensive but there is some variety in terms of density. Furthermore, there is only a limited number of points in which the bus network crosses national borders.

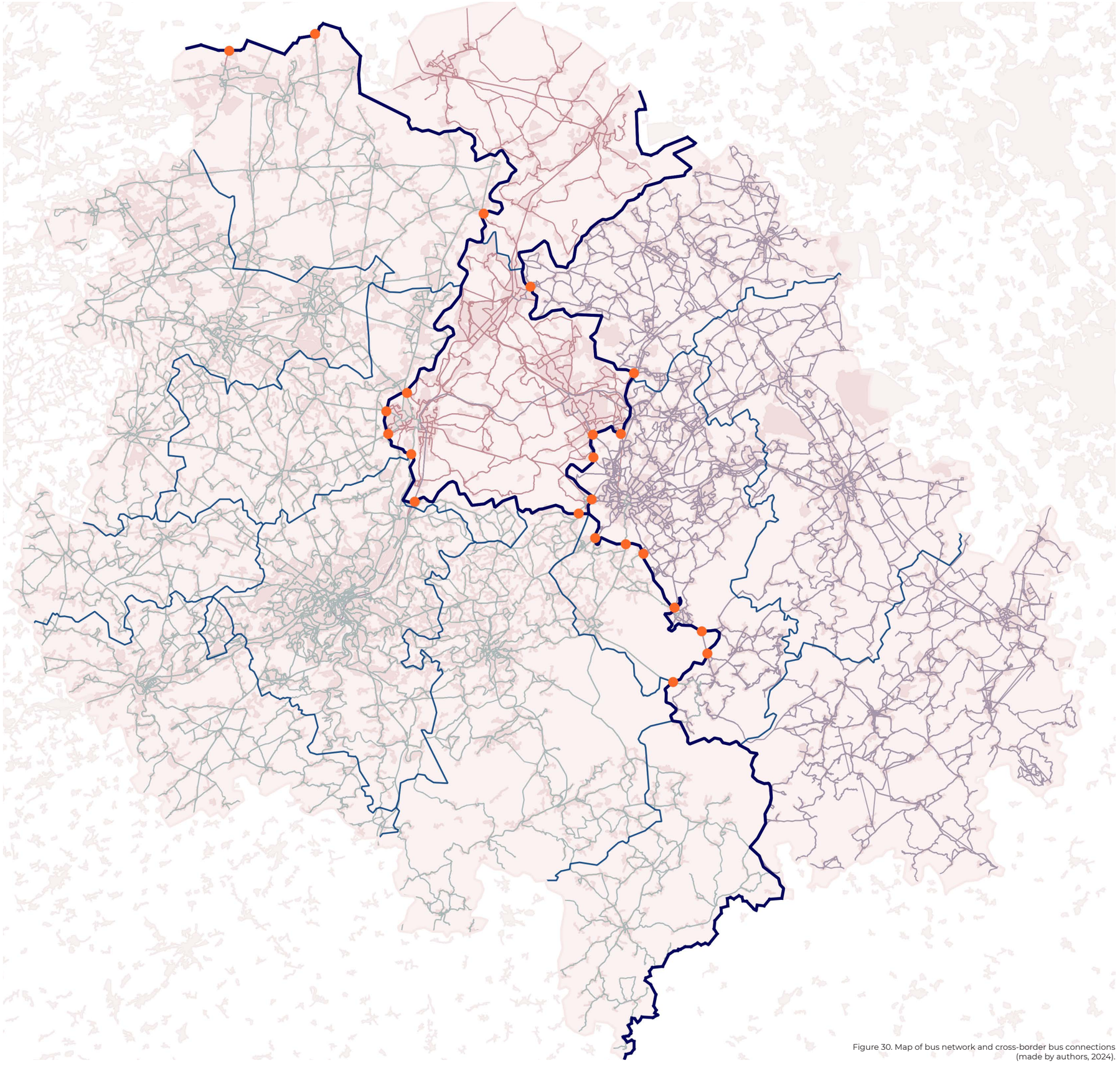


Figure 30. Map of bus network and cross-border bus connections (made by authors, 2024).

bus & train
cross-border crossings

Figure 31 presents an overview of the points in which either the railway or the bus network crosses national boundaries. This map will be used as a guide to vision-making in terms of the public transport network.

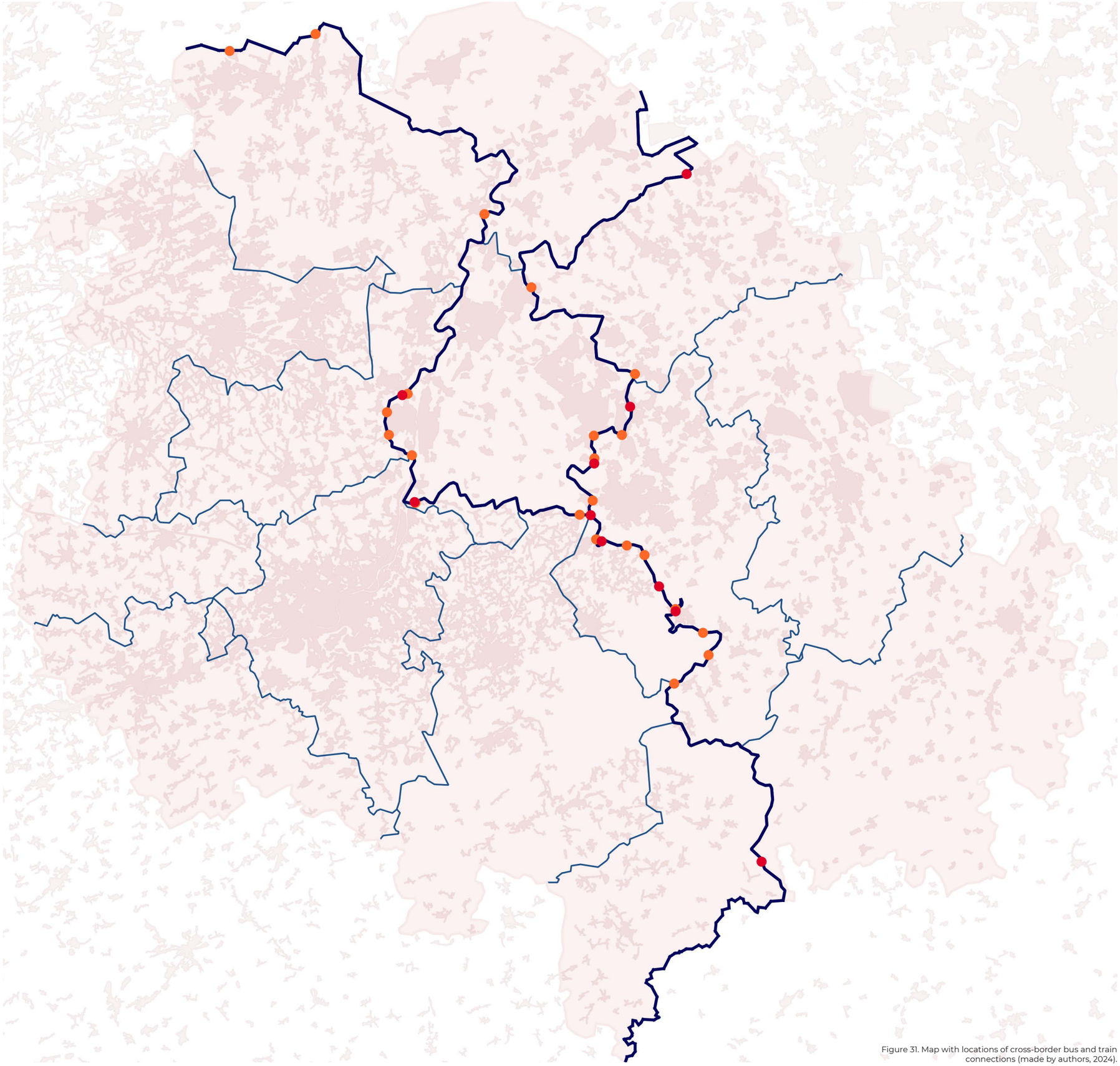


Figure 31. Map with locations of cross-border bus and train connections (made by authors, 2024).

3.3 stakeholder analysis

The next step in the analysis of the Maas-Rhein involves a stakeholder analysis. Figure 32 shows a power-interest matrix for all relevant stakeholders in the CMIYC project. The stakeholders include parties such as railway operators, bus operators, commuters, residents, governmental organizations and so on.

Figure 32. Power-Interest matrix of with relevant stakeholders (made by authors, 2024).

3.4 SWOT analysis

strenghts

The final section of the Maas-Rhein analysis consists of a SWOT analysis. Figure 33 presents the identified strengths of the region, mainly focussing on its strategic position in Europe.

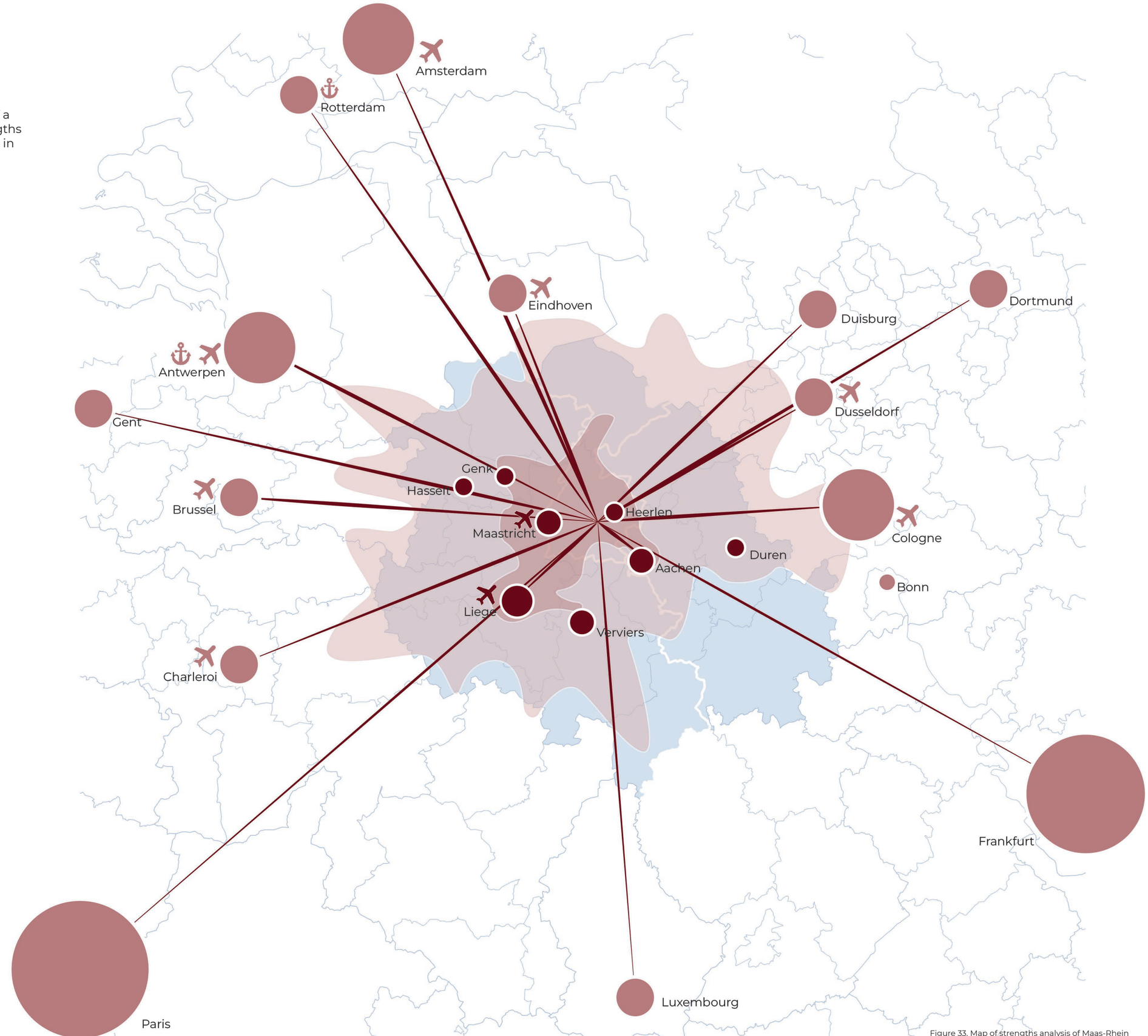


Figure 33. Map of strengths analysis of Maas-Rhein (made by authors, 2024).

opportunities

In terms of opportunities, the Maas-Rhein has plenty of potential. Figure 34 summarizes these opportunities, including elements like education, logistic hubs and green space.

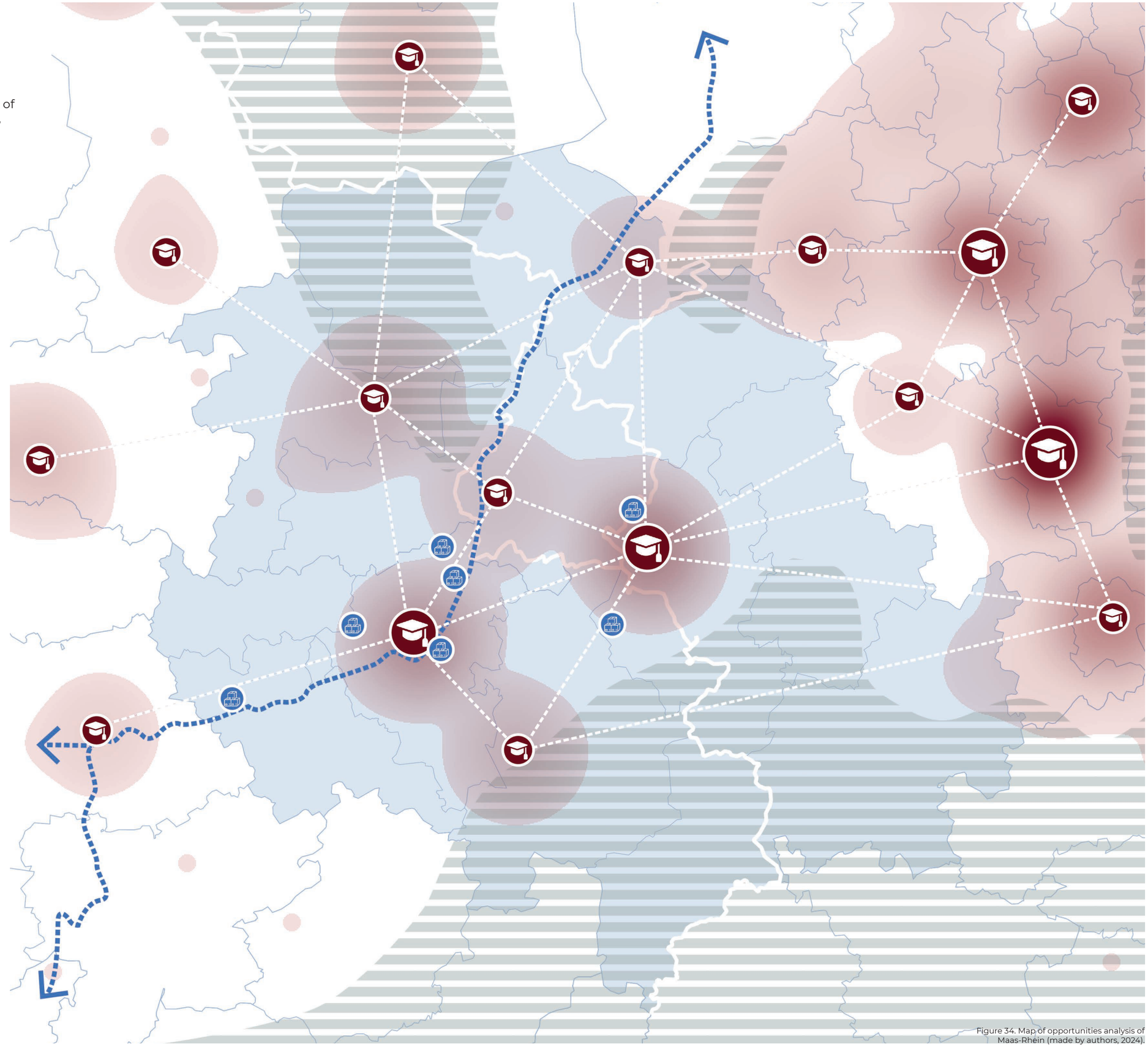


Figure 34. Map of opportunities analysis of Maas-Rhein (made by authors, 2024).

weaknesses

Furthermore, we identified some weaknesses for the Maas-Rhein region. These include the high use of cars and rather high levels of congestion. Figure 35 presents these, as well as some other weak points.

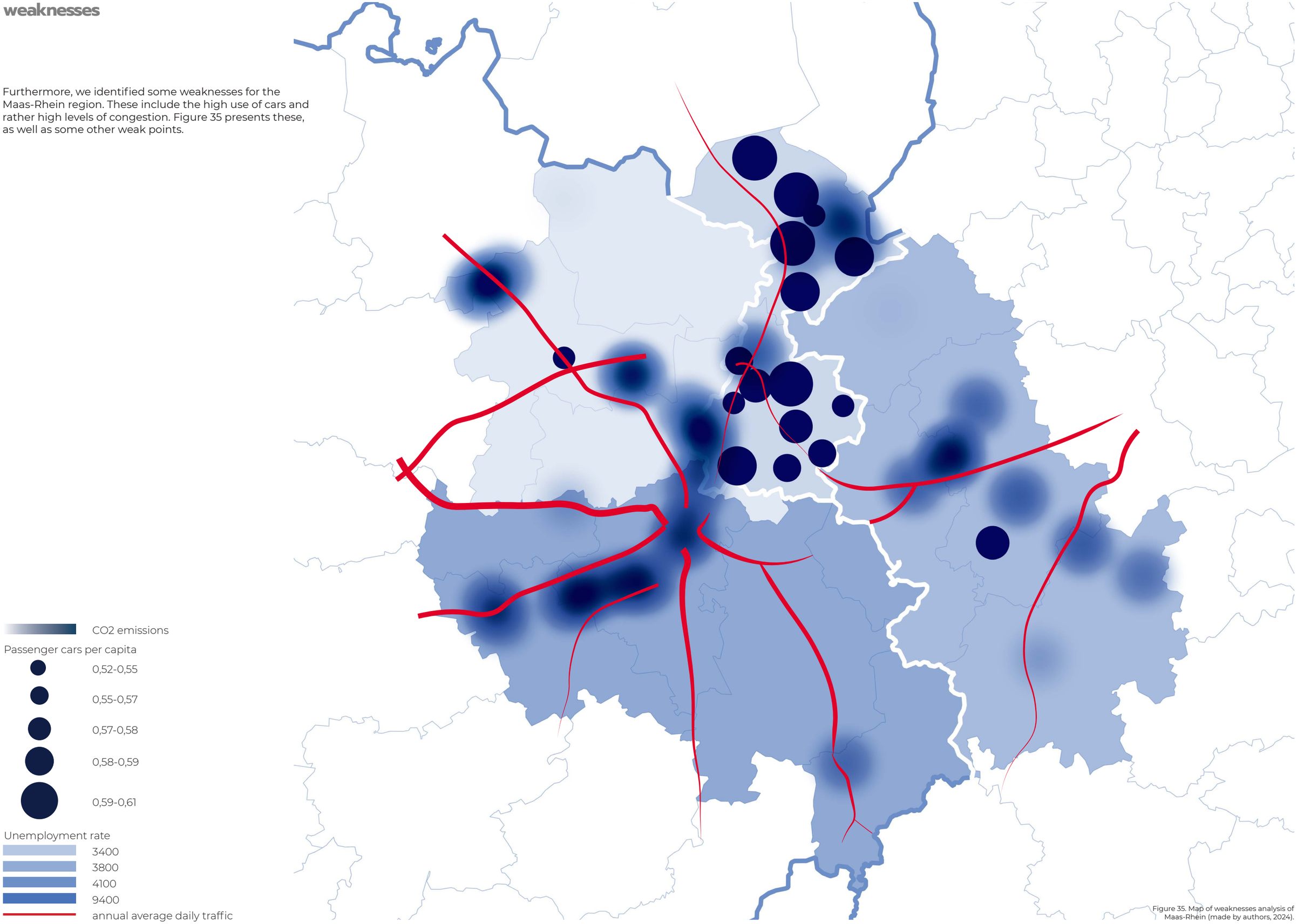


Figure 35. Map of weaknesses analysis of Maas-Rhein (made by authors, 2024).

threats

Finally, the Maas-Rhein experiences some threats. These include commercial competition from centres outside the region, as well as the decline of green space that is observed. Figure 36 presents these threats in a spatial context.

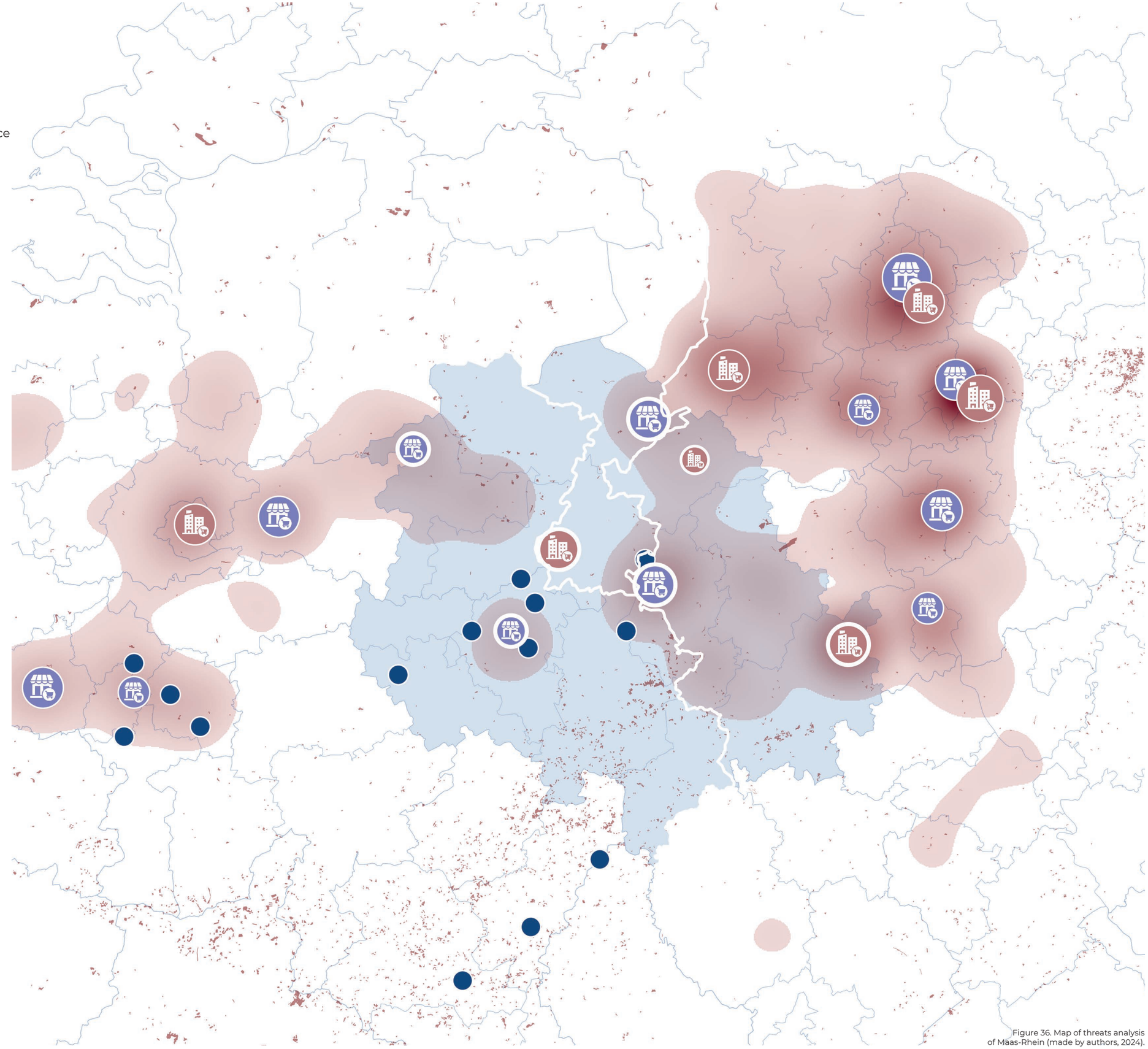


Figure 36. Map of threats analysis of Maas-Rhein (made by authors, 2024).

04
vision

The vision chapter aims to communicate the vision for Maas-Rhein approximately 75 years from now. First, the vision approach will be explained, which was fundamental in the vision-making process. Secondly, the vision statement will be presented, after which the vision maps will create a spatial understanding of the vision. Finally, the updated systemic section will display the situation around transport-related CO2 emissions in a cross-border, peri-urban context after the realization of the vision.

4.1 vision approach

The vision-making process was guided by a clear approach: the combination of analysis, megatrends and identified values that the CMIYC project wants to incorporate (fig. 37). The analysis incorporates the problem of CO2 emissions as a consequence of lack of equal accessibility as well as the spatial analysis on the Maas-Rhein. Furthermore, principles from circularity, sustainable land use and decentralization will be used as guidelines throughout the vision-making and strategy design process.

The analysis was carried out and presented in chapters one and three. Both the megatrends and values were identified based on the five pillars for a sustainable future: people, planet, prosperity, partnership & peace (United Nations Sustainable Development Group, 2022). Figure 38 shows the megatrends per pillar and the interrelations between the different trends. From this overview, the relevant trends for Maas-Rhein were selected. Each trend was considered whether the vision should accommodate or battle this trend, which was vital for the vision-making process. Figure 39 shows the guiding values for each pillar. The vision first and foremost incorporates the high-priority values, after which the medium and lower-priority values were considered.

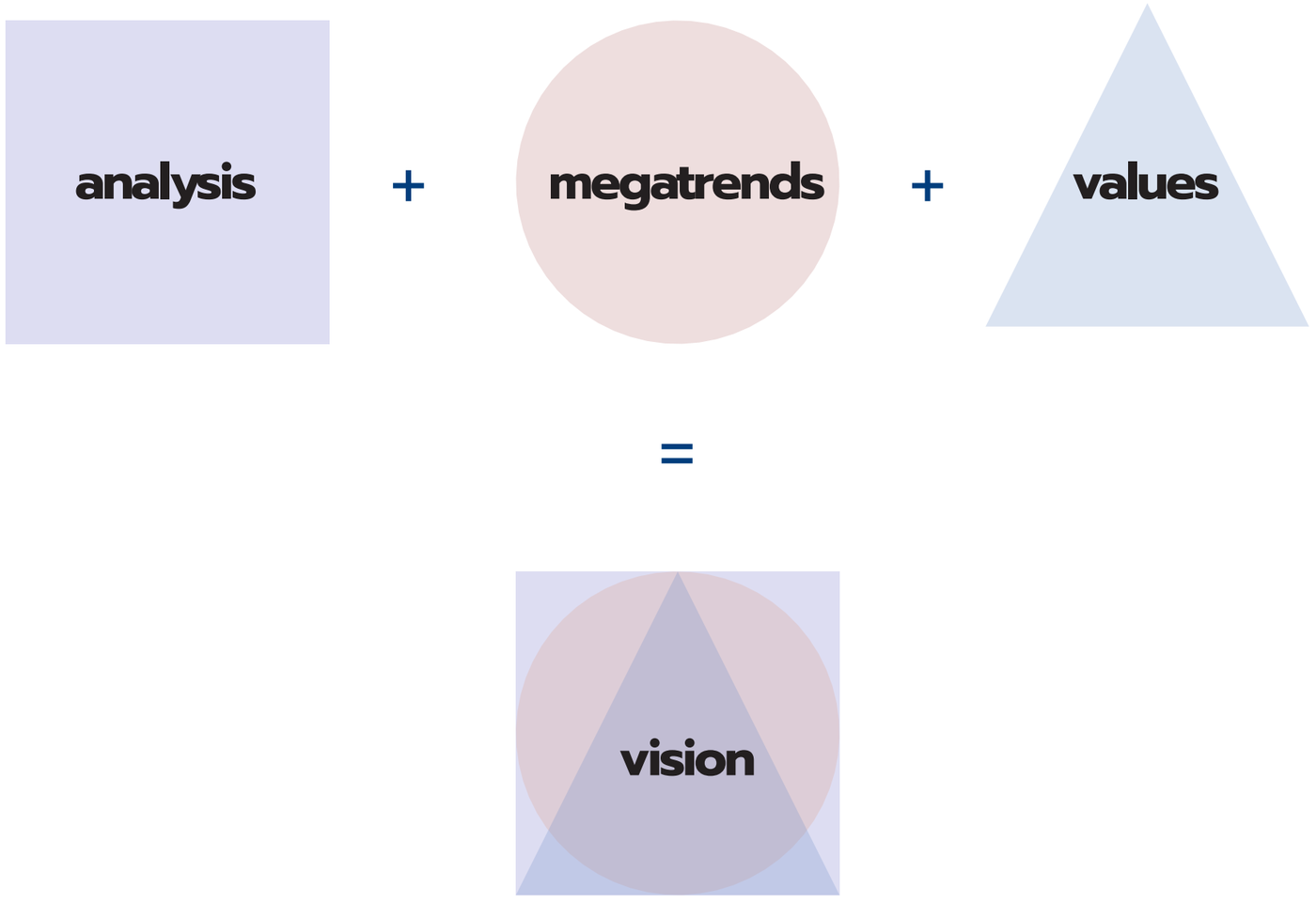


Figure 37. Visual representation of vision-making approach (made by authors, 2024).

megatrends

XL L M S

strategies

vision

analysis

widening inequalities

diversity of education and learning

growing consumption

individualism

climate change and environmental degradation

aggravating resource scarcity

anywhere/ somewhere/X-where

consumer-centricity

hyper-personalization

recycling

smart responsive city

technology fear

sustainable behaviour

extreme weather events

pollution

environmental regulations

global warming & rising sea level

land use change

resources availability

changing nature of work

localization

continuing urbanisation

anywhere/ somewhere/X-where

data infrastructure and governance

accelerating tech changes hyper connectivity

artificial intelligence

decentralisation

autonomous transportation

power sources and energy storage

inceasing demographic imbalance

aging voters

changing labor force

global population is growing

accelerating tech changes hyper connectivity

migration

data infrastructure and governance

changing security paradigm

securitisation

increasing influence of new governing systems

big tech in politics

e-governance

citizen engagement

people lens

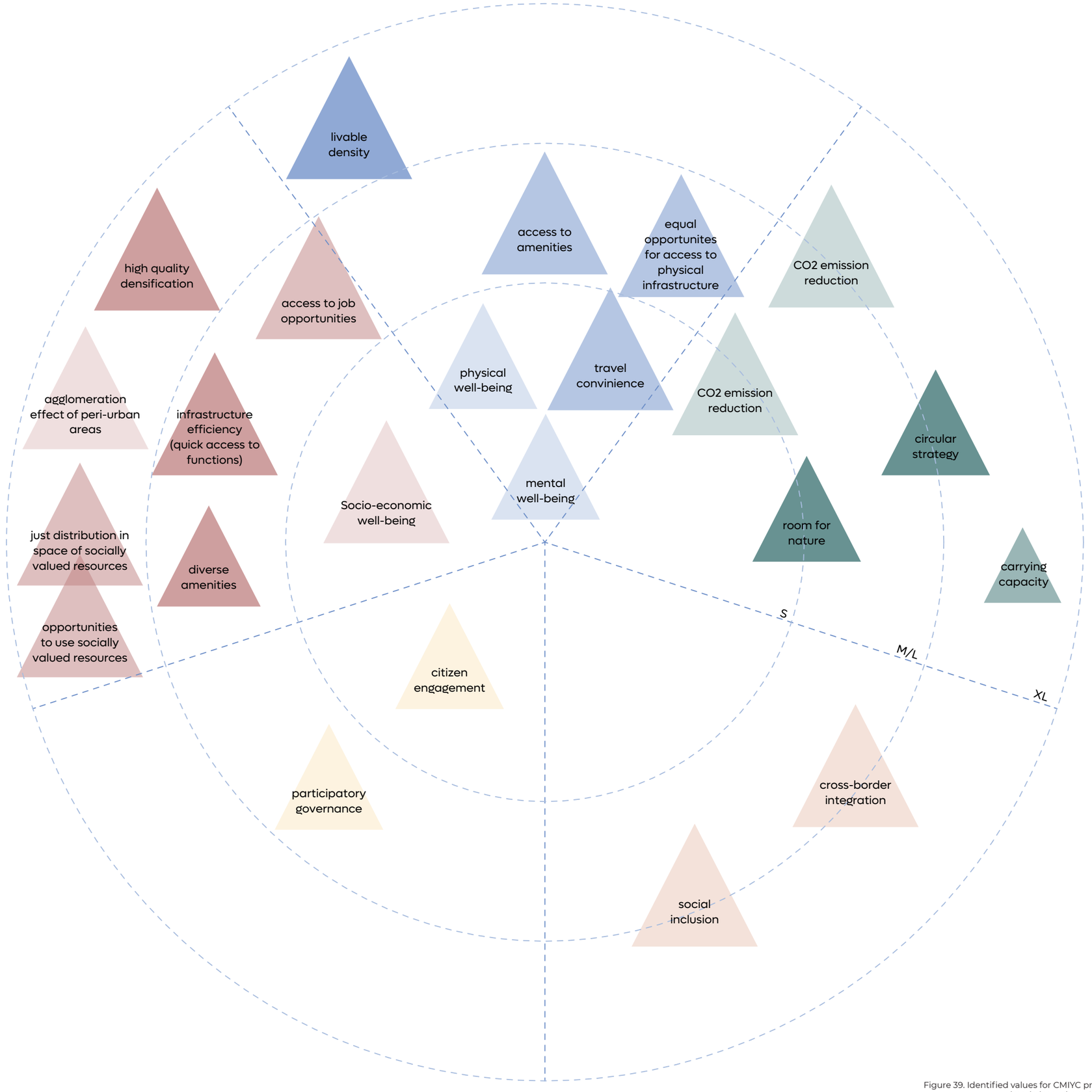
planet lens

prosperity lens

partnership lens

peace lens

Figure 38. Overview of megatrends (made by authors, 2024; adapted from European Commission ,2022).



