RECONFIGURING TRAVEL PATTERNS

The Necessary Rapid Just Transition to Car-Free Urban Planning in a Cross-Border Context

THOMAS VAN DAALHUIZEN

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"...imagine a future where the old mining infrastructure serves as the backbone of a multi-modal transport corridor..."

COLOPHON

Reconfiguring Travel Patterns
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The 19th of June 2023

MSc graduation thesis in Urbanism
P5 report
MSc Urbanism I   Q4 2022-2023
TU Delft Faculty of Architecture and the Built Environment
Department of Urbanism, Julianalaan 134, 2628 BL, Delft, The Netherlands.

Research studio: Planning Complex Cities
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2022-2023

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This thesis investigates transition strategies to achieve just and sustainable mobility networks in cross-border contexts. The thesis draws on existing theories such as Mobility Justice, Socio-Technical Systems, Multi Level Perspective and Metagovernance. The thesis is written as part of the graduation studio Planning Complex Cities 2022-2023 and contains all the products necessary for the P5 presentation.

CONTENT

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ABSTRACT

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There is a need to broaden discussions on sustainable mobility beyond electric cars and address the challenges faced by border regions and marginalised groups dependent on public and soft transport. This thesis explores how a transition strategy can support the creation a just and sustainable multi-modal network in a cross-border context. The provinces of Limburg and the mining district are used as a case study. Valuable insights are derived from comprehensive analyses, contributing to a holistic strategy for the region. Key findings emphasise the role of garden cities in shaping the strategy, connecting neighborhoods and promoting mobility alternatives. Improving public transport connections within the mining region is crucial for reducing car dependency and generating positive impacts. Collaboration among stakeholders is essential due to the lack of cross-border connections and administrative barriers. Repurposing the old mine infrastructure offers a transformative opportunity to establish a sustainable transport system. The envisioned future sees opportunities for the old mining infrastructure to act as a multi-modal transport backbone, integrated with multiple garden cities for enhanced connectivity and community. A pattern language approach guides the strategy-making process, tested through a workshop simulation. Policy recommendations stress cross-border collaboration, flexibility, co-creation, and data sharing. By following these recommendations, the region can achieve a just and sustainable multi-modal network, fostering regional integration, equal opportunities, and access to resources.

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INTRODUCTION

Border regions present unique challenges and complexities when it comes to achieving sustainable mobility and navigating mobility transitions. These regions usually are disadvantaged in terms of job opportunities, shrinking population partly caused by outflow of young talent and a lack of good access to services and amenities due to administrative boundaries. This coupled with the lack of efficient public transport networks connecting these regions, creates a distinct set of hurdles. In this thesis, we delve into the intricacies of cross-border mobility in regions such as the Euregions spanning the Netherlands and Belgium, aiming to propose a transition strategy that fosters a just and sustainable multimodal network.

The current paradigm of car-centric urban design exacerbates the challenges faced by border regions. Entire cities have been molded to accommodate personal motorised vehicles, resulting in space congestion, pollution, and an ever-expanding infrastructure demand. While the transition to electric cars has been embraced as a sustainable alternative, it brings forth a new cycle of challenges, including the reliance on scarce raw materials like cobalt, derived from non-renewable sources. To align with the European Commission's vision of a zero-carbon mobility network, a paradigm shift is needed, one that reimagines the built environment and supports the reduction of car trips by 75 percent by 2050.

However, in border regions, these transformative changes are further complicated by the significant institutional and administrative differences that exist between neighbouring countries. These disparities can hinder the implementation of sustainable mobility strategies and hinder cross-border cooperation. Additionally, the lack of efficient public transport connections between regions presents a significant barrier to achieving seamless and sustainable multimodal networks.

In light of these challenges, this thesis aims to propose a comprehensive transition strategy tailored to the specific needs of cross-border

regions. Exploring how a transition strategy can support the creation of a just and sustainable multi-modal network in a cross-border context, the provinces of Limburg and the mining district is used as a case study. The strategy will encompass not only the physical expansion of alternative transportation networks but also the integration of governance mechanisms and creating a shared identity.

Inclusivity and stakeholder engagement will be at the forefront of this transition strategy and play a crucial role. Engaging residents and various stakeholders is essential to garner support, ensure compliance with policies, and gather invaluable insights from those directly affected by mobility changes. By actively involving all relevant parties, we can foster a sense of ownership and shared responsibility, leading to more inclusive and sustainable mobility outcomes.

Through this thesis, we embark on a journey to navigate the unique challenges of cross-border mobility transitions. A comprehensive strategy is proposed that addresses governance, infrastructure, and stakeholder engagement, striving to pave the way for a just and sustainable future in border regions. Hoping to serve as a model of inclusive and environmentally conscious mobility for other border regions to follow.

01 |

THE PROBLEM

Content

Trams crossing the border establishing a connection between Turnhout and Eindhoven in 1897
Photo: Unknown, Collection RHce, nr. 0132275

1.1 | PROBLEM FIELD

1.1.1 Electric Cars

The last few years there has been an increase in the number of electric cars being sold and they are replacing older vehicles that still use fossil fuel (IEA, 2022) (fig. 1.1). The main aim is to decrease the amount of carbon emissions that has been rising quickly over de past decades (fig. 1.2). Electric cars rely on batteries. Like many other batteries, the lithium-ion in their turn rely on raw materials, like cobalt, lithium and rare earth elements that have been linked to grave environmental and human rights concerns (fig. 1.3). Cobalt has been especially problematic (Tabuchi & Plumer, 2021).
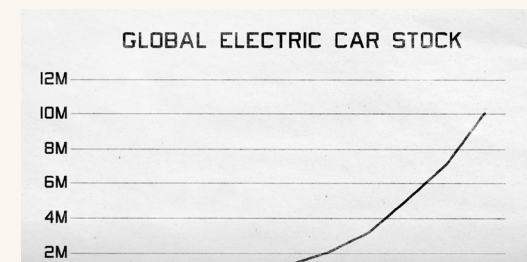
This model is unsustainable, states Kherdeen (2021) and besides that it also depends on how the batteries for the electric car are charged (Kherdeen, 2021; Tabuchi & Plumer, 2021). Furthermore, Tire Wear Particles (TWP) that emerge from friction between the tires of vehicles and the road surface have caused widespread contamination in the environment (Ding et al., 2022) and are seen as a health hazard.

1.1.2 European Green Deal

However, awareness for a sustainable just future has been increasing. With the current challenges in the world, the European Union has drafted an aspiring plan called the European Green Deal "Fit for 55". One of the main topics is mobility and especially the emissions originating from car traffic. Therefore, the European Commission has set the goal to decrease the use of cars by 75 percent (European Commission, 2021). Replacing it with more public transport, making use of the waterways and supporting an increase in soft transportation modes. As such institutions have a huge impact on how our built environment looks, we will have to adapt to a new standard of mobility.

The current paradigm is one in which entire cities have been designed to match its inhabitants, that all have a personal vehicle to get around (Kherdeen, 2021). Policy integration is considered an essential condition for constructing a more sustainable society. However, proponents of sustainable development differ in their views about what is to be integrated, what is to be developed, how to link environment and development, and for what how long. Regional planning has been a locus of attempts to resolve these differences and realise policy integration (Bafarasat et al., 2022).

Figure 1.1 Increase in number of electric cars being sold (Harris, 2022)

Figure 1.2. Annual CO2 emissions (Ritchie & Rosado, 2020)

Figure 1.3.
Right top, Working conditions of cobalt mines in Congo.
Photo: Afrewatch 2020
Right bottom, The Mutanda copper mine in Katanga province, Democratic Republic of Congo, in 2012.
Photographer: Simon Dawson/Bloomberg

1.1.3 Agglomeration Benefits

Agglomeration benefits, such as increased job opportunities and access to services, that normally arise when cities and regions strengthen their economic space, aare not present in cities and regions that are divided by a national border (fig. 1.4) (Marlet et al., 2014). The stimulation of disadvantaged regions by means of extra funds has proven unsuccessful (Gorter & Ederveen, 2002).

The most effective way to increase or sustain the level of services and job opportunities in border regions is to make better use of services and job opportunities across the border. Breaking down barriers created by borders could lead to the much-needed positive impulses and raise the pull factor of border regions to households and businessess (Marlet et al., 2014). Figure 1.5 shows the difference in access to jobs when taking into account the national or international market. Access to jobs rises drastically when opportunities across the border are included.

Good access to services and job opportunities is very important for the attractiveness of a region. The willingness to travel for these different needs decreases drastically with every minute spend in transit (fig. 1.6). Border regions that can't make use of the agglomeration benefits of regions across the border therefore have a higher chance to see shrinkage of population. Furthermore they

see higher unemployment rates and the outflow of higher educated personnel as well as promising young people (Redding & Sturm, 2008).

Not all regions will benefit in a similar way. This is very much dependent on the type of region, either rural or urban, and the region on the other side of the border. Table 1.1 gives an overview of the effects of taking away the barrier of borders considering the different matches between region types.

Figure 1.6. Willingness to travel to work or services in relation to travel time (Marlet et al., 2014)

Cities and regions inland

Cities and regions on borders

Figure 1.4. Difference in agglomeration benefits for cities and regions in a border region (Marlet et al., 2014).

Table 1.1 Type of border regions and the effects of breaking down border barriers (Marlet et al., 2014).

Region 1	Region 2	Effects of breaking down border barriers
Urban	Urban	More agglomeration benefits for households and business will increase the locational advantages for both regions
Urban	Rural	More agglomeration benefits for households and businesses in region 2. A larger offer in terms of recreation and nature and a limited increase in agglomeration benefits increase the attractive force of region 1 to some extent
Rural	Rural	Support for services will increase together with a small increase in job opportunities which sustains or slows down the decline of quality of life.

Figure 1.5a. Access to jobs within national borders (van den Berge et al., 2020)

Figure 1.5b. Access to jobs including jobs across national borders (van den Berge et al., 2020)

This research will take a closer look at the Dutch-Belgian Border (fig. 1.7)
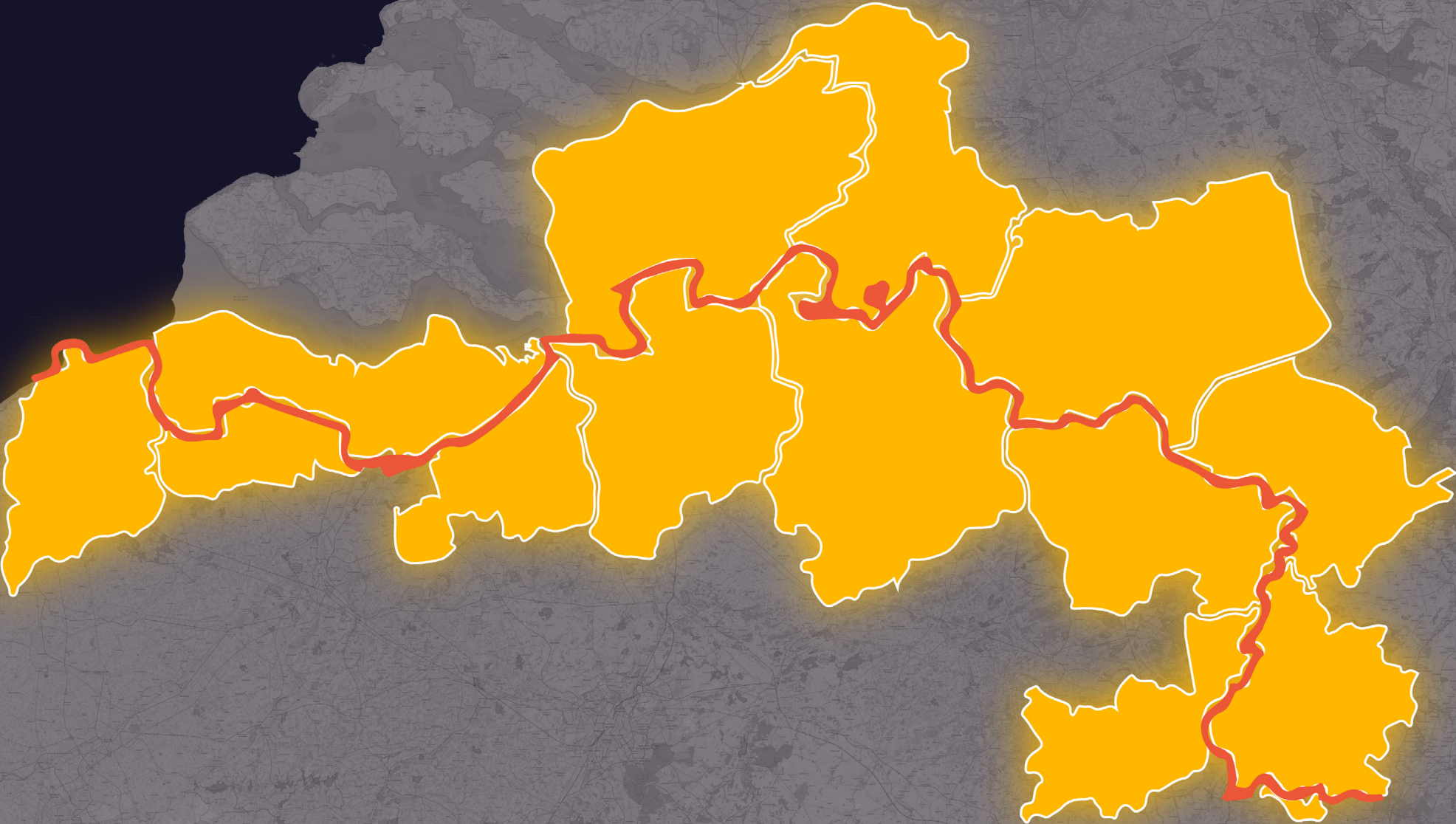
Figure 1.7. Border of the Netherlands and Belgium as interest area for this research.

1.1.4 Cohesion Policy

The European Union has a Cohesion policy that enhances a fair and sustainable development in all Euregions, while supporting the green and digital transition through (European Commission, 2022b). The Euregions consist of many different border regions. The Cohesion Policy can briefly be described with the following three points:

1. A comprehensive and targeted approach to development: funding, governance, consistency, and synergies with national policies;
2. Place-based, multilevel, and partnership-led policies, tailoring its support to most vulnerable territories;
3. Continued adaptability to emerging and unexpected challenges.

The 8th Cohesion Report (Dijkstra et al., 2022) shows that Cohesion Policy has helped to narrow territorial and social disparities between regions in the EU. Thanks to Cohesion funding, the GDP per capita of less developed regions is expected to increase by up to 5% by 2023 (European Commission, 2022a).

The Netherlands has seven Euregions on its borders with Belgium and Germany (fig. 1.9). These are formal cross-border administrative collaborations part of the European union. Projects in these areas are financed by many different subsidies such as the Interreg program. All the funds have to support the development and integration in the Euregion (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2018).

The ministry of Interior and Kingdom Relations (2019) states 6 factors that could work as barriers in a cross-border context (fig. 1.8). Two of these factors are important when it comes to the shift in mobility when we look at the challenge from a regional spatial perspective.

- Lack of transport networks
- Institutional and administrative differences

Difference in language and culture

Institutional and administrative differences

Lack of transport networks

Information backlog

Psychological factors

Economic differences

Figure 1.9. Six factors that could work as a barrier for collaboration in cross-border regions (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2019)

Eems Dollard Regio
EUREGIO
Euregio Rijn-Waal
Euregio Rijn-Maas-Noord
Maas-Rijn
Euregio Vlaanderen - Nederland
Euregio Scheldemond

Figure 1.8. Euregions on the Dutch border with the Netherlands and Belgium (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2018)

1.1.5 Transport Networks
During the last half of the 19th century and the first half of the 20th century there were multiple railroads and tramways that crossed the border between the Netherlands and Belgium (fig. 1.10) (Lansink & Broek, 2021 & Departement van Waterstaat, 1931). Most of these connections were closed and only three remain till this day. Nowadays, the network mostly consist of roads that have no border crossing facilities due to the Schengen agreement. This shows that currently the movements over the border are mainly dependent on cars and other forms of soft transportation.

1.1.6 Planning Systems
Moreover, the planning systems in The Netherlands and Belgium differ greatly. The Netherlands is moving towards a more centralised approach and has been moving in that direction for a long time (Nadin et al., 2018). The intention of the system is a planning hierarchy in which planning is conducted systematically defined by integrated rationality and definition of goals (Healey, 1997; Wolsink, 2003). In practice decisions are mostly based on negotiations with involved stakeholders, making the practice into collaborative planning in which actors cooperate, become involved in the process of developing similar through, and are forced to 'communicate in the same language (Healey, 1998). Belgium on the other hand is decentralising their planning system and putting it in the hand of local authorities (Nadin et al., 2018).

These two differing planning systems thus form a barrier for collaboration in a cross-border context.

In line with the need to find a new way of sustainable mobility and the challenges that Euregions are facing in terms of governance current knowledge gaps have been identified by Nikulina et al. (2019). These gaps consist of (1) missing information on behavioural changes when transitioning into a new mobility network, (2) the difficulties of policy development that support these changes, (3) the institutionalisation of planning capacity and (4) social sustainability in mobility planning. Based on their literature review the notion is that in the future, mobility planning should be people-oriented, and place based.

Figure 1.10. Right. Rail and Tram network of the Netherlands (Departement van Waterstaat, 1931)

Figure 1.11. Below. Old Rafters of the station in Baarle-Nassau on the route to Belgium (Visit Baarle, n.d.)

1.2 | PROBLEM STATEMENT

According to the present paradigm, entire cities have been planned so that every resident may travel by personal automobile (Kherdeen, 2021). The use of cars does not only create health hazards but pollutes the surrounding environment and presents several challenges in terms of the use of urban space for infrastructure, a scarce commodity (Ding et al., 2022). Besides that, the new trend to transition to electric cars creates demand for scarce raw materials such as cobalt inevitably creating a new cycle in which we use materials from a non-renewable source for our new way of "sustainable" transport (Kherdeen, 2021; Tabuchi & Plumer, 2021).

We therefore need a paradigm shift towards a built environment where we try to implement the goal set by the European Commission of transitioning to a zero-carbon mobility network. The first milestone is to reduce the amount of car trips with 75 percent by the year 2050.

This drastic change will not only call for the expansion of existing networks of alternative means of transport, but also means we must redesign many of our neighbourhoods to support this change. Furthermore, the residents and many other stakeholders must be included to make this transition inclusive. This can insure that policy and projects are supported and there is compliance with possible regulations.

But achieving this transformation is easier said than done. In cities, the sustainable transformation of transport systems is often constrained by barriers of rebound effects, conflicting visions at different levels and lack of consensus among stakeholders leading to continued planning for cars (Nikulina et al., 2019).

Border regions are lacking public transport infrastructure as well as the agglomeration benefits that many other cities have due to their location. It is therefore that these regions in particular are vulnerable to changes in accessibility to services and job opportunities when changing transportation modes. Cross-border cooperation and breaking down barriers caused by borders could help to support this change in mobility in cross border regions.

The challenge is to investigate what **transitional strategy** can contribute to achieve a just and **sustainable multimodal network** in a **cross-border context**

1.3 | RESEARCH QUESTIONS

Main Research Question

What transitional strategy can contribute to achieve a just and sustainable multimodal network in a cross-border context?

Sub Research Questions

SQ1 — How has regional mobility evolved in the last 100 years?

SQ2 — What are current travel patterns in the cross-border region of NL/BE?

SQ3 — How do the planning systems in The Netherlands and Belgium support different travel modes?

SQ4 — What spatial and policy conditions have to be present to make a just transition towards a new mobility network in a cross-border context?

SQ5 — What will be the implications of the mobillity transition on the spatial and social sustainability in the region?

Figure 1.12. Impression of new car-free neighbourhood in Utrecht Render: OKRA & marco.broekman

1.4 | RELEVANCE

1.4.1 Scientific Relevance

Moving towards a more sustainable future has become increasingly important. Getting to the goal of a zero-carbon society has many challenges of which one is sustainable mobility. The thesis adds to the body of knowledge on how to transition to a zero-carbon network especially focusing on border regions. These regions are usually the ones that see the disappearance of services and job opportunities which creates a need to travel longer distances. One part of the transition is to change the network but the other is to discover the relations between origin and destination. Euregions have big opportunities to support this transition by means of the services and jobs they can provide in a cross-border context. Besides that, studies have stated that the current knowledge gap is (1) missing information on behavioural changes when transitioning into a new mobility network, (2) the difficulties of policy development that support these changes, (3) the institutionalisation of planning capacity and (4) social sustainability in mobility planning (Nikulina et al., 2019). Another relevant theory this thesis can add to is the Multi-Level Perspective as there is a lack of attention in studies for the urban dimension of sociotechnical regimes and innovation-oriented policies (Coutard & Guy, 2007; Hommels, 2005; Monstadt, 2009). This thesis contributes to bridging that knowledge gap.

1.4.2 Societal Relevance

Another part of this thesis is on how residents of border regions can be included in the transition process. The transition has to be inclusive so that policy and projects are supported and there is compliance with possible regulations. This thesis could provide a strategy that ensures that future changes are done in an inclusive way considering the needs of residents as well as creating the much-needed support to complete the transition towards a more sustainable multi-modal network. Furthermore, the research can help contribute to the development of cross-border regions as frontrunners in sustainable multi-modal transport networks. Not only focusing on the infrastructure aspect but even more on increasing the social capacity of the region by providing mobility justice.

Figure 1.13. Collection of news articles related to the research topic

1.5 | RESEARCH AIM

1.5.1 Aim

Current trends such as shifting to electric cars lack the urgency to start transitioning to a more sustainable mobility network. The aim of the research is to devepop a strategy that decreases the use of cars in a cross-border region by the year 2050. This thesis suggests that cross-border regions will be specifically hit by a mobility shift. Therefore, it will develop a transition strategy to guide the mobility transition that will lead to a just and sustainable multi-modal network. Besides that this strategy aims to increase cross-border cooperation in region of the Netherlands and Belgium when it comes to planning. This strategy will moves through different scales and will draw not only on the physical context but includes governance structures as well as recommendations for policies. A key component of the strategy will be the development of a pattern language. By doing so design principles can be added to the body of knowledge that might be applicable in different contexts.

1.5.2 Objectives

Some of the main objectives this research puts forth are:

- To bridge the current knowledge gaps on policy development, institutionalisation of planning capacity and social sustainability in mobility planning. Furthermore the lack of attention to urban processes when it comes to transition is socio-technical systems will be addressed;
- To understand the patterns of cross-border travel and their impact on relation between the regions;
- To explore how to use the socio-technical system approach to understand mobility systems in a cross-border context;
- The creation of a regional vision to facilitate a mobility transition while taking into account the needs of citizens and other stakeholders;
- The development a transition strategy that can be operationalised with a pattern language that supports the mobility transition. The patterns can be used at different scales, for instance regional, city, neighbourhood and street, but also in terms

of policy-making;
- Adapting a pattern language into a strategic design to support the mobility transition;
- Testing the developed pattern language in other areas along the border to discover its applicability in different conditions;
- Producing a framework for policy integration in cross-border regions with an impactful sustainability transition at hand.

The sub-questions and methods that will be introduced in chapter 3 will support the development of these objectives.

1.5.3 Products

- Analysis of the region
- Vision map
- Regional spatial strategy
- Pattern language
- Strategic design
- Policy recommendations

Figure 1.14. Collection of expected output based on Shenitzer Schwake (2020) & Hill (2020)

34

02 |

THEORY

Content

*Border crossing at Reusel specifically
designed for cars in 1966
Photo: Jos Pé, Collection RHCe, nr. 0014209*

2.1 THEORETICAL FRAMEWORK

2.1.1 Introduction
This chapter will introduce the theories that will form the body of knowledge that will be the foundation of this research. Before discussing and elaborating on each theory a brief explanation on how each theory relates to the others is essential (fig. 2.1). There are four main theories part of this research. (1) Mobility Justice, (2) Socio-technical Systems, (3) Multi-Level Perspective and (4) Metagovernance.

2.1.2 Relation of theories
The mobility justice theory is concerned with exploring when the mobility options of individuals are just. This theory draws on 5 different concepts of justice (Sheller, 2018) and can be seen as the goal of the transition strategy, achieving a just mobility network with regards to the planetary boundaries. The mobility justice theory ties into the Socio-technical Systems theory. A socio-technical system consist of 6 different aspects (Davis et al., 2014) of which one is the goal that the system is trying to achieve. The system this thesis focusses on is the urban system in which infrastructure and mobility play an important role. This system approach is introduced as the new urban paradigm. Looking at cities as a system is needed in order to account for their complexity (Cilliers, 1999; Cooper et al., 1971; UN Habitat, 2012, 2016). In order to transition Socio-Technical Systems (STS), the Multi-Level Perspective (MLP) introduces a model to destabilise the current regime, in this case the socio-technical system, and create room for innovations (Geels, 2011). The STS is part of the MLP as it the regime that we are trying to change. The last theory but just as important theory is the governance framework in which this process will play out. For complex systems and transitions a tailor-made governance approach is needed (Meuleman, 2019), in other words a metagovernance approach.
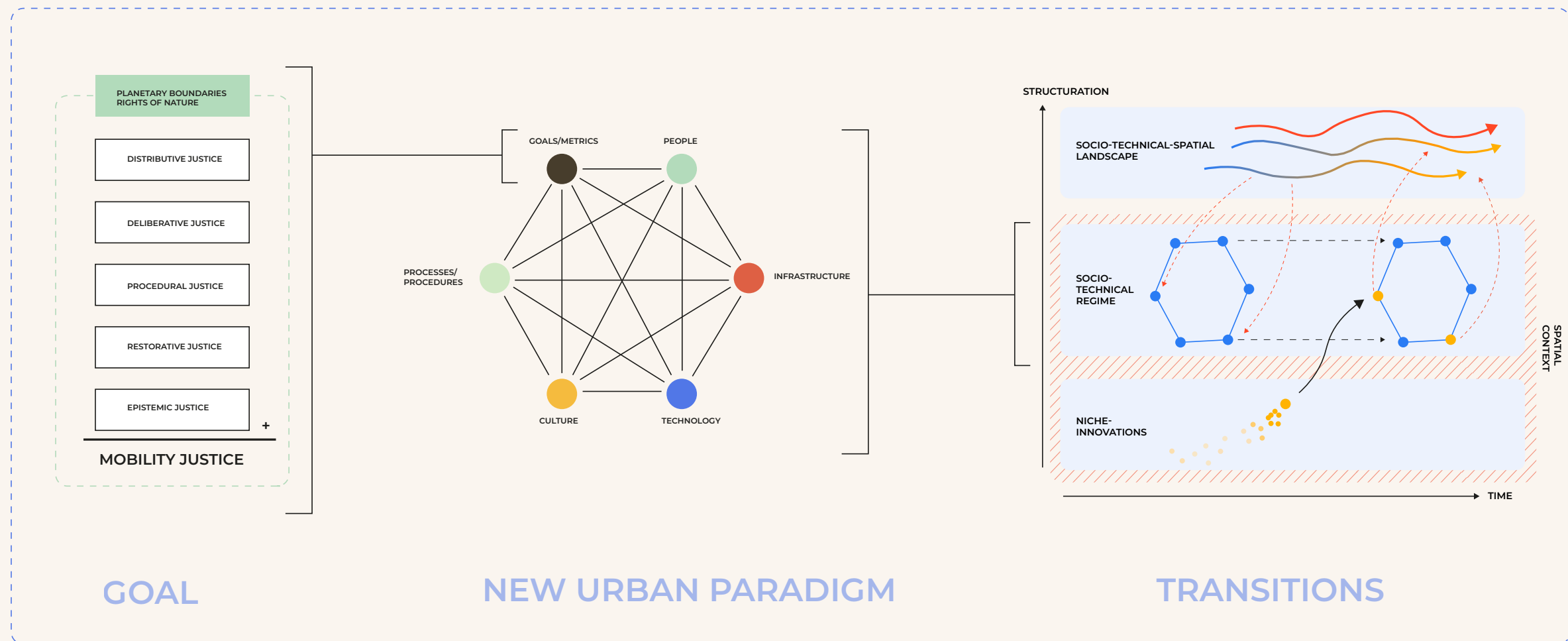
Figure 2.1. Theoretical Framework showing relations between theories

2.2 | MOBILITY JUSTICE

2.2.1 Introduction

The awareness around justice in its many forms is increasing. The connection to sustainability and sustainable cities is addressed by Dillard et al. (2008) and Larsen (2008) who argue that growing inequality, socio-spatial fragmentation, and lack of access to public goods are threats to our cities. Border regions especially are dealing with these threats, high skilled workers are leaving the regions and moving to bigger cities, there is a decrease in socio-spatial unity, and the lack of agglomeration benefits due to the borders (Marlet et al., 2014). All this impacts the access to public goods. Accessibility of goods has a relation with the movement of citizens throughout the region. The possibilities to move around are diverse and depend on the mobility of a citizen group.

2.2.2 New paradigm on mobilities

Mobility justice combines the new paradigm on mobilities and different theories of justice. The new paradigm on mobilities is introduced by Sheller and Urry (2006), focussing on how mobilities rather than being secondary to space have always been the precondition for different kinds of subjects and scales. She continues the spatial turn in social sciences that has been introduced by scholars such as Lefebvre (1991) building on the relational analysis of space and the understanding that space is always under construction. Therefore, we should think about mobility in the same terms, as being relational and always under construction. Thus, movement is not the outcome of spatial and political relations, but in fact a necessary component in their making (Sheller, 2018).

Furthermore, mobility justice is different from spatial justice and transport justice as it is based on movement whereas spatial justice and transport justice are derived from a standstill position of the individual. Adopting a mobility justice framework creates the possibility to look beyond the social analysis from the perspective that nation-states, societies, or people are sedentary, and we are able to uncover relational power dynamics creating friction in movement and mobilities (Cheung, 2020). Mobile commons is another term Sheller (2018) introduces which

is a *"socially produced shared space"* (Sheller, 2018, p. 160) with communal decision making and governing *"outside of capitalism and beyond or beneath the limits of national borders"* (Sheller, 2018, p. 169 & Cheung, 2020).

2.2.3 Types of Justice

The mobility justice model is made up of 5 different types of justice that together create the concept of mobility justice.

The first type of justice is Distributive justice, this focusses on providing a critical minimum of accessibility for all people. This requirement is also supported by (Martens, 2017). It highlights prioritising the planning and funding of mobility systems instead of the traditional cost-benefit analysis that can show the expected effects of transport infrastructure intervention.

The next type is Deliberative justice. This describes the access previously excluded actors have to processes of deliberation through which substantive values are arrived at. Such a process is grounded in pro-active recognition of persons, especially those presently excluded from deliberation and their active participation in it.

Procedural justice is concerned with the fairness of processes by which mobility systems are governed. This is dependent on the way that relevant information is provided to affected citizens. It therefore includes the accessibility of information and therefore enables the possibility for informed consent (Petzer et al., 2020).

Restorative justice introduces the recognition of those immobilized or bound into mobilities and a pro-active undertaking to address injustice and thereby supporting their inclusion and participation (Sheller, 2018).
The last type of justice is epistemic justice. This relates to the sharing of knowledge or knowing something. This type of justice ensures that there is proactive production of knowledge but at the same time the capacity to adapt to external influences (Petzer et al., 2020).

The addition of both restorative and epistemic justice to the model shows the importance of giving attention to immobilities created by specific forms of mobility. One example of such immobilities is the negative effects of a highway passing through an inner-city community that was built to serve suburban car commuters. (Petzer et al., 2020). The model provides a way to look at mobility issues from an analytical point of view, with specific consideration given to groups whose interest have traditionally been marginalised in the mass automobility era (Golub et al., 2016; Lugo, 2018; Pereira et al., 2017).

Overall, this model of mobility justice including its many types of justice shows that the distribution of mobility options is not the only important component in mobility justice to achieve transport equity. The model includes aspects that go beyond the physical movement and shows what regulatory changes must be made to decision-making processes relating to mobility systems.

2.2.4 Including the Planets Perspective

The mobility justice model as introduced by Sheller is very people-oriented and doesn't include a very important aspect that nowadays should be included. Planetary boundaries are not introduced as the frame in which mobility justice must operate. The concept of planetary boundaries was introduced by Rockström et al. (2009) as a new approach to global sustainability in which they defined 9 different planetary boundaries within which humanity can operate safely.