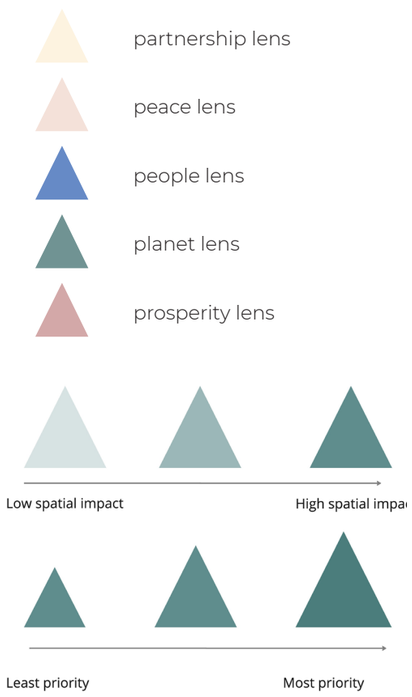


Figure 39. Identified values for CMIYC project (made by authors, 2024).

4.2 vision statement

In 75 years from now, a possible scenario presents a future in which West Netherlands will be flooded. Maas-Rhein will be a very important and central region in North-Western Europe to serve as a backbone for the Randstad and other large coastal metropolitan areas. Therefore, the sustainable future of the Maas-Rhein region is of high importance.
We envision the Maas-Rhein region to be a place where what is not in your direct vicinity, is still within reach. This is not only referring to physical proximity to amenities, services and (infra)structures but also to the possibility of accessing job opportunities, education, social networks, communities and other intangible resources. This wide variety of elements is required for environmental, social and economic sustainable development of the peri-urban areas in the Maas-Rhein region in the long term.
More specifically, the vision includes a variety of elements on our S, M and XL scales:

XL vision

- Framework for optimizing the EU railway network.

- Explore novel technology for increased cooperation between nations.

M vision

- Dense and diverse organization of services and amenities throughout the region to reduce the need for travel.

- The presence of smart mobility connections to improve cross-border accessibility, through the establishment of new corridors or enhancing existing ones. Both in terms of optimizing public transport facilities, as well as using a flexible shared (electric) mobility system.

S vision

- The presence of high-quality basic services and amenities in smaller settlements reduces the need for travel.

- The presence of a wider variety of services and amenities in larger settlements reduces the need for travel.

- Last-mile accessibility to the mobility network, through the use of slow (shared) modes of transport.

Although this vision includes elements on three scales, **it is important to note**, that the vision maps only cover the XL and M scale directly. However, the vision elements on the different scales are highly interrelated. The elements on the S scale, such as the quick access to public transport stops by slow modes of transport, will positively affect the accessibility to the cross-border network.
The improvements to the cross-border networking, including the optimization of the bus and train network, as well as the use of smart sharing systems and electric vehicles, will then in turn provide more access to the optimized international network, which will improve equal accessibility of the region to other areas within North-Western Europe. Furthermore, the frameworks on the XL scale can potentially result in more cooperation between actors on the M-scale, which can then result in more extensive accessibility on the S-scale. The strategy chapter will emphasize the interrelatedness of the M and S scale, as well as present a spatial representation of the S scale.

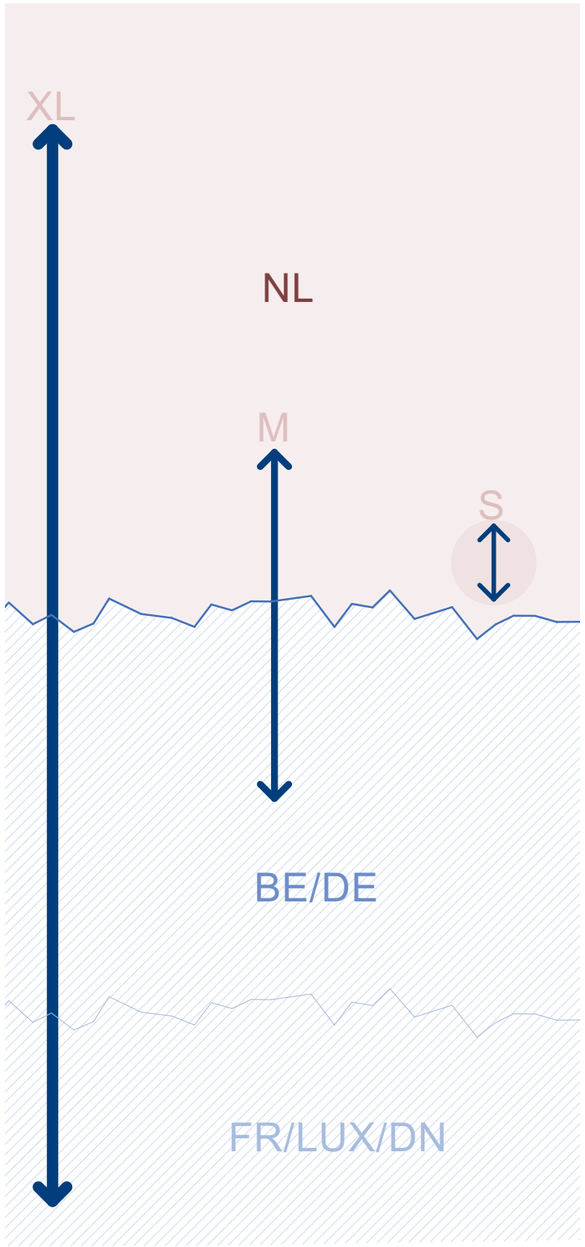


Figure 40. Visual representation of XL, M and S scale (made by authors, 2024).

4.3 vision maps

XL

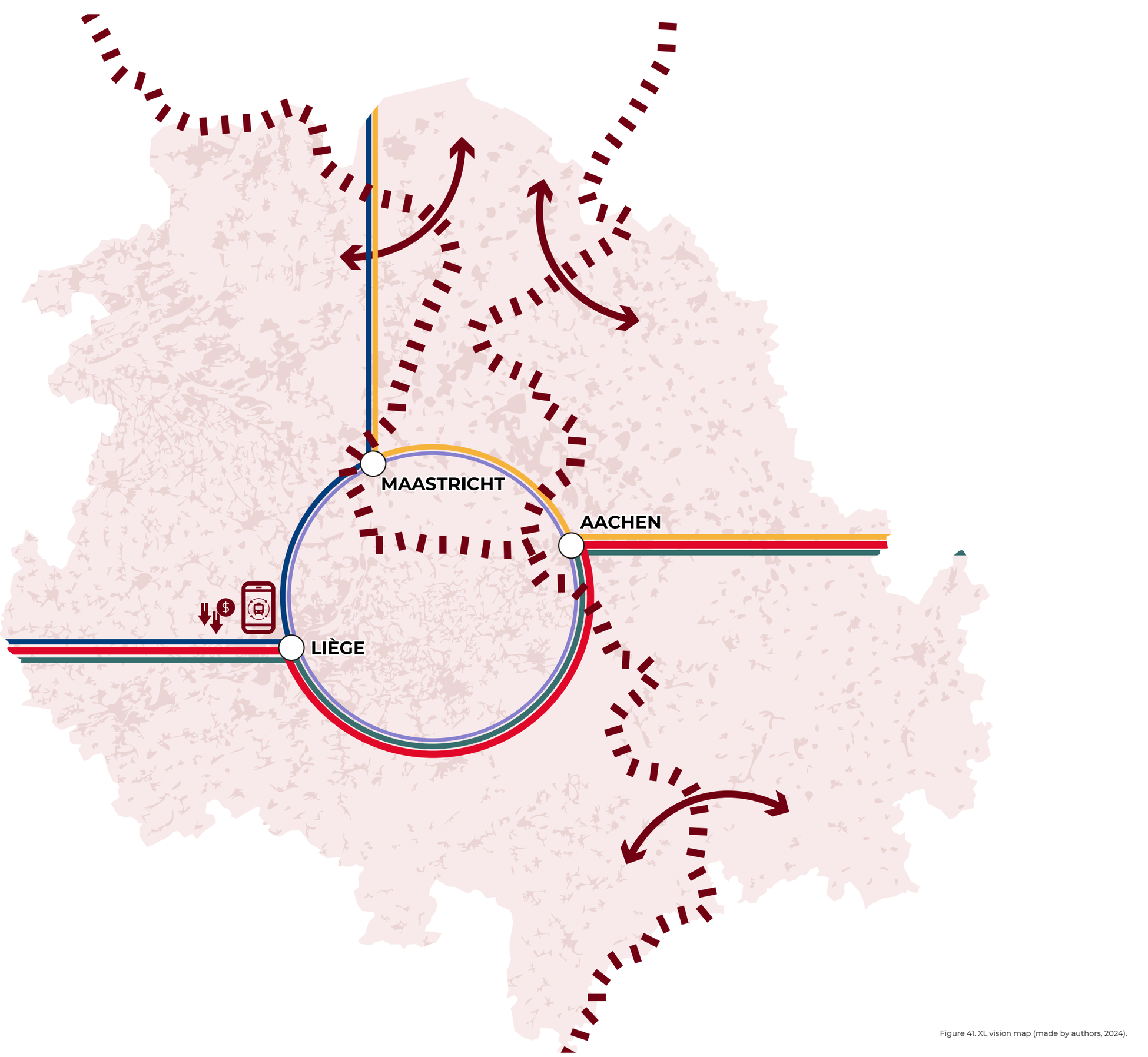


Figure 41. XL vision map (made by authors, 2024).

Antwerp
Brussels
Charleroi
Liège
Maastricht
Heerlen
Aachen

30km
10km

mobility
jobs
amenity diversity
SGIs
green/public space
density

green corridor
urban corridor
densification
mobility connection

Figure 42. M vision map (made by authors, 2024).

4.4 systemic section

after vision

After presenting the systemic section of the current situation on the dynamics of mobility and transport-related CO2 emissions (fig. 23), figure 43 presents the updated version after the realization of the aforementioned vision statement. It includes a wider and more sustainable variety in land use, as well as a decrease in CO2 emissions. Furthermore, the sharp contrast in terms of accessibility between the urban and peri-urban in a cross-border context is minimized.

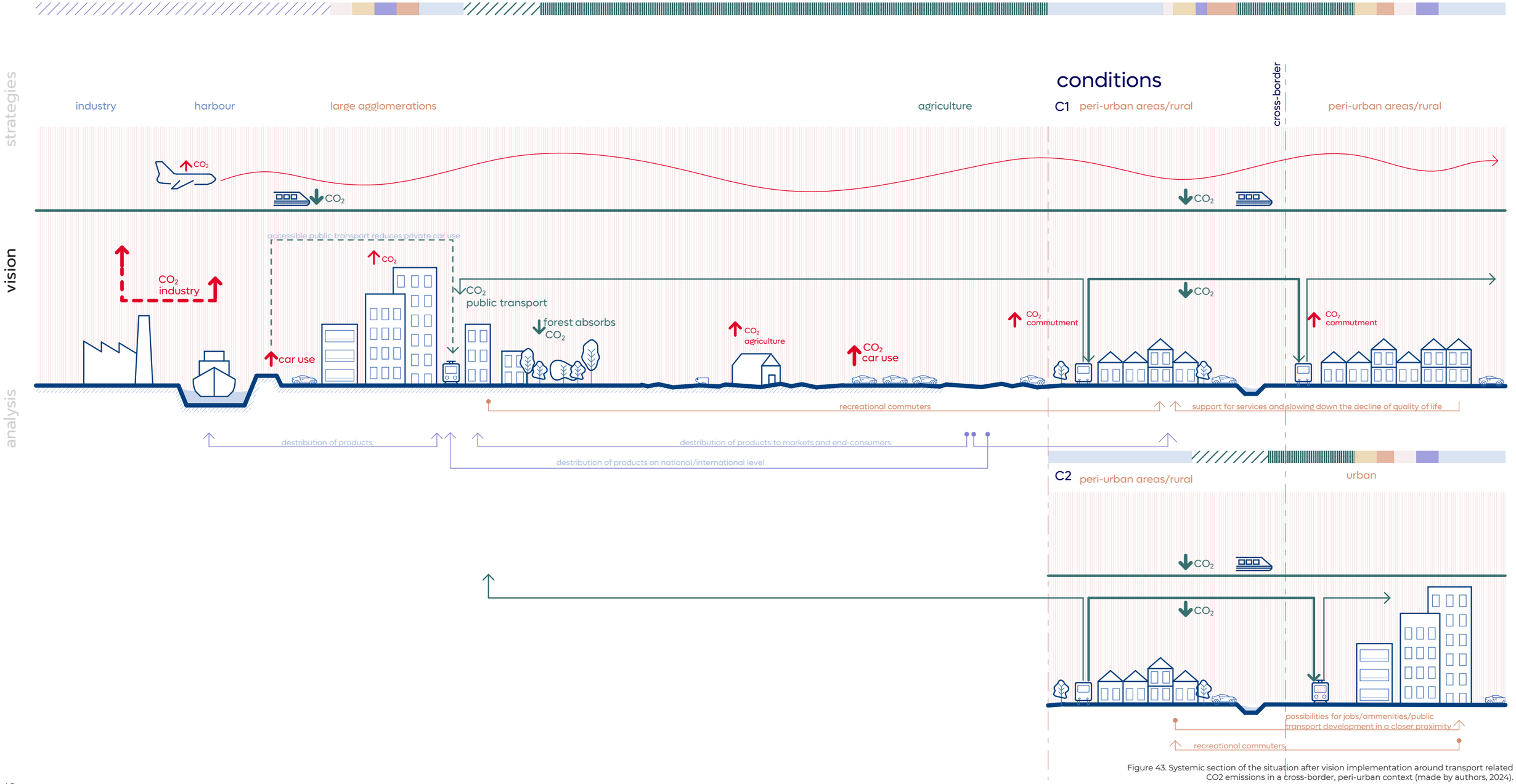


Figure 43. Systemic section of the situation after vision implementation around transport related CO2 emissions in a cross-border, peri-urban context (made by authors, 2024).

05
strategies

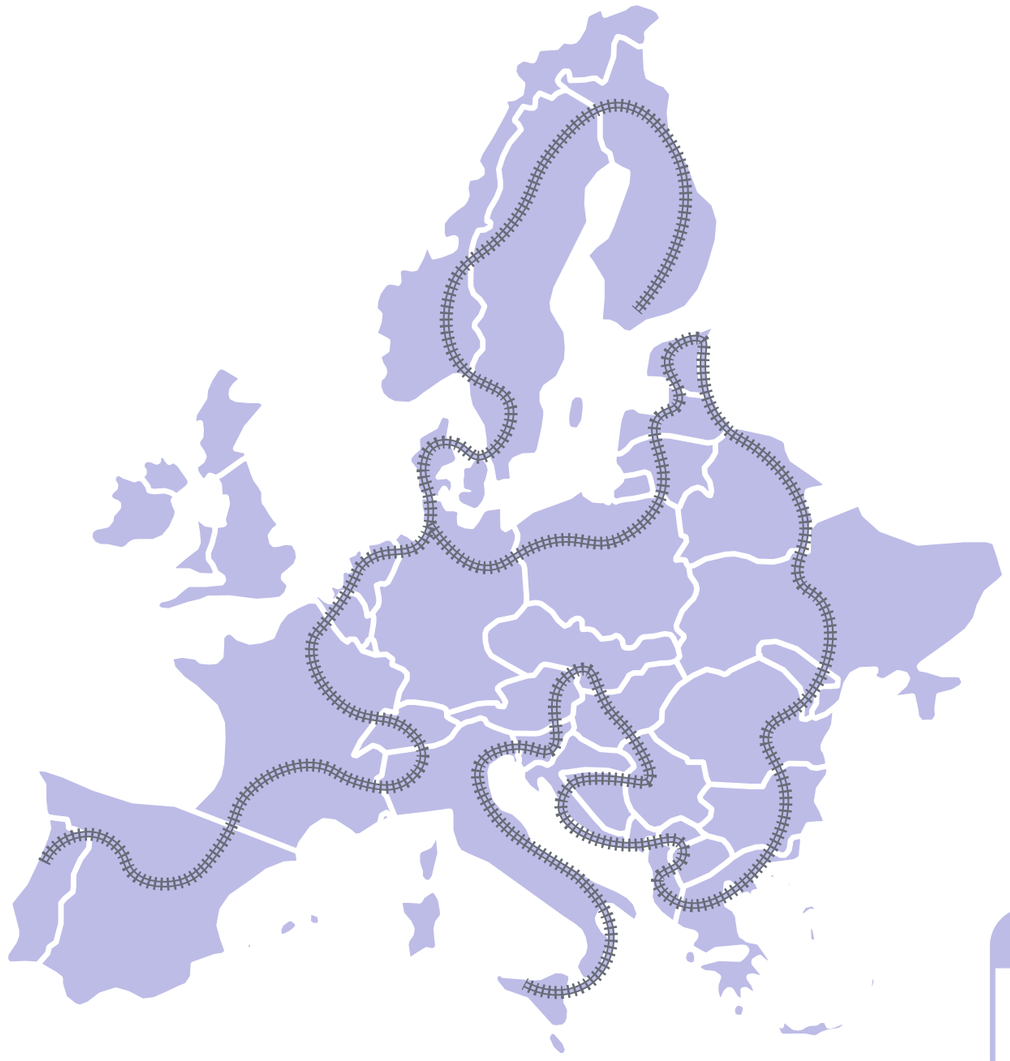
The fifth chapter will revolve around the CMIYC strategy. First, the strategy on the XL scale, which consists of a regulatory framework and exploration of blockchain technologies, will be presented. This section will be followed by an explanation of how the strategy for the M and S scale is developed, after which the strategy will be explained in detail. Finally, five areas will be presented in which the strategy will be applied from start to finish. The chapter concludes with a timeline of the strategy for the S, M and XL scales.

5.1 XL strategy

After developing a strategy for the S and M scale, it is imperative to consider how this approach for the future Maas-Rhein region fits into the larger framework of the European Union (EU). Before diving deeper into the goals and the corresponding policies that the XL Cross Me If You Can (CMIYC) strategy includes the EU's position on transport and mobility policy in terms of historical development will be established, as well as the competencies that the EU is equipped with to intervene in the transport and mobility sector of individual member states. The section on mobility strategy for the XL scale will be followed by an exploration of blockchain technology as a means to further enhance cooperation between (EU member) states.

In 1957, in the Treaty of Rome, the EU established that Transport must be one of the EU's core common policies. However, well into the 1980s is when the first policy regarding transport and mobility started to arise (Heinrich-Böll-Stiftung, 2021), including the first mention of a European Transport Network in the Maastricht Treaty. Between the mid-1980s and a little after 2010, the focus of EU transport policy lies on establishing a Single European Railway area and the Trans-European Transport Network (TEN-T) that stretches across Europe. The first refers to a single competitive market, and the latter refers to a physical railway network. More recent policy is focussed on the European Green Deal, which strives for climate neutrality by 2050. This ambition includes goals such as a 90% reduction of greenhouse gasses (European Commission, n.d.). The "Sustainable and Smart Mobility Strategy" as proposed by the European Commission, is part of the European Green Deal and is therefore more focussed on an e environmentally sustainable transport system (Heinrich-Böll-Stiftung, 2021).

To understand how the XL CMIYC strategy can be positioned within existing and future EU policy it is essential to set out the legal basis for EU action in the transport and mobility sector. The actions of the EU in this case are based on the Treaty on the Functioning of the European Union (TFEU). Specifically articles 4(2)(h&g), Articles 170 to 172 and Articles 90 to 1000 cover transport and the TEN-T (EPRS, 2020). Furthermore, in the fields of transport and TEN-T, the EU has shared competencies with the individual member states, meaning that although measures are adopted at the EU level, the responsibility for implementation and financing of said measures lies primarily with the member states (ibid).



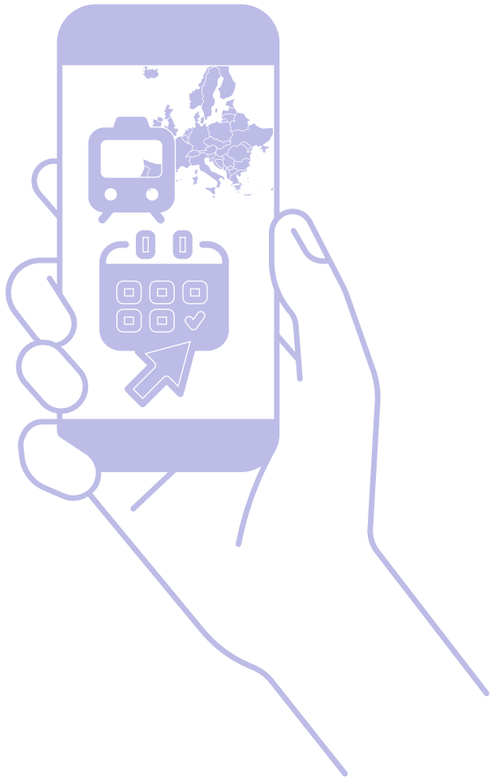


Figure 44. Illustrations of deliverables of XL strategy (made by authors, 2024).

railway system framework

To reduce greenhouse gas emissions, which is the main aim of the complete CMIYC strategy, as well as highly prioritized in the European Green Deal (European Commission, n.d.), a strong, just, and sustainable European transport network is crucial. Two important lessons from the European Mobility Atlas tell us that not only trains and railways will be the backbone of a sustainable transport network, but that private cars will not use the limited public space efficiently. Slow modes and a variety of public transport modes would result in a more sustainable and efficient use of public space, as well as a more sustainable future for mobility. Therefore, the XL CMIYC strategy will focus on cross-border mobility between the EU member states, specifically prioritizing the rail network and other public transport modes.

There are three goals that XL aims to achieve, through policy and digitalization measures on the EU level, which are supplemented by more local spatial interventions on the S and M scale.

Goal 1: More cooperation on the railway between EU nation-states

Goal 2: A cross-border mobility network throughout the EU

Goal 3: More integrated mobility platform

For each goal, the following sections will explore the challenges, the current policies and measures that are in place and what the CMIYC strategy aims to contribute. Finally, all policies and measures will be visualized on a timeline to further understand the priority and urgency of each component of the XL strategy.

Goal 1:
More cooperation on railway between EU nation states

As mentioned before, an important element in EU transport policy is the establishment of a Single European Railway Area (SERA). However, a crucial aspect of the current railway system is that it is highly specific to each member state. Railway networks often reflect the settlement structure and population density of a country, resulting in very different physical infrastructures, as well as highly varying scheduling and management practices (Heinrich-Böll-Stiftung, 2021). Furthermore, the current railway market is not unified, and most of the member states have restrictions in terms of allowing competition into their local markets, further complicating the establishment of a SERA (ibid.). A Single European Railway Market would create a dynamic for more cooperation, especially in terms of non-physical elements, such as pricing, scheduling, and other management elements of a unified railway market. Furthermore, increased competition in the railway market will incentivize individual operators to focus on the end-user perspective, improve their quality and reduce their costs.

Currently, the EU has a set of measures in place to battle the challenges that arise around establishing a SERA. Four so-called railway packages, including legislative measures on market standards and regulatory frameworks amongst other things, have been adopted by the EU. Furthermore, the European Union Agency for Railways (ERA) (Heinrich-Böll-Stiftung, 2021).

The CMIYC strategy for the XL scale proposes **drafting and adopting a renewed Railway legislative package**. As the most recent package was adopted in 2016, and the first in 2001 (European Commission, n.d.-a), a new version will provide a boost for the practical establishment of the SERA. This 2025 railway package will include a technical component and a market component, similar to its predecessor. The technical component will include legislative measures such as technical standards for rail networks throughout Europe, for instance the harmonization of the electrification systems of railway networks in Europe (fig. 4). The market component will focus more on better enforcing the right for railway operators to operate throughout the EU, amongst other things. Furthermore, the CMIYC strategy proposes that this **Railway Legislation Package is renewed every five years**, to help ensure its quality, relevance and applicability throughout decades.

Goal 2:
A harmonized railway network throughout the EU

Historically, it was never smooth sailing for the railway network in Europe. In the early decades of the 19th century, the railway was invented and adopted to be one of the main means of transportation. However, the cross-border infrastructure was severely damaged during the Second World War and never properly rebuilt. After the war, the Iron Curtain in Germany resulted in more fragmentation of Europe. Meanwhile, motorized modes of road transport were prioritized in policies (Heinrich-Böll-Stiftung, 2021). As a result of this historical development and lack of prioritization and investment of financial means the current rail network resembles a patchwork full of gaps at the borders. It is therefore not surprising that the share of rail in passenger transport in 2017 was merely 7.8%, with over 80 per cent consisting of domestic transport (Ibid.).

Currently, the European Commission is trying to emphasize the potential of the modal shift to the railway in terms of cutting transport-related CO2 emissions. This potential becomes evident in the fact that the railway only accounts for a negligible two per cent of the total transport energy consumption in the EU (Ibid.). 2021 was established as the European Year of Rail (AGE, n.d.), to raise awareness of the potential of the train as the sustainable, comfortable and safe future of transport. This initiative was part of the European Green Deal (Ibid.). Furthermore, EU funding does currently emphasize the need for cross-border transport, however, there is a significant gap between the size and quantity of projects and the funding available. Individual member states prioritize projects that benefit their domestic network and the majority of funding is tied up in major projects, leaving little to no budget for the large number of smaller projects (Heinrich-Böll-Stiftung, 2021).

To achieve the second goal, the CMIYC strategy for the XL scale recognizes the prioritization of the EU cross-border rail infrastructure. Not only is more awareness of the potential of the rail network necessary but mostly investments in closing the gaps in the physical infrastructure are crucial. We propose to create **a regulatory framework that will guide the reallocation of funding** to close the most obvious existing cross-border gaps in the rail network. Since the Maas-Rhein region will serve as the metropolitan backbone for a sustainable Europe in 2100, the CMIYC strategy proposes to start with railway infrastructure projects in this region and expand outwards from there based on a prioritized list of which interventions serve the greatest amount of people. The framework will contain measures on which projects to prioritize, which role the member states will play in this decision-making process and how the (co-)funding will be allocated.

Goal 3:
More integrated mobility platform

With every EU member state having its railway, bus, and various other modes of public transport operators, including their respective digital platforms, the patchwork metaphor is not unique to the physical railway infrastructure in the EU. The challenges that come with navigating the fragmented public transport operator platforms result in diminished travel convenience and comfort, essentially decreasing the potential use of the public transport network in the EU.

Currently, mobility on a small urban scale is seeing a transformation in the form of connected mobility, including elements such as shared bikes and e-scooters, ride- and car-sharing, both for last-mile passengers and transport functions (Heinrich-Böll-Stiftung, 2021). This new form of mobility has altered the nature of short-distance trips in urban centres, as well as the trips from suburban areas to urban centres. As of now, these emerging shared modes of transport mainly consist of mobile applications that have a strong focus on business-to-consumer services. These apps and transformed mobility on the micro-urban level can be considered part of the Mobility as a Service (MaaS) concept. However, it is important to realize that this development towards a more MaaS-oriented transport system comes with negative side effects. For instance, chauffeurs who work for Uber are only provided with the digital platform but are not guaranteed a basic income (Ibid.).

Therefore, joining mobility services within one digital platform will be the next endeavour towards a future in which MaaS is dominant. The CMIYC XL strategy proposes to create **a unified digital platform for the railway, bus, tram and metro networks** within the Maas-Rhein region, starting with the development of this application in 2025. This will not only enable cross-border commuters to reach their destination more efficiently but will create more comfort when planning their daily commute. These are rather short-term uses of the application, however, once this application is developed, shared mobility modes can be incorporated through cooperation with the individual businesses. One single card, which is also available in the application, can be used for all modes of transport that are incorporated into the digital platform. Eventually, this development can provide a legal base to create a more secure livelihood for those who currently do not have a basic income within the mobility sector. By 2060, this development in the Maas-Rhein region will be complete, and a digital infrastructure will be established to create a similar mobility platform throughout the EU.

blockchain framework

This section will present an exploration of blockchain technology as a means to further enhance cooperation between (EU member) states. The blockchain is a type of distributed ledger technology first developed as the underlying infrastructure for cryptocurrencies like Bitcoin. It acts as a digital database known as the “chain” that safely and openly records transactions (Nakamoto, 2009), reducing the risk of fraud, bribery, and tampering with data (Lu et al., 2021a). It is a decentralised database shared among multiple locations, sites, and computers without central administration. Blockchain technology can be used in various applications such as criminal records, voting systems, money tracking, custody of court files, financing state structures and company licences. In relation to regional planning and urban developments, this empowers stakeholders to securely and openly access, verify, and monitor information regarding land ownership, zoning regulations, permits, and development approvals.

Smart contract is a key feature of a blockchain technology that can be described as an agreement made between network nodes and securely stored in a decentralised manner using a peer-to-peer system. These contracts can automate various processes such as updating land registries, approving permits, and facilitating payment transactions, thus eliminating the need for intermediaries and speeding up the progress of development projects (S. Aggarwal and N. Kumar, 2021). This could save time and resources, as well as improve the efficiency of regional planning authorities and encourage community engagement in decision-making. Moreover, implementation of blockchain-based systems for voting and governance can involve residents, businesses, and other urban stakeholders in urban policies and initiatives. Also, this technology allows for transparent monitoring of environmental data, resource consumption, and carbon emissions.

However, there are some difficulties associated with the implementation of blockchain as well. Firstly, due to its shortcomings in dealing with large volumes of transactions and data processing, scaling becomes a problem for it. Secondly, once extensively adopted, there is concern about data privacy, security and regulatory compliance. In addition, organisational and governmental lack of knowledge in terms of technology complexity and resource requirements serve as another challenge.

Nevertheless, this technology has its own advantages over many others that have been used in governance systems. It may be seen as a very robust tool capable of scaling over the next decades amid technological advancements, with potential of enhancing transparency efficiency and social justice during municipal development. Therefore, blockchain technology integration will be included in the XL vision for the Maas-Rhein, and will be expanded throughout the coming 75 years.

5.2 M&S strategy making

introduction & goals

The Maas-Rhein vision highlights the corridor as an important element. The corridors, which take a line-like shape, are meant to not only benefit the areas inside the corridor but also those above, under or in between them. By concentrating development of amenities, services, sustainable transport and intangible resources, and providing sustainable connections to this development, the region will flourish. The strategy therefore essentially aims to meet the objectives that were established in the first chapter of this report:

- A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rhein region, by the European Green Deal.

- High-quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport.

- Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport.

In order to develop the spatial vision into a strategy for the Maas-Rhein region, it is first and foremost important to understand what the current situation in these corridors is. To that end, the following section will present a spatial analysis of the urban corridors and the green corridors. The analysis of the urban corridor will be used to create a classification of different settlement structures and the corresponding amenities, services, intangible resources and sustainable transport options. The analysis of the green corridor will show an overview of the variety of places that fall within the boundaries of the corridor, in terms of settlement size, the presence of green space, recreational amenities and open spaces. This analysis will result in a deeper understanding of the dynamics that the strategy will have to be able to interact with and therefore be vital in the process of considering different interventions and strategy approaches.

classification of urban corridors

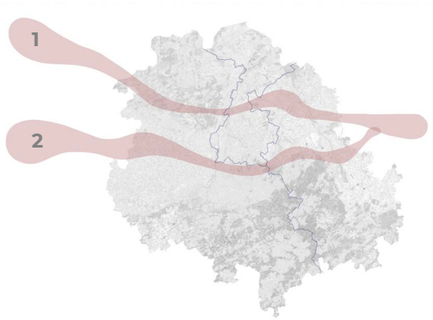


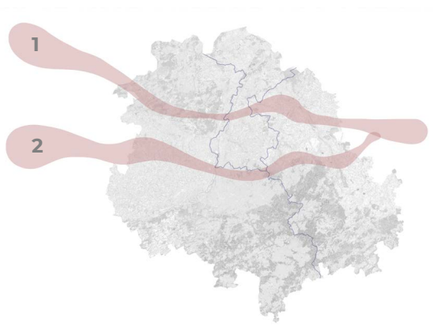
Figure 45 presents the analysis of a large number of settlements in both corridors one and two. The analysis was carried out by consulting public information on several parameters (bus, train, Services of General Interest (SGI's; European Commission, 2017), Other amenities, Open space & industry/ big employer) or calculating (Density population & Density building). For each settlement, the parameters were considered to be present to a small, medium or large extent. After visualizing the analysis (fig.45) there appeared to be a clear pattern of different types of settlements in the corridors. The next pages will explain this typology in more detail.

corridor 1

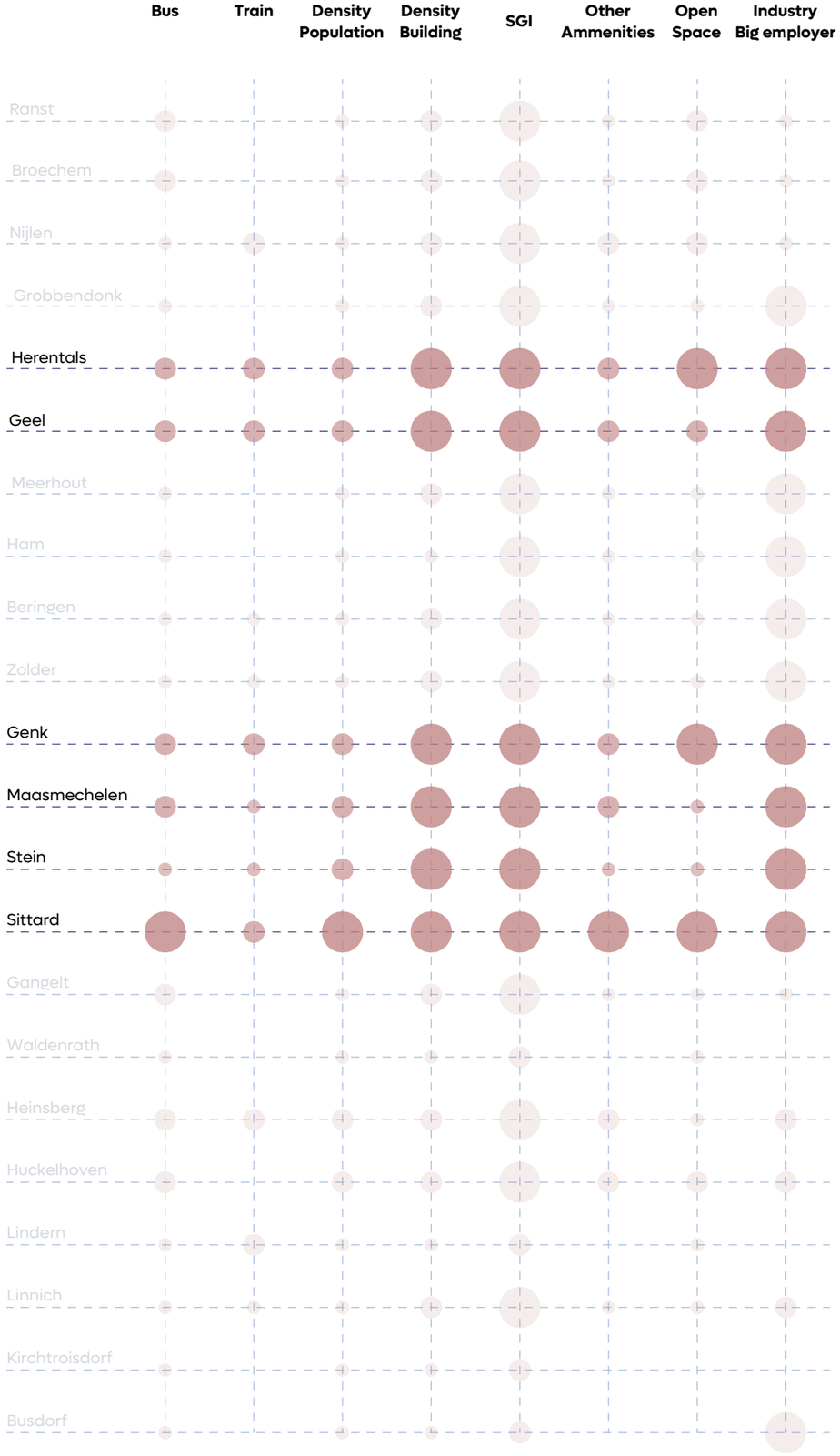
corridor 2

Figure 45. Visual representation of classification analysis of urban corridors (made by authors, 2024).

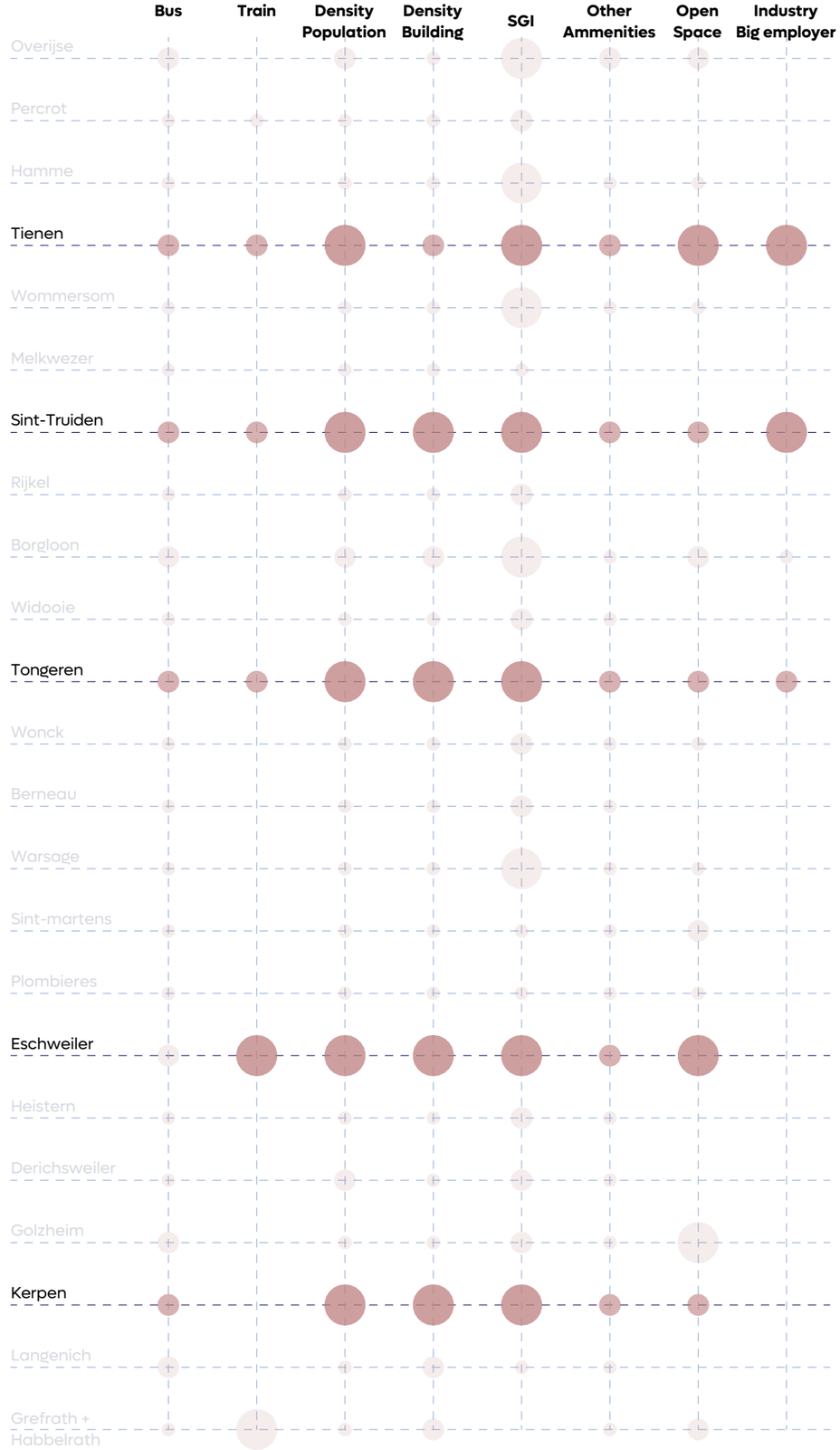
classification of urban corridors
large



The first type of settlement that was identified can be considered a larger-sized settlement (fig. 45a). Although there is still some variety between these settlements, there seems to be a common denominator in the presence of public transport stops amenities and the presence of industry or a big employer.



corridor 1

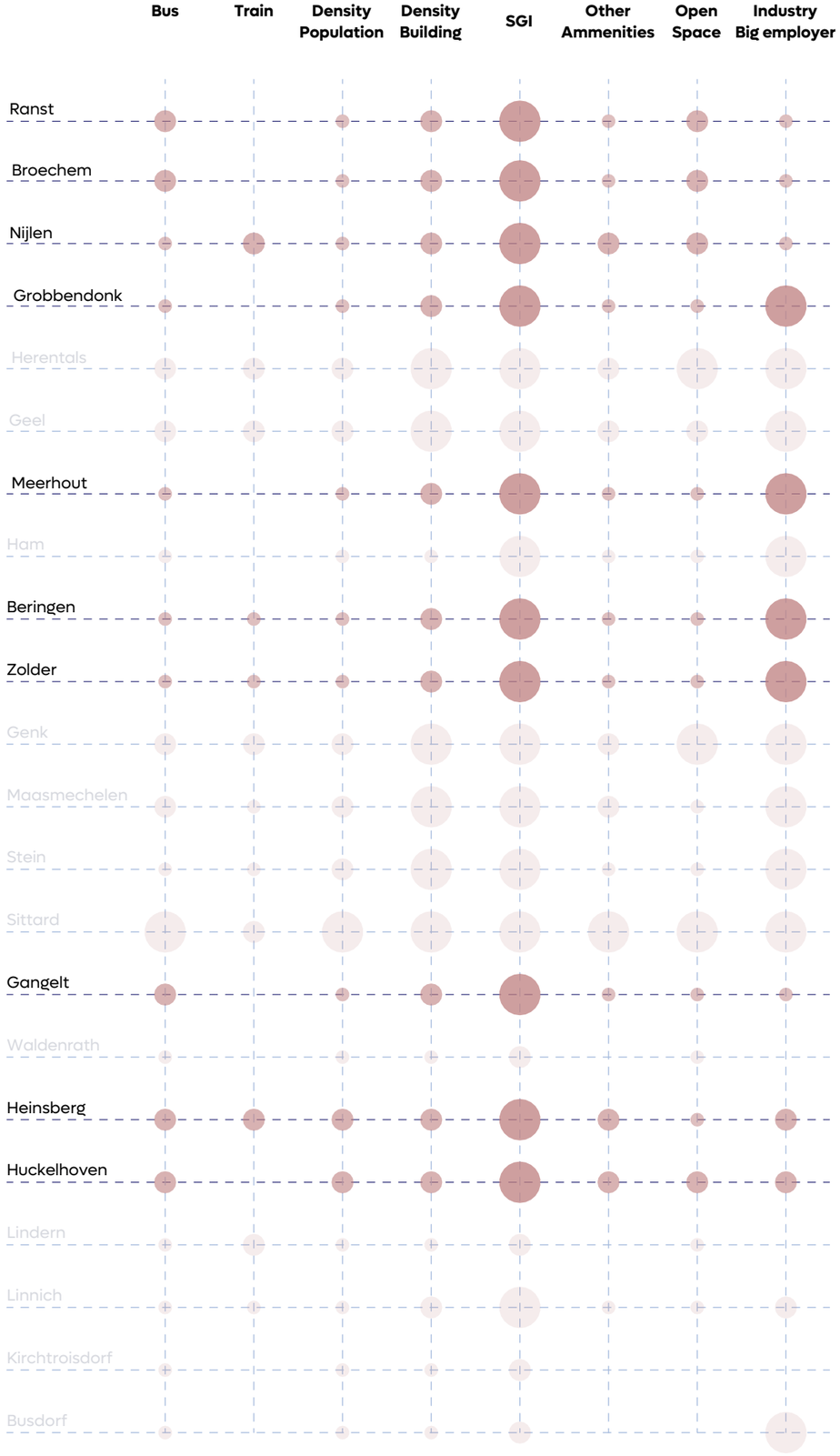


corridor 2

Figure 45a. Classification analysis of urban corridors with large settlements highlighted (made by authors, 2024).

classification of urban corridors
medium

The second settlement type found in the urban corridor is the more medium-sized settlements (fig. 45b). These consist of settlements that all still include public transport stops, albeit to a lesser extent, all include SGIs, but a lesser variety of other amenities.



corridor 1

corridor 2

Figure 45b. Classification analysis of urban corridors with medium settlements highlighted (made by authors, 2024).

classification of urban corridors
small

The final type that was identified in the urban corridor is the smaller settlements (fig. 45c). These places usually lack access to public transport stops, and have SGIs to a lesser extent. Additionally, they usually do not include any other amenities and have little to no presence of any industry or big employers.

corridor 1

corridor 2

Figure 45c. Classification analysis of urban corridors with small settlements highlighted (made by authors, 2024).

urban corridors analysis in space

To understand how the classification of settlements in the urban corridor analysis lands in space, figure 46 presents an overview of the pattern of small, medium and large settlements in both corridor one and two. A clear pattern of larger settlements, with medium and smaller settlements in between can be distinguished.

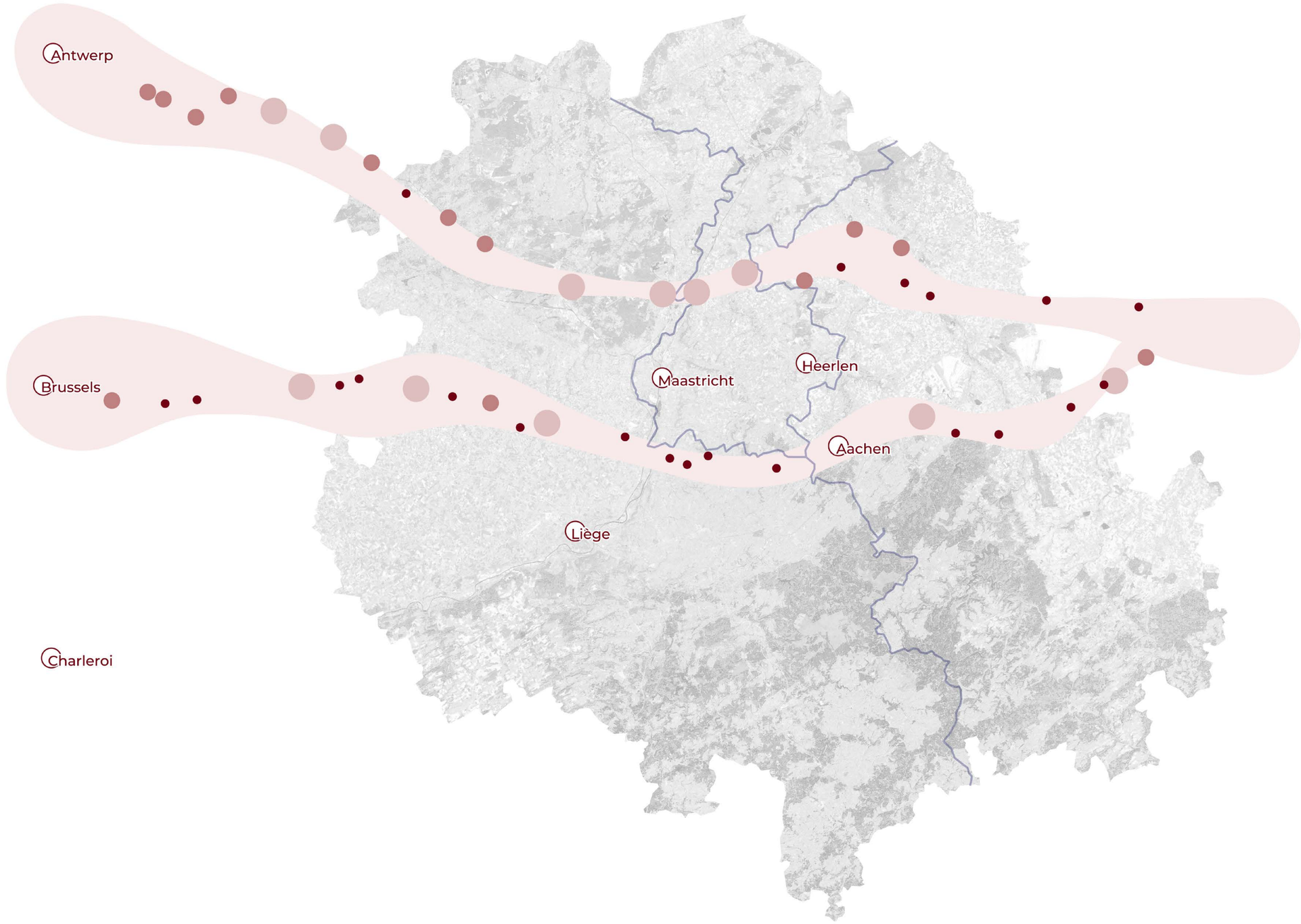
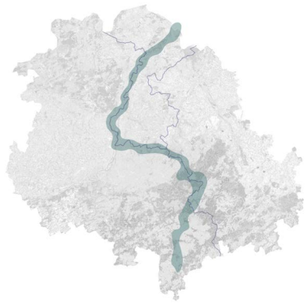
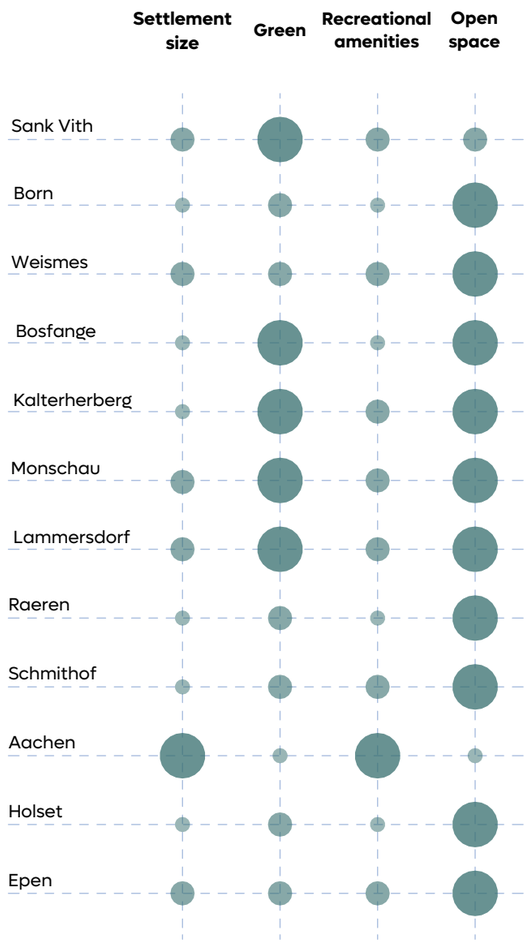


Figure 46. Map with geographical locations of settlements in urban corridor analysis (made by authors, 2024).

analysis of green corridors



The analysis of the green corridor aims to create a better understanding of the variety between places that the corridor will have to serve. Figure 47 presents this overview, with a focus on the settlement size, the current presence of green space, the current presence of recreational amenities and the current amount of open space.



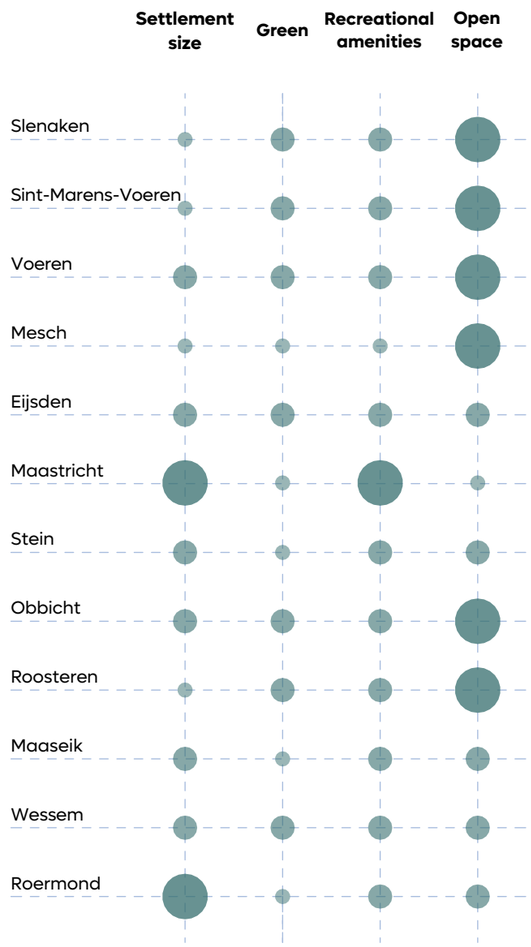


Figure 47. Visual representation of analysis of green corridors (made by authors, 2024).

green corridors analysis in space

Figure 48 displays how the settlements from the green corridor analysis are situated within the Maas-Rhein. Where we see a clear distinction between areas with more green space towards the south of the corridor and larger settlements with less green space in the middle, around the larger cities.

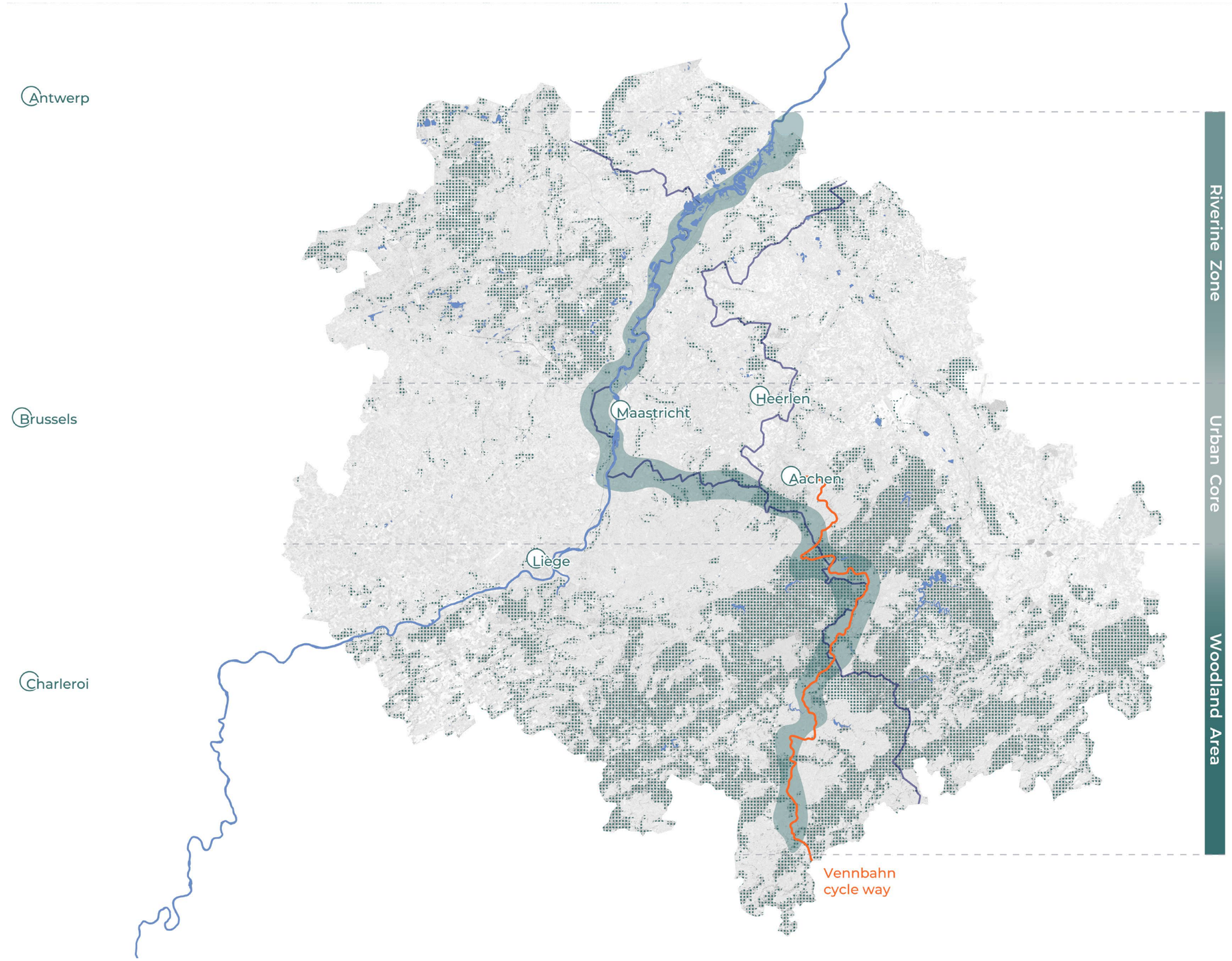
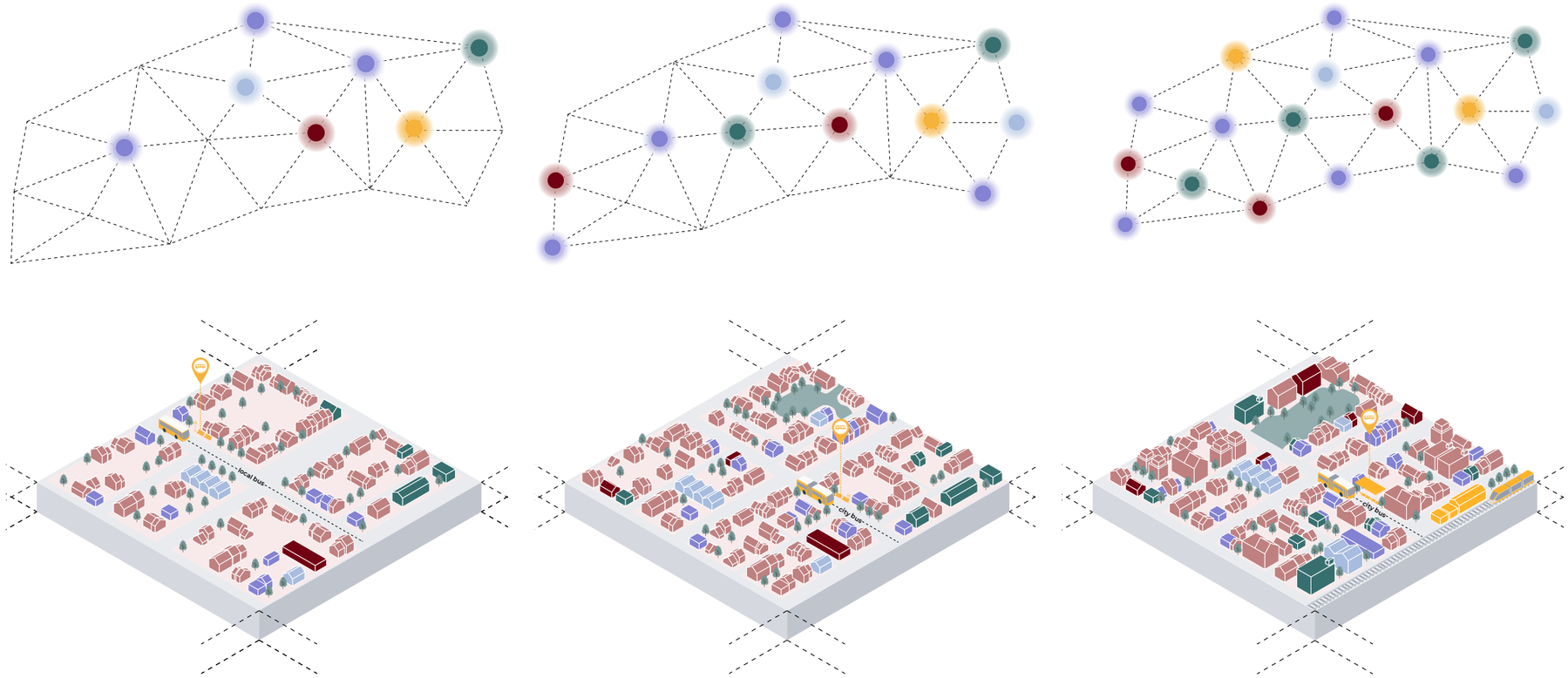


Figure 48. Map with geographical locations of settlements in green corridor analysis (made by authors, 2024).

current situation in urban corridors

After analysing both the urban corridors and green corridors, the remainder of the strategy-making process revolves around creating a final overview of the dynamics at play in the Maas-Rhein region to be able to create an effective and comprehensive strategy. To that end, figure 49 presents both a spatial and textual summary of the settlement typology that was observed in the urban corridor. This visual will be guiding in considering what every settlement type will need to achieve the CMIYC strategy goals.

What is important to note, is that an S settlement is not equal to the S scale that the CMIYC project is working with. The S scale is referring to an area where the strategy can be applied, within this S scale the strategy can deal with a variety of settlement types, which are classified as S, M and L settlements.



S settlement **M settlement** **L settlement**

	Bus	Train	Density Population	Density Building	SGI	Other Ammenities	Open Space	Industry/Big employer
S settlement	Bus stop(s): present Connection to XL centers: not present	Hardly present Some settlement close to train line, far from train station.	Between 150 and 1000	Between 27.000 m2/km2 and 60.000 m2/km2	Present to varying extent	Present to varying extent	Hardly present	Hardly present
M settlement	Bus stop(s): present Connection to XL centers: present in majority	Limited present different types of stations, ig: goods station.	Between 1000 and 2300	Between 60.000 m2/km2 and 110.000 m2/km2	Present	Present to considerable extent	Present to considerable extent	Present to considerable extent
L settlement	Bus stop(s): present Connection to XL centers: present	Present to considerable extent	Between 2300 and 5000	Between 110.000 m2/km2 and 170.000 m2/km2	Present	Present to good extent	Present to good extent	Present to good extent

Euroregions

- SGI's
- job opportunities
- education
- mobility
- other amenities

Figure 49. Visual representation of S, M and L settlements in the urban corridor (made by authors, 2024).

settlement size and distribution structure

Based on the settlement typology in the urban corridor and how this typology lands in space (fig. 46) a conceptual model of settlement structures throughout the whole Maas-Rhein is presented in Figure 50. The model that represents the current situation shows a clear pattern of small, medium and large settlements and the respective accessibility to a variety of services and amenities. The strategy in section 5.3 aims to alter the current model in such a way that a larger variety of amenities and services becomes available in certain areas of the region, the urban corridors, without urbanizing the full corridor.

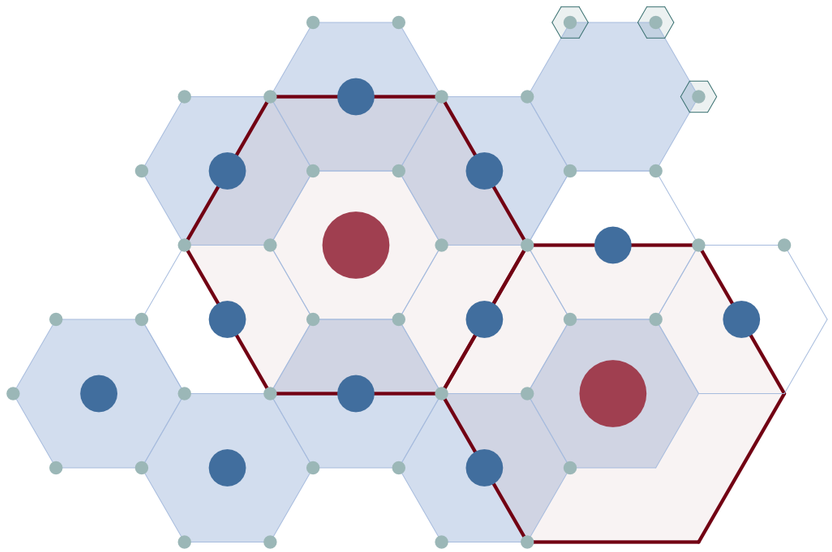


Figure 50. Conceptual representation of spatial pattern of different settlements throughout Maas-Rhein before and after strategy implementation (made by authors, 2024; adapted from Dastrup, 2020).

5.3 M&S strategy

After establishing a clear understanding of the corridors, as well as the dynamics that the strategy will have to be able to interact with, the strategy will consist of a flexible framework and multi-step application of this framework to any small-scale area in the Maas-Rhein region. The CMIYC strategy is, therefore, not shaped around a set of (site-)specific interventions. The strategy framework consists of an intervention matrix for both the urban and green corridors and a set of cards that represent each intervention in the matrix.

The intervention matrix for the urban corridor (fig. 52) includes interventions in three main categories: mobility, form and sustainable land use, which all include sub-categories. Furthermore, the matrix is based on the 'degree of effort' that is required for development. This 'degree of effort' can be determined based on a variety of parameters: the extent of the challenge in the area, the level of financial investment available, the complexity of the conditions in the area and the available technology. The interventions for each category can be considered based on the degree of effort selected for an S-scale area.

The same principle is applied in the design of the intervention matrix of the green corridor (fig. 57). However, rather than 'degree of effort', this matrix is based on the 'degree of engagement'. Based on the analyses in the previous section, the green corridor will be interacting with a wide variety of places, therefore the matrix provides interventions for different types of future engagement with the corridor. Interventions will be aimed at generating, preserving, activating and regulating access to green spaces and will be selected based on the current situation in the area of intervention and on the foreseen interaction with the green corridor.

The intervention cards for both the urban and the green corridor each include one measure from the intervention matrix (fig. 53 & fig. 58) and provide a better understanding of each intervention, the cards are coloured based on their respective category in the urban and green corridor intervention matrix. Figure 51 presents a visual explanation of the design of the intervention cards, including the title, action code and base colour and gradient. Following the overview of all intervention cards.

The remainder of this section will explain the different interventions in further detail, starting with the intervention matrix and cards for the urban corridor, followed by the intervention matrix and cards for the green corridor.