As the foreseen mobility transition is triggered by the fact that we have to change our transportation modes to not further exhaust earths resources, the addition of planetary boundaries is necessary to this model. This leads to a new model (fig. 2.2) that still ensures that there is mobility justice but within the boundaries of the planet and respecting the rights of nature.

Figure 2.2. New Mobility Justice Model including the People and Planet Perspective (adapted from Sheller, 2018)

NEW URBAN PARADIGM

2.3.1 Introduction

The United Nations Human Settlements Programme (UN-Habitat) is mandated by the UN General Assembly to promote socially and environmentally sustainable towns and cities. In 2012 the UN-Habitat declared in their 'Manifesto for Cities – The Urban Future We Want' *"the battle for a more sustainable future will be won or lost in cities"* (UN Habitat, 2012, p.3). In the manifesto 'The city we need' (UN Habitat, 2016) they further elaborate on how win this battle, by implementing the New Urban Paradigm. The New Urban Paradigm has to recognise local context, cultures and costums, but is most importantly founded on two key conditions:

1. The respect of public and private uses of land
2. Well-coordinated system of system

2.3.2 The System Approach

The UN-Habitat argues that a city can only function properly when it coordinates very different agendas related to land use, housing, energy, water, waste, mobility, health, education, economic development, gender equality, cultural vitality and social inclusion. To achieve this coordination city a systems approach is seen as the solution. It is not only the manifesto of the UN-Habitat that suggest that the new urban paradigm should concern itself with a system approach. Already in 1971, Cooper et al. suggested that system approaches have the ability to consider interconnections. They also state that the system approach can permit flexible and continuing responses to dynamically changing urban conditions, including citizens attitudes as well as changing economics and technologies. Moreover, the system approach allows actions and reactions from a multiplicity of decisionmakers.

The UN Habitat (2016) has the same notion on that a system approach can help all stakeholder groups and government authorities to better understand the complexity of a city in terms of social, economic, and political interactions. But clarifies that a system approach can help planners and decision-makers to have a better overview

of unwanted consequences of policy changes. More importantly it can contribute to a better understanding and awareness of the importance of place making and building a sense of identity. This new improved awareness will put public spaces on the leading edge when it comes to urban development as a means of greening the city, improving mobility, thus providing opportunities for more social interaction, as well as access to public goods and materialising a sustainable future. Cilliers (1999) has a similar statement, a higher level of understanding city design can be reached when considering the interconnections between all systems and the interrelationships, interdependencies and interactions between city and the system components. All together this could lead to more effective urban renewal initiatives. It is the urban renewal that is desperately needed to achieve a just and sustainable future. The New Urban Paradigm suggested by the UN-Habitat and introduced by other scholars is thus one of systems.

2.3.2 Peri-Urban & Rural Regions

In contrast to this very urban based system approach, we can't forget the importance of peri-urban and rural regions and their role in the transition towards a resilient region. This broader view on a system approach is needed as the border area of the Netherlands and Belgium includes many different types of regions on the urban-rural spectrum all be it mainly characterised as urban and peri-urban. The EU funded a project, ROBUST, focused on unlocking synergies between rural, urban, and peri-urban areas (European Commission, 2020).

A key focus was creating stronger relationships between neighbouring rural-urban communities to help them develop shared plans for sustainable growth. Present day urban and rural areas don't differ that much anymore they intersect and interact with one another. Urban areas are expanding and there is an increase in economic activity in greenbelt areas states Wiskerke, professor of Rural Sociology at Wageningen

University (Dunne, 2022). Furthermore, tackling shared challenges such as the mobility transition need to be inclusive development and should therefore look beyond the city borders.

An example is a project in Graz, Austria where ROBUST helped increase public transport provision in peri-urban areas, driving down car use. The team achieved this by bringing together local government officials, businesses, and NGOs to analyse the effects of an enhanced regional transport system on citizens' behaviour (Dunne, 2022). This shows that peri-urban areas have an important role to play in the system as well (fig 2.3).
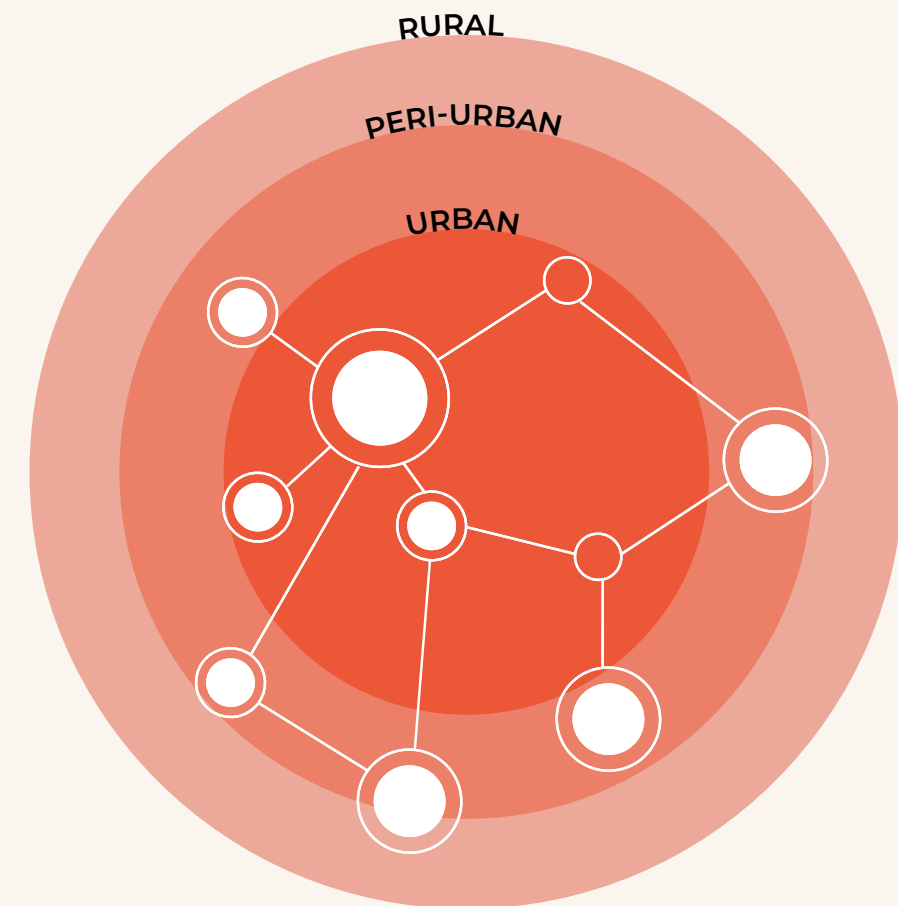
Figure 2.3. Visualisation of the New Urban Paradigm, a systems approach

SOCIO-TECHNICAL SYSTEMS

2.4.1 Introduction

As stated in the previous paragraph a system approach helps to improves the understanding of cities and how to design or plan them. One such systems approach is the Sociotechnical systems theory which has been often used to analyse complex systems that rely on the interaction between humans and technology such as road and rail transport (Cornelissen et al., 2013; Stanton et al., 2013). Therefore, this approach is relevant when it comes to mobility transitions. The Socio-technical Systems theory (STS) was first introduced by (Trist & Bamforth, 1951). They argued that analysis was needed to implement new technologies while considering behavioural changes that might become issues. In short, socio-technical research concerns itself with mutual benefits derived from the intersection of social and technical elements (Emery, 1980). Based on that, the socio-technical systems approach defines both a social and technical dimension which are considered subsystems that together form a supra-system. The success of a socio-technical system is thus the product of interactions between these subsystems (Abbas & Michael, 2022). This is also known as joint optimisation.

2.4.2 Socio Technical Systems and Mobility Design

For a long time, the socio-technical systems approach has been used in new technology and work design (Davis et al., 2014). According to Davis et al. the systems approach should evolve to be used in a much wider context. *"In particular, we need to: extend our conceptualization of what constitutes a system; apply our thinking to a much wider range of complex problems and global challenges"* (p.171). One of these global challenges they address is environmental sustainability, which is the basis of this thesis. To make the Socio-technical systems approach applicable to a wider field a new framework was developed that portrays a complex organisation by hexagon, which is embedded in an external context. The hexagon is made up of 6 interrelated components (fig. 2.4) based on the initial work of Leavitt (1964).

Currently the design and renewal of urban areas are below future standards due to the lack of knowledge on how the technical and societal elements of urban environments interacts (Campbell, 1996; Ellis, 2014; Ogbazi, 2013; Waddell, 2002). Mobility design is often made up of disciplinary silos (Patorniti et al., 2017). For example, transport and civil engineers are interested in road and pavement configurations; urban designers investigate the amenities and use of the roadside, pathways, and human spaces; urban planners examine land use planning and the block scale; lastly architects often only focus on the design and development of a single plot. This shows the lack of understanding about the way technical and societal elements interact (Campbell, 1996; Ellis, 2014; Ogbazi, 2013; Waddell, 2002).

2.4.3 Cities as Socio Technical Systems

Patorniti et al. (2017) therefore investigated if cities have complexity and sociotechnical system characteristics to understand if STS could be a useful approach to better integrate technical and societal elements in urban planning. They used 2 characteristics to test if cities are complex systems: (1) linear versus nonlinear and (2) open versus closed systems (Cilliers, 1999). To test if cities can be socio-technical systems they used two core characteristics of STS: (1) The identification of socio (human) and the technical (technology or other artefacts) features and (2) the existence of qualities of joint optimization (Walker et al., 2008). The conclusion is that cities have characteristics that match with both complexity and STS, therefore opening up the possibility to do what Davis et al. (2014) suggested; using the STS approach to gain a better understanding of cities and how to design them taking into account global challenges such as environmental sustainability or in this case the challenge to reduce the use of cars drastically.
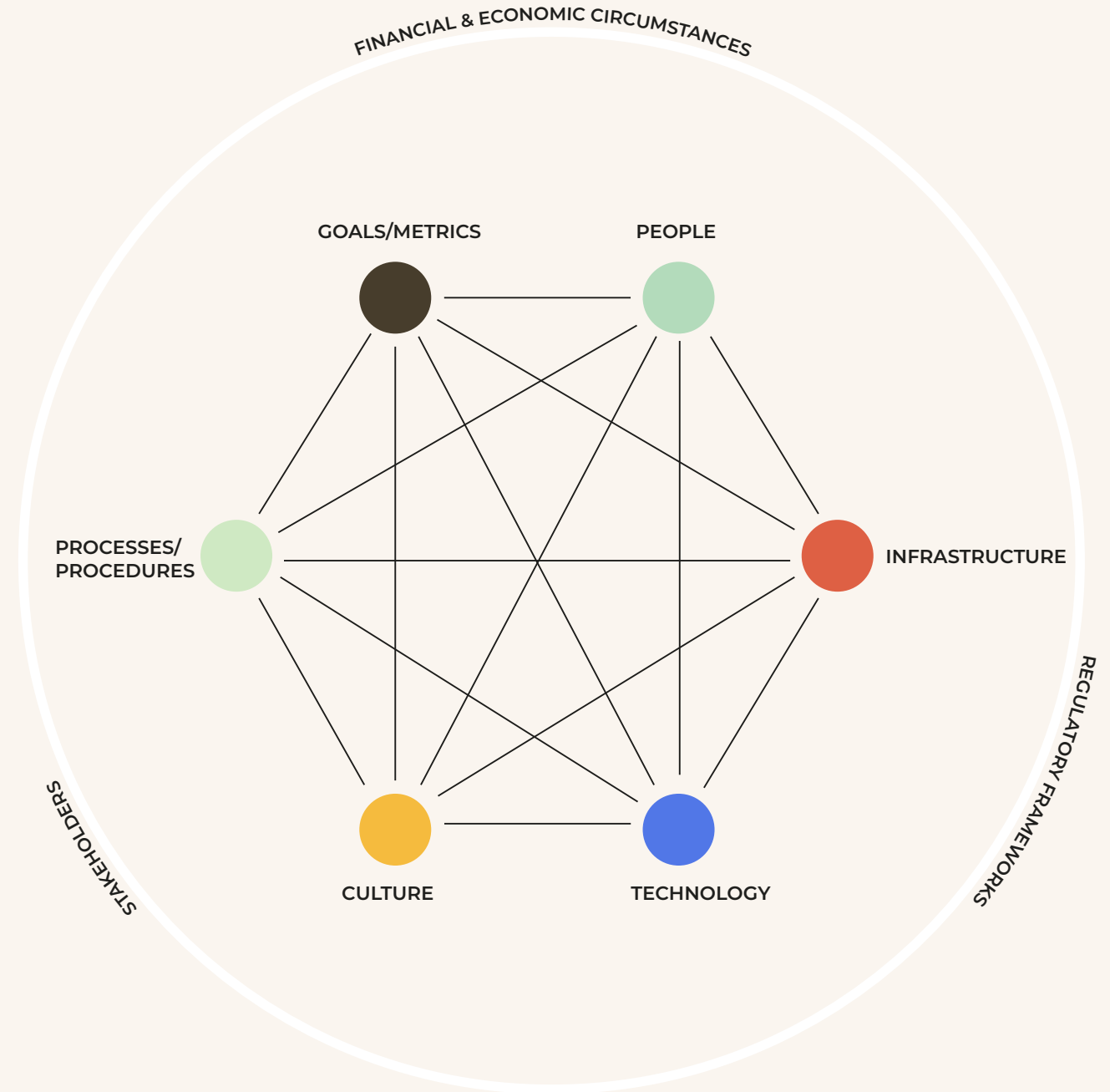
Figure 2.4. Socio Technical Systems Framework (Davis et al., 2014 adapted from Leavitt, 1964)

2.4.4 Understanding Socio Technical Systems

Davis et al. (2014) provide an overview of steps that have to be taken in order to fully analyse and understand existing socio-technical systems (table 2.1.). Their approach to a system analysis uses a specific event or scenario as main focal point, which might not be the best approach when it comes to analysing an urban system. Moreover, it doesn't specifically mention the spatial dimension that is needed in order to understand urban systems. However, step 4, *"Consider the implication of the external environment"* can be seen as a brief analysis of for instance the urban context of event or scenario. In chapter 3.3 the suggested analytical framework of Davis et al. (2014) will operationalised and merged with a widely practised analysis method known as the Urbanism of Networks approach by Dupuy (1991).

Table 2.1 . Steps involved in analysing and understanding an existing socio technical system (Davis et al., 2014)

1	Gather relevant data from appropriate sources, including key actors, stakeholders, subject matter experts, and internal and external documents.
2	Analyze and classify data, using techniques such as template analysis (King, 2004). Initial template consists of the socio-technical framework.
3	Identify and group key system factors. Visually represent the groups of factors on each node of the framework.
4	Consider the implication of the external environment in which the system is embedded within the node to which it relates.
5	Systematically consider relationships between each set of factors, and identify contingencies and direction of relationships.
6	Visually inspect the hexagon framework and assess underexplored or related areas, and reappraise evidence or seek input from colleagues and subject matter experts (e.g., with expertise in buildings and infrastructure).
7	Add any additional relevant factors that emerge from the data during analysis or following previous step.
8	If appropriate: Generate a timeline of key factors leading up to the event or scenario, grouped by the six factors. Classify as: long-standing issues (3 + months); issues immediately preceding the event (0–3 months); and factors involved on the day.
9	Test analysis on key stakeholders for accuracy, omissions and interpretations, and modify as necessary after discussion.
10	Generate key inferences regarding the system and how it works.

2.5 | MULTI-LEVEL PERSPECTIVE

2.5.1 Introduction
When viewing cities and their surroundings as a system, a better look at system transitions or transformations is needed. Previous transformations can be characterised as the 're-emergence, 'renaissance' and 'entrepreneurialism (Dillard et al., 2008; Larsen, 2008). During these transformations critical infrastructures of energy, water, waste and transport have been essential and for a long time the organisation and supply of this infrastructure were mostly an administrative and engineering feat (Graham & Marvin, 2002). But lately, additional aspects such as economic, ecological, population and institutional constraints are generating new challenges and pressure on urban growth and how to manage the critical infrastructure of cities (Hodson & Marvin, 2010).