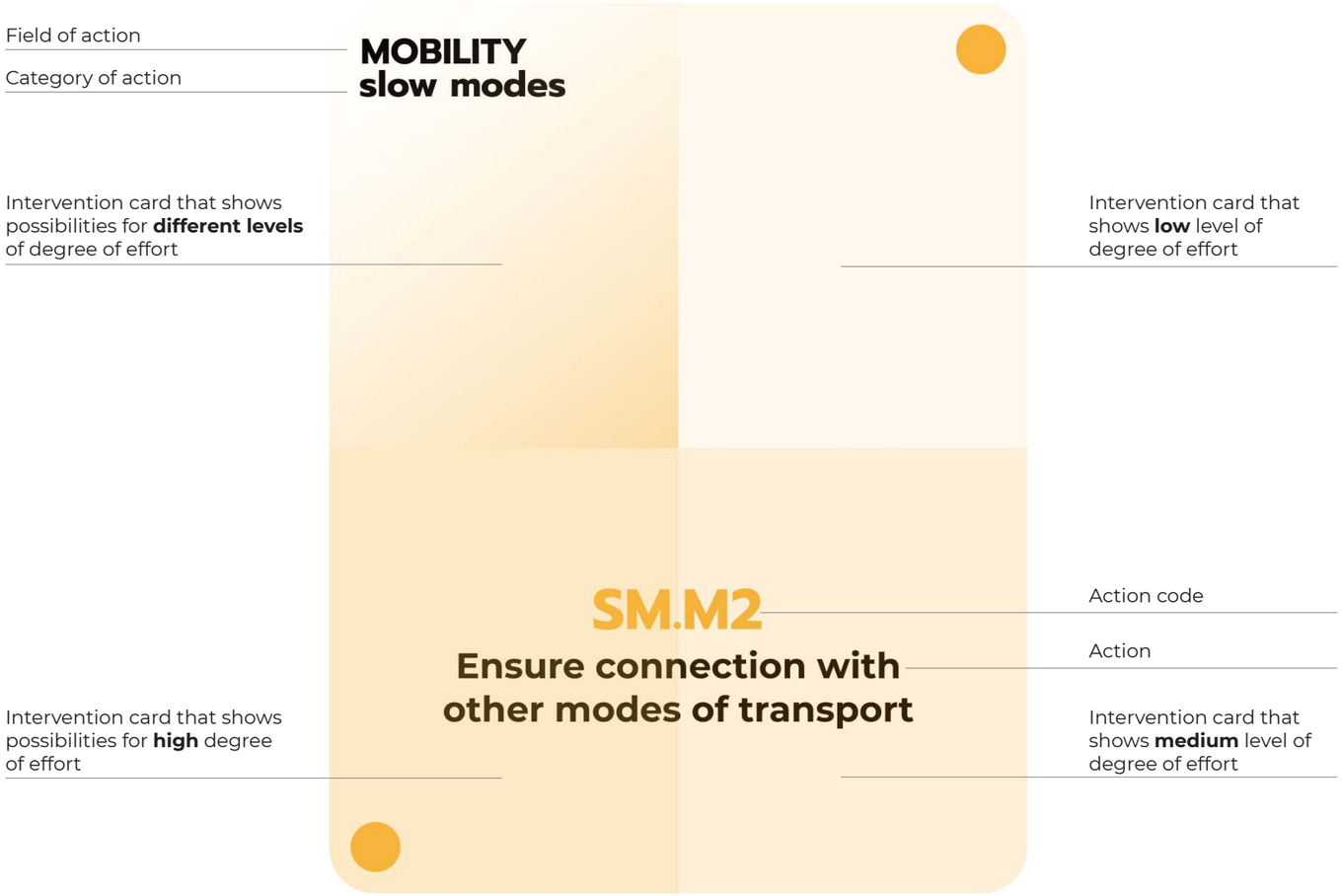


Figure 51. Visual explanation of intervention card design (made by authors, 2024).

intervention matrix
urban corridor

vision strategies analysis

DEGREE OF EFFORT	MOBILITY					FORM		SUSTAINABLE LANDUSE		
	Bus	**Slow modes**	**Train**	**Shared mobility**	**Transport hub**	**Density Population**	**Density Building**	**SGI**	**Other Ammenities**	**Open Space**
Low	**B.L1** Increased frequency: small to moderate extent **B.L2** Improve existing bus routes with minor adjustments	**SM.L1** Attractiveness of biking and walking infrastructure: small to moderate extent **SM.L2** Policies to incentivise use of slow modes.	**T.L1** Upgrade existing train stations with basic amenities	**SHM.L1** Promote existing ride-sharing platforms and encourage automated and efficiency-improved carsharing initiatives	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs	**DP.L1** Encourage infill development	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms	**OA.L1** Create attractive business climate for local and external parties	**PS.L1** Implement minor enhancements such as street furniture and art installations
Medium	**B.M1** Increased frequency: small to large extent **B.L2** Improve existing bus routes with minor adjustments **B.M3** Add more bus stops along existing routes	**SM.M1** Attractiveness of biking and walking infrastructure: small to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensure connection with other modes of transport	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones	**TH.L1 Enhance existing transportation nodes with improved signage and passenger information** **TH.L2 Ensure existing mode cross in transport hubs** **TH.M1 Upgrade transportation hubs to include increased intermodal connectivity and seamless transfer options**	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
High	**B.H1** Increased frequency: medium to large extent **B.H2** Add more bus stops to existing and/ or new routes **B.H3** Add new bus routes **B.H4** Implement Bus Rapid Transit (BRT) systems with segregated lanes **B.H5** Hydrogen bus	**SM.H1** Attractiveness of biking and walking infrastructure: to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensuring connection with other modes of transport **SM.H2** Add (protected) bike and walking infrastructure that connects the urban and peri-urban	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology **T.H1** Unified transport system across border **T.H2** Activating existing infrastructure **T.H3** Adding new infrastructure	**SHM.L1 Promote existing ride-sharing platforms and encourage initiatives** **SHM.M1 Subsidize shared mobility services** **SHM.M2 Establish designated pick-up/ drop-off zones** **SHM.H1 Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms, ensuring seamless and personalized door-to-door transportation** **SHM.H2 Establish vertical mobility hubs with flying taxi services and drone delivery networks for efficient and eco-friendly urban mobility.**	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning **DB.H1** Implement Transit-Oriented Development (TOD) strategies, including increased building heights and density bonuses near transit corridors	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks **SGI.H1** Invest in cutting-edge technology and customer service initiatives to ensure exceptional service reliability and satisfaction	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfront developments, and world-class amenities	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programming

Figure 52. Intervention matrix for urban corridor (made by authors, 2024).

intervention cards
urban corridor cards

vision

analysis

strategies

Bus	Slow modes	Trains	Shared mobility	Transport hub	Density population	Density building	SGI	other amenities	public space
MOBILITY bus **B.LMH1** Increased frequency of public transport	MOBILITY slow modes **SM.LMH1** Attractiveness of biking & walking infrastructure	MOBILITY trains **T.L1** Upgrade existing train stations with basic amenities	MOBILITY shared mobility **SHM.L1** Promote existing ride-sharing platforms and encourage initiatives	MOBILITY transport hub **TH.L1** Enhance existing transportation nodes with improved signage and passenger information	FORM density population **DP.L1** Encourage infill development	FORM density building **DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	SUSTAINABLE LAND USE SGI **SGI.L1** Implement basic service standards	SUSTAINABLE LAND USE other amenities **OA.L1** Create attractive business climate for local and external parties	SUSTAINABLE LAND USE public space **PS.L1** Implement minor enhancements such as street furniture and art installations
MOBILITY bus **B.LH2** Improve existing or add bus routes with minor adjustments	MOBILITY slow modes **SM.L2** Policies to incentivise use of slow modes	MOBILITY trains **T.M1** Improve timetable coordination by implementing AI technology	MOBILITY shared mobility **SHM.M1** Subsidize shared mobility services	MOBILITY transport hub **TH.L2** Ensure existing mode cross in transport hubs	FORM density population **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	FORM density building **DB.M1** Introduce mixed-use zoning	SUSTAINABLE LAND USE SGI **SGI.L2** Implement monitoring mechanisms	SUSTAINABLE LAND USE other amenities **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	SUSTAINABLE LAND USE public space **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
MOBILITY bus **B.MH3** Add more bus stops to existing and/ or new routes	MOBILITY slow modes **SM.M2** Ensure connection with other modes of transport	MOBILITY trains **T.H1** Unified transport system across border	MOBILITY shared mobility **SHM.M2** Establish designated pick-up/drop-off zones	MOBILITY transport hub **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options	FORM density population **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	FORM density building **DB.H1** Implement Transit-Oriented Development (TOD)	SUSTAINABLE LAND USE SGI **SGI.M1** Upgrade service quality to meet higher performance benchmarks	SUSTAINABLE LAND USE other amenities **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfronts, and amenities	SUSTAINABLE LAND USE public space **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural program
MOBILITY bus **B.H4** Implement Bus Rapid Transit (BRT)	MOBILITY slow modes **SM.H2** Add bike and walking infrastructure that connects the urban and peri-urban	MOBILITY trains **T.H2** Activating existing infrastructure	MOBILITY shared mobility **SHM.H1** Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms	MOBILITY transport hub **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport			SUSTAINABLE LAND USE SGI **SGI.H1** Invest in cutting-edge technology & customer service initiatives to ensure exceptional service		
MOBILITY bus **B.H5** Hydrogen bus		MOBILITY trains **T.H3** Adding new train infrastructure	MOBILITY shared mobility **SHM.H2** Establish vertical mobility hubs with flying taxi services and drone delivery networks						

Figure 53. Intervention cards for urban corridor (made by authors, 2024).

The first set of interventions consists of interventions in the (functioning of) the bus network (fig.54a). As the base of these cards indicates, three of these interventions can be used for a variety of degrees of effort, the bottom two however can only be used when seeking to implement a high degree of effort.

MOBILITY
bus

B.LMH1

Increased frequency of public transport

Implementing increased driving frequency of public transport vehicles will allow for optimized use of existing infrastructure. This measure will ensure more convenient and comfortable travel.

low/medium/high
degree of effort

MOBILITY
bus

B.LH2

Improve existing or add bus routes with minor adjustments

Improving and adding minor adjustments to existing bus routes, such as reviewing the most efficient routes from stop A to stop B, allows for optimal use of existing infrastructure.

low/high
degree of effort

MOBILITY
bus

B.MH3

Add more bus stops to existing and/ or new routes

Providing new bus stop infrastructure allows for connections between more remote areas.
This can be applied to newly developed areas or areas that are planned to be developed.

medium/high
degree of effort

MOBILITY
bus

B.H4

Implement Bus Rapid Transit (BRT)

High-capacity, efficient public transportation system that utilizes dedicated lanes or rights-of-way to provide fast, reliable bus service.

high
degree of effort

MOBILITY
bus

B.H5

Hydrogen bus

A hydrogen bus is a type of bus that utilizes hydrogen fuel cells to generate electricity, which powers electric motors to propel the vehicle. These buses are considered zero-emission vehicles because they produce only water vapor and heat as byproducts.

high
degree of effort

Figure 54a. Interventions cards for bus (made by authors, 2024).

The next sub-category of mobility is ‘slow modes’ of transport (fig. 54b), which includes both walking and cycling. This set of cards serves a variety of degrees of effort.

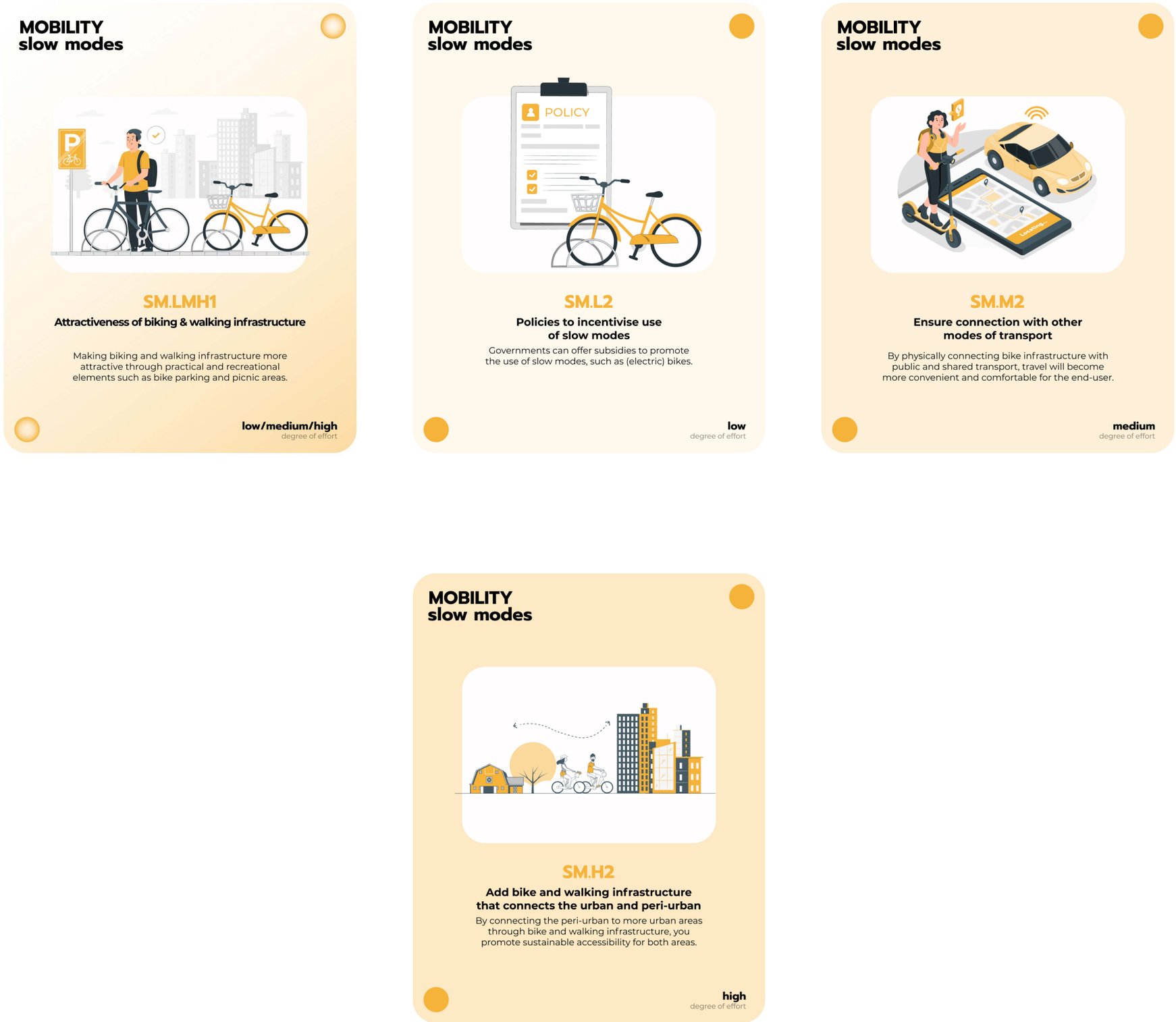
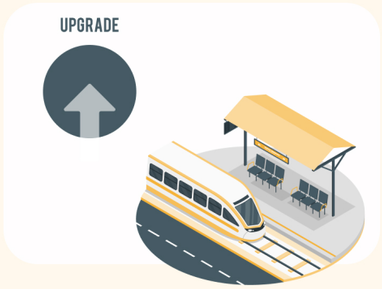


Figure 54b. Interventions cards for slow modes (made by authors, 2024).

The (functioning of) railway network is the third sub-category of mobility interventions (fig. 54c). This set does not include cards with a gradient base; therefore, all cards are specific to a certain degree of effort.

MOBILITY
trains



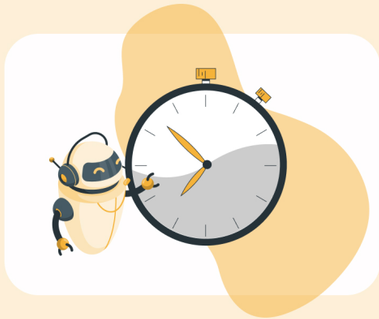
T.L1

Upgrade existing train stations with basic amenities

By providing well-maintained basic amenities in train stations, such as clean public restrooms or a room for nursing mothers, public transport becomes more accessible and comfortable.

low
degree of effort

MOBILITY
trains



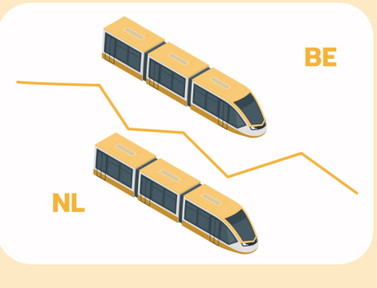
T.M1

Improve timetable coordination by implementing AI technology

By implementing AI technology to improve scheduling practices, travel will become more receptive to the varying demands of end-users.

medium
degree of effort

MOBILITY
trains



T.H1

Unified transport system across border

A unified transport system that stretches across borders will allow for more convenient and comfortable travel, especially for cross-border commuters.

high
degree of effort

MOBILITY
trains

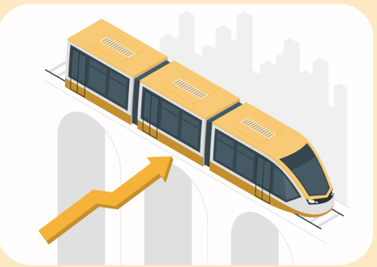
T.H2

Activating existing infrastructure

Activating existing infrastructure, such as rail tracks, infrastructure projects will be more cost-effective and less invasive for nature.

high
degree of effort

MOBILITY
trains



T.H3

Adding new train infrastructure

Adding new train infrastructure to the current railway network can help improve sustainable accessibility both within and between nations.

high

Figure 54c. Interventions cards for trains (made by authors, 2024).

The fourth sub-category for mobility interventions is ‘shared mobility’ (fig. 54d) CMIYC defines shared mobility as “transportation services and resources that are shared among users, either concurrently or one after another. This includes public transit; micromobility (bikesharing, scooter sharing) and commute-based modes or ridesharing (carpooling and vanpooling) (Shared Use Mobility Center, n.d.)

MOBILITY shared mobility

SHM.L1

Promote existing ride-sharing platforms and encourage initiatives

Promoting existing ride-sharing platforms and encouraging initiatives is a relatively simple and cost-effective measure to increase shared mobility.

low
degree of effort

MOBILITY shared mobility

SHM.M1

Subsidize shared mobility services

Subsidizing shared mobility services can result in a larger share of shared mobility in the network, resulting in lower CO2 emissions.

medium
degree of effort

MOBILITY shared mobility

SHM.M2

Establish designated pick-up/drop-off zones

Designated pick-up and drop-off zones improve connectivity where various modes of transport meet, such as in mobility hubs.

medium
degree of effort

MOBILITY shared mobility

SHM.H1

Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms

A fully autonomous, AI-driven, shared mobility fleet would drastically reduce the need and relative comfort of private motorized vehicles, and would therefore highly contribute to CO2 emission reduction.

high
degree of effort

MOBILITY shared mobility

SHM.H2

Establish vertical mobility hubs with flying taxi services and drone delivery networks

This measure is an extremely innovative solution that would severely change the future of mobility.

high

Figure 54d. Interventions cards for shared mobility (made by authors, 2024).

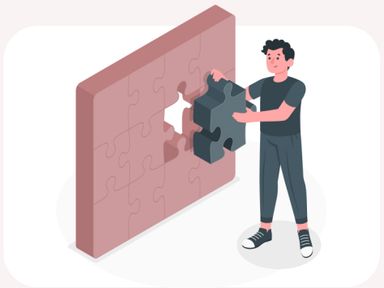
The final sub-category is ‘transport hubs’ (fig. 54e), which essentially is any place where transport is concentrated, including train stations, bus stops, park and ride facilities, etcetera. As the base suggests, the cards in this set are specific to a degree of effort.

Figure 54e. Interventions cards for transport hub (made by authors, 2024).

intervention cards
form: density population

The second category includes two sub-categories, the first of which is the population density. Figure 55a presents the interventions included in the matrix for this sub-category.

FORM
density
population



DP.L1

Encourage infill development

By implementing regulations that encourage infill development, the population density of settlements will increase without extending settlement boundaries further, as the space in between current structures will be used for development first. This intervention will help preserve scarce public space.

low
degree of effort

FORM
density
population

DP.M1

Implement policies to incentivize higher density development and redevelopment projects

Policies that incentivize higher density (re)development will further ensure that the population density of settlements will increase without extending settlement boundaries further. This intervention will help preserve scarce public space.

medium
degree of effort

FORM
density
population

DP.H1

Undertake large-scale urban regeneration projects to increase population density around transit nodes

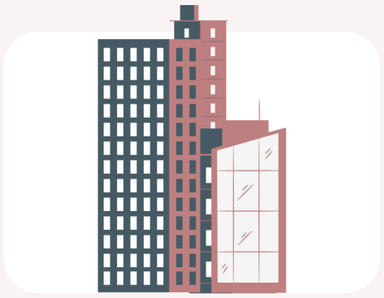
Large-scale regeneration projects around transit nodes will even further ensure population density within settlements, rather than expansion into public space, leaving more room for green, blue and other types of space.

high
degree of effort

Figure 55a. Intervention cards for density of population (made by authors, 2024).

The second category in ‘form’ is the building density. Figure 55b displays the set of interventions designed for developing this element.

FORM
density
building



DB.L1

Relax zoning regulations to allow for slightly higher building densities in targeted areas

This is a rather soft measure to aim for more building density in settlements, essentially preventing further expansion of settlement boundaries.

low
degree of effort

FORM
density
building

DB.M1

Introduce mixed-use zoning

Mixed-use zoning consists of designating space for specific functions, especially focusing on a variety of functions. Mixed-use is ideally applied in denser areas, and will therefore encourage more building density.

medium
degree of effort

FORM
density
building

DB.H1

Implement Transit-Oriented Development (TOD)

TOD measures ensure the increased density of buildings around transport nodes. Ensuring that development takes place around these nodes, rather than expanding the settlement, increases building density around the transport nodes.

high
degree of effort

Figure 55b. Intervention cards for density of buildings (made by authors, 2024).

The last category in the urban corridor intervention matrix is ‘sustainable land use’, of which the first sub-category is ‘SGI’s’. Figure 65a presents the interventions designed for this sub-category.

SUSTAINABLE LAND USE
public space

PS.L1

Implement minor enhancements such as street furniture and art installations

Small enhancements can improve public space both aesthetically and practically, resulting in higher quality public space.

low
degree of effort

SUSTAINABLE LAND USE
SGI

SGI.L2

Implement monitoring mechanisms

Monitoring mechanisms allow for consistent measurement of the basic service standards and quality. This provides insight into areas of improvement.

low
degree of effort

SUSTAINABLE LAND USE
SGI

SGI.M1

Upgrade service quality to meet higher performance benchmarks

Meeting higher performance benchmarks through upgrading will lead to more pleasant use of basic services and therefore reduce the need for travel to other services.

medium
degree of effort

SUSTAINABLE LAND USE
public space

PS.H1

Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programe

This level of intervention will reshape the future of public space. Social hubs with green, interactive and cultural elements will sharply increase the public space quality and use.

high
degree of effort

Figure 56a. Intervention cards for SGI’s (made by authors, 2024).

‘Other amenities’ is the second sub-category for sustainable land use. A set of three interventions is proposed to implement based on the selected degree of effort (fig. 56b).

SUSTAINABLE LAND USE
other amenities

OA.L1

Create attractive business climate for local and external parties

In creating an attractive business climate, this intervention will incentivize investors and business owners to (re)locate their business in more peri-urban areas.

low
degree of effort

SUSTAINABLE LAND USE
other amenities

OA.M1

Develop community facilities like parks, recreational areas, and cultural centers

Community facilities further diversify the amenities that the peri-urban has to offer. This will reduce the need for travel to other (peri-)urban areas.

medium
degree of effort

SUSTAINABLE LAND USE
other amenities

OA.H1

Undertake major urban renewal projects to create iconic landmarks, waterfronts, and amenities

Urban renewal projects of this size will reshape the future of settlements where this intervention is applied. This level of intervention will sharply increase the development of the settlement. The settlement will most likely transform from peri-urban to urban.

high
degree of effort

Figure 56b. Intervention cards for other amenities (made by authors, 2024).

The final set of cards revolves around public space, the remaining sub-category of sustainable land use (fig. 56c). This set consists of three interventions, which are all specific to a selected degree of effort.

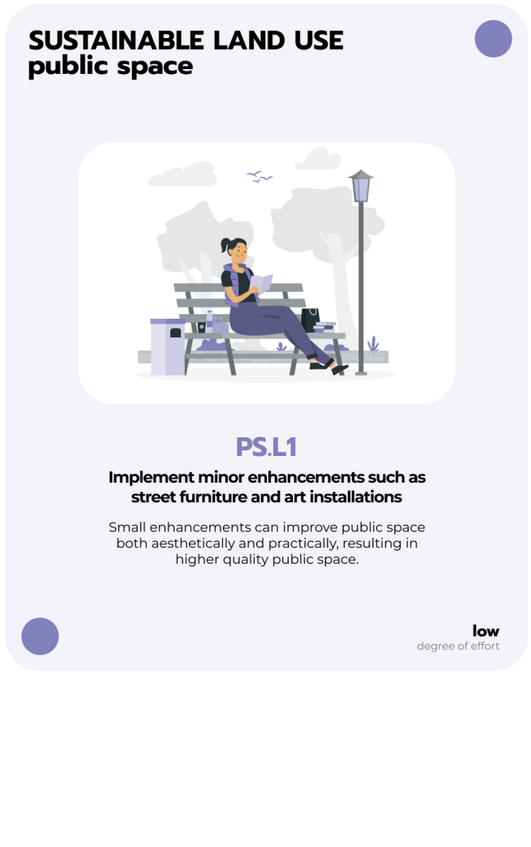


Figure 56c. Intervention cards for public space (made by authors, 2024).

DEGREE OF ENGAGEMENT	Generate Green	Preserve Green	Activate Green	Access Green
Low	**Landscape management** Only allow for low-impact development Not interrupting existing green space	**Assessment & monitoring** Monitor health indicators of ecosystems Assess flora & fauna through biodiversity surveys	**Community engagement** Organize volunteer programs and community events: tree planting litter clean up	**Proximate access** Site can be experience at its boundaries **Remote access** Site serves as visual green resource for local community
Medium	**Landscape management** Plant native trees & shrubs to enhance biodiversity, willdlife habitat & improve air quality Establish community gardens and orchards	**Policy** Tax incentives & subsidies to landowners who conserve or restor green space in the corridor	**Development** Incentivize low-impact development: recreational facilities (restaurants, information centers, tiny house holiday homes)	**Conditional access** Limit access to some extent: Foot path or bike line only roads entrance fee for specific areas opening hours for specific areas
High	**Green infrastructure** Design streetscapes: tree lined sidewalks permeable pavement, aesthetic entrance to corridor with green planting	**EIA (environmental impact assessment)** Conduct EIA's for development projects in or in close proximity to the corridor **Land use planning** Establish protected and conservation areas to safeguard them from high-impact development	**Infrastructure design** Incorporate green space amenities: seating areas playgrounds cafe's other recreational facilities Integrate cultural & educational elements: art installations informative signage other elements	**Full access** Design slow mode infrastructure that connects neighborhoods & green space Enhance signage and maps to facilitate navigation and encourage exploration of the corridor integrate design principles that ensure equal access to and use of corridor for people of all ages, abilities, and mobility levels.

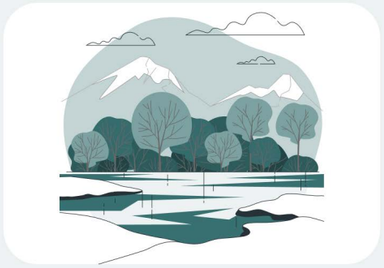
Figure 57. Intervention matrix for green corridor (made by authors, 2024).

Figure 58. Intervention cards for green corridor (made by authors, 2024).

intervention cards
green corridor: generate

The first potential use of the green corridor intervention matrix is the generation of green space (fig. 58a), based on the current situation and the degree of engagement that an area will have with the green corridor in the future. The interventions in this set of cards are specific to a selected level of engagement with the corridor.

GREEN
generate



GG.L1

Low landscape management

Only allow for low-impact development
without interruption of existing green space.

low
degree of engagement

GREEN
generate

GG.M1

Medium landscape management

Plant native trees & shrubs to enhance
biodiversity, wildlife habitat & improve air quality
Establish community gardens and orchards.

medium
degree of engagement

GREEN
generate

GG.H1

Add green infrastructure

Design streetscapes: tree lined sidewalks,
permeable pavement, aesthetic entrance to
corridor with green planting

high
degree of engagement

Figure 58a. Interventions cards for generating green space (made by authors, 2024).

Preserving existing and future green space is another category of intervention in the green corridor. The cards designed for this goal are presented in Figure 58b.

Figure 58b. Interventions cards for preserving green space (made by authors, 2024).

Another category of interventions in the matrix includes activating the current and future green space (fig. 58c). In this case ‘activating’ refers to the active use of the green space, in a way that is not damaging to the environment but does allow for more interaction between people and the green corridor.

Figure 58c. Interventions cards for activating green space (made by authors, 2024).

The final potential use of the green corridor matrix is regulating the access to the green space in the green corridor (fig. 58d). Different levels of access directly help enforce the different levels of engagement with the corridor and are therefore very efficient interventions.

Figure 58d. Interventions cards for accessing green space (made by authors, 2024).

5.4 areas of application

After carefully reviewing the intervention matrix and cards for the urban corridors as well as for the green corridor, this section will display the application of this strategy in five selected areas of interest. These areas were selected because of their typical characteristics as they present challenges and conditions that are common throughout the Maas-Rhein region.
As mentioned before, the CMIYC strategy does not include crucial site-specific interventions within a given time to reach its goals. Rather, the strategy takes the shape of a flexible framework that can be applied throughout the region, both in and outside the corridors, as areas of application will demonstrate.

The following section will demonstrate the application of the CMIYC strategy intervention matrix and cards for five selected areas. The process of application in each area is identical and will first be explained.

First, each area will be introduced through a short introduction, an overview of the current spatial situation and challenges at hand and the goals for the respective areas. Following this introduction, a power-interest matrix including the relevant stakeholders for the identified challenges will be presented to demonstrate the position of each stakeholder. Based on the current situation, the identified challenges and the goals, a set of interventions will be selected from the intervention matrix for the urban corridor, the green corridor, or both, depending on the location of the area. Some areas are located inside both corridors, whereas others fall within one or even outside of the corridors. After a careful selection of the interventions on the matrix, the corresponding intervention cards will be presented. The next step is identifying which interventions stakeholders will agree on, which technology the interventions require, and which interventions are crucial for reaching the goals for the area. This will be done by placing the selected interventions on a diagram that includes these elements and highlighting the crucial interventions.
To illustrate, the interventions that stakeholders do not agree on, for which the technology is unknown, and that are not crucial will not be implemented. After this process, the visual representation of the area currently and after the successful implementation of the selected interventions is presented. Finally, each area will conclude with an evaluation of the established goals and how the strategy application helped reach these goals.
What is important to keep in mind is that, although the application of the CMIYC strategy takes place on the S scale, the combination of these interventions on the S scale throughout the urban and green corridors is what constitutes the strategy on the M scale.

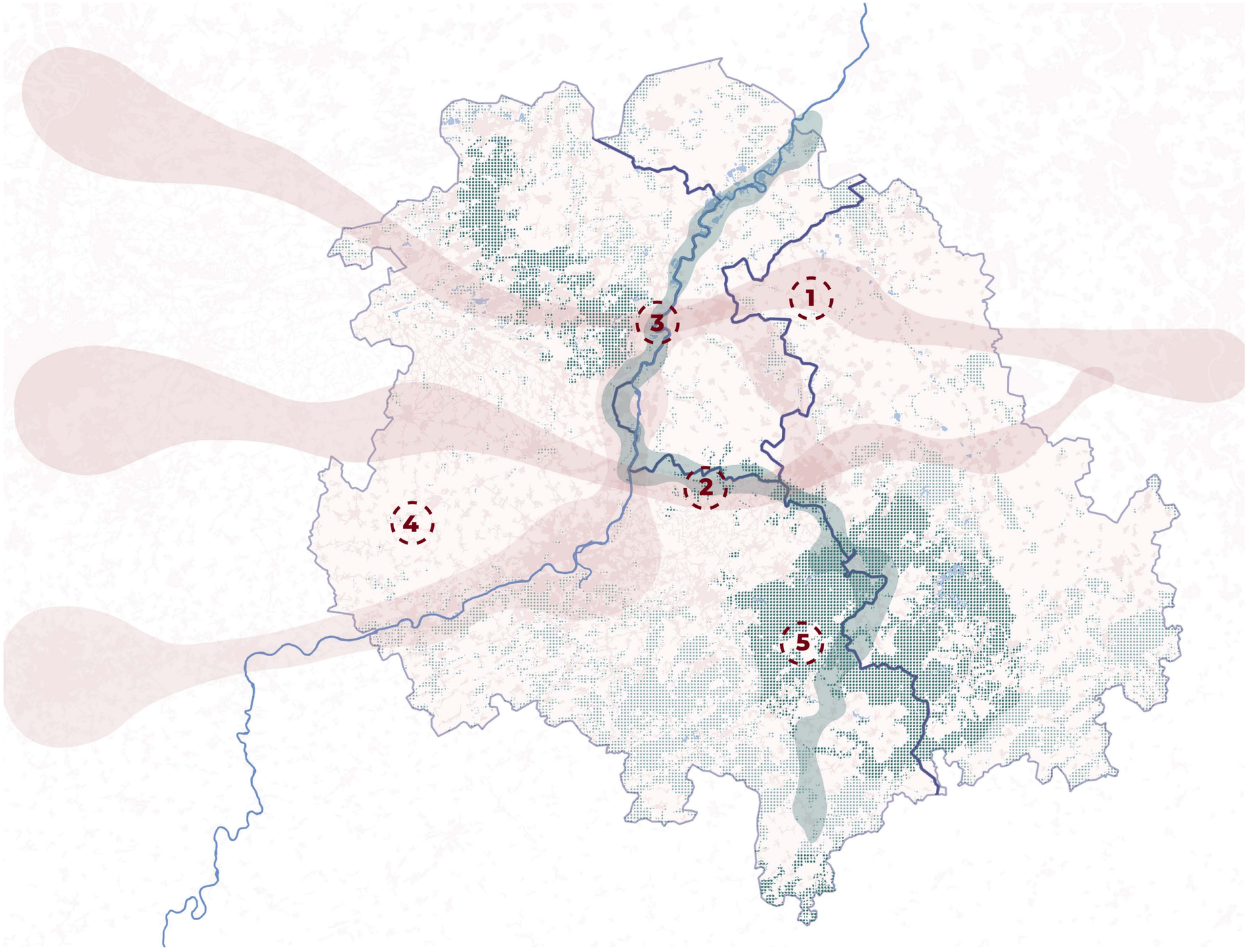


Figure 59. Map with overview of 5 areas where strategy will be applied (made by authors, 2024).

5.5 area one

curent situation: Linnich-Lindern

Linnich-Lindern is the first area of application. It is located in the German part of the Maas-Rhein and a variety of conditions can be observed. Amongst other things, there is a lack of connectivity between settlements, but mostly a lack of connectivity to large urban centres outside the Maas-Rhein. In order to create a more sustainable future for the Lindern-Linnich area, four goals are established.

strategies

Improve connectivity between main settlements in area

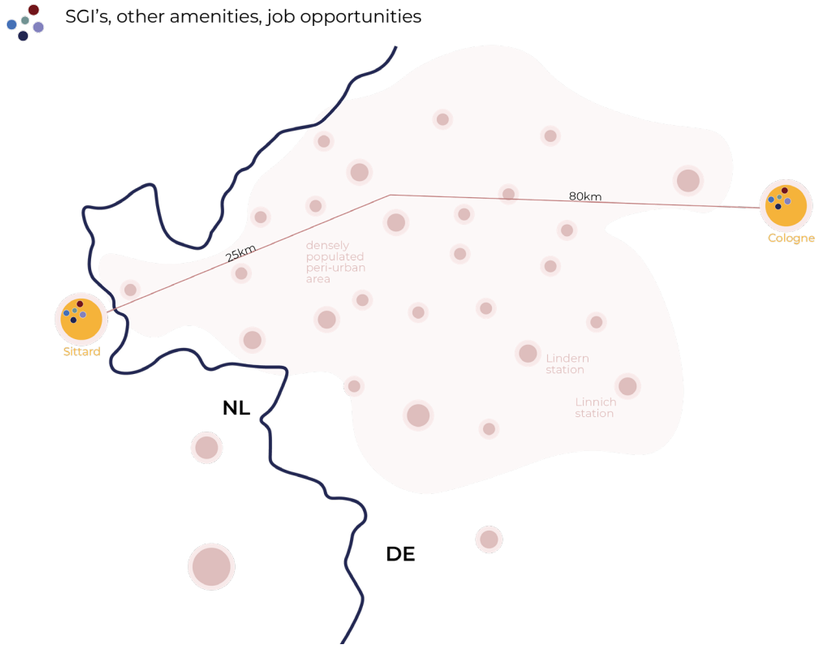
vision

Improve connectivity with larger urban centers on both German and Dutch side of border (Cologne & Sittard)

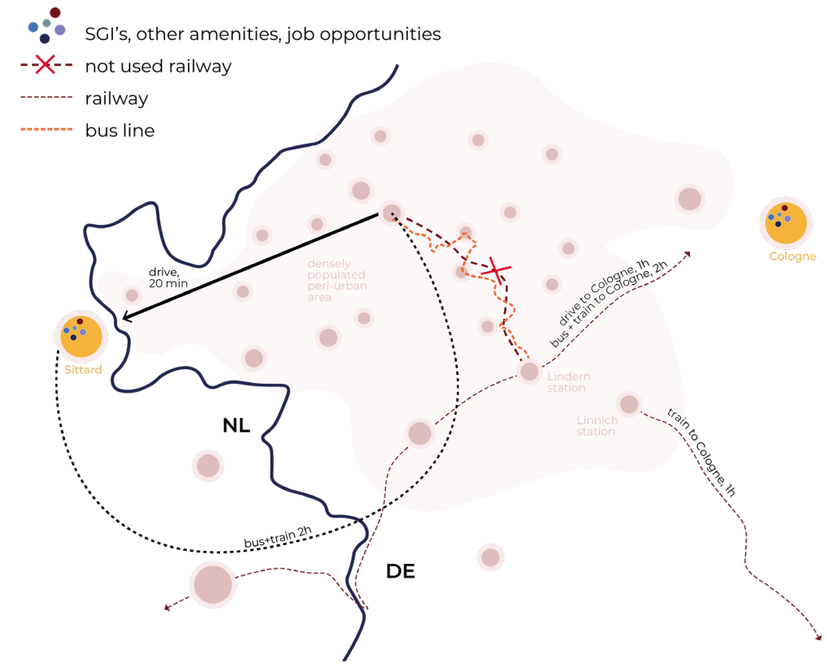
analysis

Improve connectivity to large local employers

Densify and deversify (by adding amenities) along newly established lines of connectivity

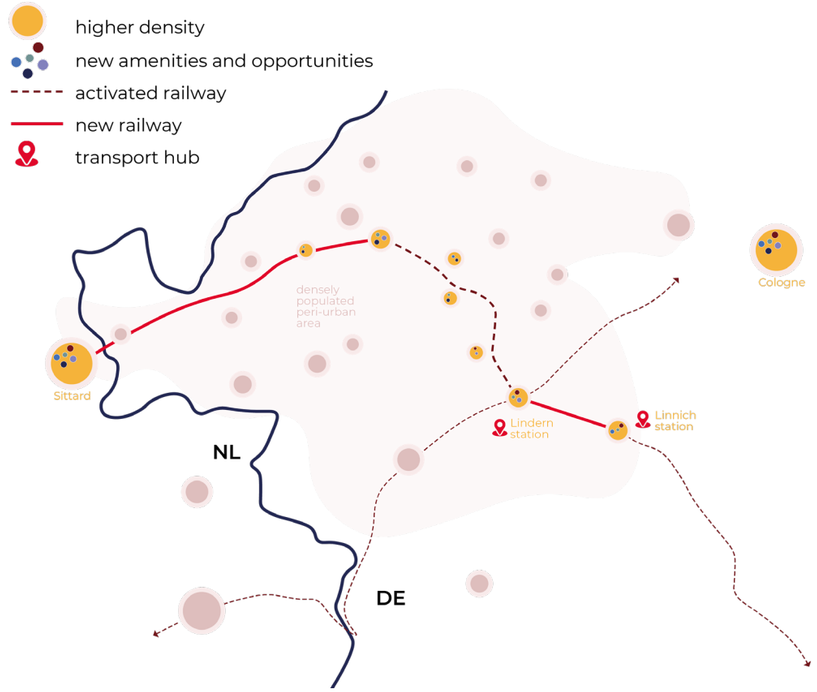


1. Geographical location
This area is geographically located between large cities. From east to west, people who live here can reach big cities in 30-60min for jobs and SGI.



2. Problem Description
There are two rail transit lines passing through Lindern and Linnich respectively, but they are not connected. Therefore, settlements along the line need to take detours to other stations and then go to big cities;

There is an area of track from Lindern that is currently unused, with the potential to connect to Sittart and shorten commuting time.



3. Solution strategy
Add a track between Lindern and Linnich to connect two separated track lines, activate the track section starting from Lindern, and add a new track connecting to Sittard in the future. Improve the bus line connection between nearby settlements and rail transit stations.

This can enhance the connection of the regional public rail transit network, provide peri-urban settlements with fair access to public transportation, encourage residents to choose public transportation, and reduce carbon emissions.

Figure 60. Conceptual representation of current spatial situation in Linnich-Lindern (made by authors, 2024).

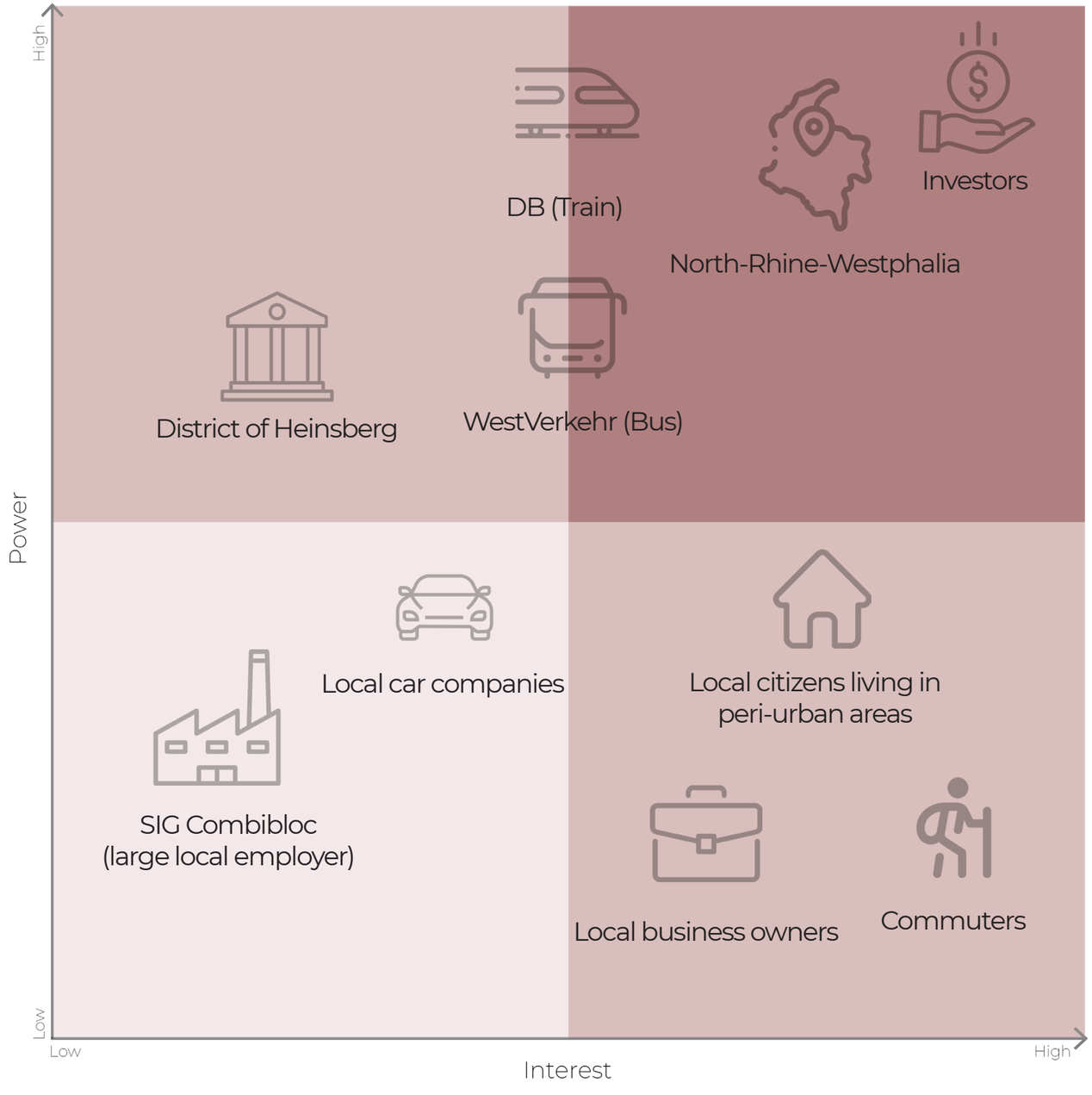


Figure 61. Power-interest matrix for stakeholders in Linnich-Lindern (made by authors, 2024).

interventions matrix:
Linnich-Lindern

vision strategies

analysis

DEGREE OF EFFORT	MOBILITY					FORM		SUSTAINABLE LANDUSE		
	Bus	Slow modes	Train	Shared mobility	Transport hub	Density Population	Density Building	SGI	Other Ammenities	Open Space
Low	**B.L1** Increased frequency: small to moderate extent **B.L2** Improve existing bus routes with minor adjustments	**SM.L1** Attractiveness of biking and walking infrastructure: small to moderate extent **SM.L2** Policies to incentivise use of slow modes.	**T.L1** Upgrade existing train stations with basic amenities	**SHM.L1** Promote existing ride-sharing platforms and encourage automated and efficiency-improved carsharing initiatives	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs	**DP.L1** Encourage infill development	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms	**OA.L1** Create attractive business climate for local and external parties	**PS.L1** Implement minor enhancements such as street furniture and art installations
Medium	**B.M1** Increased frequency: small to large extent **B.L2** Improve existing bus routes with minor adjustments **B.M3** Add more bus stops along existing routes	**SM.M1** Attractiveness of biking and walking infrastructure: small to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensure connection with other modes of transport	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include increased intermodal connectivity and seamless transfer options	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
High	**B.H1** Increased frequency: medium to large extent **B.H2** Add more bus stops to existing and/ or new routes **B.H3** Add new bus routes **B.H4** Implement Bus Rapid Transit (BRT) systems with segregated lanes **B.H5** Hydrogen bus	**SM.H1** Attractiveness of biking and walking infrastructure: to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensuring connection with other modes of transport **SM.H2** Add (protected) bike and walking infrastructure that connects the urban and peri-urban	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology **T.H1** Unified transport system across border **T.H2** Activating existing infrastructure **T.H3** Adding new infrastructure	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones **SHM.H1** Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms, ensuring seamless and personalized door-to-door transportation **SHM.H2** Establish vertical mobility hubs with flying taxi services and drone delivery networks for efficient and eco-friendly urban	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning **DB.H1** Implement Transit-Oriented Development (TOD) strategies, including increased building heights and density bonuses near transit corridors	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks **SGI.H1** Invest in cutting-edge technology and customer service initiatives to ensure exceptional service reliability and satisfaction	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfront developments, and world-class amenities	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programming

Figure 62. Intervention matrix for urban corridor applied to Linnich-Lindern (made by authors, 2024).

intervention cards:
Linnich-Lindern

strategies

vision

analysis

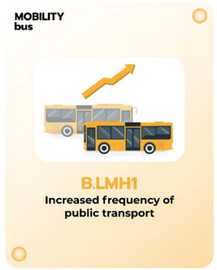


Figure 63. Overview of intervention cards selected for Linnich-Lindern (made by authors, 2024).

interventions on diagram:
Linnich-Lindern

goals: agreed

goals: not agreed

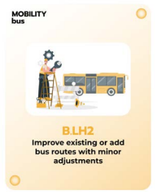
strategies

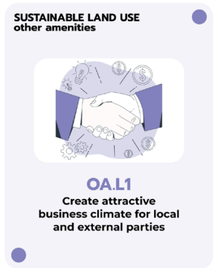
vision

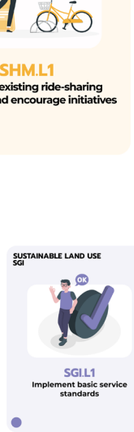
analysis

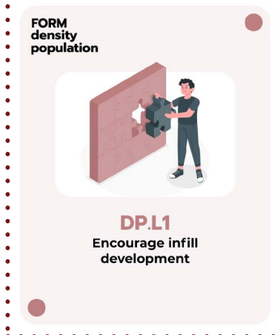
technology: known

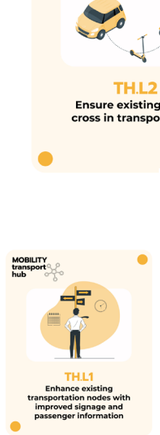
technology: unknown

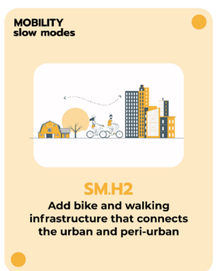


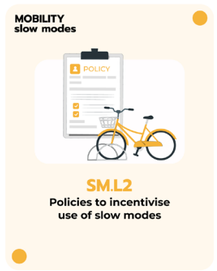


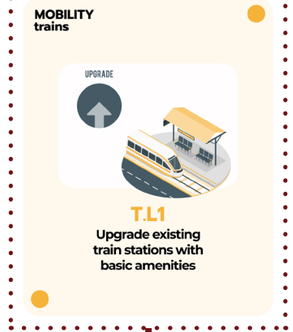


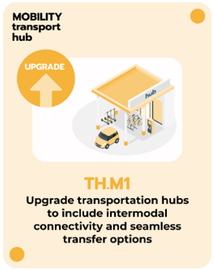


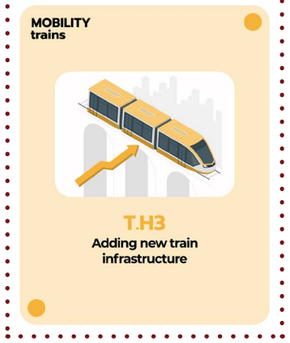


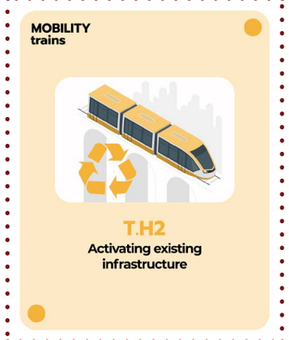


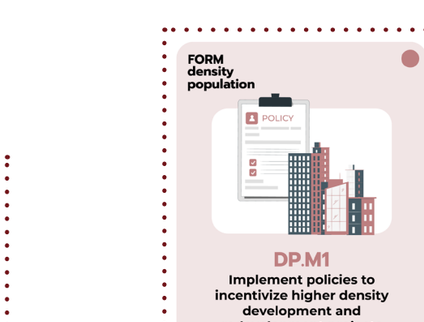


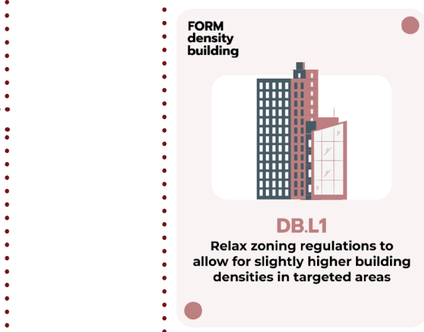




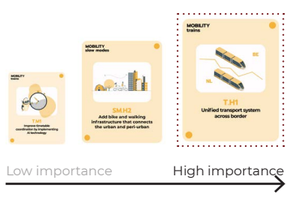




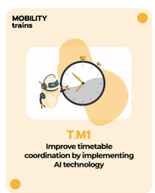


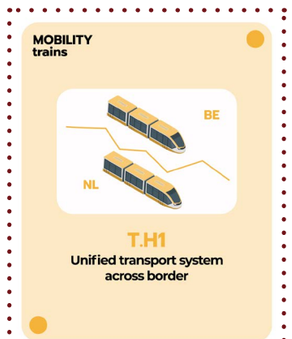


After selecting the interventions cards from the matrix and placing them on the diagram, the majority of interventions will likely be agreed upon by stakeholders and do not require unknown technology. However, the majority of crucial interventions will likely not be agreed upon by stakeholders but will have to be implemented regardless.



Low importance → High importance





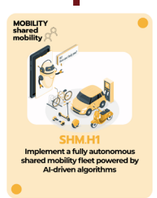


Figure 64. Intervention cards placed on stakeholder-technology diagram for Linnich-Lindern (made by authors, 2024; adapted from Christensen, 1985).

Figure 65. Visual representation of Linnich-Lindern before CMIYC strategy application (made by authors, 2024).

T.H2 T.L1 DB.L1 TH.L2 DB.M1 OA.L1 SHM.M1

to M. Gladbach
Erkelenz
Hückelhoven
Baal
Körrenzig
Brachlen
to Sittard
Lindern
to Aachen
Linnich
to Düren
Rurdorf
Welz

T.L1 DP.L1 T.H3 SM.H2

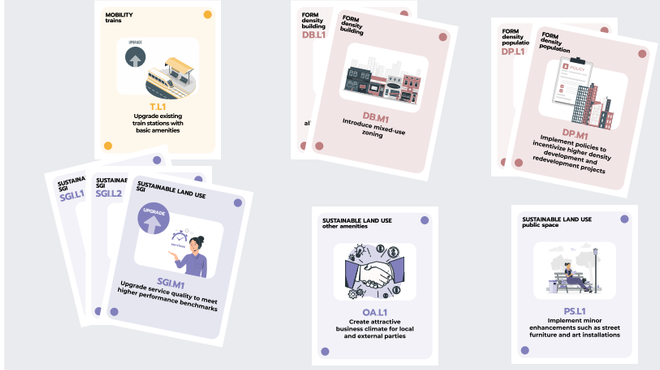
T.L1 SHM.L1 DP.L1

Figure 66. Visual representation of Linnich-Lindern after CMIYC strategy application (made by authors, 2024).

Improve connectivity between main settlements in area

Improve connectivity with larger urban centers on both German and Dutch side of border (Cologne & Sittard)

Improve connectivity to large local employers



Densify and diversify (by adding amenities) along newly established lines of connectivity

sustainable landuse

Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport

High quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport

CO2

A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rijn region, in accordance with the European Green Deal

5.6 area two

curent situation:

Wonck-Plombieres

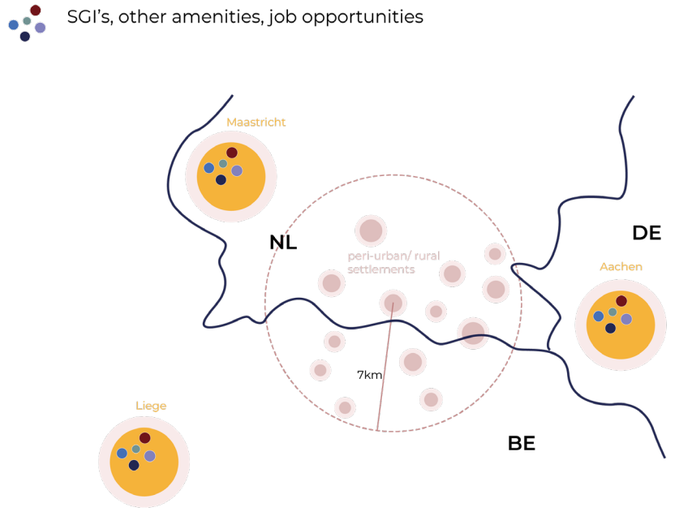
The second area of application is Wonck-Plombieres. It is located in the border region between Maastricht and Aachen. Since this area is situated in both the urban and green corridor, both intervention matrices will be applied. The goals for this area are presented, as well as the current situation and challenges in the area.

Improve connectivity with and within green areas on the green corridor on both sides of the border

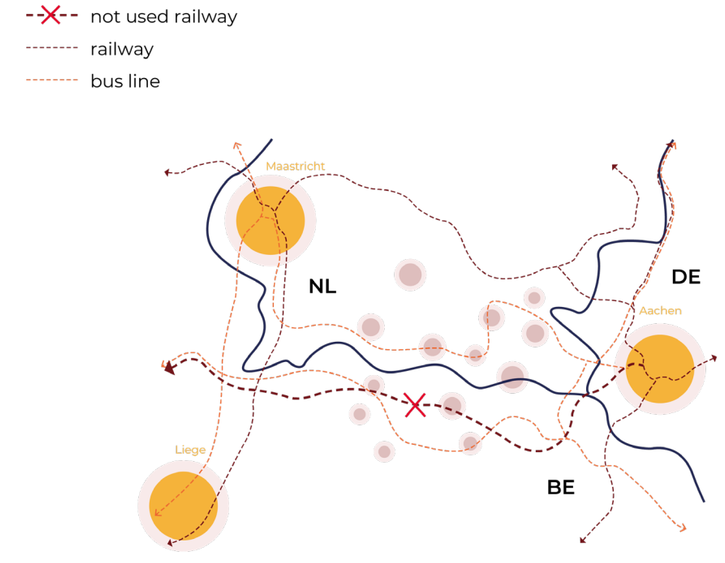
Improve cross-border connectivity and connectivity with the three main cities of the region (Maastricht, Liege, Aachen)

Preserve the green corridor maintaining low density in the area

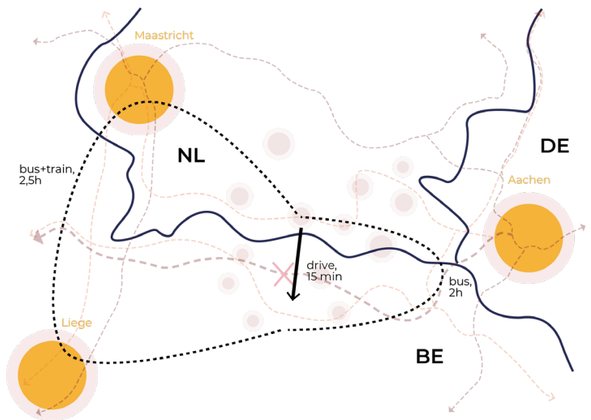
Provide the settlements with an adequate amount of SGI's within slow mode reach



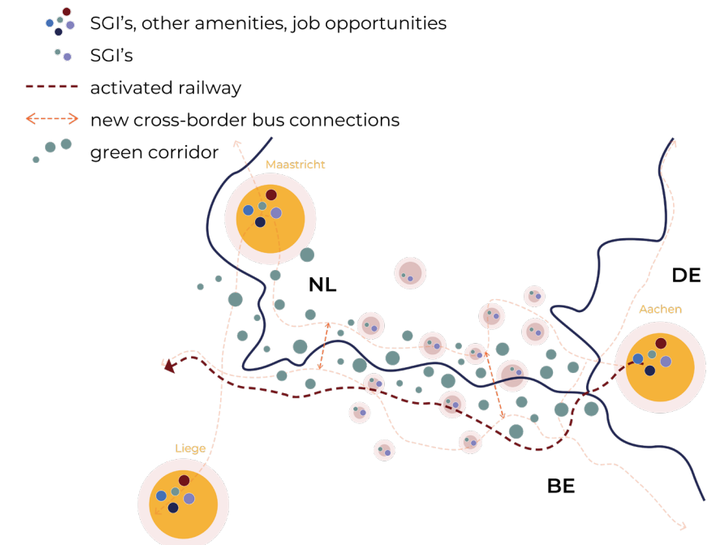
1. Geographical location
The geographical location of this area has a lot of potential as it is between Maastricht, Liege and Aachen. The three cities are all within a range of about 10km and can be reached by car in about 3 hours.
This area is also where the peri-urban corridor and green corridor overlap.



2. Current mobility system
Rail transportation: There is a rail line from Aachen to Tongeren. It is currently used as a backup freight line and has the possibility of being used as a passenger line to serve the peri-urban area.
Bus: At the border, bus lines are within the scope of each country. There are only cross-border lines in the south of Maastricht and near Aachen. Taking public transportation requires a long detour.



3. Current mobility system-commuting time
It takes 2-2.5 hours to cross the border by public transportation, while it only takes 15 minutes to drive. With such a transportation system, residents tend to choose to travel by car.



4. Solution strategy
Transform freight lines into passenger lines. Add cross-border bus lines to provide settlements with the option of taking public transportation to rail transit.

Create an intersection of multiple modes of transportation, and upgrade the train station to a mobility hub, thus providing a variety of transfer modes and commercial services. Increase slow-travel facilities, connect settlements with nature, and divide green spaces into protected areas and recreational areas. The protected area is a buffer area that limits human activities, entertainment areas, and traffic lines. Full access area provides residents with the possibility to get close to nature.

Figure 67. Conceptual representation of current spatial situation in Wonck-Plombieres (made by authors, 2024).

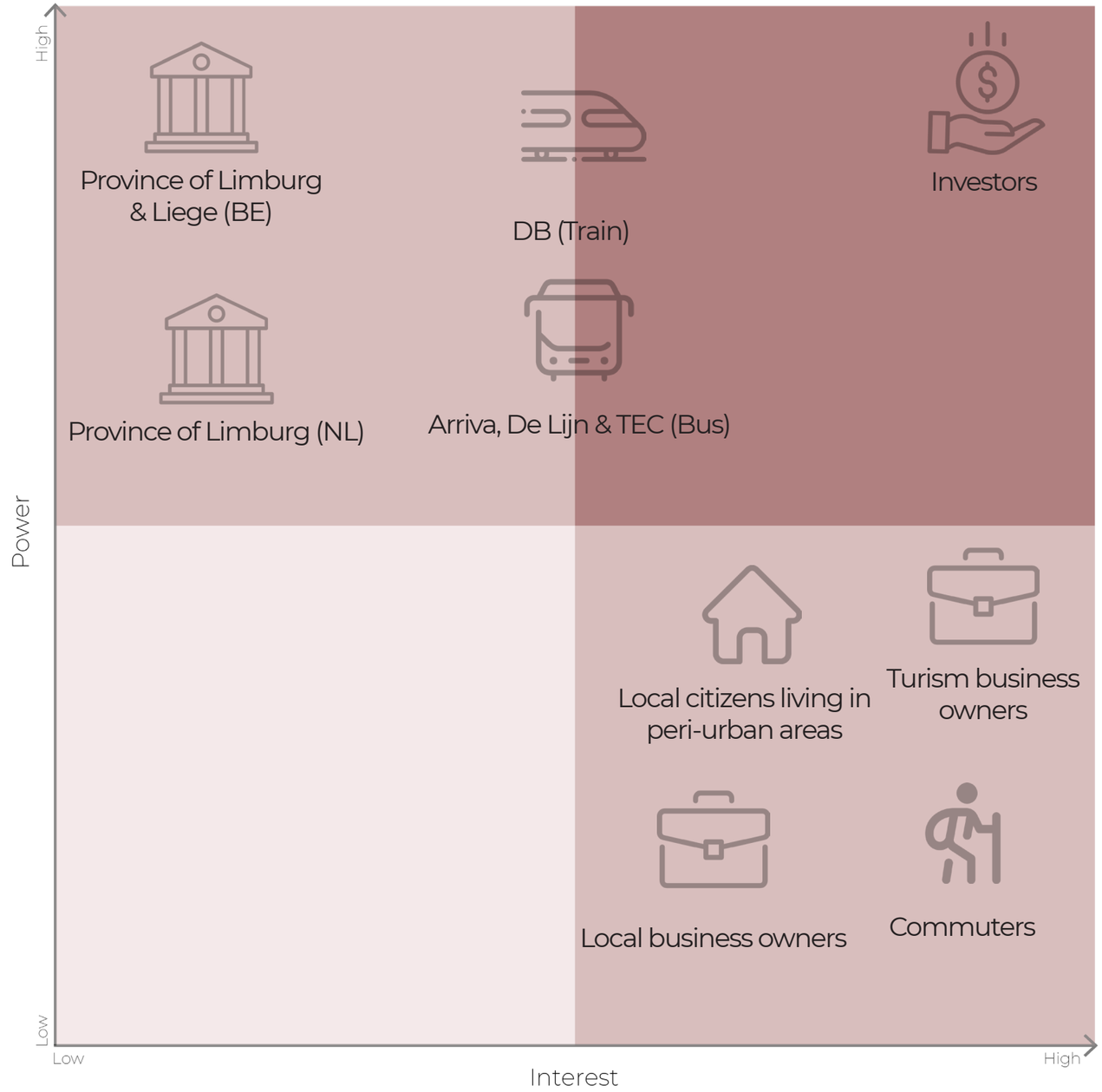


Figure 68. Power-interest matrix for stakeholders in Wonck-Plombieres (made by authors, 2024).

intervention matrix:
Wonck-Plombieres

analysis → strategies → vision

DEGREE OF EFFORT	MOBILITY					FORM		SUSTAINABLE LANDUSE		
	Bus	**Slow modes**	**Train**	**Shared mobility**	**Transport hub**	**Density Population**	**Density Building**	**SGI**	**Other Ammenities**	**Open Space**
Low	**B.L1** Increased frequency: small to moderate extent **B.L2** Improve existing bus routes with minor adjustments	**SM.L1** Attractiveness of biking and walking infrastructure: small to moderate extent **SM.L2** Policies to incentivise use of slow modes.	**T.L1** Upgrade existing train stations with basic amenities	**SHM.L1** Promote existing ride-sharing platforms and encourage automated and efficiency-improved carsharing initiatives	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs	**DP.L1** Encourage infill development	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms	**OA.L1** Create attractive business climate for local and external parties	**PS.L1** Implement minor enhancements such as street furniture and art installations
Medium	**B.M1** Increased frequency: small to large extent **B.L2** Improve existing bus routes with minor adjustments **B.M3** Add more bus stops along existing routes	**SM.M1** Attractiveness of biking and walking infrastructure: small to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensure connection with other modes of transport	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include increased intermodal connectivity and seamless transfer options	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
High	**B.H1** Increased frequency: medium to large extent **B.H2** Add more bus stops to existing and/ or new routes **B.H3** Add new bus routes **B.H4** Implement Bus Rapid Transit (BRT) systems with segregated lanes **B.H5** Hydrogen bus	**SM.H1** Attractiveness of biking and walking infrastructure: to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensuring connection with other modes of transport **SM.H2** Add (protected) bike and walking infrastructure that connects the urban and peri-urban	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology **T.H1** Unified transport system across border **T.H2** Activating existing infrastructure **T.H3** Adding new infrastructure	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones **SHM.H1** Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms, ensuring seamless and personalized door-to-door transportation **SHM.H2** Establish vertical mobility hubs with flying taxi services and drone delivery networks for efficient and eco-friendly urban	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning **DB.H1** Implement Transit-Oriented Development (TOD) strategies, including increased building heights and density bonuses near transit corridors	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks **SGI.H1** Invest in cutting-edge technology and customer service initiatives to ensure exceptional service reliability and satisfaction	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfront developments, and world-class amenities	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programming

Figure 69. Intervention matrix for urban corridor applied to Wonck-Plombieres (made by authors, 2024).

intervention matrix:
Wonck-Plombieres

DEGREE OF ENGAGEMENT

strategies

vision

analysis

	Generate Green	Preserve Green	Activate Green	Access Green
Low	**GG.L1 Landscape management** Only allow for low-impact development Not interrupting existing green space	**GP.L1 Assessment & monitoring** Monitor health indicators of ecosystems Assess flora & fauna through biodiversity surveys	**GA.L1 Community engagement** Organize volunteer programs and community events: tree planting litter clean up	**GAC.L1 Proximate access** Site can be experience at its boundaries **GAC.L2 Remote access** Site serves as visual green resource for local community
Medium	**GG.M1 Landscape management** Plant native trees & shrubs to enhance biodiversity, willdlife habitat & improve air quality Establish community gardens and orchards	**GP.M1 Policy** Tax incentives & subsidies to landowners who conserve or restor green space in the corridor	**GA.M1 Incentivize low-impact** development: recreational facilities (restaurants, information centers, tiny house holiday homes)	**GAC.M1 Conditional access** Limit access to some extent: Foot path or bike line only roads entrance fee for specific areas opening hours for specific areas
High	**GG.H1 Green infrastructure** Design streetscapes: tree lined sidewalks permeable pavement, aesthetic entrance to corridor with green planting	**GP.H1 EIA (environmental impact assessment)** Conduct EIA's for development projects in or in close proximity to the corridor **GP.H2 Land use planning** Establish protected and conservation areas to safeguard them from high-impact development	**GA.H1 Infrastructure design** Incorporate green space amenities: seating areas playgrounds cafe's other recreational facilities **GA.H2** Integrate cultural & educational elements: art installations informative signage other elements	**GAC.H1 Full access** Design slow mode infrastructure that connects neighborhoods & green space Enhance signage and maps to facilitate navigation and encourage exploration of the corridor integrate design principles that ensure equal access to and use of corridor for people of all ages, abilities, and mobility levels.

Figure 70. Intervention matrix for green corridor applied to Wonck-Plombieres (made by authors, 2024).

intervention cards:
Wonck-Plombieres

strategies

vision

analysis

MOBILITY
bus

B.LMH1
Increased frequency of public transport

MOBILITY
slow modes

SM.LMH1
Attractiveness of biking & walking infrastructure

MOBILITY
trains

T.L1
Upgrade existing train stations with basic amenities

MOBILITY
shared mobility

SHM.L1
Promote existing ride-sharing platforms and encourage initiatives

MOBILITY
transport hub

TH.L1
Enhance existing transportation nodes with improved signage and passenger information

SUSTAINABLE LAND USE
SGI

SGI.L1
Implement basic service standards

SUSTAINABLE LAND USE
public space

PS.L1
Implement minor enhancements such as street furniture and art installations

MOBILITY
bus

B.LH2
Improve existing or add bus routes with minor adjustments

MOBILITY
slow modes

SM.L2
Policies to incentivise use of slow modes

MOBILITY
trains

T.M1
Improve timetable coordination by implementing AI technology

MOBILITY
shared mobility

SHM.M1
Subsidize shared mobility services

MOBILITY
transport hub

TH.L2
Ensure existing mode cross in transport hubs

SUSTAINABLE LAND USE
SGI

SGI.L2
Implement monitoring mechanisms

SUSTAINABLE LAND USE
public space

PS.M1
Renovate public spaces to improve accessibility, safety, and aesthetics

GREEN
preserve

GP.L1
Assessment & monitoring

low
degree of engagement

MOBILITY
bus

B.MH3
Add more bus stops to existing and/ or new routes

MOBILITY
slow modes

SM.M2
Ensure connection with other modes of transport

MOBILITY
trains

T.H2
Activating existing infrastructure

MOBILITY
shared mobility

SHM.M2
Establish designated pick-up/drop-off zones

MOBILITY
transport hub

TH.M1
Upgrade transportation hubs to include intermodal connectivity and seamless transfer options

SUSTAINABLE LAND USE
SGI

SGI.M1
Upgrade service quality to meet higher performance benchmarks

GREEN
activate

GA.M1
Incentivize low-impact development

MOBILITY
bus

B.H5
Hydrogen bus

MOBILITY
slow modes

SM.H2
Add bike and walking infrastructure that connects the urban and peri-urban

GREEN
generate

GG.H1
Add green infrastructure

GREEN
preserve

GP.H1
Establish protected & conservation areas to safeguard them from high-impact development

GREEN
access

GAC.M1
Conditional access

GREEN
preserve

GP.H2
Conduct environmental impact assessment for development projects in or in close proximity to the corridor

GREEN
activate

GA.H2
Incorporate green space amenities

Figure 70. Intervention matrix for green corridor applied to Wonck-Plombieres (made by authors, 2024).

interventions on diagram:
Wonck-Plombieres

goals: agreed

goals: not agreed

strategies

vision

analysis

technology: known

technology: unknown

MOBILITY bus

B.MH3
Add more bus stops to existing and/ or new routes

MOBILITY transport hub

TH.L1
Enhance existing transportation nodes with improved signage and passenger information

MOBILITY shared mobility

SHM.M2
Establish designated pick-up/drop-off zones

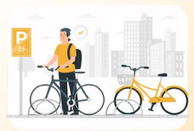
MOBILITY transport hub

TH.L2
Ensure existing mode cross in transport hubs

MOBILITY slow modes

SM.L2
Policies to incentivise use of slow modes

MOBILITY slow modes



SM.LMH1
Attractiveness of biking & walking infrastructure

MOBILITY shared mobility

SHM.L1
Promote existing ride-sharing platforms and encourage initiatives

SUSTAINABLE LAND USE public space

PS.L1
Implement minor enhancements such as street furniture and art installations

MOBILITY trains

T.L1
Upgrade existing train stations with basic amenities

SUSTAINABLE LAND USE SGI

SGI.L1
Implement basic service standards

GREEN activate

GA.M1
Incentivize low-impact development

GREEN generate

GG.H1
Add green infrastructure

GREEN activate

GA.H2
Incorporate green space amenities

GREEN access

GAC.M1
Conditional access

MOBILITY bus

B.LMH1
Increased frequency of public transport

MOBILITY bus

B.LH2
Improve existing or add bus routes with minor adjustments

GREEN preserve

GP.L1
Assessment & monitoring

MOBILITY slow modes

SM.M2
Ensure connection with other modes of transport

MOBILITY transport hub

TH.M1
Upgrade transportation hubs to include intermodal connectivity and seamless transfer options

MOBILITY trains

T.H2
Activating existing infrastructure

MOBILITY slow modes

SM.H2
Add bike and walking infrastructure that connects the urban and peri-urban

MOBILITY shared mobility

SHM.M1
Subsidize shared mobility services

SUSTAINABLE LAND USE SGI

SGI.L2
Implement monitoring mechanisms

SUSTAINABLE LAND USE SGI

SGI.M1
Upgrade service quality to meet higher performance benchmarks

GREEN preserve

GP.H2
Conduct environmental impact assessment for development projects in or in close proximity to the corridor

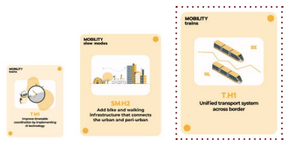
GREEN preserve

GP.H1
Establish protected & conservation areas to safeguard them from high-impact development

MOBILITY trains

T.M1
Improve timetable coordination by implementing AI technology

After selecting the intervention cards from the matrix and placing them on the diagram, the majority of interventions will likely be agreed upon by stakeholders and do not require unknown technology. However, the majority of crucial interventions will likely not be agreed upon by stakeholders but will have to be implemented regardless.