2.5.2 Sustainability Transitions
With an increasing complexity of system transformations, Geels (2004) and Elzen et al. (2004) suggest looking at systemic changes as 'socio-technical transitions'. Systemic changes often involve transformation in the overall configurations of for instance transport systems. This encompasses, technology, markets, consumer practices, infrastructure, cultural meaning, and scientific knowledge. If we add the dimension of sustainability, it becomes even clearer to look at transitions form a socio-technical transition point of view.

Sustainability transitions, such as the proposed transitions in this thesis have three different characteristics to 'normal' transitions. First, they are often goal oriented (Smith et al., 2005). Secondly, they often do not offer obvious (individual) user benefits as achieving sustainability is a collective good. Therefore, sustainable solutions score lower on price/performance ratio than existing technologies. Given that, it is harder for environmental innovations to trigger a systemic change without any changes in economic frame conditions, such as taxes and subsidies. This requires changes in policies (Geels, 2011). The third and last characteristic is the large firms that are active in sectors wherein sustainable innovations mostly have to take place. This includes sectors such as transport, energy production and agri-food. The presence of these large firms in these sectors has an advantage. Usually, these companies have experience with large scale testing and specialised manufacturing capabilities making them an important partner in sustainability transitions. Even though they might not be the leaders of a systemic change, their involvement can help to accelerate the development of sustainable innovations, all be it with the right support and governance (Geels, 2011).

Given the characteristics of a sustainability transition, interactions between technology, policy/power/politics, economic/business/markets, and culture/discourse/public opinion are necessary. This again shows suitability of looking at a mobility transition in a cross-border context as a socio-technical transition (Geels, 2011).

2.5.3 The Mult-Level Perspective
With the transition includes a systemic change, Geels (2011) proposes the Multi-Level Perspective approach (MLP). The MLP goes further than implementing one single technical innovation and looks at transitions that aim for a structural change. The MLP framework includes different concepts ranging from economics (trajectories, regimes, niches, speciation, path dependence, lock-in, routines), to science and technology studies (sense making, social networks, innovation as a social process shaped by broader societal context). Furthermore, it draws on the structuration theory and neo-institutional theory, which focus on rules and institutions as a base structure on which actors draw in their actions (Geels, 2004; Geels & Schot, 2007; Grin et al., 2010)

The approach views socio-technical transitions as non-linear processes that are the result of interaction between three different levels.
1. Socio-technical landscape
2. Socio-technical regime
3. Niches

This creates a framework in which the higher levels are more stable than the lower levels due to the number of actors and alignment between different elements. In this analytical framework the Socio-technical regime is the level where the transitions will manifest when one regime transforms into a new one. The socio-technical landscape and niches are connected to the regime. Niches consist of technologies or practices that are substantially different from the regime and the landscape acts as an external environment that influences the way of interaction between the socio-technical regime and the niche innovations.

2.5.4 Socio-technical landscape
The first level is the socio-technical landscape. This level is the context that influences the way in which the regime and niches are operating (Rip & Kemp, 1998). Important is that the landscape level does not only include material and technical aspects as a basis but also addresses demographic trends, political ideologies, societal values, and macro-economic patterns. All these factors are combined into the concept of the socio-technical landscape. The term landscape is chosen because all factors form the external context that both actors in the niche and regime levels can't influence in the short run. The landscape level usually changes slowly. This way of looking at context is very similar to Braudel's concept of the longue durée (Braudel & Wallerstein, 2009). The longue durée is a perspective that focusses on the slowly changing relationships between people and the environment they live in, adding knowledge from disciplines such as climatology, demography and physical geography (Buchanan, 2010).

This view on the socio-technical landscape as slow moving and stable should be more nuanced. Also, the landscape has its dynamics that can occur on a much shorter temporal scale earlier than suggested. A more nuanced conceptualisation of landscape dynamics is given by Van Driel & Schot (2005). They differentiate three types of dynamics: (1) factors that do not change (or change very slowly), such as physical climate, (2) rapid external shocks, such as wars or oil price fluctuations, and (3) long-term changes in a certain direction (trend-like patters), such as demographical changes but also the more pressing issue we are facing nowadays, the sustainability transition.

Moreover, sustainable transition theories often argue the destabilising character of landscape developments regarding the regime, such as the rapid external shocks, the second type of dynamics introduced by Van Driel & Schot. On the other hand, we have to take into account the stabilising factor of landscape developments. For instance, car-based mobility systems are currently stabilised by trends such as (1) globalisation and increasing world-trade, (2) individualisation and people becoming increasingly footloose, (3) rapidly growing international tourism, (4) growing wealth and the rise of second and third cars in households, this is especially the case in the western world and also important (5) the shift towards a network society that generates increasing flows and 'space of flows' that facilitates them (Geels, 2011).

Concluding, the socio-technical landscape considers the context and its dynamics with respect to multiple different paces that create change. It has both a stabilising and destabilising character and is therefore important to take into account when aiming for a systemic change as it influences the interaction between the sociotechnical regime and niches therefore also influencing the spatial and temporal aspect of transitions.

2.5.5 Socio-technical regimes
The socio-technical regime acts as a base structure that accounts for the stability of an existing socio-technical system (Geels, 2004). The regime consists of a semi-coherent set of rules that orient and coordinate activities of social groups that reproduce the various elements of socio-technical systems (Geels, 2011, p.27). Within the regime rules there is a duality of structure which means that these rules are both a medium as well as an outcome of actions. This can be explained as following: on the one hand actors execute and draw upon the rules from the regime resulting in actions in local practices. On the other hand, rules shape actors (Giddens, 1984). Regimes rules usually one of the following (1) cognitive routines and shared beliefs, (2) capabilities and competences, (3) lifestyle and user practices, (4) favourable institutional arrangements and regulations, (5) legally binding contracts. Regimes can be characterised by lock-in and innovations that trigger small adjustments. These small adjustments make for a stable yet slow trajectory of change. The socio-technical regime aims to grasp the meta-coordination between many different sub-regimes all part of the socio-technical system. Some of these subsystems

are technology, politics, markets, user preferences and cultural meaning. All these subsystems have their own dynamics but also interact and co-evolve with one another (fig. 1). Alignment between these subsystems can bring more stability but could also create more tension.

2.5.6 Niche innovations
The last level in the MLP framework is the niche innovations. Niches consist of R&D laboratories, subsidised demonstration projects or small market niches where users have special demands and most importantly are willing to support emerging innovations (Geels, 2011). Actors such as entrepreneurs and start-ups work on innovations that stray from the normal path given by the existing regimes. By investing in innovations niche-actors hope to enter the regime with their new visions or even replace the regime all together. Triggering a systemic change is easier said than done. Due to lock-in mechanisms and niche-innovations the proposed system change may not match with the current infrastructure, regulations, or consumer practices. These circumstances are the socio-technical regime. On the other hand, niches are every important because they provide a spark that can lead to a systemic change. A closer look at niche innovations and their development shows there are three distinct processes (Kemp et al., 1998; Schot & Geels, 2008):

1. Articulation of visions: This can help with guiding the activities surrounding the innovation as well as attract attentions and funding from external actors.
2. Building of social networks: This process will expand the resource base of niche-innovations, also working towards the goal of attracting more attention and funding. Having powerful actors such as governments and transport companies on board can help with legitimacy and resources.
3. Learning and articulation: This process happens on many different aspects such as design, user preferences, infrastructure requirements, business models and policy instruments. Focussing more on the implementation of the niche-innovation when it will enter the socio-technical regime.

All these processes lead to creating momentum, which is necessary to replace the existing regime.

This momentum is the sum of more precise and broadly accepted expectations, the alignment of learning processes resulting in a stable design and the increase of the niches network (Geels, 2011).

All these levels and their interactions can be visualised in a diagram (fig. 2.5). This diagram shows the dynamics between all three levels. Even though all sociotechnical transitions are different the transition pattern can be characterised by the interaction between processes that happen on the previous explained levels. The first being that niche-innovations build up momentum, then changes in the socio-technical landscape result in pressure on the regime, resulting in a window of opportunity to destabilise the current system and replacing it with the niche innovation.

2.5.7 The Spatial Context
Critics of the Multi-Level Perspective question the lack of geographical sensitivity (Hodson & Marvin, 2009). An important problem is the lack of attention in studies for the urban dimension of sociotechnical regimes and innovation-oriented policies (Coutard & Guy, 2007; Hommels, 2005; Monstadt, 2009). Over the years responsibilities regarding key aspects of technology, innovation and competitiveness have been transferred from national level to the city level. It is the spatial variation of sociotechnical regimes (cities and their surroundings) that shape the transitions and thus spatial conditions can play a key role in sustainable mobility transitions. Spatial variations are the product of urban processes and the spatial scale should be incorporated in the MLP. Raven et al. (2012) introduce the spatial dimensions as a relational scale comprised of a network of actors across different territories. The three different levels of the MLP, niche, regime and landscape are produced and reproduced by relationships between actors acting across space and time. To make this more concrete the MLP framework will be adjusted to incorporate the spatial dimension (fig. 2.6). The socio-technical landscape will be renamed the socio-technical-spatial landscape and the socio-spatial regime and niche innovations will be operating within a spatial context that can be influenced by the socio-technical-spatial landscape.
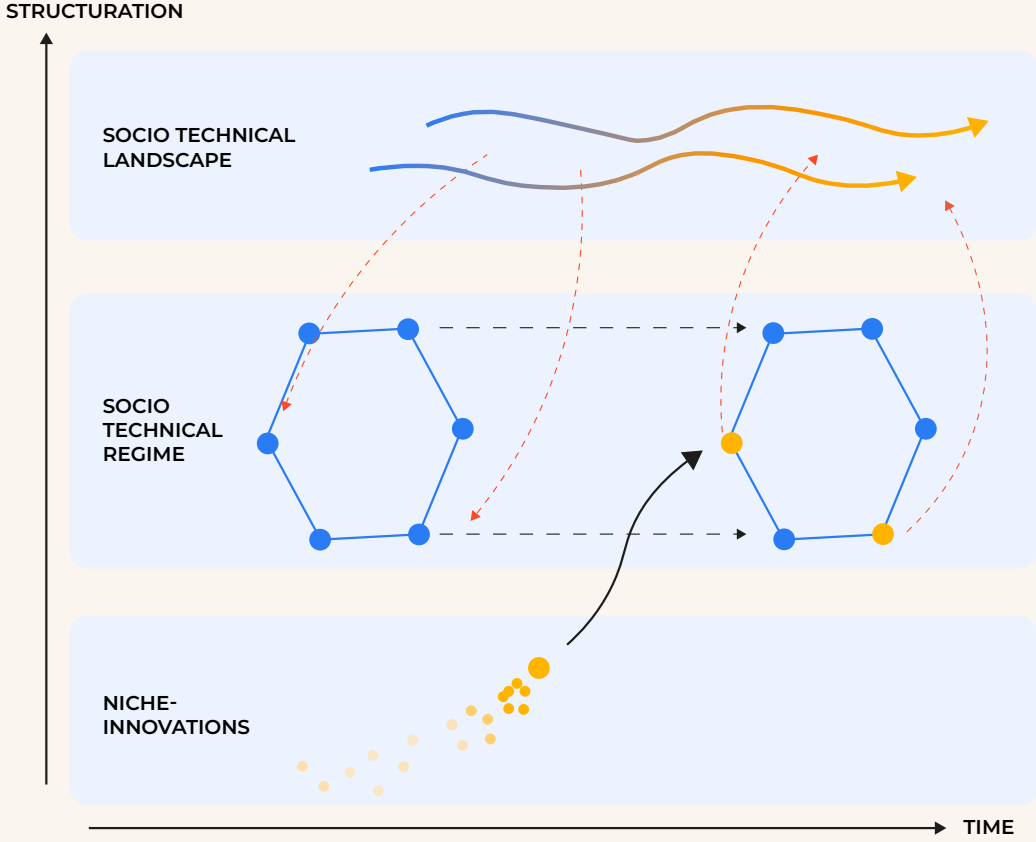
Figure. 2.5. Multi-level perspective on transitions (Geels, 2011)

2.5.8 Pathways of transitions
Geels vision on socio-technical transitions has a strong bottom-up approach with niche innovations starting the transition, due to the momentum they build up. Other scholars argue that this bottom-up bias does not highlight the possibility of the transition starting in either the socio-technical regime or the socio-technical landscape (Berkhout et al., 2004, p.62). In a reaction Geels (2011, p.32) states *"To counter this bias, I think more explicit attention needs to be paid to ongoing processes at the regime and landscape level"*. To overcome the bottom-up bias four transition pathways have been developed that consider the timing and nature (symbiotic or competitive) of multi-level interactions (Geels & Schot, 2007).

1. Transformation
This pathway starts from the landscape level, where the landscape developments put pressure on the regime when niche-innovations are still underdeveloped. In other words, the timing for the niche innovations is not right due to the lack of progress they made in their own processes (previously described). In this pathway key actors modify the direction of innovation activities and development paths. These modifications will lead to slow adjustments of the regime reacting to the pressure provided by the landscape level. Despite the fact that niche-innovations do not have a breakthrough in this transition process, the experiences from such innovations will find a way into the regime, but often in a more scaled down version (Smith, 2007).

2. Reconfiguration
Different from the previous pathway, in this transition the niche-innovations are more developed when landscape developments put pressure on the regime. Dependent on the nature of the niche there are chances for integration and changing the regime. If the nature of the niche-innovation is symbiotic key actors can adopt the innovation as an addition to the regime to solve local problems. Incorporating the niche-innovation in the regime can trigger a systemic change in the base structure and thus 'completing' the transition.

3. Technological substitution
In this pathway there is pressure from the landscape development but contrary to the transformation pathway there are now multiple competing niche-innovations that are well

developed. Tension in the regime then creates a window of opportunity for the niche innovation than then can break through and replace the regime. Another option is when the niche-innovations have gained enough momentum they can replace the regime without the help of landscape pressures.

4. De-alignment and re-alignment
This last pathway includes major pressure from the socio-technical landscape level. This pressure leads to fragmentation of sub regimes that together form the regime (de-alignment). The fragmentation creates space that multiple niche-innovations can take advantage of to emerge. Different competing niche-innovations will then co-exist for some time creating uncertainty about which one will become the 'winner'. The last step

is then the re-alignment that will eventually occur around one innovation. This process will then create a new regime.

2.5.9 Conclusion
One of the important notions of the MLP is the absence of simple causality in transitions. The MLP shows that there is no single 'cause' or driver that starts and guides the transitions. It is instead the processes in multiple dimensions and multiple levels that link up and reinforce each other, a process also known as circular causality (Geels, 2011). When looking at the applicability of the MLP it shows that this approach is useful when it comes to mobility transitions (Nykvist & Whitmarsh, 2008) as it has proven its use during case studies concerning shipping, aviation, and highway systems (Geels, 2011). Based on these studies the MLP is useful when developing a transition strategy for this thesis.
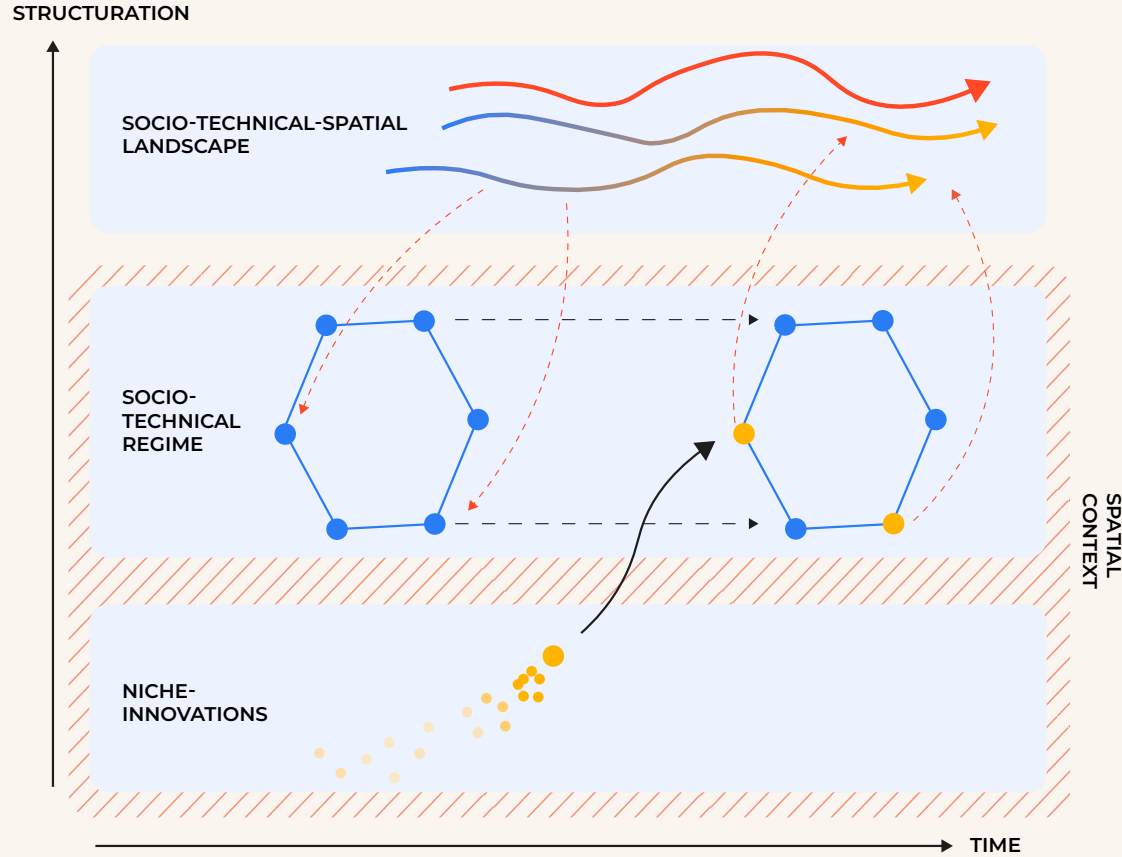
Figure. 2.6. Updated Multi-level perspective on transitions, including the spatial dimension (adapted from Geels, 2011)

2.6 | METAGOVERNANCE

2.6.1 Introduction
Now that we have set the standard to view the city and the peri-urban region as a system as well as introducing the Multi-Level Perspective, we have to look at the process of achieving the goal of mobility justice. There is a growing concern that strong institutional frameworks and well thought out planning systems will not suffice to ensure the successful implementation of sustainability goals such as the Sustainable Development Goals (SDG) (Meuleman, 2019). The SDG's have been set up the UN as common goals that all nations should stand for. For this thesis especially SDG 9, 11 and 16 are relevant (UN Department of Economic and Social Affairs, 2023).

9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation

11 SUSTAINABLE CITIES AND COMMUNITIES
Make cities and human settlements inclusive, safe, resilient and sustainable

16 PEACE, JUSTICE AND STRONG INSTITUTIONS
Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels

2.6.2 Defining Governance
To achieve sustainable goals and development, getting the governance right is one of the main pillars from an academic perspective (Meadowcroft, 2011, p.536). However, in most countries the public sector is organised in line with hierarchical governance principles introduced by Max Weber (Weber et al., 1978). Examples of this type of governance are 'silos', which is the division

of tasks that could have integrated, a clear chain of command and a heavy focus on stability and legality (Meuleman, 2019).

Before looking at the different types of governance a definition of governance is needed. Many scholars have defined governance completely different. One definition Bevir (2011) gives is very broad: governance is about *"issues of social coordination and the nature of all patterns of life"*. This definition stays rather vague as to in which fields governance operates.

Another scholar, Rayner (2015) states governance as a heuristic lens through which the contextual realities of coordination of multiple actors and institutions in the policy system can be reconstructed in detail. Rayner's definition shows it strength in the relational context. Additionally, We can define governance as a collection of normative insights into the organization of influence, steering, power, checks and balances in human societies (in 't Veld, 2013). Meuleman (2019, p.6) states that: *"Governance is how societal challenges are tackled and opportunities are created. Governance is about polity (institutions) and politics (processes) and not about policy (the substance)"*. This definition of governance already becomes clearer as it states what governance is about and what it excludes, but it only mentions the institutions explicitly and no other actors.

The United Nations (UNDP, n.d.) takes a more state-centric approach in their definition of governance, in the context of this thesis this makes sense. This leads to the following understanding governance in which both the definition of Meuleman (2019) and the United Nations (UNDP, n.d) are integrated: *Governance is about polity and politics, it comprises the mechanisms, processes and institutions, through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences. Governance is explicitly not about the contents of the policy itself but focusses on the process of implementing and creating the policy.*

2.6.3 Governance Environment
Another term introduced by Meuleman is the governance environment. A governance framework for mobility transitions is always in interaction with its context. The relation between its surroundings can be both predictable and unpredictable. The importance of understanding this environment is important as it may influence the feasibility of specific solutions based on governance styles. The definition of a governance environment is the set of rules and laws, institutional setting, policy instruments, division of tasks and roles of governments and societal stakeholders. Besides that, the environment also consists of relevant culture, history and geographical conditions that function within a boundary or transboundary context (Meuleman & Niestroy, 2015), in this case the Dutch-Belgian border.

2.6.4 Governance styles
Before a more in-depth view is given on the best governance style or mix of styles suitable for the goals of this thesis, an overview of the most common and distinctive styles is presented. Most governance literature distinguishes three different basic styles, namely hierarchical, network and market governance (Meuleman, 2019). These different styles mimic the three modes of social order introduced by Streeck & Schmitter (1985), state (hierarchical), community (network) and market (fig. 2.7).
Of all three styles hierarchical governance is still the most practiced style worldwide. It remains an important tool to provide solutions in specific context and issues. This style is derived from the fact that there can be enforcement by means of legitimate authority. Examples of this are employer and employee relationships (Steenkamp & Geyskens, 2012). In more detail hierarchical governance is based on the notion that decision-making is done

Creating favourable and stable Political and Social Environment

Mobilises Peoples participation

STATE hierarchical

CIVIL SOCIETY network

MARKET market

Stimulates open Growth and opportunities for People

Figure. 2.7. Three modes of social order (adapted from Streeck & Schmitter, 1985)

top-down, in silos and without any interaction with possible stakeholders. Hierarchical governance values stability, rationality and sees strategy as a planning and design tool.
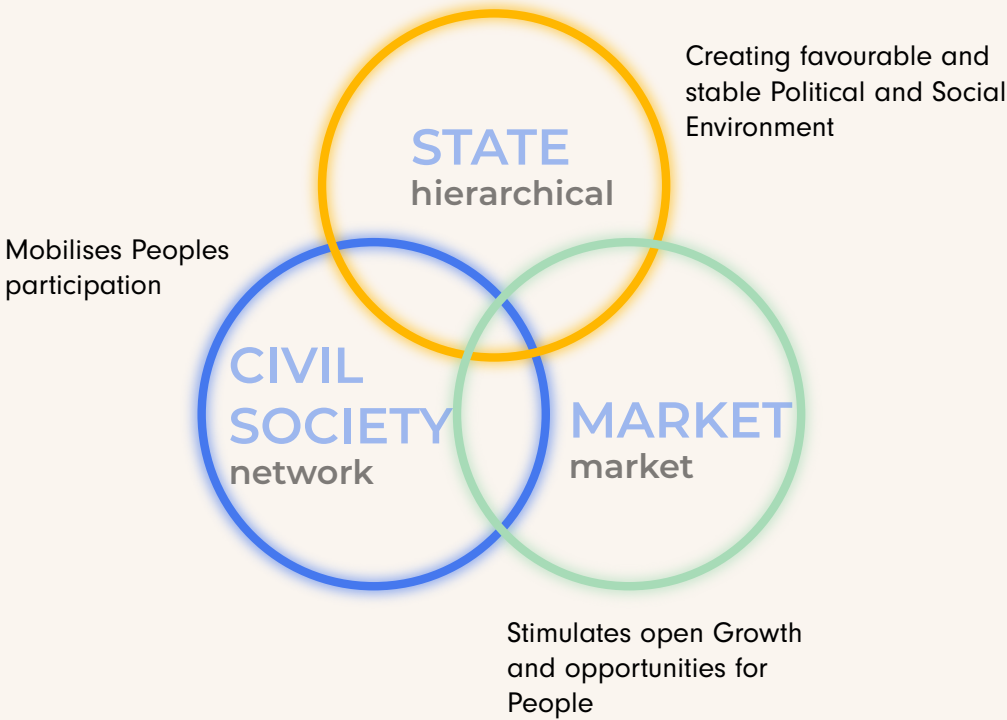
Network governance has seen an increase in use and is widely practiced in the Netherlands (Meuleman, 2019). It includes ways to deal with complexity and is very suitable for sustainable development. This style can be described as cooperative instead of focusing on coercion and competition. It can be used to manage complex networks that consist of a diverse variety of stakeholders both from different levels in the government as well as societal groups, institutions, and private organisations (Kickert et al., 1997). Network governance favours dialogue and participation which are opposites of the discourse in hierarchical governance. On the other hand, it can be seen as governance style that manages an evolution instead of a revolution. Therefore, the speed at which we have to change our systems to achieve the sustainability goals set both by the EU and UN' might not be compatible with this type of governance as network governance leads more to incrementalism instead of taking big steps.

Lastly market governance showed that it can lead to efficient but also ineffective solutions. It is a style that is based around the idea that organisations should function as if they were business units as private companies are thought to be more efficient and effective. Therefore, this type of governance prefers the use of market-based instruments, such as taxes. It focuses on efficiency, competition and empowerment. Besides these three basic styles many combinations are practiced.

2.6.5 Sustainability Governance
There are currently four different types in which the many approaches to sustainability governance can be clustered (Meuleman, 2019):

1. Strong leadership is necessary (Hierarchical)
2. Strong bottom-up and partnership action is necessary (Network)
3. Focus on transition management (Market & Network)
4. Multi-perspective approach: apply situational governance (metagovernance)

A closer look at the last two types of governance is necessary due to their applicability in the case of a mobility transition in a cross-border context.

First of all, transition management is developed as a new governance-model based on complex systems thinking. As we have established in a previous paragraph the city and the peri-urban region can be characterised as a complex socio-technical system. Therefore, this governance-model could be applied. In short, transition management acknowledges the complexity of a system and is characterised by a bottom-up approach. In line with the Multi-level Perspective, this bottom-up approach leads to niche-innovations, that later will develop into regimes (Geels, 2011; Grin et al., 2010). Meuleman (2019), categorises transition management as market governance in its basis due to the dependence on niche-innovations. It includes entrepreneurial, creative, and competitive values and builds on individual initiatives. Besides market governance there is a role for network governance and a small role for hierarchy as it aims for standardization and change in regimes. This mix of governance styles will become clearer once we look at the transition management cycle introduced in the next paragraph.

As with many processes transition management sees the governance process as cyclical with different phases at various scale levels (Loorbach, 2007). In its basis there are four different activity phases (fig. 2.8) which are derived from an actor behaving in the context of societal transitions such as the mobility transition. The phases will be explained below also stating what the goal of the phase itself is.

1. Strategic
Activities on the societal system level. These activities consider a long-time horizon and focus on complex societal problems and creating new possible futures. This phase often consists of opinion making, visioning and politics.
Goal: Transition Agenda

2. Tactical
Activities on the sub-system level. These activities are concerned with building up and breaking down system structures. These structures can range from institutions to regulations but also

physical structures such as infrastructure. This phase consists of negotiations, collaboration, and lobbying.
Goal: Transition scenarios and transition agenda

3. Operational
Activities on everyday decisions and actions. These activities focus on the short-term instead of the strategic phase that focusses on the long-term. Involved actors start to recreate previous system structures or try to change and restructure them.
Goal: Transition Experiments

4. Reflexive
Activities in this phase are related to evaluation. Existing situations will be reflected on to surface their interrelation or lack thereof. This phase consists of debates, assessment, and research.
Goal: Transition Monitoring.

Based on the transition management cycle it becomes clear that transition management incorporates all three governance styles. Albeit in an uneven distribution. Especially there is a lack of hierarchical governance, which in the case of sustainability transitions is interesting. Central

leadership at a (supra)national level is seen as a crucial success factor of sustainable development. Examples are countries such as Germany and Finland where some form of hierarchical governance helped achieving sustainability goals (Meuleman, 2019). A hierarchical governance doesn't necessarily mean that the government makes decisions without considering the opinion of it's citizens. However, this approach can support a shared responsibility and shared action of governmental and non-governmental parties by having a claim to authority and legitimacy. These shared actions derived from hierarchical governance can be designed to steer behaviour and are therefore a welcome addition to the market and network governance styles (Kanie & Biermann, 2017, p.75)

2.6.6 Metagovernance
The use of all three governance styles makes transition management a type of metagovernance. Frantzeskaki & Loorbach (2014) even describe transition management as "a metagovernance approach made operational by a series of process and content combining steps".

This conclusion introduces the second governance

Transition arena

Transition monitoring

Transition scenarios
Transition agenda

Transition experiments
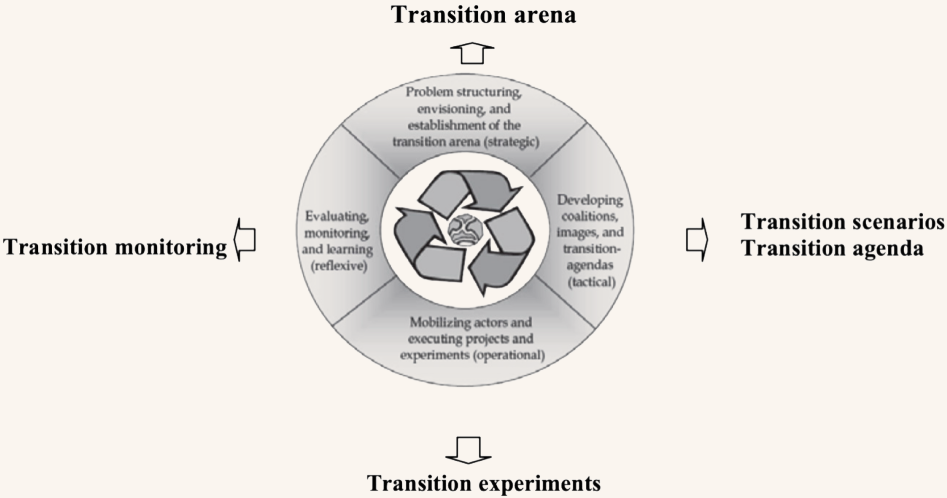
Figure. 2.8. The Transition Management Cycle (Loorbach, 2010)

style worth discussing, the multi-perspective approach. The multi-perspective approach can be described as situational governance and is also known as metagovernance. Metagovernance can be explained as the governance of governance that is used to create a coordinated governance style to achieve the best possible outcome. This governance style is created through designing and managing combinations of all three basic governance styles, hierarchical, market and network (Meuleman, 2019).

Sustainable developments are all about creating a balance between the environmental, economic and social dimensions of life, while keeping in mind future generations. Meadowcroft (2011) argues that these three lenses should not be handled separately as it leads to unwanted consequences. Therefore, an integrated approach is needed, which is also called meta-policy. This shows the similarities with metagovernance which also has three main styles and argues that they should be in balance. When combining the dimensions of Meadowcroft and the three governance styles it shows that holistic goals need holistic governance (fig. 2.9).

Metagovernance is especially relevant in a cross-border context as a survey on governance trends for sustainable development concluded that there is a need to combine different governance styles. The combination of styles is needed to achieve compliance of international agreements with expanding collaborative governance (Olsen et al., 2015). Combining the different governance styles always has to be seen in relation to the context of the project. As earlier explained, this can be described as the governance environment. Characteristics that shape this environment are economic, ecologic, social, spatial and administrative (Meuleman, 2019).