Low importance → High importance

Figure 72. Intervention cards placed on stakeholder-technology diagram for Wonck-Plombieres (made by authors, 2024; adapted from Christensen, 1985).

visual before:
Wonck-Plombieres

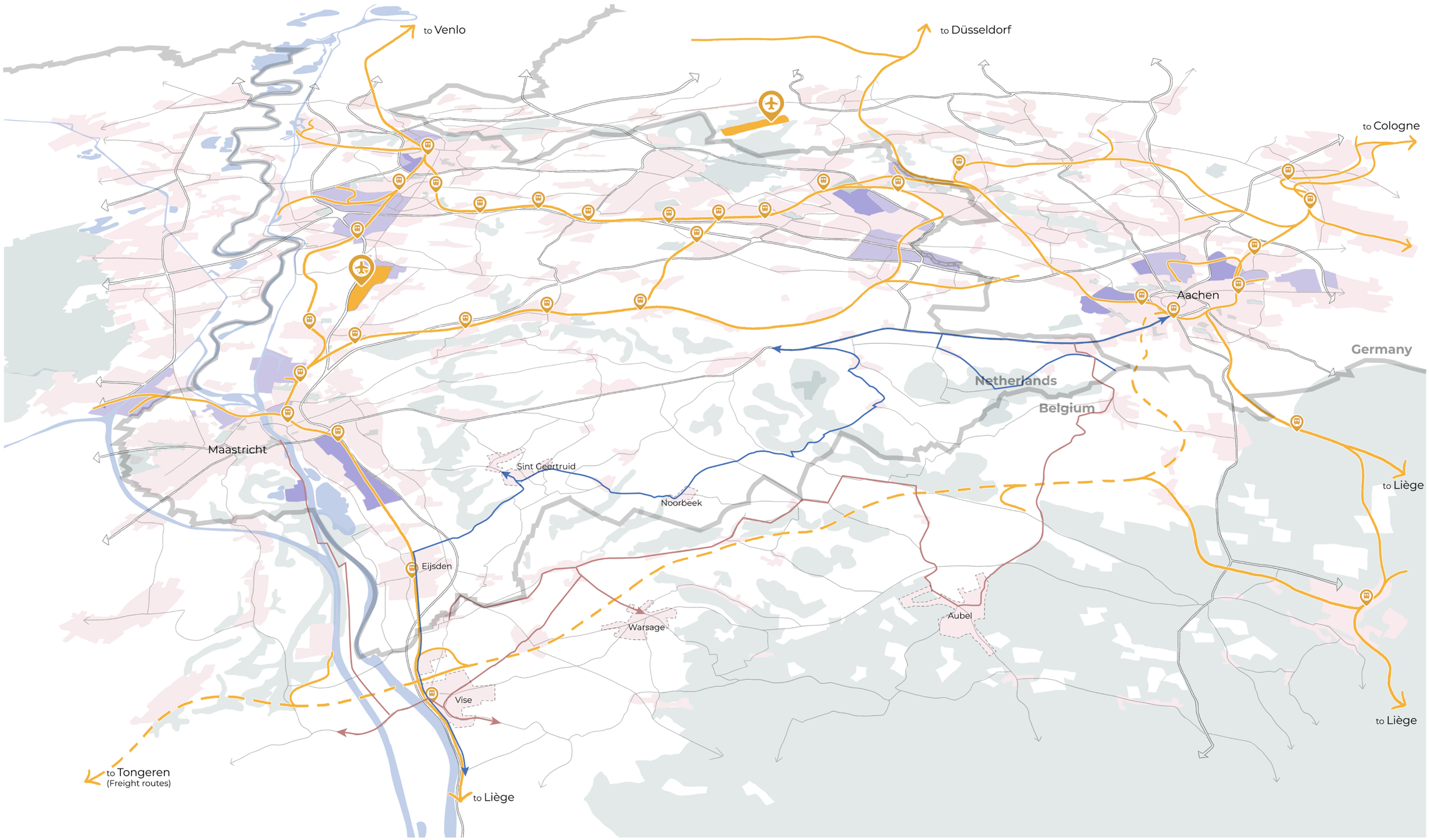


Figure 73. Visual representation of Wonck-Plombieres before CMIYC strategy application (made by authors, 2024).

visual after:
Wonck-Plombieres

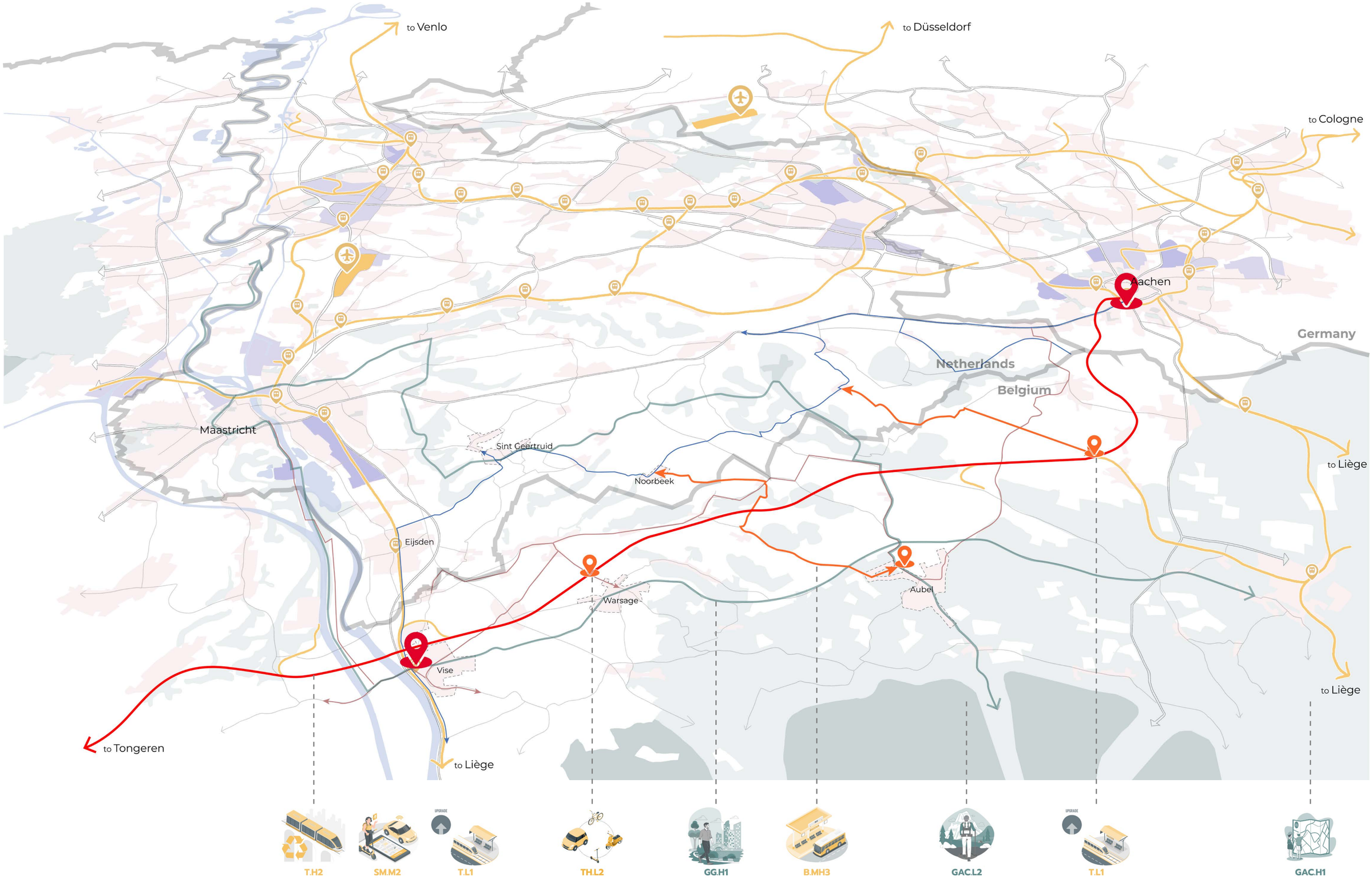


Figure 74. Visual representation of Wonck-Plombieres after CMIYC strategy application (made by authors, 2024).

strategies

Improve cross-border connectivity and connectivity with the three main cities of the region (Maastricht, Liege, Aachen)

Improve connectivity with and within green areas on the green corrdidor on both sides of the border

Preserve the green corridor mantaining low density in the area

Provide the settlements with an adequate amount of SGI's within slow mode reach

sustainable landuse

Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport

High quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport

CO2

A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rijn region, in accordance with the European Green Deal.

vision

analysis

5.7 area three

curent situation:

Maasmechelen-Stein

The third area of application is Maasmechelen-Stein, which again is located in the border region between Belgium and Netherlands. However, area 3 is situated north of Maastricht. Similar to area two, this area is also situated in both the urban and green corridor, and therefore both intervention matrices will be applied. The goals for this area are presented, as well as the current situation and challenges in the area.

strategies

Improve cross-border connectivity

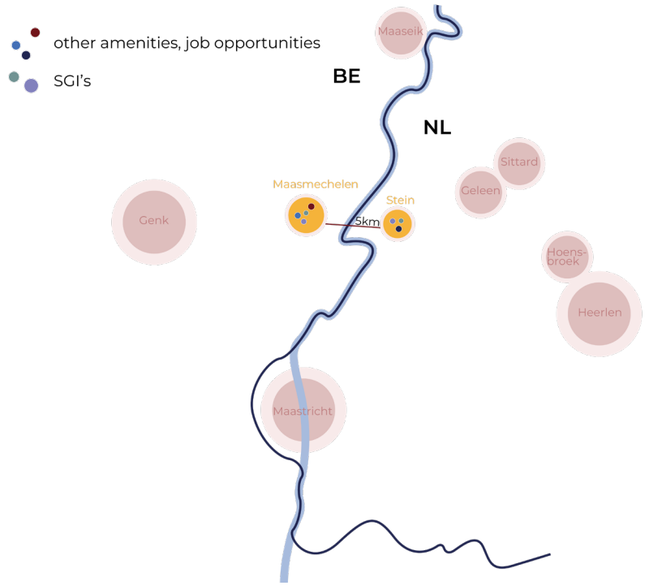
vision

Improve connectivity with green areas on the green corridor on both sides of the border

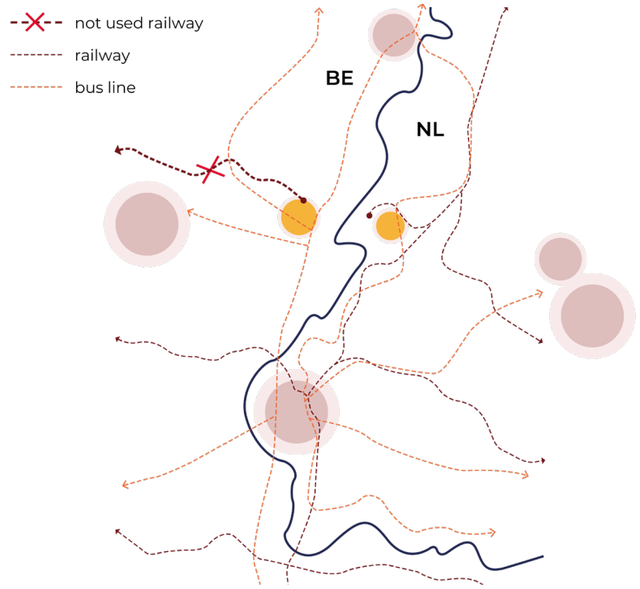
analysis

Preserve the green corridor and ensure the use of it as public space

More diverse amenities, within slow mode reach for the built environment in the area

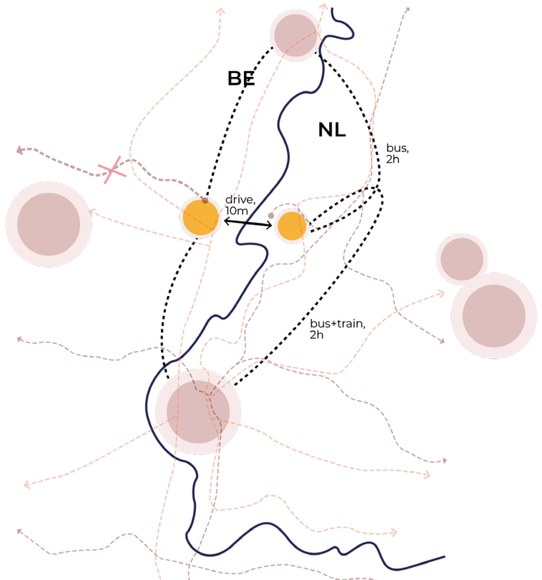


1. Geographical location
Maasmechelen (BE) and Stein (NL) are located on both sides of the border, only 5 km apart. A large industrial area is gathered near Stein, which means residents in BE have cross-border commuting needs.

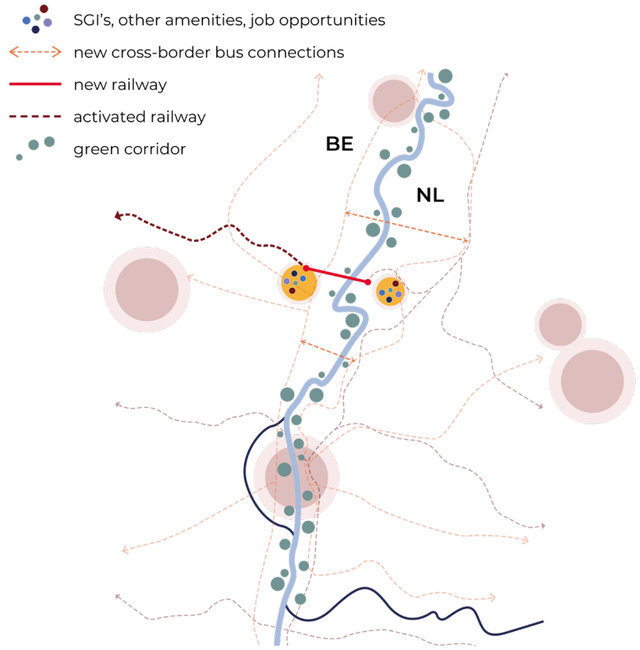


2. Current mobility system
North-south train lines within the NL border stop at Stein, and east-west train lines within the BE border stop at Maasmechelen.
one unused train line from Maasmechelen to Hasselt.

Bus lines on both sides of the border only cross between Maaseik to the north of Stein and Maastricht to the south.



3. Current mobility system-commuting time
To travel from Maasmechelen (BE) to Stein (NL) using public transportation, one needs to detour via Maaseik or Maastricht, taking approximately 2 hours. However, if driving, it only takes 10 minutes.



4. Solution strategy
Add a new train line connecting Maasmechelen (BE) to Stein (NL), and activate the train line from Maasmechelen to Hasselt. Connect with public rail transit in large areas. Increase cross-border transportation lines to connect more small settlements located on the border to provide convenient commuting for residents.

In the green corridor along the river, connect and upgrade existing low-grade roads, transform and upgrade green spaces along the river, and provide residents with high-quality recreational green space and more opportunities to get closer to nature.

Figure 75. Conceptual representation of current spatial situation in Maasmechelen-Stein (made by authors, 2024).

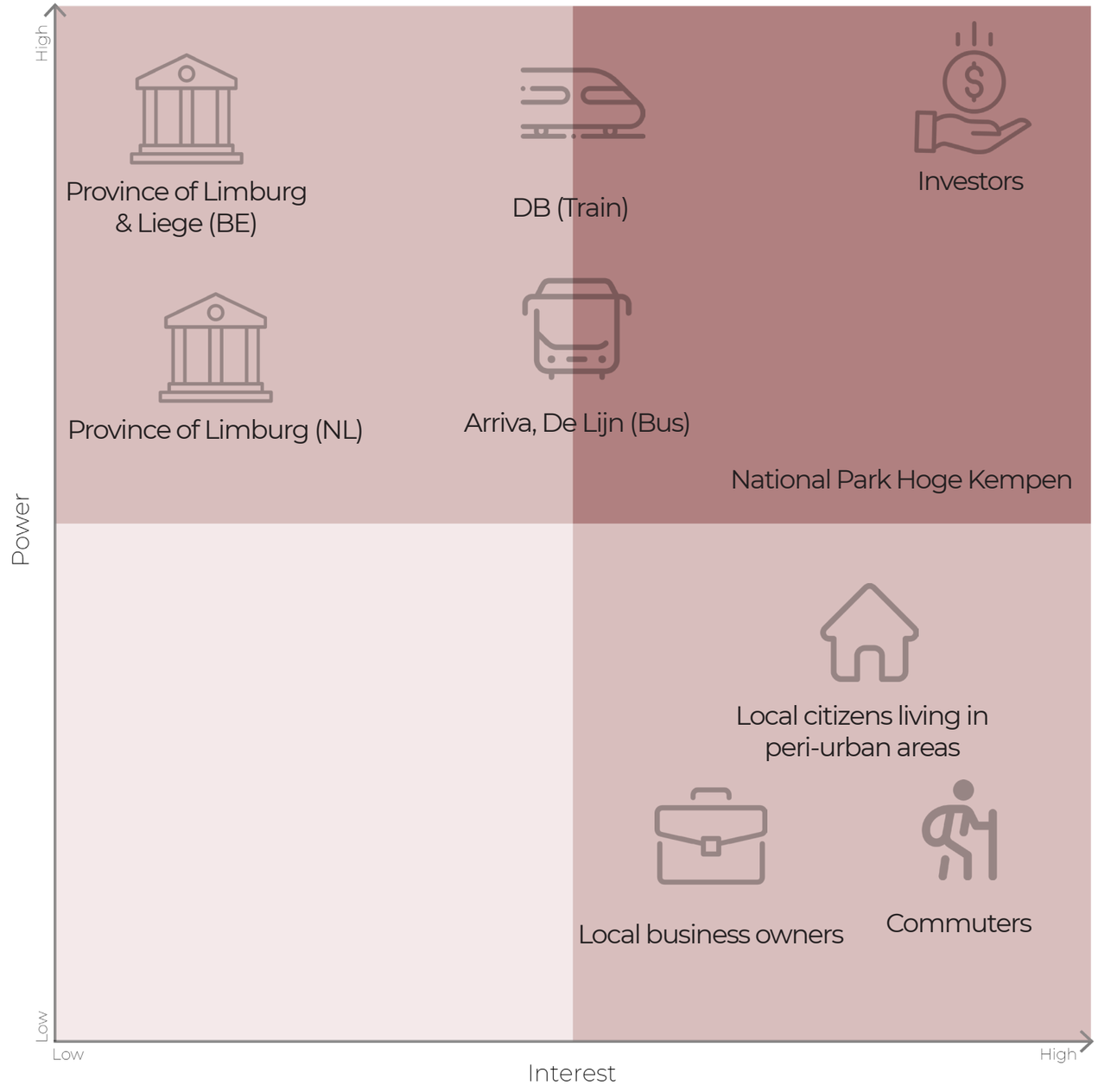


Figure 76. Power-interest matrix for stakeholders in Maasmechelen-Stein (made by authors, 2024).

intevention matrix:
Maasmechelen-Stein

analysis → vision → strategies

DEGREE OF EFFORT	MOBILITY					FORM		SUSTAINABLE LANDUSE		
	Bus	**Slow modes**	**Train**	**Shared mobility**	**Transport hub**	**Density Population**	**Density Building**	**SGI**	**Other Ammenities**	**Open Space**
Low	**B.L1** Increased frequency: small to moderate extent **B.L2** Improve existing bus routes with minor adjustments	**SM.L1** Attractiveness of biking and walking infrastructure: small to moderate extent **SM.L2** Policies to incentivise use of slow modes.	**T.L1** Upgrade existing train stations with basic amenities	**SHM.L1** Promote existing ride-sharing platforms and encourage automated and efficiency-improved carsharing initiatives	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs	**DP.L1** Encourage infill development	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms	**OA.L1** Create attractive business climate for local and external parties	**PS.L1** Implement minor enhancements such as street furniture and art installations
Medium	**B.M1** Increased frequency: small to large extent **B.L2** Improve existing bus routes with minor adjustments **B.M3** Add more bus stops along existing routes	**SM.M1** Attractiveness of biking and walking infrastructure: small to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensure connection with other modes of transport	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include increased intermodal connectivity and seamless transfer options	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
High	**B.H1** Increased frequency: medium to large extent **B.H2** Add more bus stops to existing and/ or new routes **B.H3** Add new bus routes **B.H4** Implement Bus Rapid Transit (BRT) systems with segregated lanes **B.H5** Hydrogen bus	**SM.H1** Attractiveness of biking and walking infrastructure: to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensuring connection with other modes of transport **SM.H2** Add (protected) bike and walking infrastructure that connects the urban and peri-urban	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology **T.H1** Unified transport system across border **T.H2** Activating existing infrastructure **T.H3** Adding new infrastructure	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones **SHM.H1** Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms, ensuring seamless and personalized door-to-door transportation **SHM.H2** Establish vertical mobility hubs with flying taxi services and drone delivery networks for efficient and eco-friendly urban	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning **DB.H1** Implement Transit-Oriented Development (TOD) strategies, including increased building heights and density bonuses near transit corridors	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks **SGI.H1** Invest in cutting-edge technology and customer service initiatives to ensure exceptional service reliability and satisfaction	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfront developments, and world-class amenities	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programming

Figure 77. Intervention matrix for urban corridor applied to Maasmechelen-Stein (made by authors, 2024).

intervention matrix:
Maasmechelen-Stein

vision strategies

analysis

DEGREE OF ENGAGEMENT	Generate Green	Preserve Green	Activate Green	Access Green
Low	**GG.L1 Landscape management** Only allow for low-impact development Not interrupting existing green space	**GP.L1 Assessment & monitoring** Monitor health indicators of ecosystems Assess flora & fauna through biodiversity surveys	**GA.L1 Community engagement** Organize volunteer programs and community events: tree planting litter clean up	**GA.L1 Proximate access** Site can be experience at its boundaries **GA.L2 Remote access** Site serves as visual green resource for local community
Medium	**GG.M1 Landscape management** Plant native trees & shrubs to enhance biodiversity, willdlife habitat & improve air quality Establish community gardens and orchards	**GP.M1 Policy** Tax incentives & subsidies to landowners who conserve or restor green space in the corridor	**GA.M1 Incentivize low-impact** development: recreational facilities (restaurants, information centers, tiny house holiday homes)	**GA.M1 Conditional access** Limit access to some extent: Foot path or bike line only roads entrance fee for specific areas opening hours for specific areas
High	**GG.H1 Green infrastructure** Design streetscapes: tree lined sidewalks permeable pavement, aesthetic entrance to corridor with green planting	**GP.H1 EIA (environmental impact assessment)** Conduct EIA's for development projects in or in close proximity to the corridor **GP.H2 Land use planning** Establish protected and conservation areas to safeguard them from high-impact development	**GA.H1 Infrastructure design** Incorporate green space amenities: seating areas playgrounds cafe's other recreational facilities **GA.H1** Integrate cultural & educational elements: art installations informative signage other elements	**GA.H1 Full access** Design slow mode infrastructure that connects neighborhoods & green space Enhance signage and maps to facilitate navigation and encourage exploration of the corridor integrate design principles that ensure equal access to and use of corridor for people of all ages, abilities, and mobility levels.

Figure 78. Intervention matrix for green corridor applied to Maasmechelen-Stein (made by authors, 2024).

intervention cards:
Maasmechelen-Stein

strategies

vision

analysis

MOBILITY
bus

B.LMH1
Increased frequency of public transport

MOBILITY
slow modes

SM.LMH1
Attractiveness of biking & walking infrastructure

MOBILITY
trains

T.L1
Upgrade existing train stations with basic amenities

MOBILITY
shared mobility

SHM.L1
Promote existing ride-sharing platforms and encourage initiatives

MOBILITY
transport hub

TH.L1
Enhance existing transportation nodes with improved signage and passenger information

SUSTAINABLE LAND USE
SGI

SGI.L1
Implement basic service standards

SUSTAINABLE LAND USE
other amenities

OA.L1
Create attractive business climate for local and external parties

SUSTAINABLE LAND USE
public space

PS.L1
Implement minor enhancements such as street furniture and art installations

MOBILITY
bus

B.LH2
Improve existing or add bus routes with minor adjustments

MOBILITY
slow modes

SM.L2
Policies to incentivise use of slow modes

MOBILITY
trains

T.M1
Improve timetable coordination by implementing AI technology

MOBILITY
shared mobility

SHM.M1
Subsidize shared mobility services

MOBILITY
transport hub

TH.L2
Ensure existing mode cross in transport hubs

SUSTAINABLE LAND USE
SGI

SGI.L2
Implement monitoring mechanisms

SUSTAINABLE LAND USE
other amenities

OA.M1
Develop community facilities like parks, recreational areas, and cultural centers

SUSTAINABLE LAND USE
public space

PS.M1
Renovate public spaces to improve accessibility, safety, and aesthetics

GREEN
activate

GA.L1
Organize volunteer programs and community events

GREEN
preserve

GP.L1
Assessment & monitoring

low
degree of engagement

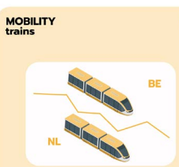
MOBILITY
bus

B.MH3
Add more bus stops to existing and/ or new routes

MOBILITY
slow modes

SM.M2
Ensure connection with other modes of transport

MOBILITY
trains



T.H1
Unified transport system across border

MOBILITY
shared mobility

SHM.M2
Establish designated pick-up/drop-off zones

MOBILITY
transport hub

TH.M1
Upgrade transportation hubs to include intermodal connectivity and seamless transfer options

SUSTAINABLE LAND USE
SGI

SGI.M1
Upgrade service quality to meet higher performance benchmarks

SUSTAINABLE LAND USE
public space

PS.H1
Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural program

MOBILITY
slow modes

SM.H2
Add bike and walking infrastructure that connects the urban and peri-urban

MOBILITY
trains

T.H2
Activating existing infrastructure

SUSTAINABLE LAND USE
SGI

SGI.H1
Invest in cutting-edge technology & customer service initiatives to ensure exceptional service

GREEN
generate

GG.H1
Add green infrastructure

GREEN
activate

GA.M1
Incentivize low-impact development

MOBILITY
trains

T.H3
Adding new train infrastructure

GREEN
access

GAC.H1
Full access

GREEN
activate

GA.H2
Incorporate green space amenities

GREEN
preserve

GP.H2
Conduct environmental impact assessment for development projects in or in close proximity to the corridor

Figure 79. Overview of intervention cards selected for Maasmechelen-Stein (made by authors, 2024).

interventions on diagram:
Maasmechelen-Stein

goals: agreed

goals: not agreed

strategies

vision

analysis

technology: known

technology: unknown

MOBILITY slow modes

SM.LMH1
Attractiveness of biking & walking infrastructure

MOBILITY slow modes

SM.L2
Policies to incentivise use of slow modes

SUSTAINABLE LAND USE public space

PS.L1
Implement minor enhancements such as street furniture and art installations

MOBILITY transport hub

TH.L1
Enhance existing transportation nodes with improved signage and passenger information

GREEN activate

GA.H1
Integrate cultural & educational elements

MOBILITY bus

B.MH3
Add more bus stops to existing and/ or new routes

MOBILITY shared mobility

SHM.L1
Promote existing ride-sharing platforms and encourage initiatives

MOBILITY shared mobility

SHM.M2
Establish designated pick-up/drop-off zones

SUSTAINABLE LAND USE public space

PS.H1
Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural program

SUSTAINABLE LAND USE public space

PS.M1
Renovate public spaces to improve accessibility, safety, and aesthetics

MOBILITY trains

T.L1
Upgrade existing train stations with basic amenities

SUSTAINABLE LAND USE other amenities

OA.M1
Develop community facilities like parks, recreational areas, and cultural centers

SUSTAINABLE LAND USE SGI

SGI.L1
Implement basic service standards

GREEN activate

GA.L1
Organize volunteer programs and community events

MOBILITY transport hub

TH.L2
Ensure existing mode cross in transport hubs

MOBILITY slow modes

SM.M2
Ensure connection with other modes of transport

GREEN generate

GG.H1
Add green infrastructure

GREEN activate

GA.H2
Incorporate green space amenities

GREEN access

GAC.H1
Full access

MOBILITY bus

B.LMH1
Increased frequency of public transport

MOBILITY slow modes

SM.H2
Add bike and walking infrastructure that connects the urban and peri-urban

GREEN activate

GA.M1
Incentivize low-impact development

GREEN preserve

GP.H2
Conduct environmental impact assessment for development projects in or in close proximity to the corridor

MOBILITY bus

B.LH2
Improve existing or add bus routes with minor adjustments

MOBILITY transport hub

TH.M1
Upgrade transportation hubs to include intermodal connectivity and seamless transfer options

SUSTAINABLE LAND USE SGI

SGI.M1
Upgrade service quality to meet higher performance benchmarks

SUSTAINABLE LAND USE SGI

SGI.L2
Implement monitoring mechanisms

GREEN preserve

GP.L1
Assessment & monitoring

MOBILITY trains

T.H3
Adding new train infrastructure

MOBILITY shared mobility

SHM.M1
Subsidize shared mobility services

MOBILITY trains

T.H2
Activating existing infrastructure

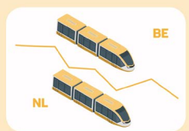
SUSTAINABLE LAND USE other amenities

OA.L1
Create attractive business climate for local and external parties

MOBILITY trains

T.M1
Improve timetable coordination by implementing AI technology

MOBILITY trains



T.H1
Unified transport system across border

After selecting the relevant interventions from both the urban and the green corridor toolbox, the interventions are placed on the diagram to gain a better understanding of the most relevant and crucial interventions. The crucial interventions are evenly divided between whether stakeholders are likely to agree or not agree. These most crucial interventions will be prioritized in the visual representation of this area.

Low importance → High importance

Figure 80. Intervention cards placed on stakeholder-technology diagram for Maasmechelen-Stein (made by authors, 2024; adapted from Christensen, 1985).

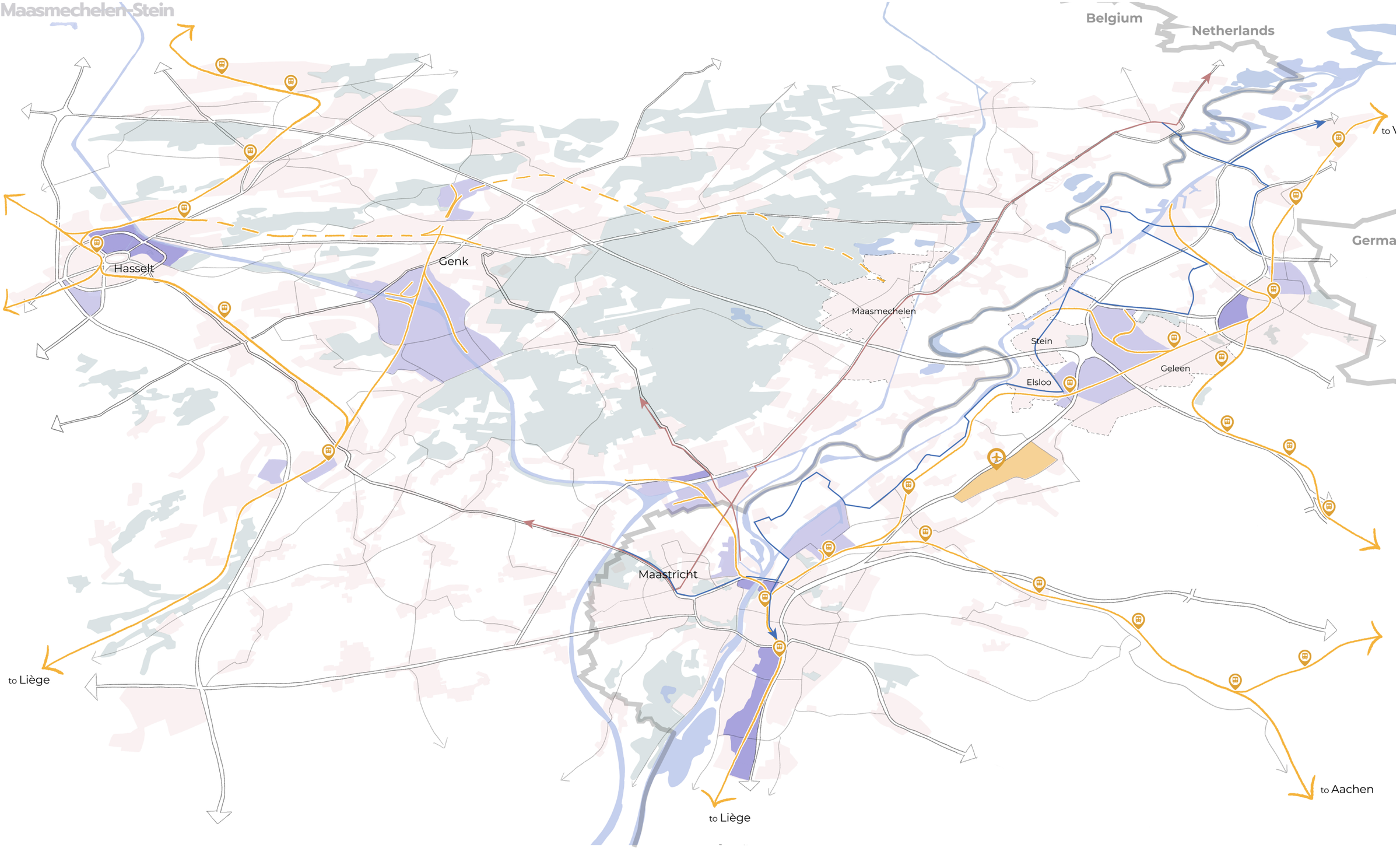


Figure 81. Visual representation of Maasmechelen-Stein before CMIYC strategy application (made by authors, 2024).

visual after:
Maasmechelen-Stein

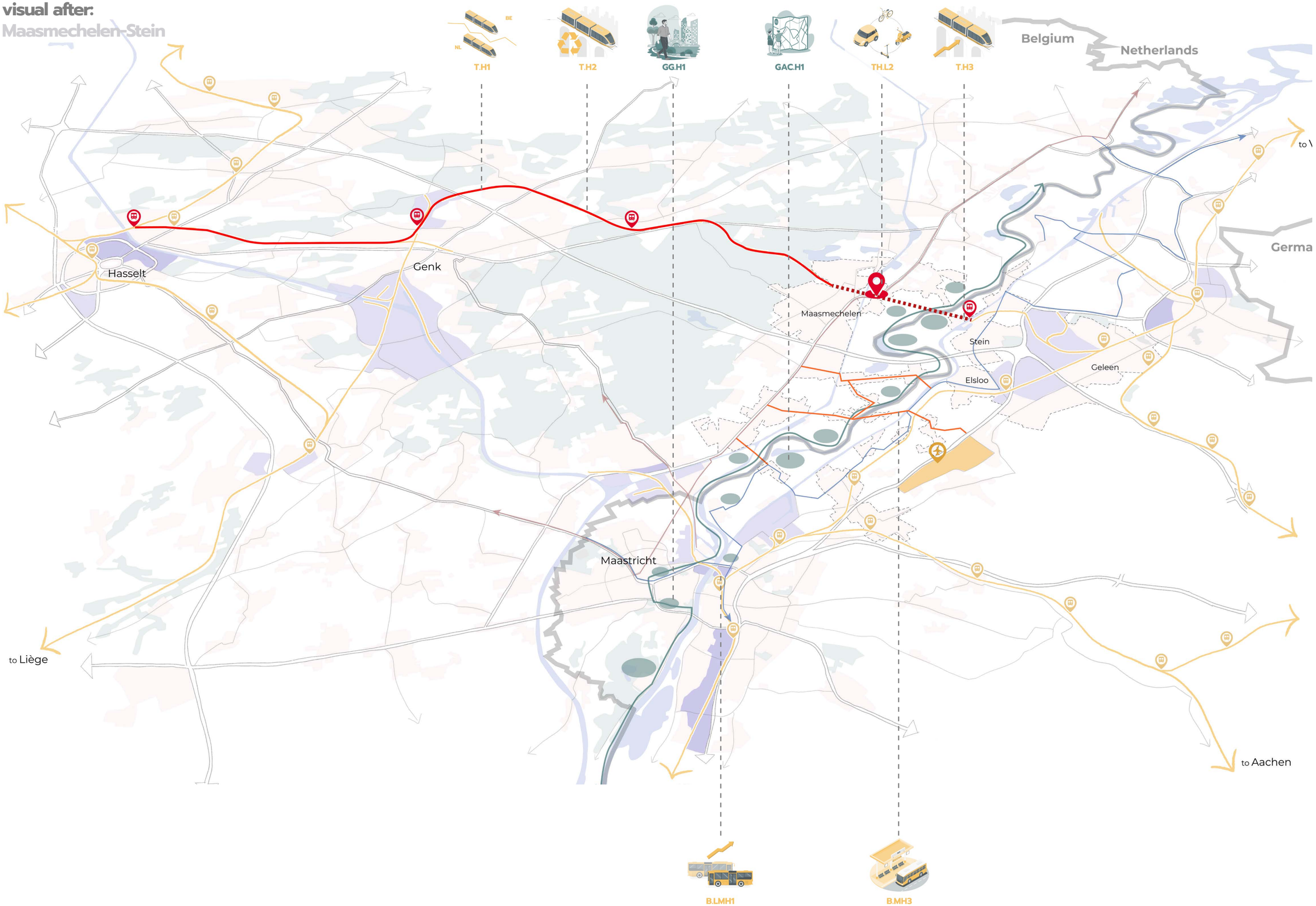


Figure 82. Visual representation of Maasmechelen-Stein after CMIYC strategy application (made by authors, 2024).

Improve cross-border connectivity

Improve connectivity with green areas on the green corrdidor on both sides of the border

Preserve the green corridor and ensure the use of it as public space

More diverse amenities within slow mode reach for the built environment in the area

sustainable landuse

Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport

High quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport

CO2

A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rijn region, in accordance with the European Green Deal

5.8 area four

curent situation:

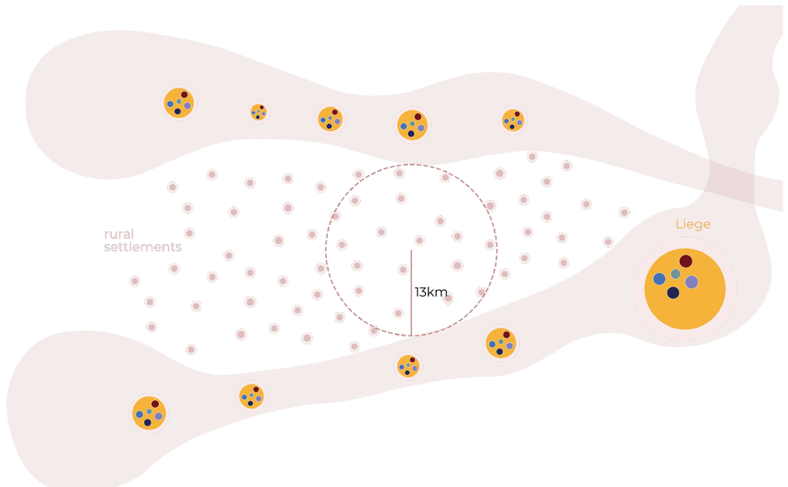
Braives

The fourth area of application is Braives, which is situated south of urban corridors, in the Belgium part of the Maas-Rhein. Unlike the previous three areas, this area is situated outside of both the urban and green corridors. As this area is not located in the green corridor, that intervention matrix will not be applied. However, this area presents an example of an area that will not be developed densely, but that will be connected to the urban corridor to still improve accessibility. Therefore, the urban corridor intervention matrix will be applied, but only the mobility and sustainable land use categories. The goals for this area are presented, as well as the current situation and challenges in the area.

Keep low density and instead improve connectivity with the development corridors

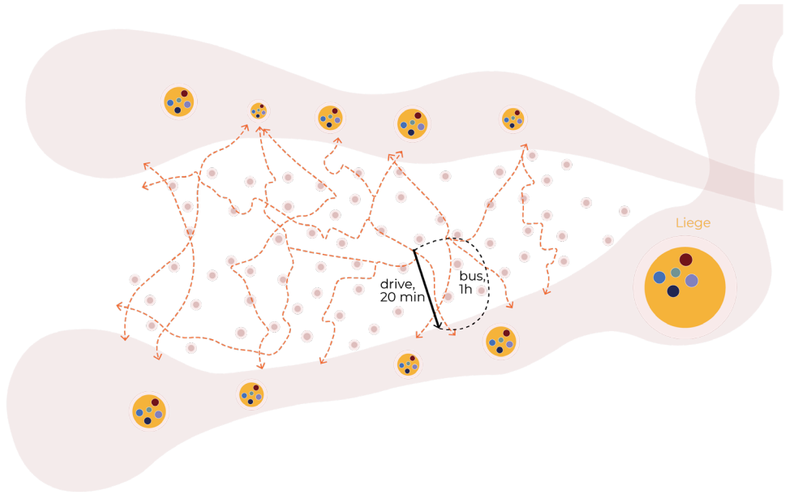
Provide the settlements with an adequate amount of SGI's within slow mode reach, if not present

SGI's, other amenities, job opportunities



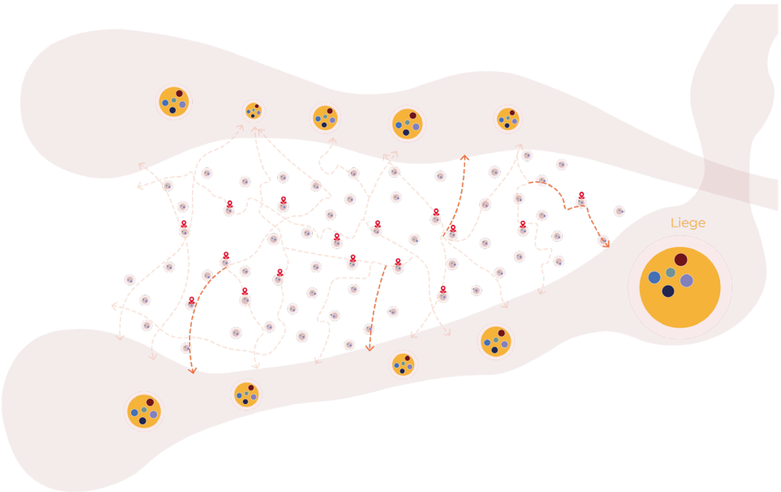
1. Geographical location
Within the corridor area, small settlements located within 13 kilometers of the urban corridor can conveniently access job opportunities and services of general interest (SGI).

bus lines



2. Problem Description
Currently, public buses serve as the primary mode of public transportation for the between areas. However, due to the partial coverage of settlements by the bus network and the low frequency of buses, residents of some settlements may spend more than twice the time commuting by bus compared to driving.

SGI's
new bus lines
transport hub: shared mobility, slow modes, bus stops



3. Solution strategy
Increase the number of bus routes or the frequency of buses and establish mobility transfer hubs (allowing residents to choose between buses, shared mobility, and slower modes of transport). This would provide convenient public transportation options for residents to travel to the urban corridor.

Utilize inefficiently used land or potential spaces within settlements, formed by future residential patterns to add SGI. This would reduce residents' daily commuting needs.

Increase green infrastructure along riverbank areas. This would provide residents with natural spaces to enjoy.

Figure 83. Conceptual representation of current spatial situation in Braives (made by authors, 2024).

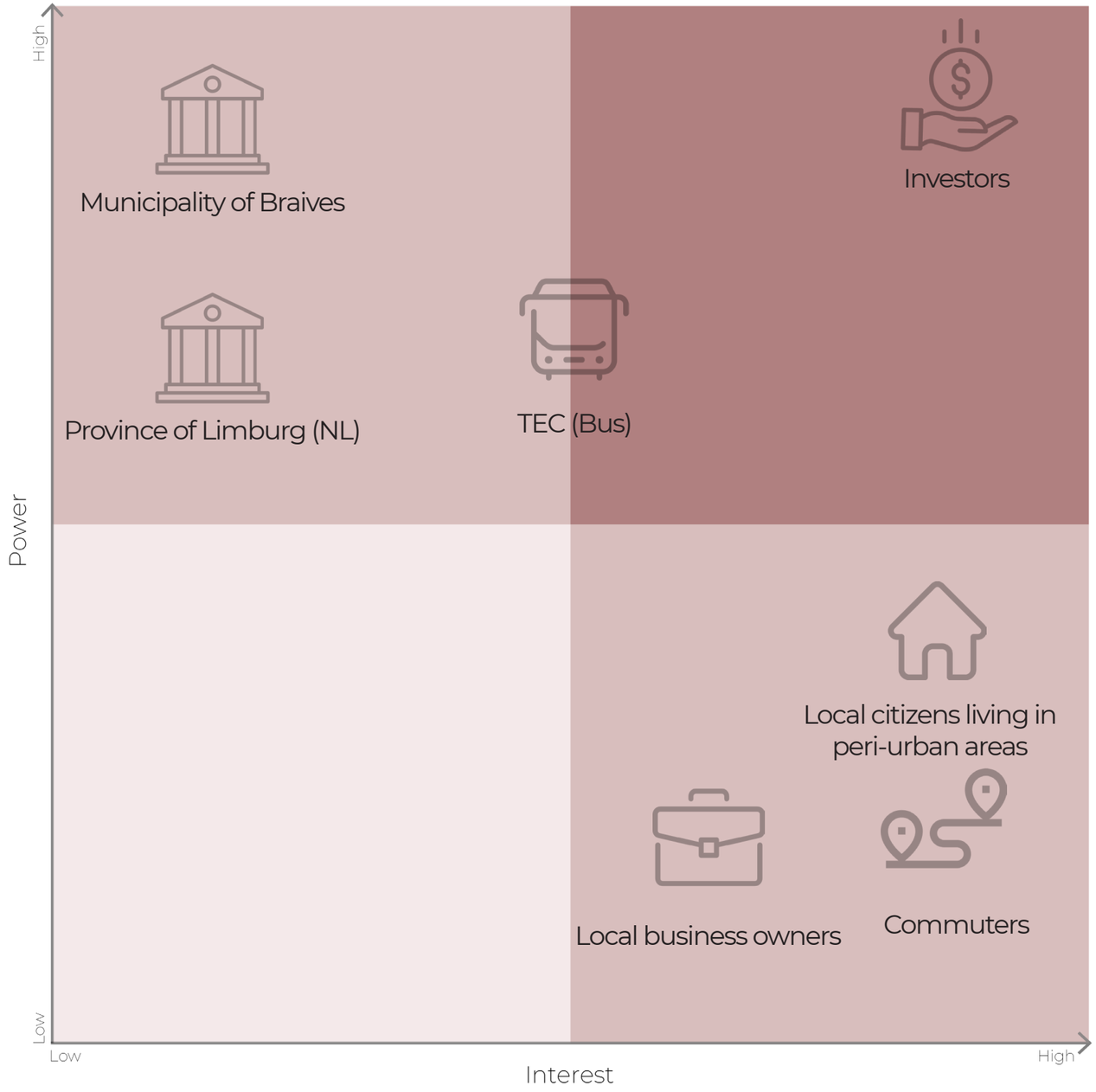


Figure 84. Power-interest matrix for stakeholders in Braives (made by authors, 2024).

intervention matrix:
Braives

strategies

analysis

DEGREE OF EFFORT	MOBILITY					FORM		SUSTAINABLE LANDUSE		
	Bus	Slow modes	Train	Shared mobility	Transport hub	Density Population	Density Building	SGI	Other Ammenities	Open Space
Low	**B.L1** Increased frequency: small to moderate extent **B.L2** Improve existing bus routes with minor adjustments	**SM.L1** Attractiveness of biking and walking infrastructure: small to moderate extent **SM.L2** Policies to incentivise use of slow modes.	**T.L1** Upgrade existing train stations with basic amenities	**SHM.L1** Promote existing ride-sharing platforms and encourage automated and efficiency-improved carsharing initiatives	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs	**DP.L1** Encourage infill development	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms	**OA.L1** Create attractive business climate for local and external parties	**PS.L1** Implement minor enhancements such as street furniture and art installations
Medium	**B.M1** Increased frequency: small to large extent **B.L2** Improve existing bus routes with minor adjustments **B.M3** Add more bus stops along existing routes	**SM.M1** Attractiveness of biking and walking infrastructure: small to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensure connection with other modes of transport	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include increased intermodal connectivity and seamless transfer options	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
High	**B.H1** Increased frequency: medium to large extent **B.H2** Add more bus stops to existing and/ or new routes **B.H3** Add new bus routes **B.H4** Implement Bus Rapid Transit (BRT) systems with segregated lanes **B.H5** Hydrogen bus	**SM.H1** Attractiveness of biking and walking infrastructure: to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensuring connection with other modes of transport **SM.H2** Add (protected) bike and walking infrastructure that connects the urban and peri-urban	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology **T.H1** Unified transport system across border **T.H2** Activating existing infrastructure **T.H3** Adding new infrastructure	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones **SHM.H1** Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms, ensuring seamless and personalized door-to-door transportation **SHM.H2** Establish vertical mobility hubs with flying taxi services and drone delivery networks for efficient and eco-friendly urban	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning **DB.H1** Implement Transit-Oriented Development (TOD) strategies, including increased building heights and density bonuses near transit corridors	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks **SGI.H1** Invest in cutting-edge technology and customer service initiatives to ensure exceptional service reliability and satisfaction	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfront developments, and world-class amenities	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programming

Figure 85. Intervention matrix for urban corridor applied to Braives (made by authors, 2024).

intervention cards:
Braives

strategies

vision

analysis

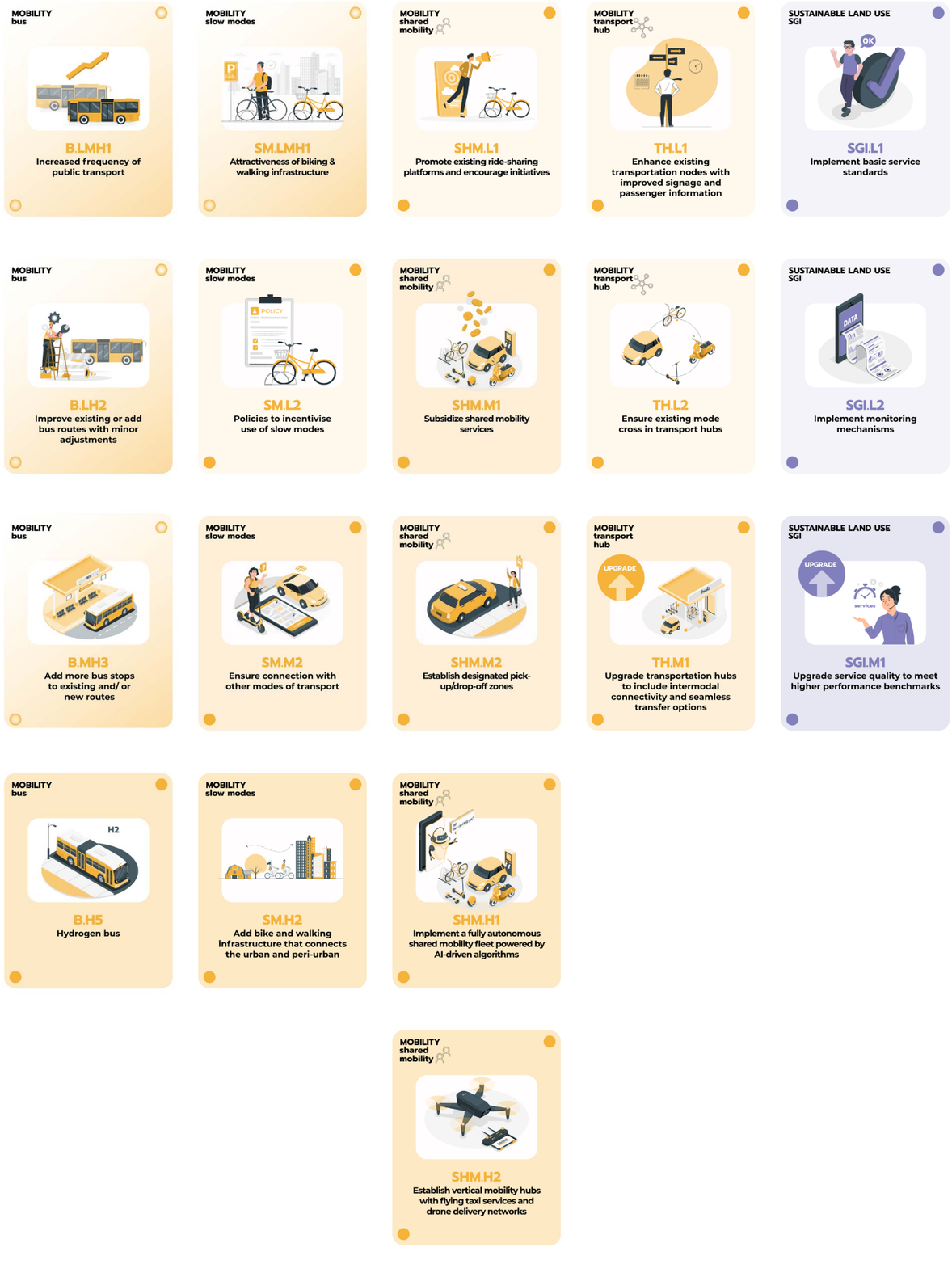


Figure 86. Overview of intervention cards selected for Braives (made by authors, 2024).

goals: agreed

goals: not agreed

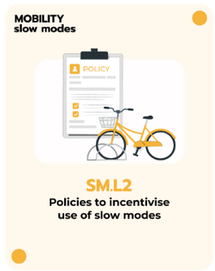
strategies

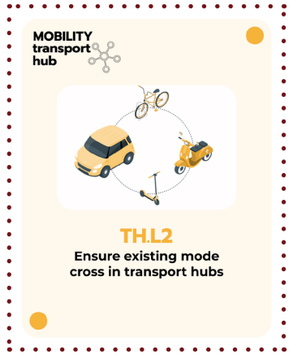
vision

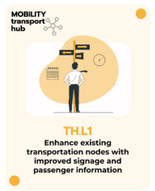
analysis

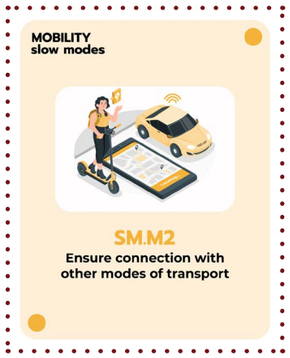
technology: known

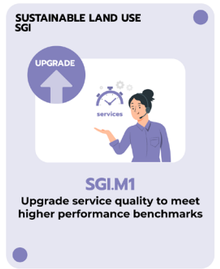
technology: unknown

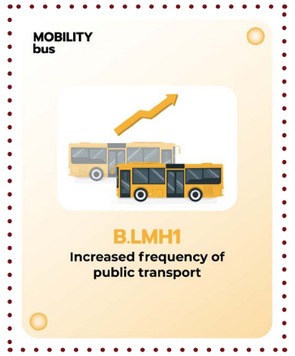


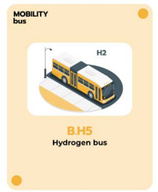


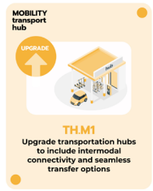


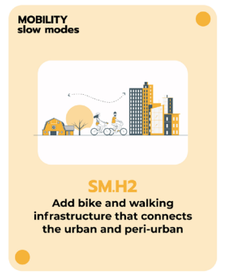


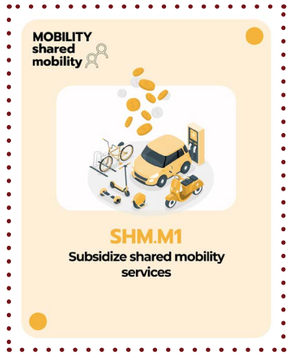


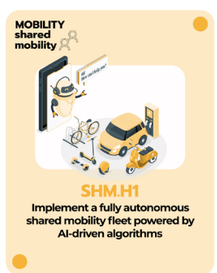


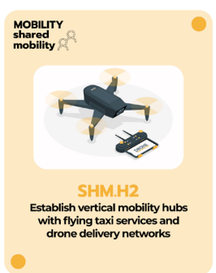












The mobility and sustainable land use interventions that were selected from the urban corridor matrix mostly include interventions for which technology is known. Furthermore, for most interventions the stakeholders are likely to agree, therefore the crucial interventions in the top-right of the diagram will be central in the visual representation of the fourth area.

Low importance → High importance

Figure 87. Intervention cards placed on stakeholder-technology diagram for Braives (made by authors, 2024; adapted from Christensen, 1985).

Figure 88. Visual representation of Braives before CMIYC strategy application (made by authors, 2024).

GG.H1

TH.L2

N64

N637

N69

N69

settlement**2**

settlement**1**

settlement**3**

N64

TH.L2

SGI.L1

B.MH3

B.LMH1

TH.L2

B.MH3

Figure 89. Visual representation of Braives after CMIYC strategy application (made by authors, 2024).

Keep low density and instead improve connectivity with the development corridors

Provide the settlements with an adequate amount of SGI's within slow mode reach, if not present

sustainable landuse

Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport

High quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport

CO2

A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rijn region, in accordance with the European Green Deal

5.9 area five

cuent situation:

Bütgenbach

The fifth and final area of application is Bütgenbach, which is located in the southern part of the Maas-Rijn, along the green corridor. Therefore, in this area, the green corridor intervention matrix will be applied, as well as the mobility and SGI category of the urban corridor intervention matrix. The goals for this area are presented, as well as the current situation and challenges in the area.

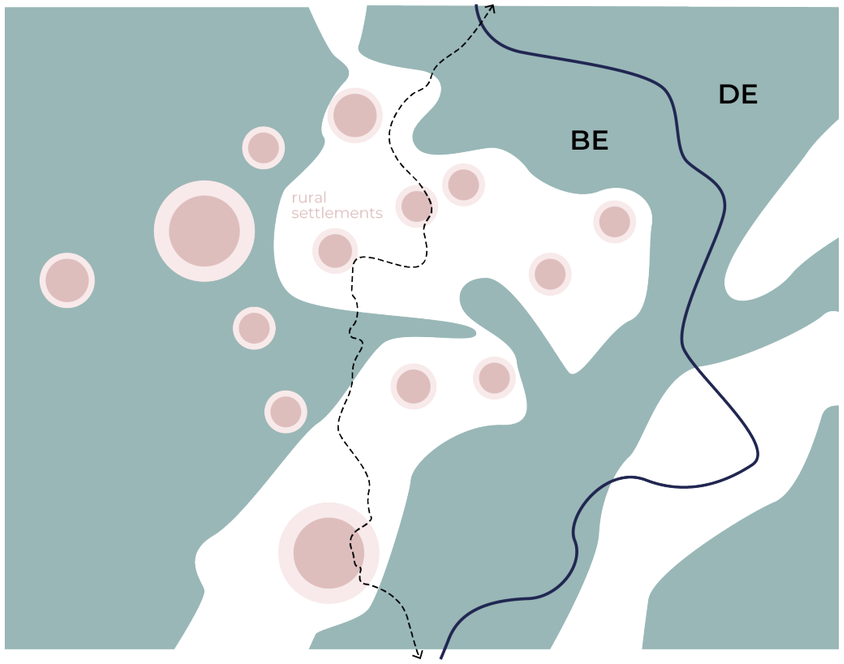
Ensure the preservation of existing green space structures

Provide safe and slow accessibility to the Vennbahn road

Generate green and recreational facilities along the Vennbahn road to increase attractivity

Encourage active engagement with the corridor

---- Vennbahn cycleway

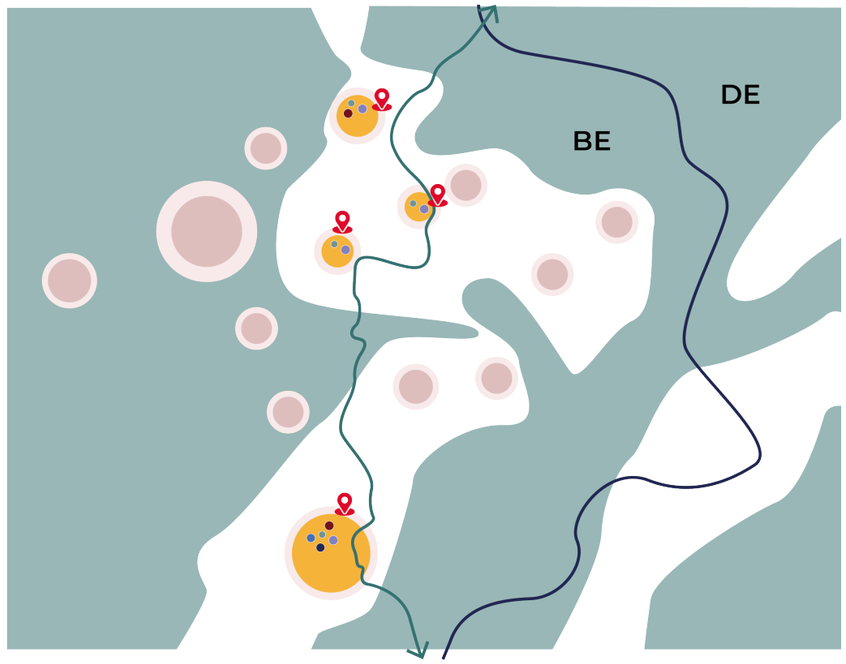


Lorem Ipsum is simply dummy text of the printing and typesetting industry. Lorem Ipsum has been the industry's standard dummy text ever since the 1500s, when an unknown printer took a galley of type and scrambled it to make a type specimen.

SGI's, other amenities, job opportunities

— low development along cycleway

transport hub: shared mobility and slow modes



Lorem Ipsum is simply dummy text of the printing and typesetting industry. Lorem Ipsum has been the industry's standard dummy text ever since the 1500s, when an unknown printer took a galley of type and scrambled it to make a type specimen.

Figure 90. Conceptual representation of current spatial situation in Bütgenbach (made by authors, 2024).

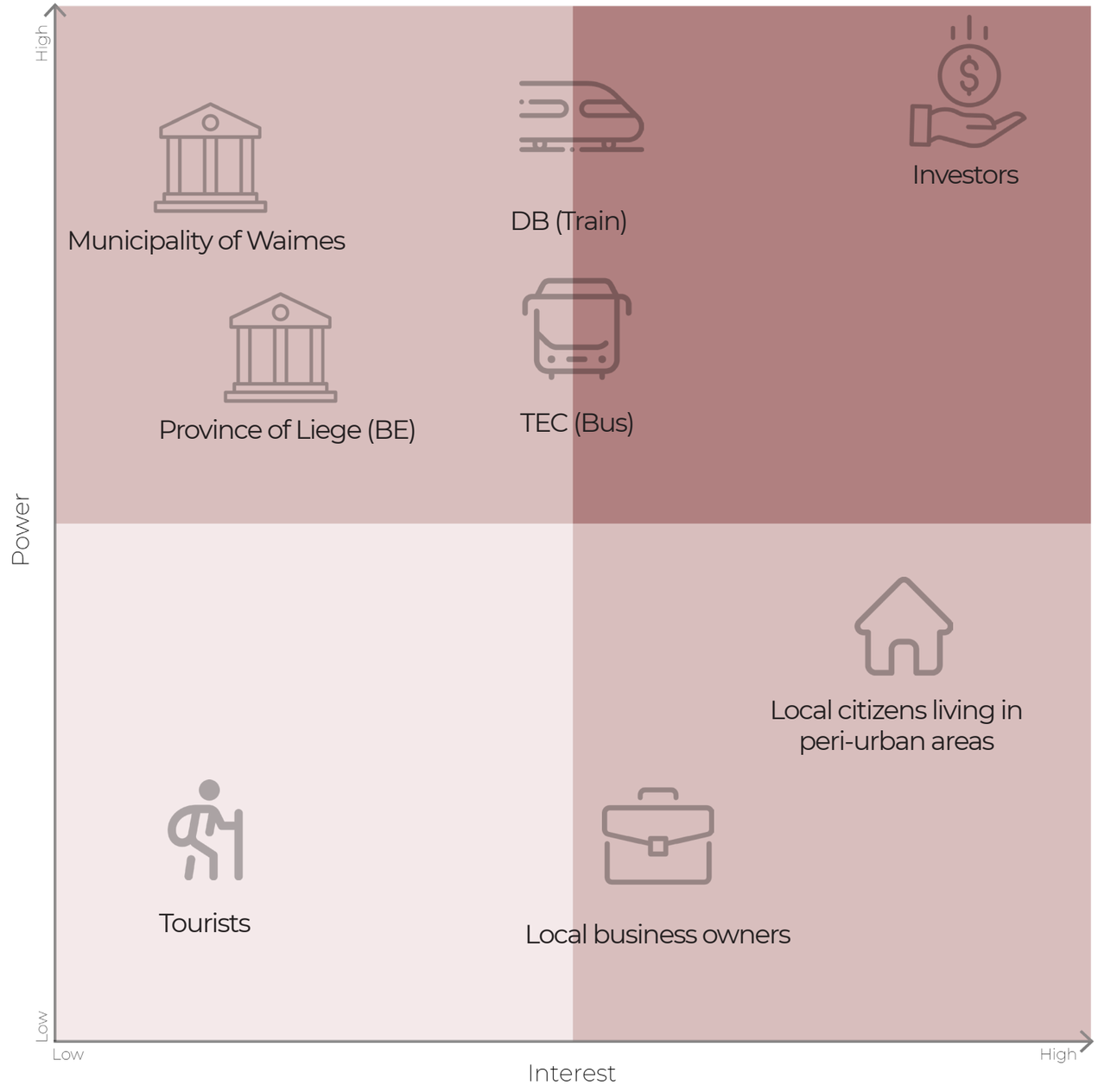


Figure 91. Power-interest matrix for stakeholders in Bütgenbach (made by authors, 2024).