2.6.7 Conclusion
In this thesis metagovernance will be used as a governance approach. This approach can help a mobility transition in a cross-border context as it is useful to combine different styles that overlap with the preferred style of the invovled countries.
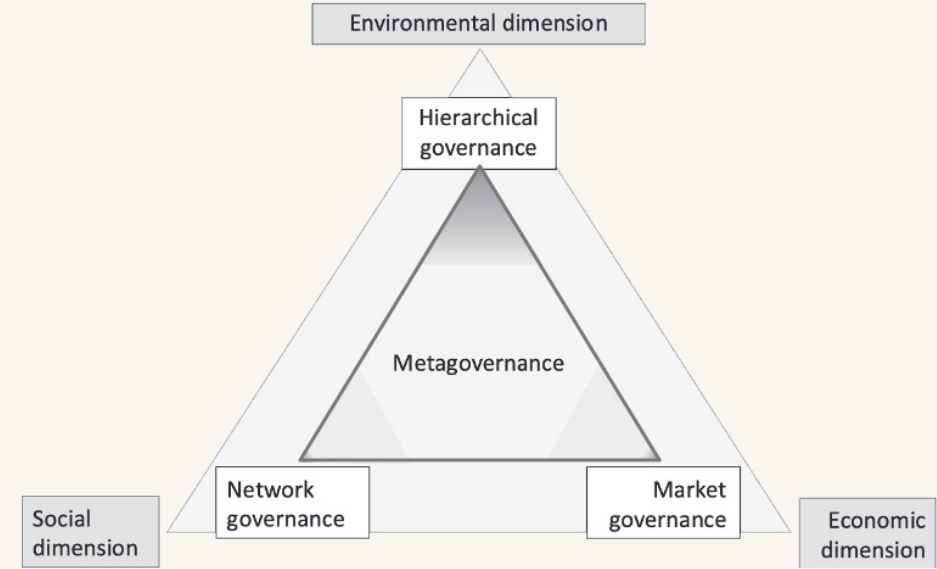
Figure. 2.9. Sustainable development and metagovernance: holistic goals meet holistic governance (Meuleman, 2019)

2.7 | CONCEPTUAL FRAMEWORK

2.7.1 The Framework

Figure 2.10 on the next page shows the conceptual framework for this research. The basis of the conceptual framework is the theory and problem field. The basis is formed by three pillars (1) Transport systems, (2) Travel Patterns and (3) Mobility justice. All three pillars contribute to achieving a systemic change that will lead to a just and sustainable network. The outcome of this systemic change will have a social and spatial impact. Therefore, the network will be assessed by looking at the social and spatial justice of the systemic change. By keeping in mind, the following core concepts of (1) Multi-Level Perspective, (2) Metagovernance, and (3) Sustainability.

2.7.2 Assessment

Spatial justice

Transitioning to a new mobility network will have a spatial impact. The new transportation modes have different spatial requirements and with growing inequality, socio-spatial fragmentation and the lack of acces to public goods as a threat to the sustainability of our cities (Dillard et al., 2008) cautiousness is needed when implementing new networks. Attention to the results of these spatial changes and how just they are is important.

Social justice

Transitioning to a new way of moving around in a cross-border context should be done carefully, because of its societal impact. Not everyone is able to make use of for instance public transport due to immobilities. Changing the networks might impact the mobility options of individuals changing their connectedness to for instance their jobs or education facilities. Furthermore, businesses will be impacted due to a change in the way their goods enter and leave their business. Where some businesses might disappear other can arise, ultimately no one should fall behind during this transition. Keeping an eye on the social justice aspect of the transition can help to accomplish this.
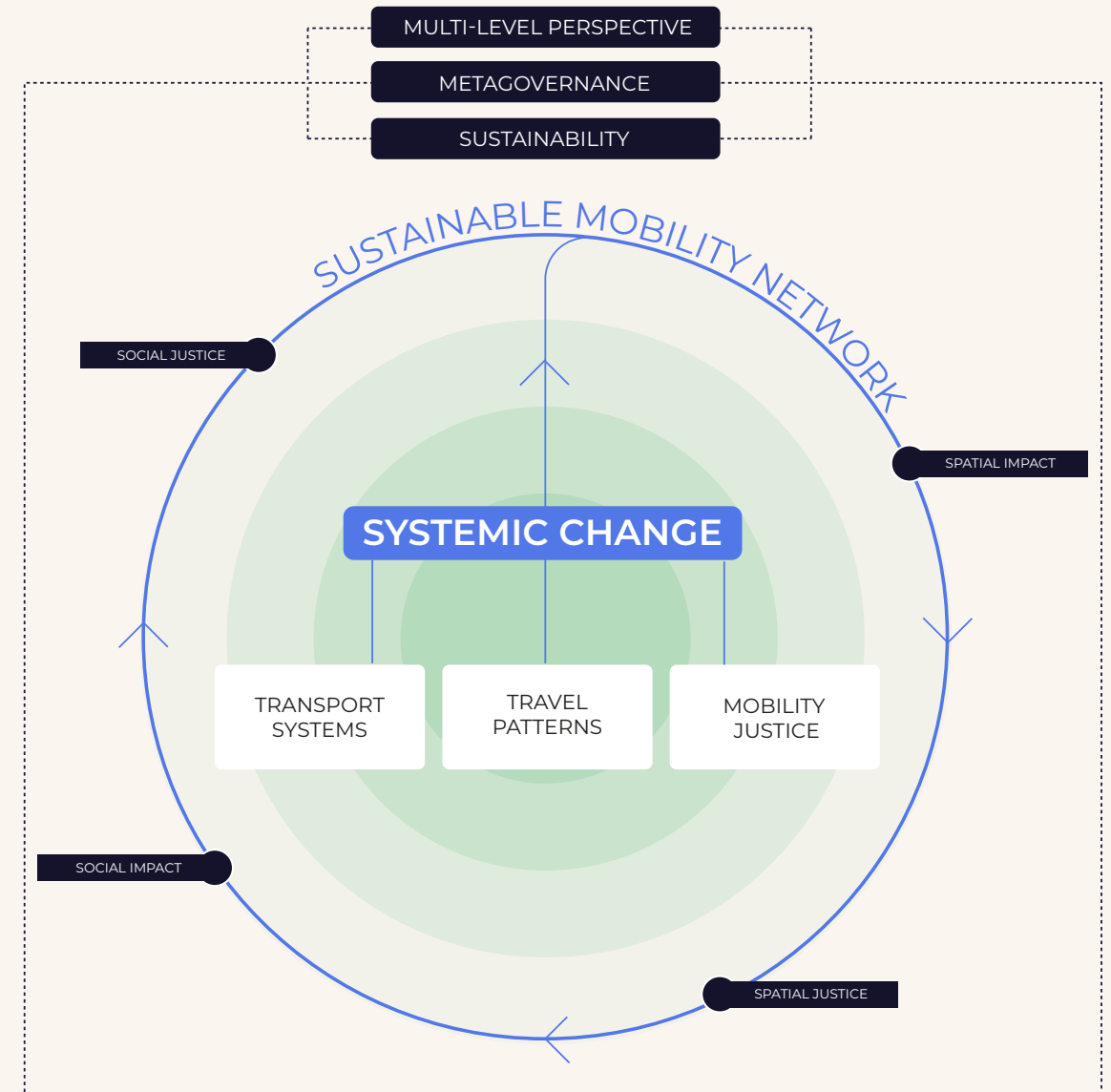
Figure. 2.10. Conceptual framework

00 |

METHODOLOGY

Content

*Border crossing in the middle of the small
town of Galder in Noord-Brabant.
Photo: Rolf van den Broek*

What transitional strategy can contribute to achieve a just and sustainable multi-modal network in a cross-border context? →

MOTIVATION

SOCIETAL & SCIENTIFIC RELEVANCE

PROBLEM STATEMENT

PERSONAL MOTORISED VEHICLES (ELECTRIC)

DISSAPEARING CON-NECTIONS

EUROPEAN GREEN DEAL

COHESION POLICY

LACK OF AGGLOMERA-TION BENEFITS

SPACE FOR ACTION

VIRTUAL & SPATIAL NETWORKS

INFRASTRUCTURE

NL-BE BORDER

URBAN/PERI-URBAN

POLICY & GOVERNANCE

RESEARCH QUESTION

TRANSITION STRATEGY

SUSTAINABLE MULTI-MODAL NETWORK

DEFINITION

SUSTAINABLE MULTI- MODAL NETWORK: REDUCTION OF CAR USE BY 75% TO STAY WITHING PLANETARY BOUDNARIES WHILE TAKING INTO ACCOUNT MOBILITY JUSTICE OF CITIZENS AND THE ENVIRONMENT

THEORETICAL FRAMEWORK

MOBILITY JUSTICE — GOAL

SOCIO-TECHNICAL SYSTEM — LENS

MULTI-LEVEL PERSPECTIVE — TRANSITIONS

METAGOVERNANCE — FRAMEWORK

Figure 3.1a. Visualisation of Methodology Part I

The process of this thesis is conceptualised in the methodology framework (fig. 3.1a & fig. 3.1b). The first halfo of the frameworks is visible on this page the rest of the framework can be found on the next page. During the process different methods will be used to gather information and design. The most used methods are mapping, and literature review. Furthermore, methods such as stakeholder analysis and policy analysis are added to the body of knowledge. The strategy will be mostly developed through research by design supported with a pattern language. The first step in the thesis process is formulating the problem statement. The problem statement is based current trends and goals set by the European Union. This leads to the space for action which nowadays is not only physical but also virtual. As this thesis focusses on mobility the space for action is more specifically about developing physical and virtual networks. To achieve changes, we need to focus on infrastructure, the location of the transition, the characteristics of urban and peri-urban regions and don't forget about policies and governance. The research question is the result of the problem statement and takes into account the spaces for action. As the research question includes sustainable multi-modal network a definition is included in the framework. The definition is not a strict description of the term but rather a way to interpret a sustainable multi-modal network. It is based on the goal set by the European Commission (2021) and includes the planetary boundaries (Rockström et al. (2009).
The theoretical framework includes the four most important theories that will be used throughout this thesis. Each theory serves its own purpose, they can be described as a goal, a lens to view cities and their surroundings, a way to transition and lastly a framework guide the transition process.

ANALYTICAL FRAMEWORK

LEVELS OF NETWORK OPERATION (DUPUY, 1991 & ROCCO, 2008)

HISTORICAL EVOLUTION — SQ1

GOVERNANCE SYSTEM — SQ3

LANDFORM & INFRASTRUCTURE — SQ1/2

ECONOMIC NETWORKS — SQ2

SOCIAL NETWORKS — SQ2

METHODS

LITERATURE REVIEW, INTERVIEWS (EXPERT), POLICY ANALYSIS, MAPPING, NETWORK ANALYSIS, DATASETS, STAKEHOLDER ANLAYSIS, PATTERN LANGUAGE

ANALYSIS

VISION

STRATEGIC INTERVENTIONS

ZERO CARBON MOBILITY

REGIONAL SPATIAL PLANNING

CROSS-BORDER GOVERNANCE

TRANSITION STRATEGY

PATTERN LANGUAGE

REDISTRIBUTION OF TRAVEL MODES

POLICIES

STAKEHOLDERS

INSTITUTIONS

NETWORKS

DESIRED OUTCOME
JUST & SUSTAINABLE MULTIMODAL NETWORK

CROSS-BORDER AGGLOMERATION BENIFITS

SPATIAL JUSTICE

SOCIAL IMPLICATIONS

SUSTAINABLE NETWORKS

SQ4

SQ5

GOAL

HAVING A SUSTAINABLE MULTIMODAL NETWORK IN THE CROSS-BORDER REGION OF NL-BE BY THE YEAR 2050

SQ1 — How has regional mobility evolved in the last 100 years?

SQ2 — What are current travel patterns in the cross-border region of NL/BE?

SQ3 — How do the planning systems in The Netherlands and Belgium support different travel modes?

SQ4 — What spatial and policy conditions have to be present to make a just transition towards a new mobillity network in a cross-border context?

SQ5 — What will be the implications of the mobillity transition on the spatial and social sustainability in the region?

Figure 3.1b. Visualisation of Methodology Part II

After the theory is explained the location of this thesis, the border region of Belgium and the Netherlands can be further investigated. This analytical framework aims to answer sub questions in order to answer the research question. Sub question 1, 2 and 3 will mostly be answered by the analysis that will be carried out by using the levels of network operation approach (Dupuy, 1991 & Rocco, 2008). For a more detailed description of this method see chapter 2.3.

Following the analysis a vision for strategic locations can be drawn up. This vision will have three main pillars, zero carbon mobility, regional spatial planning, and cross-border governance structure. Zero carbon mobility is an operationalisation of sustainable multi-modal networks.

Based on the vision and the analysis a transition strategy will be designed. The transition theory draws from the theories introduced earlier and

will have as a main component the pattern language. This pattern language will form the design element in the strategy. The strategy will incorporate a redistribution of travel modes, the use of policies, stakeholder engagement, the involvement of institutions and the development of new networks. The transition strategy aims to reach the goal: Having a sustainable multi-modal network in the cross-border region of NL-BE by the year of 2050.

The desired outcome is the end result of the project and will be used to answer the last sub question. This sub question looks into the implications of the newly developed network on both spatial and social justice. This whole process will ensure the ability to answer the main research question.

3.2 | METHODS

3.2.1 Introduction
This chapter will give a brief explanation of the different methods used throughout the research. An overview of which sub question uses which method is provided at the end of the chapter (fig. 3.3).

3.2.2 Literature Research
One of the most important methods throughout this thesis is literature research. A literature study was carried out to introduce the problem field and will form the basis of the theoretical framework. Therefore, it explores current trends and concepts that are concerned with mobility transitions in an urban and peri-urban context. Besides that, literature research is necessary to do the analysis (SQ 1, 2& 3) of the study area based on the network levels of operation approach (Dupuy, 1991; Rocco, 2008).

3.2.3 Interviews (including a workshop)
In impactful transitions such as mobility involve "entrepreneurial capacity as well as structuring knowledge for action"(Nevens et al., 2013). An urban challenge like a mobility transition requires knowledge networks consisting of both experts and locals in order to produce answers for the problem and think of potential solutions relevant for their specific context (Chang et al., 2018). Interviews held with participating stakeholders will help to confirm the results from the analysis or even open new doors of research. It is important to both interview experts and locals. Experts can help to steer the project. Obtaining more knowledge current processes and decisions will contribute to a better understanding of the problem field. Interviews with experts can also provide useful tools to include in the strategy. These expert interviews will be qualitative due to the nature of these interviews. It is about gathering more information and not about testing any hypotheses. Interviews with locals will provide crucial information on the location and its shortcomings regarding mobility. These interviews will also help to map the motives that residents have to cross the border as well as what type of transportation method they prefer (SQ 2). As a follow-up on the interviews a workshop, regarding

the development and impact of the transition strategy could be organised (SQ 4, 5)

3.2.4 Policy analysis
Policy analysis in an urban planning context involves evaluating and assessing the effectiveness of different policies and strategies related to the development and management of cities and urban areas. This may include analysing the potential impacts of land use regulations, transportation plans, housing policies, and other initiatives on issues such as economic development, social equity, and environmental sustainability. Research, through policy analysis, can suggest new alternatives and can reveal conflict and incompatibilities that currently happening within the policy frameworks of the Dutch and Belgian governments (SQ3). It can reveal appropriate and inappropriate policy instruments and furthermore, it can help to ensure that solving one problem will not give rise to a more serious one (Bracken, 2014). The goal of policy analysis in urban planning is to provide decision-makers with the information and insights they need to make informed choices about how to best manage and shape the growth and development of their communities. This may include identifying best practices from other cities, as well as recommending new policies or changes to existing policies to address specific challenges or opportunities.

3.2.5 Mapping
Mapping is a crucial tool in urban planning and design and will be used throughout this research. It allows planners and designers to visualise the physical and functional characteristics of a city or neighborhood, as well as its potential for future development. Maps can be used to identify patterns of land use, transportation, demographics, and other factors that shape the built environment (SQ 1 t/m 5).

One common type of mapping used in urban planning is GIS (Geographic Information Systems) mapping, which uses digital technology to overlay multiple layers of data onto a base map. It support the analysis and helps to compare

different pieces of information in a visual format, and make informed decisions about land use and development (Longley, 2015).

3.2.6 Network analysis
In urban planning, network analysis can be used to study the connections and relationships between different elements of the built environment, such as transportation networks, land use patterns, and social networks (Borgatti et al., 2018; Haggett, 1965; Watts, 2004).
Besides physical networks there are also always social and economic networks part of the context. A social network analysis can be used to study the connections and relationships between different groups in the community, such as neighborhoods or demographics (Lin, 2007). An economic network analysis can be used to study the connections and relationships between different economic actors within a city, such as businesses, workers, and consumers (Goyal, 2009). Each of these types of network analysis correspond with different layers in the analytical framework.

By using these techniques, it is possible to gain a better understanding of the connections and relationships between different elements of the location, which can help inform decision-making and policy development (SQ 1, 2& 3).