Intervention matrix:
Bütgenbach

vision strategies

analysis

DEGREE OF EFFORT	MOBILITY					FORM		SUSTAINABLE LANDUSE		
	Bus	Slow modes	Train	Shared mobility	Transport hub	Density Population	Density Building	SGI	Other Ammenities	Open Space
Low	**B.L1** Increased frequency: small to moderate extent **B.L2** Improve existing bus routes with minor adjustments	**SM.L1** Attractiveness of biking and walking infrastructure: small to moderate extent **SM.L2** Policies to incentivise use of slow modes.	**T.L1** Upgrade existing train stations with basic amenities	**SHM.L1** Promote existing ride-sharing platforms and encourage automated and efficiency-improved carsharing initiatives	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs	**DP.L1** Encourage infill development	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms	**OA.L1** Create attractive business climate for local and external parties	**PS.L1** Implement minor enhancements such as street furniture and art installations
Medium	**B.M1** Increased frequency: small to large extent **B.L2** Improve existing bus routes with minor adjustments **B.M3** Add more bus stops along existing routes	**SM.M1** Attractiveness of biking and walking infrastructure: small to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensure connection with other modes of transport	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics
High	**B.H1** Increased frequency: medium to large extent **B.H2** Add more bus stops to existing and/ or new routes **B.H3** Add new bus routes **B.H4** Implement Bus Rapid Transit (BRT) systems with segregated lanes **B.H5** Hydrogen bus	**SM.H1** Attractiveness of biking and walking infrastructure: to large extent **SM.L2** Policies to incentivise use of slow modes **SM.M2** Ensuring connection with other modes of transport **SM.H2** Add (protected) bike and walking infrastructure that connects the urban and peri-urban	**T.L1** Upgrade existing train stations with basic amenities **T.M1** Improve timetable coordination by implementing AI technology **T.H1** Unified transport system across border **T.H2** Activating existing infrastructure **T.H3** Adding new infrastructure	**SHM.L1** Promote existing ride-sharing platforms and encourage initiatives **SHM.M1** Subsidize shared mobility services **SHM.M2** Establish designated pick-up/ drop-off zones **SHM.H1** Implement a fully autonomous shared mobility fleet powered by AI-driven algorithms, ensuring seamless and personalized door-to-door transportation **SHM.H2** Establish vertical mobility hubs with flying taxi services and drone delivery networks for efficient and eco-friendly urban	**TH.L1** Enhance existing transportation nodes with improved signage and passenger information **TH.L2** Ensure existing mode cross in transport hubs **TH.M1** Upgrade transportation hubs to include intermodal connectivity and seamless transfer options **TH.H1** Develop new multimodal transportation hubs with integrated facilities for various modes of transport	**DP.L1** Encourage infill development **DP.M1** Implement policies to incentivize higher density development and redevelopment projects **DP.H1** Undertake large-scale urban regeneration projects to increase population density around transit nodes	**DB.L1** Relax zoning regulations to allow for slightly higher building densities in targeted areas **DB.M1** Introduce mixed-use zoning **DB.H1** Implement Transit-Oriented Development (TOD) strategies, including increased building heights and density bonuses near transit corridors	**SGI.L1** Implement basic service standards **SGI.L2** Implement monitoring mechanisms **SGI.M1** Upgrade infrastructure and service quality to meet higher performance benchmarks **SGI.H1** Invest in cutting-edge technology and customer service initiatives to ensure exceptional service reliability and satisfaction	**OA.L1** Create attractive business climate for local and external parties **OA.M1** Develop community facilities like parks, recreational areas, and cultural centers **OA.H1** Undertake major urban renewal projects to create iconic landmarks, waterfront developments, and world-class amenities	**PS.L1** Implement minor enhancements such as street furniture and art installations **PS.M1** Renovate public spaces to improve accessibility, safety, and aesthetics **PS.H1** Transform public spaces into vibrant social hubs with green infrastructure, interactive features, and cultural programming

Figure 92. Intervention matrix for urban corridor applied to Bütgenbach (made by authors, 2024).

intervention matrix:
Bütgenbach

vision strategies

analysis

DEGREE OF ENGAGEMENT	Generate Green	Preserve Green	Activate Green	Access Green
Low	**GG.L1 Landscape management** Only allow for low-impact development Not interrupting existing green space	**GP.L1 Assessment & monitoring** Monitor health indicators of ecosystems Assess flora & fauna through biodiversity surveys	**GA.L1 Community engagement** Organize volunteer programs and community events: tree planting litter clean up	**GA.L1 Proximate access** Site can be experience at its boundaries **GA.L2 Remote access** Site serves as visual green resource for local community
Medium	**GG.M1 Landscape management** Plant native trees & shrubs to enhance biodiversity, willdlife habitat & improve air quality Establish community gardens and orchards	**GP.M1 Policy** Tax incentives & subsidies to landowners who conserve or restor green space in the corridor	**GA.M1 Incentivize low-impact** development: recreational facilities (restaurants, information centers, tiny house holiday homes)	**GA.M1 Conditional access** Limit access to some extent: Foot path or bike line only roads entrance fee for specific areas opening hours for specific areas
High	**GG.H1 Green infrastructure** Design streetscapes: tree lined sidewalks permeable pavement, aesthetic entrance to corridor with green planting	**GP.H1 EIA (environmental impact assessment)** Conduct EIA's for development projects in or in close proximity to the corridor **GP.H2 Land use planning** Establish protected and conservation areas to safeguard them from high-impact development	**GA.H1 Infrastructure design** Incorporate green space amenities: seating areas playgrounds cafe's other recreational facilities **GA.H1** Integrate cultural & educational elements: art installations informative signage other elements	**GA.H1 Full access** Design slow mode infrastructure that connects neighborhoods & green space Enhance signage and maps to facilitate navigation and encourage exploration of the corridor integrate design principles that ensure equal access to and use of corridor for people of all ages, abilities, and mobility levels.

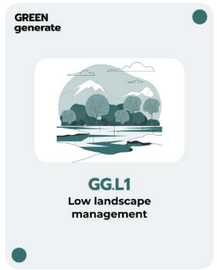
Figure 93. Intervention matrix for green corridor applied to Bütgenbach (made by authors, 2024).

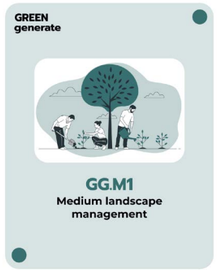
intervention cards:
Bütgenbach

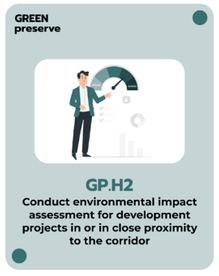
strategies

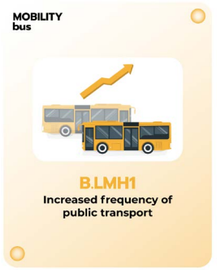
vision

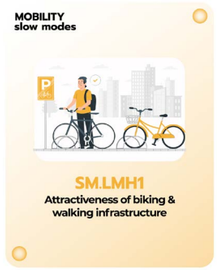
analysis

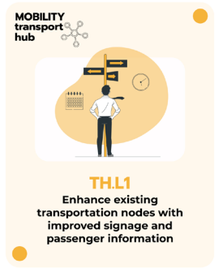












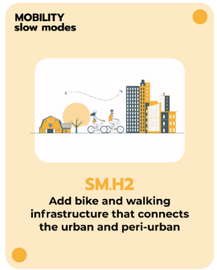


Figure 94. Overview of intervention cards selected for Bütgenbach (made by authors, 2024).

interventions on diagram:
Bütgenbach

goals: agreed

goals: not agreed

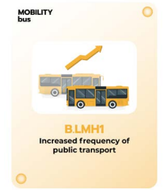
strategies

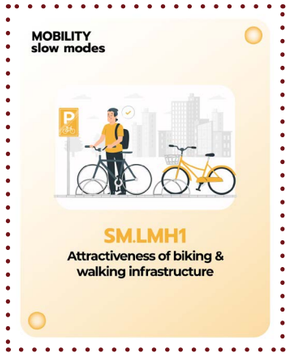
technology: known

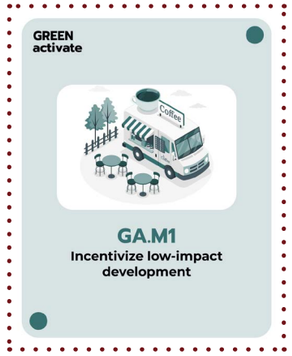
vision

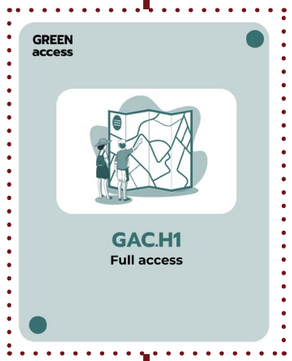
analysis

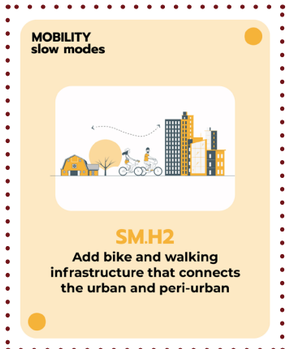
technology: unknown

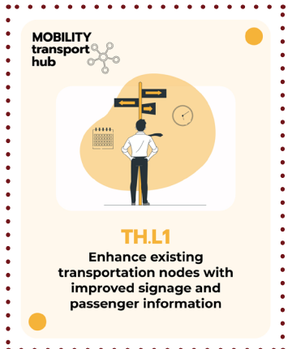


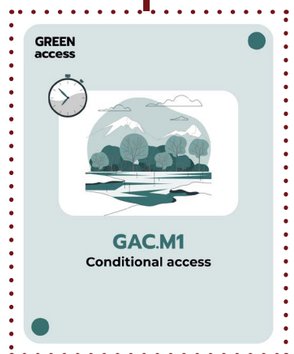












For the final area, the selected interventions were placed on the diagram. No interventions make use of unknown technology and stakeholders are likely to agree upon most interventions. Therefore, the most crucial interventions will be guiding the visual representation of the fifth and final area.

Low importance — High importance

Figure 95. Intervention cards placed on stakeholder-technology diagram for Bütgenbach (made by authors, 2024; adapted from Christensen, 1985).

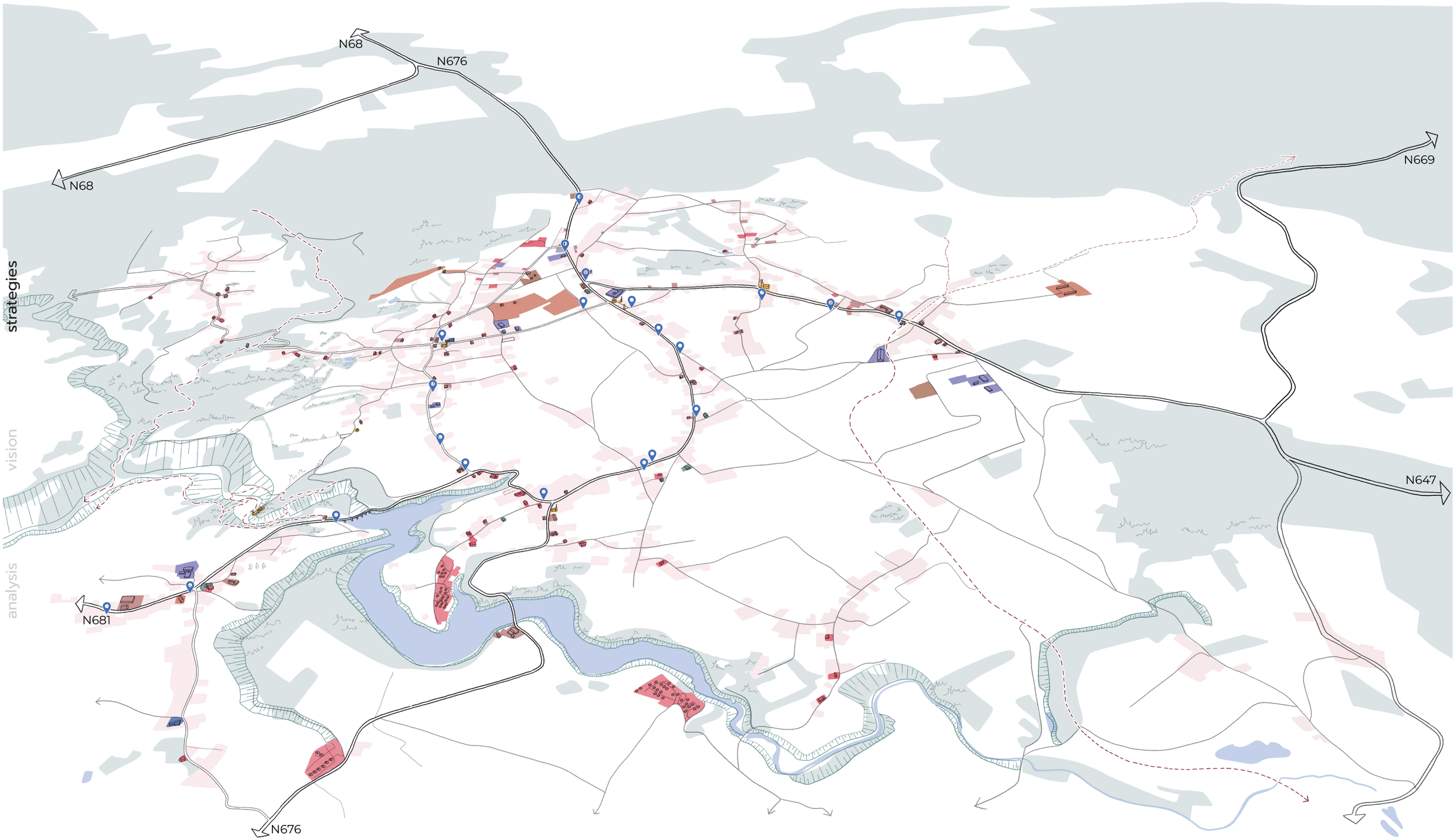


Figure 96. Visual representation of Bütgenbach before CMIYC strategy application (made by authors, 2024).

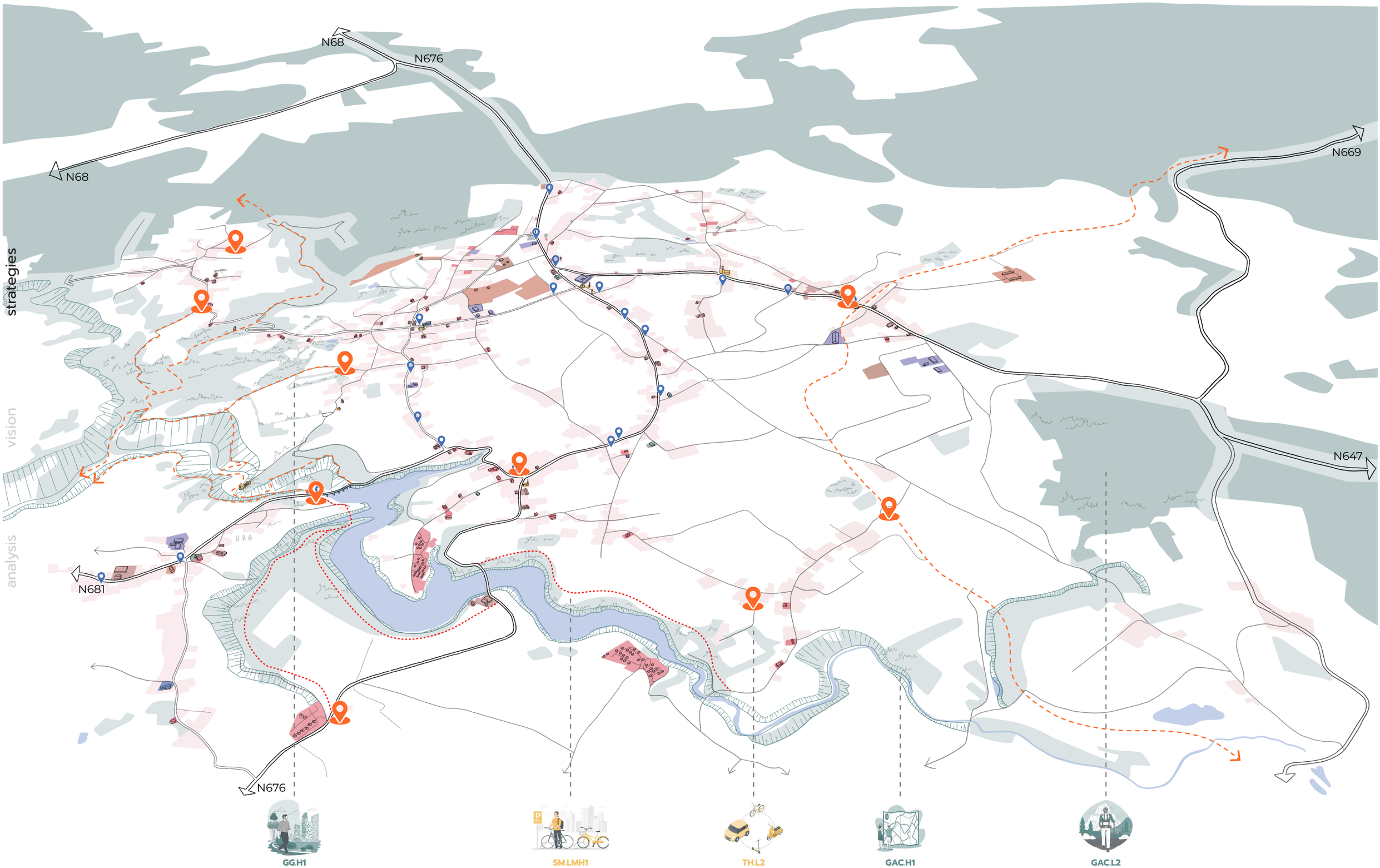


Figure 97. Visual representation of Bütgenbach after CMIYC strategy application (made by authors, 2024).

Ensure the preservation of existing green space structures corridors

Provide safe and slow accessibility to the Vennbahn cycle way corridors

Generate green and recreational facilities along the Vennbahn road to increase attractivity for visitors and opportunities for locals

Encourage active engagement with the corridor

Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport

High quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport

A 90% reduction of CO_2 emissions associated with the use of private motorized vehicles in the Maas-Rijn region, in accordance with the European Green Deal

5.10 timeline

After presenting the strategy for the XL scale as well as the application of the CMIYC strategy on the five exemplary areas for the S and M scale, it is important to get an understanding of where these interventions would take place in time. To that end, figure 98 presents the timeline for the CMIYC strategy. The timeline includes the interventions, indicated with the action code from the intervention cards, the interventions that take place on the M scale and finally the regulatory framework for the railway network and the implementation of blockchain technology that are part of the XL strategy.

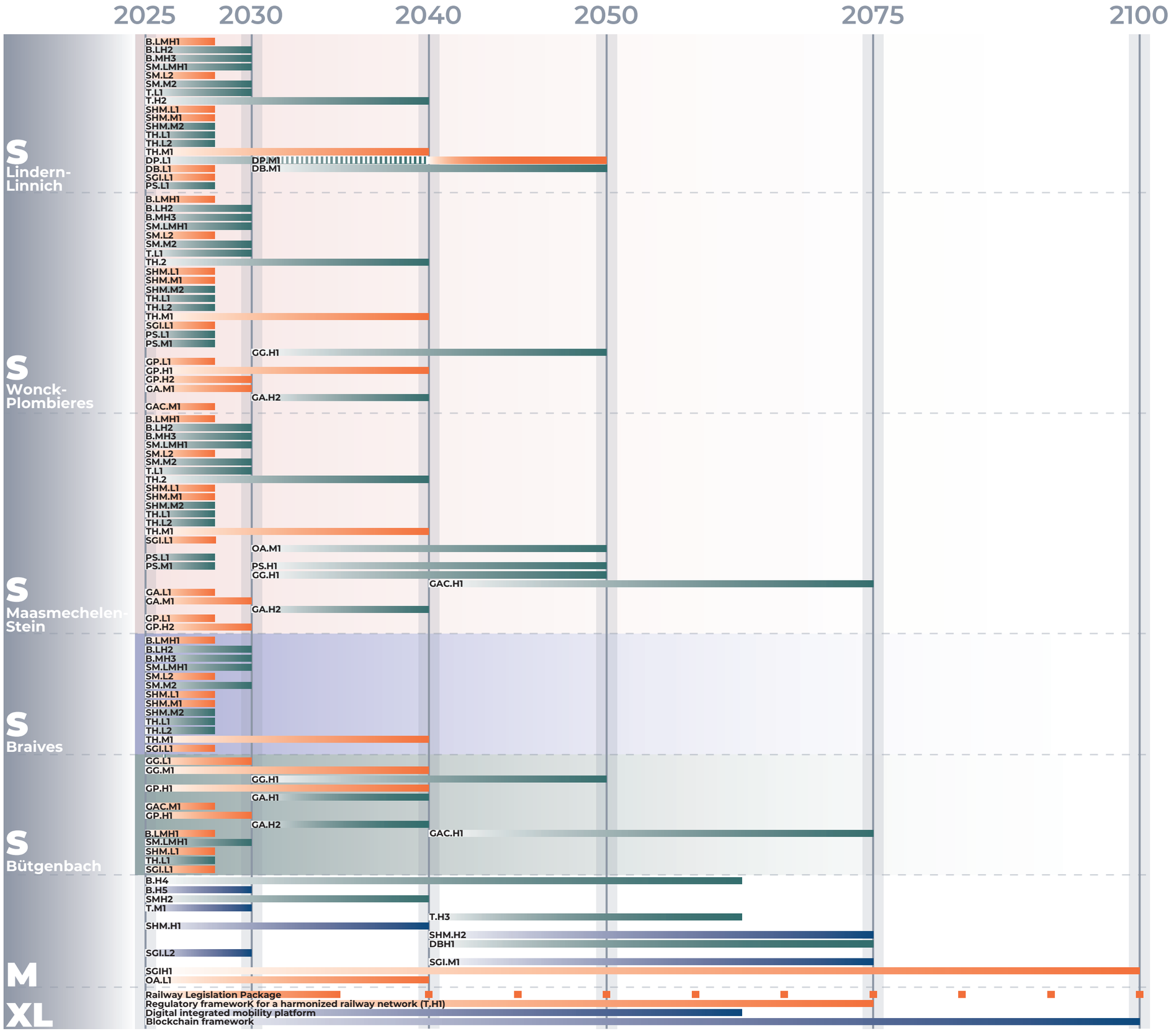


Figure 98. Timeline of CMIYC strategy (made by authors, 2024).

06
conclusions&reflections

The sixth and final chapter of the CMYIC report will consist of the final conclusions and reflections. The conclusion will include an overview of the report, a description of how the project goals were met and will provide an answer to the central research question. The remaining two sections on reflections will include a project reflection regarding the limitations, values, ethics and public goods connected to the CMIYC project as well as a series of four individual reflections on the regional design process.

6.1 conclusions

The CMIYC project aimed to address the challenge of reducing carbon emissions associated with the use of private motorized vehicles. Before developing a spatial vision and translating this vision into a strategy, an analysis of the problem was carried out which resulted in the following central research question: What strategies can foster a more socially and environmentally sustainable future approach to mobility in which access to amenities and opportunities for peri-urban areas in a cross-border context is prioritized, whilst also fostering affordable and sustainable international accessibility? This central research question was accompanied by a set of objectives that the project aims to meet:

- A 90% reduction of CO2 emissions associated with the use of private motorized vehicles in the Maas-Rhein region, by the European Green Deal.

- High-quality basic service provision in peri-urban settlements, within reach by the use of slow modes of transport.

- Equal accessibility to diverse amenities, services and opportunities through the use of sustainable modes of transport.

All objectives were addressed through the process of vision-making and designing a strategy for a variety of scales (S, M and XL) complete with spatial interventions and policy frameworks. The use of principles from circularity, sustainable land use and decentralization was central to this process. The XL strategy prioritizes the future development use of the railway network, as well as introducing a unified digital platform for sustainable modes of transport and therefore contributes to meeting the first goal regarding a 90% transport-related CO2 emission reduction. Furthermore, the strategy for the S and M scale is a flexible framework of interventions that can be applied to any S-scale area, and when applied throughout the corridor will work for the M scale. As the application in the five exemplary areas has demonstrated, the adoption of the CMIYC strategy on a multitude of S-scale areas in the Maas-Rhein contributes to meeting all three project objectives.

When applied correctly, the CMIYC project has the potential to create a novel, more socially and environmentally sustainable approach to mobility in peri-urban areas in a cross-border context. This in turn will result in more equal access to amenities and opportunities. This dual approach will result in a significant reduction of transport-related CO2 emissions. If it’s up to Cross Me If You Can, in 2100 the Maas-Rhein will be a future-proof region in which what is not in your direct vicinity is still within reach.

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If it’s up to Cross Me If You Can, in 2100 the Maas-Rhein will be a future-proof region in which what is not in your direct vicinity is still within reach.

6.2 group reflection

The CMIYC project's main aim was to address the lack of equal accessibility and use of private motorized vehicles, in order to reduce transport-related CO2 emissions. To a certain extent this goal will be achieved as the implementation of the strategy will reduce both the need for travel and encourage the use of sustainable modes of transport. However, it is important to note that there are also limitations and considerations associated with the CMIYC strategy. Therefore, the remainder of this section will consist of a group reflection on the project.

The first point to be aware of when discussing limitations is the fact that although the CMIYC strategy aims to provide flexibility in terms of how and where the strategy can be applied, it is still only a limited selection of interventions. The sets of interventions are not all-encompassing. Due to time constraints and the scope of this quarter, the focus for the interventions was placed on mobility, land use and form, however, a wider range of categories and sub-categories could even further enhance flexibility. The scope of the project and the time set out for it resulted in several other limitations, including the relatively small presence of the mobility-related energy system and the economic models behind the proposed interventions. The incorporation of these aspects would further increase the robustness of the vision and strategy. Finally, the adoption of the CMIYC vision and strategy would create a variety of public goods, especially in the areas of application. These public goods would include high-quality, attractive and accessible green space and open space, increased SGI's and recreational amenities, amongst other things. Although these public goods are at the core of the outcome of our strategy, throughout the project, a clear identification of these created public goods is not present. This could have further emphasized the great potential of the CMIYC project.

When planning and designing a vision and strategy for the Maas-Rhene, the CMIYC project aimed to always cater for the vision and strategy towards the people in the region. Especially in the vision-making, the values played an important role in this process. Often these aspects are forgotten or not prioritized when designing a spatial intervention. The values for the CMIYC project were identified to guide the vision, and therefore did not only include values such as "CO2 emission reduction" but also 'socio-economic well-being', 'mental well-being' and 'social inclusion'. When reflecting upon the incorporation of these values, the strategy section could have further emphasized the 'people-oriented values', rather than indirectly trying to incorporate these values.

Finally, the group dynamic was first and foremost a positive one and the working atmosphere was always enjoyable. After establishing our expectations and preferences in the very first week, a review of the working dynamic was not necessary. Each team member performed very well and contributed equally, which contributed to the nice atmosphere, as well as everyone's fun and positive attitude.

6.3 personal reflections

Mariia Deinega

This quarter and group work enriched me with valuable insights and learnings that reshaped my understanding of urban development and project management.

One of the most important learnings from this project for me has been the navigation through the complexities of time and scale, addressing vision and strategies from region to local areas, while embracing uncertainty as a catalyst for innovation and progress. Along with this, I realised the importance of interdisciplinary collaboration and stakeholder engagement in urban development initiatives to be able to reach the objectives of the design and effectively address complex urban challenges. Tools that were presented to us during the lectures such as Tools on Diagram and Power Interest Matrix showed different ways of approaching stakeholder's collaboration and evaluating the position of each of them. At the same time, my studying trip during week 4.6 with the Honors program to Alta Scuola Politecnica school in Italy with students from Politecnico di Milano and Politecnico di Torino also helped me to delve into understanding stakeholder collaboration by working on group analysis on a particular given stakeholder represented in innovation district MIND in Milan, and later running through negotiation session with other stakeholders. I believe I was able to bring gained insights to my group afterwards and improve our project.

Furthermore, this quarter has deepened my appreciation for the essential role of technology and innovation in shaping the future of urban environments and helped me to interlink my current research on decentralised governance with Blockchain technology that I am working on at the Honors program as well. Embracing cutting-edge solutions not only helped us to enhance the efficiency and effectiveness of our interventions but has also provided new perspectives and potential for our strategies.

Although it was a challenge for our group to bring together the concepts of circular economy, decentralisation and sustainable land use together, as all of these topics are already complex enough to be analysed on their own, I believe, they helped us to bring a new dimension to the significance of sustainability as a guiding principle in our project. My insight from the lecture on Circularity and Spatial Planning also helped me to understand the importance of reconsideration of global and personal values as one of the main triggers for the shift to sustainability, which we also tried to address in our work along with analysis on global trends.

On an individual level, this project has been a journey of growth and self-discovery. Initially, I was quite sceptical about group work and the possible outcome of working with others on such a complex task. Fortunately, I am glad to admit that the dynamic and collaboration level in our group made me enjoy the process. The challenging time of dealing with our fifth member taught me to be upfront about my expectations and standards, while also being respectful and open to finding a common solution.

Eleonora Anghileri

Complexity. Everything has to do with complexity. Whether we're talking about teamwork or regional design, it's impossible to ignore this element. Four individuals with diverse backgrounds, cultures, life experiences up to this point, and different attitudes dealing with a vast territory where lives and things, all facets of life, have happened, are happening, and will happen: the epitome of complexity, both territorial and human, with layers of diversity and overlapping opportunities.

But that's not necessarily a disadvantage, quite the opposite. Dealing with complexity can give us the opportunity to grow and see our project grow in ways we wouldn't have expected, especially compared to working on our own. Decoding complexity, whether in teamwork or in reading, analysing and understanding the territory, means understanding how to approach work by considering, on the one hand, the perspective of each member of the group, and then that of the group as a whole, and, on the other hand, all the contexts (temporal, social, economic, environmental and institutional) that coexist in the various dimensions of urban planning, and especially in territorial planning.

I think that is partly what happened to us. For Cross Me If You Can, working with complexity meant identifying the strengths and weaknesses of individuals first, and then of the group as a whole, and assembling those individualities into a new organism capable of thinking with a single brain at some moments, and with four separate ones at others, in order to bring a fresh view and an original contribution to the work. Working within complexity then meant teaching this new organism the best way to work, to be as efficient as possible, but also to learn from others, to understand when is the right time to think and discuss and when it's time to consolidate and produce.

For our project, working within complexity meant choosing a particular context because of its cross-border dimension, involving three countries, three borders whose permeability depends solely on the medium of the crossing: sometimes subtle, sometimes formidable walls. Finally, and above all, deciphering complexity meant working through scales, XL, L, M and S, and working through scales at the right time, making each of them more relevant during analysis, vision or strategy. This approach, based on the concept that everything that happens at one of these scales deeply influences what happens elsewhere, allowed us to identify problems and solutions by recognising their different spatial and temporal relevance, and to construct the structure we intended to represent with the conceptual framework and upon which all our argumentation is based. The general problem, the CO2 problem, only became visible when we stepped back and looked at the data and dimensions from a certain distance. But in order to identify the cause of the problem, we had to get close again, very close, and observe how people live, work, move, and why. And from here, on the contrary, by observing, understanding and interpreting these patterns, we have been able to develop strategies of action that, by gradually transforming these patterns, paths and daily habits of people at the S scale, are able to kick start mechanisms of change and transformation towards sustainable development at the higher scales: the S scale helping the M, the M helping the L and the XL. And that is how we dared to cross that border.

Yuanjie Wang

I'm personally interested in the relationship between research investigation and design strategy, as well as how planning policies can help implement design strategies.

My understanding is that data analysis is an effective method for identifying regional issues. Personally, I find various aspects of the Netherlands unfamiliar, and documents, news, and other information sources help me identify general issues that need urgent attention. Data analysis helps link problems with spatial contexts and provides a more intuitive understanding. However, relying solely on such analysis can be sterile. After identifying problems at a larger scale, further investigations, including site surveys and interviews, are necessary to connect residents' living situations with spatial issues. Understanding the motivations behind people's current travel and lifestyle choices is crucial if we want to transition to a more sustainable future and determine how to change spaces and networks to influence lifestyle changes.

For example, the syntax analysis results showed that the region's road traffic system is well-connected, while public transportation accessibility is poor. Zooming into the area, it became apparent that bus routes circumvent the border and primarily cross into urban areas, resulting in significantly longer travel times compared to driving. Undoubtedly, residents would choose to drive in such circumstances.

Regarding policies, our project has corresponding policy proposals at different scales. I believe that policies should not only be top-down but also involve interventions at smaller scales that feed back into M/L strategies and policy formulation to encourage the transition to a sustainable future. For instance, in the integration of mobility and sustainable land use, I observed several instances of land mixed-use for family entrepreneurship. I propose that different forms of functional mixing be targeted at the Maas-Rhein regional scale. In areas with higher urban corridor densities, vertical mixing at the building scale should be encouraged. Conversely, in low-density areas in the green corridor and between corridor, where future development prospects are limited, policies should facilitate family entrepreneurship. This could involve providing low-interest loans or streamlining permit applications.

Additionally, this project has served as a wake-up call for me. Many assumptions about residents' needs based on past knowledge and generalized research reports or news articles often do not align with reality, sometimes drastically so. During field surveys, residents were more concerned about noise from neighboring renovations than from nearby facilities, contrary to our prior assumptions. Therefore, involving the public in the design, policy-making, and implementation processes is crucial. Although our project had a short timeline and couldn't fully explore this aspect, I believe that using methods introduced in workshops to connect geographic information with residents' commuting complaints during the initial data analysis phase is beneficial. This approach helps identify which issues are of high concern to the public and where they occur. However, social media data cannot represent the opinions of all demographics. Thus, these data can only serve as a supplementary method for problem localization.

Michelle Dijkstra

During this R&D studio, we were asked to create a spatial vision and strategy for battling CO2 emissions as a result of transport and mobility, which essentially revolves around translating our ideas of a sustainable future into a workable format that can be used to inspire and mobilise stakeholders over the decades to come.

Initially, this task seemed rather daunting to me, as I realized that although I have quite the variety of ideas, I don't have a design background to underpin this translation of ideas to a visual representation. However, after the first few sessions in the course, I started to realize that ideas and a group that is willing to truly collaborate is all that is absolutely necessary.

This quarter has presented our group with some challenges, but also opportunities. In terms of the group work process, the first few weeks revolved around as figuring out our group dynamic and workflow. Quickly, a smooth flow arose in which the current members of our group all contributed equally. I specifically refer to our current group members, as a previous group member was not able to contribute in a similar was because of personal circumstances and therefore dropped out of this course. Although this initially felt like a challenge, the way the group readjusted to maintain the previously established workflow was fascinating. This dynamic persisted all throughout the remaining weeks of the project. Whenever a group member functioned differently, the other members seamlessly readjusted to ensure that the workflow was not disturbed.

In terms of the regional planning and design process, I gained extensive insight into the elements of time and scale. I have never previously worked with a variety of scales and an extensive time-period. The complexities that come with this have improved my ability to think outside the box during the design process, whilst relying on research and analysis of possible futures. The importance and interdependence of research and design was underlined for me. Another important take-away for me was the time required for each part of the regional design process. Initially I felt too much time was set out for analysis, and ultimately vision-making. However, as I underwent the process, I realized how crucial a vision based on a strong analysis is. The vision is very fundamental for the strategy development in the CMIYC project, as the strategy essentially expands on the idea of the corridors in the vision.

To conclude, I have experienced the regional design group project as a very positive and enjoyable process. Not only was I able to learn from my group members and develop my design skills, I also gained more confidence in the relevance of skills that I already possess.

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