3.2.7 Datasets
During the research datasets will play an important role to be able to carry out the different methods. For methods such as mapping and network analysis data is necessary. Therefore, there will be no direct data analysis but rather data forming the basis of other analyses methods.

3.2.8 Stakeholder analysis
Considering and understanding stakeholders and then acting to engage them is generally agreed as being one of the most critical parts of any managed change initiative (Murray-Webster & Simon, 2006). Therefore doing a stakeholder analysis is neccesary. A Stakeholder analysis is the process of identifying and assessing the interests, influence, and impact of different groups of people who have a stake in a proposed urban development project. Stakeholders can include residents, business owners, community organizations, government agencies, and other groups that may be affected by the mobility transition. Creating a power-interest matrix (fig.

3.2) will help to understand the role each stakeholder must play in the transition strategy.
An additional layer to include in this type of analysis is the attitude. The information gathered through stakeholder analysis can be used to develop strategies (SQ 4) for engaging and involving stakeholders at the right moment in the transition process and to make more informed decisions.

3.2.9 Pattern language
A pattern language is a method of describing good design practices for a particular problem field, such as addressing mobility transitions in cross-border regions. It is a set of interconnected patterns, each of which describes a problem and a solution that can be applied in a variety of contexts (Alexander et al., 1977). The thought behind a pattern language is that the patterns can be used together to create a coherent and holistic design, rather than just a collection of isolated solutions (SQ 4).

In urban planning, a pattern language can be used to describe the layout and organization of a city or neighborhood (Alexander et al., 1977). Examples
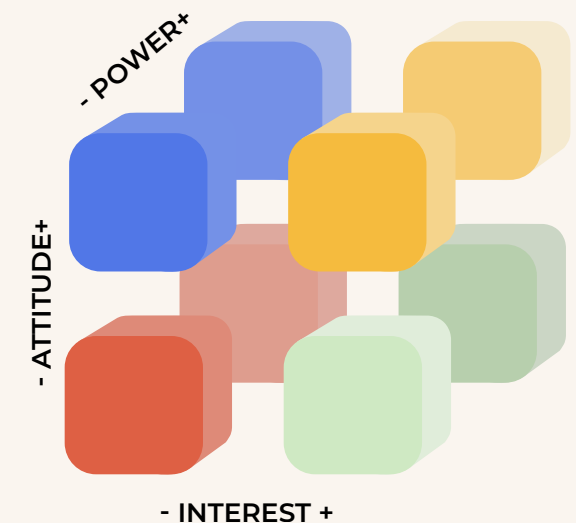
Figure 3.2. Framework for a Stakeholder analysis including the 3 axes of a power-interest matrix (Murray-Webster & Simon, 2006)

of patterns could be "Street Hierarchy" which describes the different types of streets and how they should be connected (Gehl, 2010), "Mixed Use" which describes how different types of buildings and uses should be integrated in a neighborhood (Duany et al., 2010), and "Transit Hub" which describes how public transportation should be integrated into a city (Cervero, 1998).

By using a pattern language, urban planners can create more livable, sustainable, and functional cities (Alexander et al., 1977). It gives a structure to the design process, and allows the designer to think of the city as a whole system, rather than just a collection of unrelated parts (Jacobs, 1992). Furthermore, it can be used as tool of communication and co-creation. This makes the development of a pattern language an open process where not only the designer develops the solutions, but other interested parties are welcomed to add to the body of knowledge.

	literature research	Interviews	policy analysis	mapping	network analysis	datasets	stakeholder analysis	pattern language
SQ1 How has regional mobility evolved in the last 100 years?	●			●	●	●		
SQ2 What are current travel patterns in the cross-border region of NL/BE?	●	●		●	●	●	●	
SQ3 How do the planning systems in The Netherlands and Belgium support different travel modes?	●	●	●	●				
SQ4 What spatial and policy conditions have to be present to make a just transition towards a new mobility network in a cross-border context?		●	●	●			●	●
SQ5 What will be the implications of the mobillity transition on the spatial and social sustainability in the region?		●		●			●	

Figure 3.3. Overview of methods used to answer sub questions

3.3 | ANALYTICAL FRAMEWORK

3.3.1 Introduction

To change the mobility network a thorough understanding of the current networks is necessary. This thesis assumes that the networked condition is beneficial as it increases the speed of information and resources flowing and being exchanged. Furthermore, it enables quicker adjustments to changes, and enhances the ability to withstand disruptions (Wandl et al., 2012). A framework that is widely used to analyse socio-technical systems such as cities and their surroundings is Dupuy's (1991) urbanism of networks approach (Rocco, 2008; Sha, 2017; Stalenberg, 2018). This approach merges a relational understanding of space and an actor focused approach.

3.3.2 What is a Network?

Urban networks connect people and places. The network city therefore refers to a society in which social, economic and cultural structures are not solely determined by the shared use of a certain space, but also (primarily) by the connections that an individual actor (person, company, institution) has with places, persons, or activities elsewhere (Rooij, 2005).

In order to fully understand the Dupuy method, it is favourable to state what is considered a network. The network in its modern meaning is characterised by three principal criteria (1) Topological, (2) Kinetic, and (3) Adaptiveness (based on Drewe, 2002; Wandl et al., 2012).

1. The topological criterion refers to the physical configuration of a network and how its nodes are connected. Networks are not abstract entities, they are related to the spatial dimension. They connect nodes via links that occur in space. The degree of connectivity of a node is a measure of its quality, and the overall connectedness of the network is a qualitative characteristic.
2. The kinetic criterion refers to movement and communication within a network. It is a relationship between space in time which

is translated in speed. The speed of these movements is a measure of the network's quality.

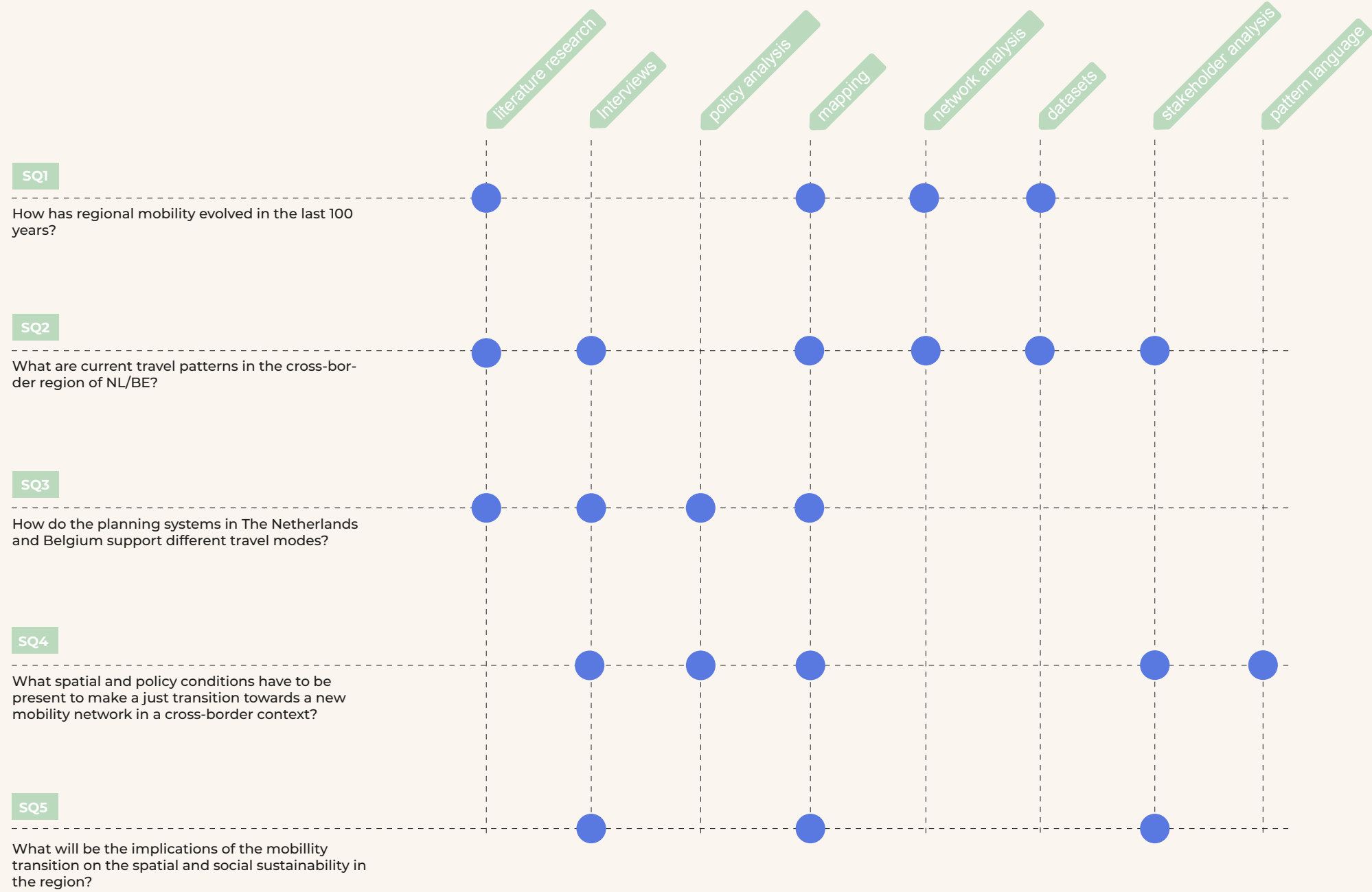3. The adaptive criterion focuses on a network's ability to evolve and adapt to the changing needs and desires of its users, with both robustness and flexibility being measures of its quality.

3.3.3 Dupuy's Urbanism of Networks

The Dupuy approach outlines various perspectives, called layers, on the socio-spatial system to incorporate its intrinsic complexity. Instead of viewing Dupuy layers as separated territories, it considers the "relations" in between these layers, representing the socio-spatial system as the primary focus. There are three layers that Dupuy (1991) identifies in his method, which he calls operators (fig. 3.4):

- 1st level operators, infrastructure, road networks and transportation, otherwise known as the technical networks. Technical networks are operated by both private and public parties, with most regulations regarding the network originating from the public parties;
- 2nd level operators, production and consumption networks. The 2nd level operators are mostly private and mostly exist of firms;
- 3rd level operators, urban household networks and territories. The urban household networks and territories can be seen as the ensemble of relationships between both the virtual and spatial networks of the 1st and 2nd level operators (Rocco, 2008).

3.3.4 Expanding the layers approach

Rocco (2008) builds on the framework of Dupuy by introducing the aspect of governance and geographical context. This enables the possibility to evaluate spatial planning principles as well as policy making. Adding these two additional layers will enrich the analysis and provide much needed context to the Dupuy Urbanism of network approach (fig. 3.4).
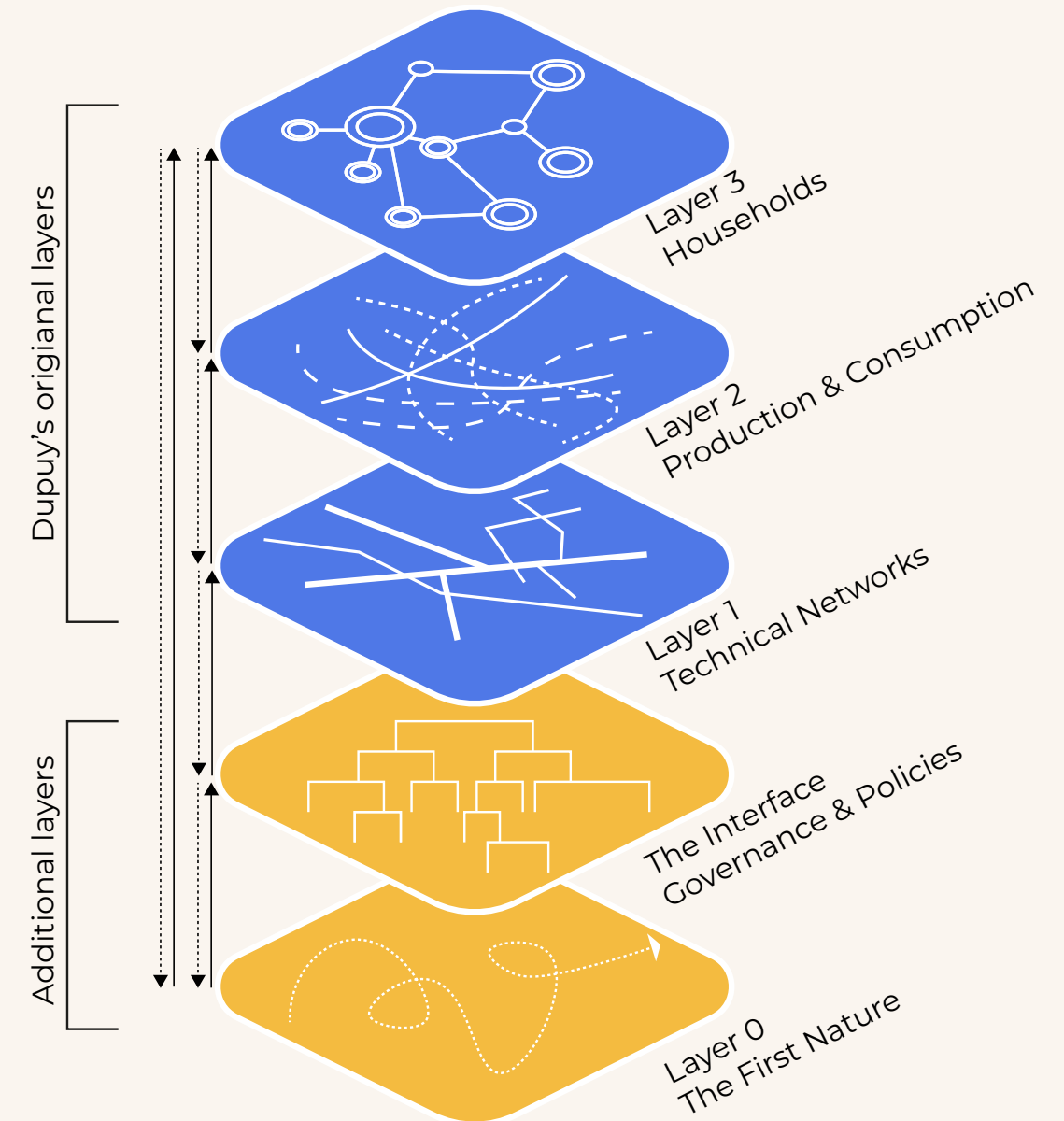

Figure 3.4. Dupuy's (1991) Urbanism of Networks approach including the additional layers introduced by Rocco (2008)
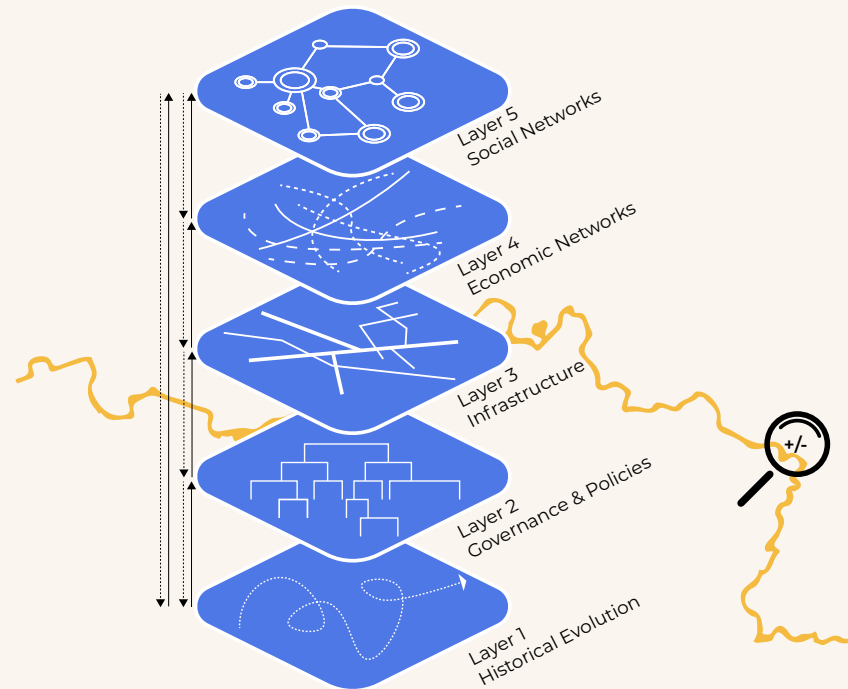
Figure 3.5. Operationalisation of Urbanism of Networks approach

3.3.5. Operationalising the layers approach

This research builds on the version suggested by Rocco (2008) and reframes some of the layers to better suit the context of a mobility transition in a cross-border region. With this enriched version there is still an important missing link regarding the possibilities to compare layers with each other. The missing link is the discontinuity of scales between layers, therefore the relations between layers become meaningless (Van Schaik, 2005). To be able to come to the right conclusions and relational context zooming in and out is essential (fig. 3.5). Moving through the scales can reveal causal relationships between different scale levels and layers. Understanding these relationships can help shape the transition strategy.

The layers used in this research are:
- Layer 1: The history of travelling across the Dutch-Belgian border and the evolution of different transit modes. Zooming in to a more local context the history of both infrastructure and identity of the region can be analysed.
- Layer 2: Governance & Policies: The governance structure of this region has a long history and could be connected to layer 1. Furthermore, it will analyse the support of different transportation methods by policies.
- Layer 3: The location of infrastructure networks is the result of historical developments as well as policy and governance structures.
- Layer 4: The economic networks in the cross-border region are highly dependent on the infrastructure that is available. On the other hand the two layers are symbiotic as different economic networks might demand special infrastructure. Furthermore, the economic networks can be the reason for movements
- Layer 5: Social structures are the result of all other layers and play an important role in understanding the activities and movement of citizens throughout the cross—border region.

3.3.6 Layer Elements

The layers represent different aspects of the urban system related to mobility (fig. 3.6). The social layer is about interactions between different individuals and social groups. Interaction can happen virtually but also manifest in space at meeting places. The economic layer is the link between places and connetions, where places like services, retail and works can be linked to the movement of commercial activities. Both the Social and Economic layer use the physical connections that make up the infrastructure layer. The governance and policy layer has a steering character as it creates the boundaries in which the physical connections can take place. The historical evolution layer is the basis of many of the networks. The structure of a network as well as embedded culture and identity is all the product of the historical evolution of the region.

The three middle layers will be the layers in which this research will look for space to act. The social and historical layer both influence this space for action and will give context.

3.3.7 Conclusion

Using the Urbanism of Networks approach highlights the interconnectedness of a system, which can be used as a tool for both analysis and action. Ultimately it will enable the connection of physical and social spaces in a meaningful and practical way (Wandl et al., 2012). The analysis carried out for each layer will draw on the theory introduced in chapter 2. This ensures a relation between theory and practice.
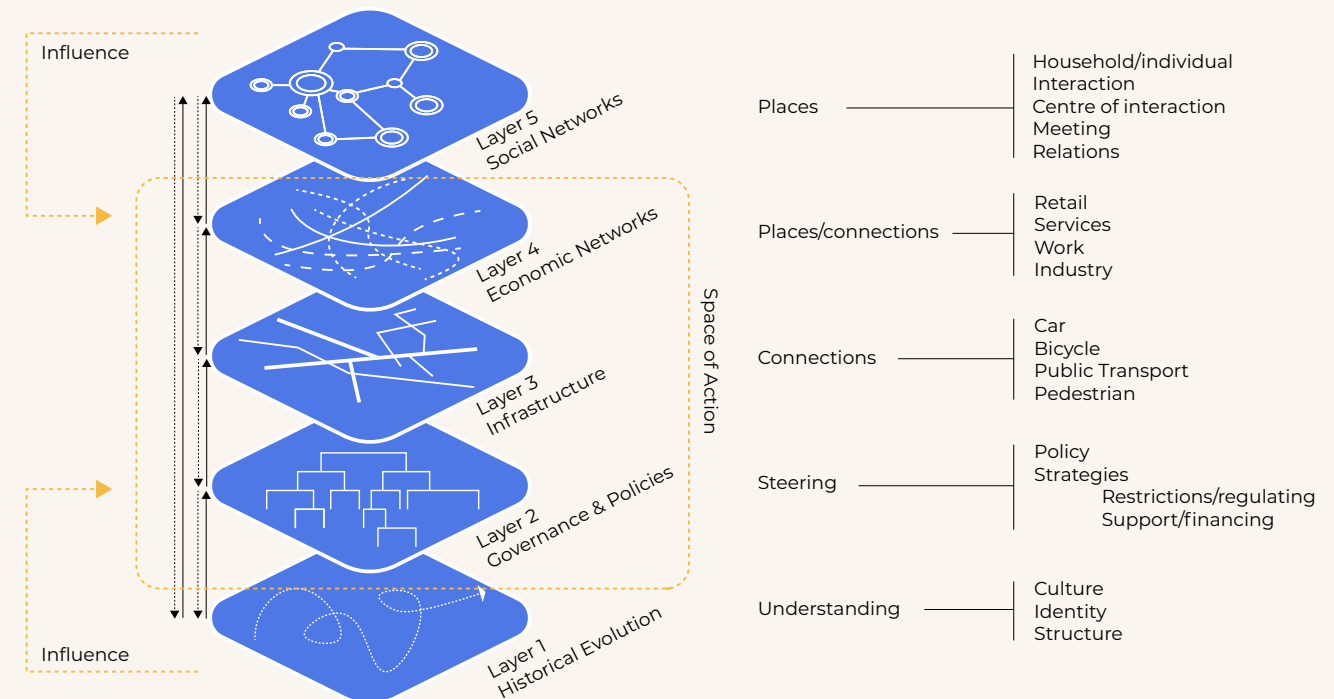
Figure 3.6. Layer elements & Space of action within the Urbanism of Networks approach

3.4 | SCALES OF RESEARCH

Throughout the research many different scales will be used (fig. 3.7). As suggested in the previous paragraph zooming in and out throughout the analysis is important to fully understand the relations between different networks (Van Schaik, 2005). The scales used in this research will be the national scale to determine which regions will be most impacted by a mobility transition. The provincial scale will reveal interconnectedness between cities and networks and will provide the background for the regional vision. Zooming in to the regional scale a closer look at border conditions is possible. Lastly the city scale will be researched as well, as this is where most citizens will interact with the results of a mobility transition.

The analysis will be mostly done on the provincial, regional and city scale. This is due to the amount of information that has to be analysed. Determining the locations of the analysis will be done by looking at different characteristics of the border region and mapping them on a national scale level.

CITY SCALE

REGIONAL SCALE

PROVINCIAL SCALE

NATIONAL SCALE
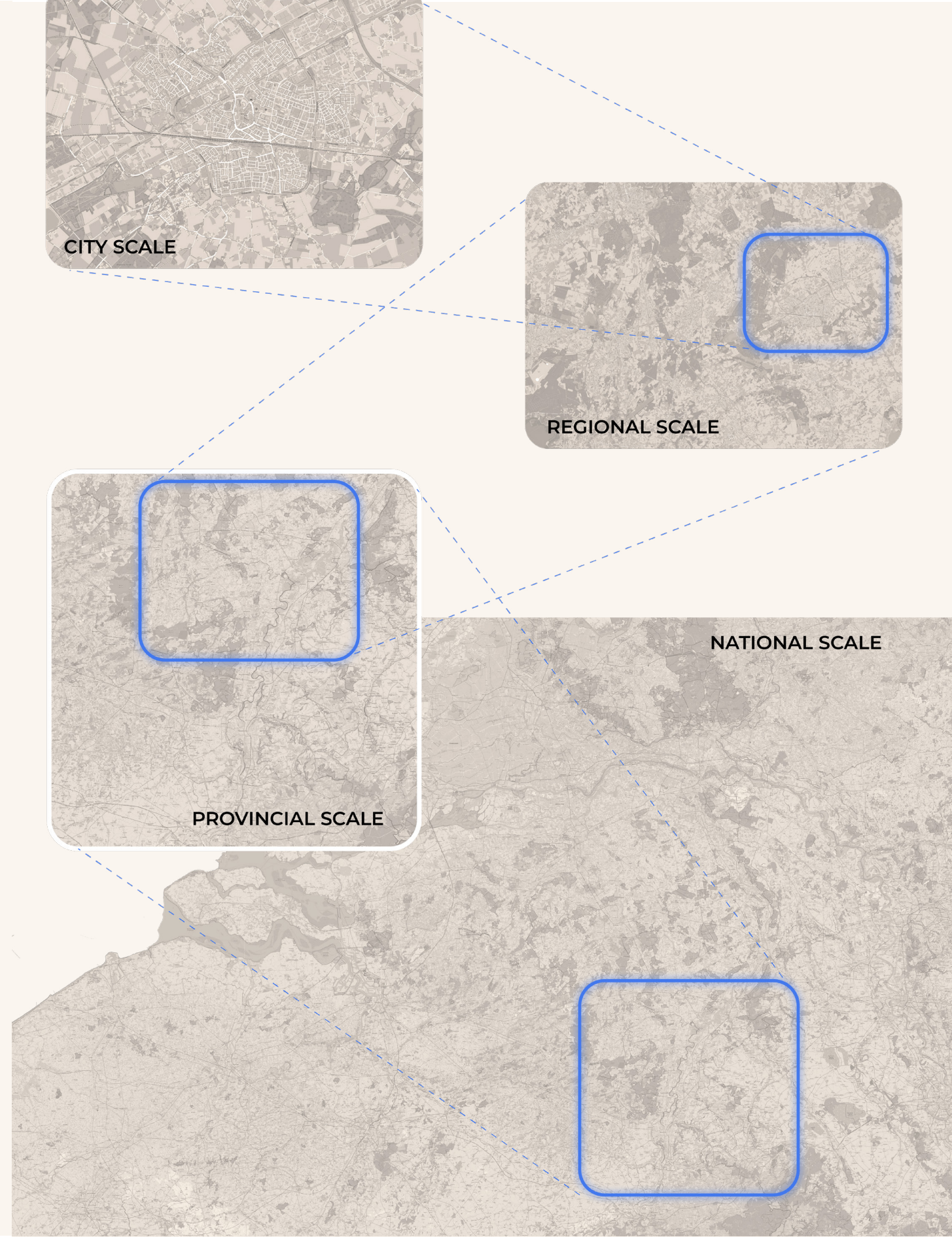
Figure 3.7 Scales of Research

3.5 | ETHICAL CONSIDERATIONS

Researchers should be aware of the ethical issues that could arise throughout the lifecycle of a research project and promote a culture of ethical reflection, debate, and mutual learning (ESRC, 2021). It is therefore important to use an ethical framework when working on a research project. This ethical thinking and attitude should be done by the researcher throughout the entire lifecycle of the research project. The lifecycle of research includes the planning and research design stage, the period of funding for the project, and all activities that relate to the project. This includes knowledge exchange and impactful activities, the publication and the archiving, future use, sharing and linking of data (ESRC, 2021).

To reflect on the ethical issues that could arise in this research project the six principles of ethical research of the Economic Social and Research Council (ESRC) based in the UK could be used (ESRC, 2021). The Six principles are:

1. Research should aim to maximise benefit for individuals and society and minimise risk and harm
2. The rights and dignity of individuals and groups should be respected
3. Wherever possible, participation should be voluntary and appropriately informed
4. Research should be conducted with integrity and transparency
5. Lines of responsibility and accountability should be clearly defined
6. Independence of research should be maintained and where conflicts of interest cannot be avoided, they should be made explicit.

During the reseach the progress will be tested against these principles to prevent any harmful actions or statements that could impact any other individual.

04 |

ANALYSIS

Content

Beneluxtrain that was used as a connection
between Amsterdam and Brussels
Photo: Cock Koelewijn
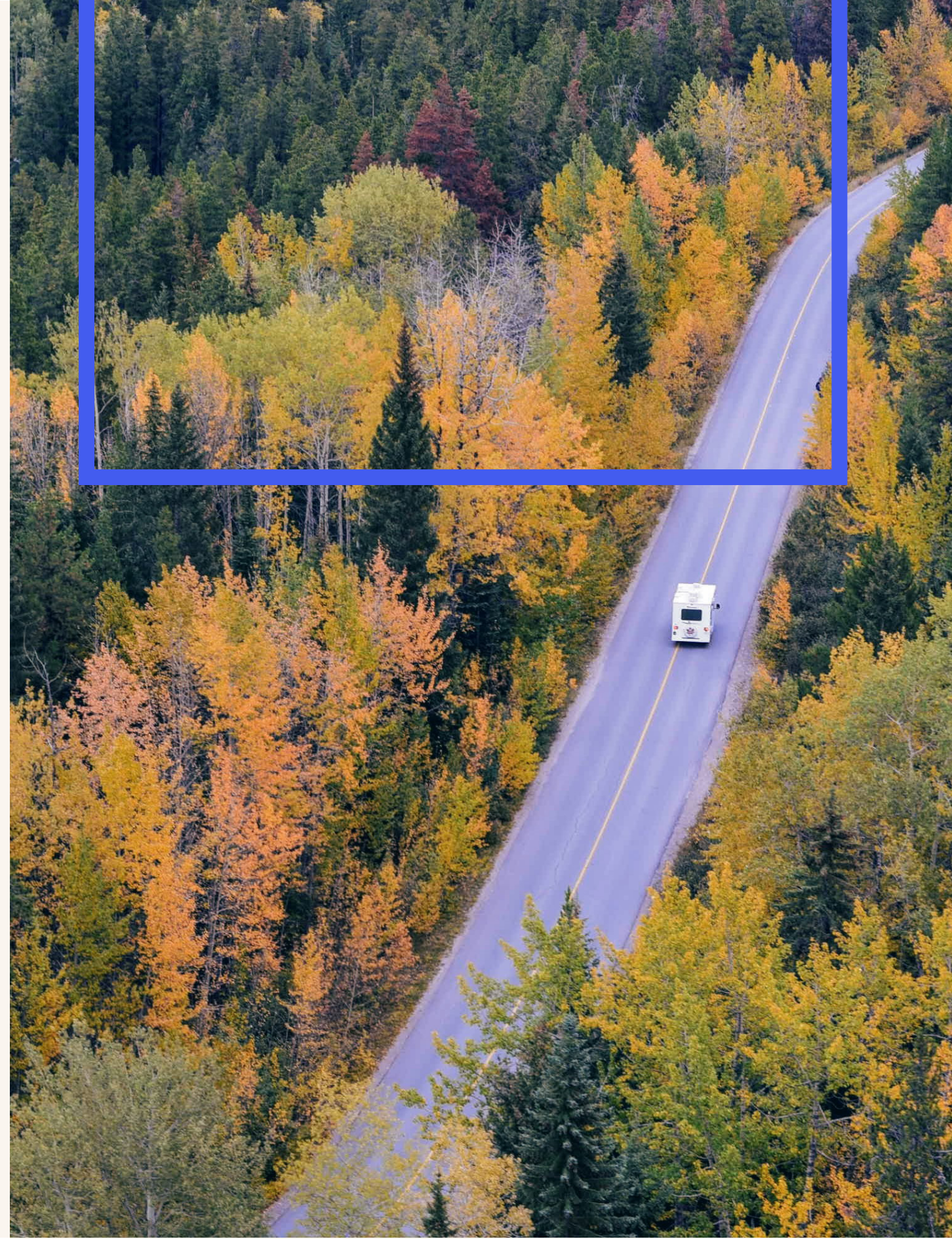
4.1 DETERMINING THE LOCATION

4.1.1 Deciding on the location

Before an in-depth analysis is possible, a more detailed location must be determined. The cross-border region of The Netherlands and Belgium in itself is to large for this research to fully cover with an analysis. Therefore, based on a national analysis several locations will be filtered to investigate further. As it is expected that not one, but multiple locations will be of interest, the thesis will use the case study method when doing the analysis, developing the vision and strategy. Only 1 location will be investigated in detail to fully understand the system of that region. Moving through the scales will ensure that relations with other regions can be noticed. After the full process of analysing, creating a vision and making a transition strategy is completed the result can be tested on the other locations during another study. For a visualisation of this process see figure 4.1.

Figure 4.1. Visualisation of Analysis, Vision and Stategy-making process

NATIONAL ANALYSIS

LOCATION #1

CASE STUDY

ANALYSIS

VISION

PATTERNS

STRATEGY
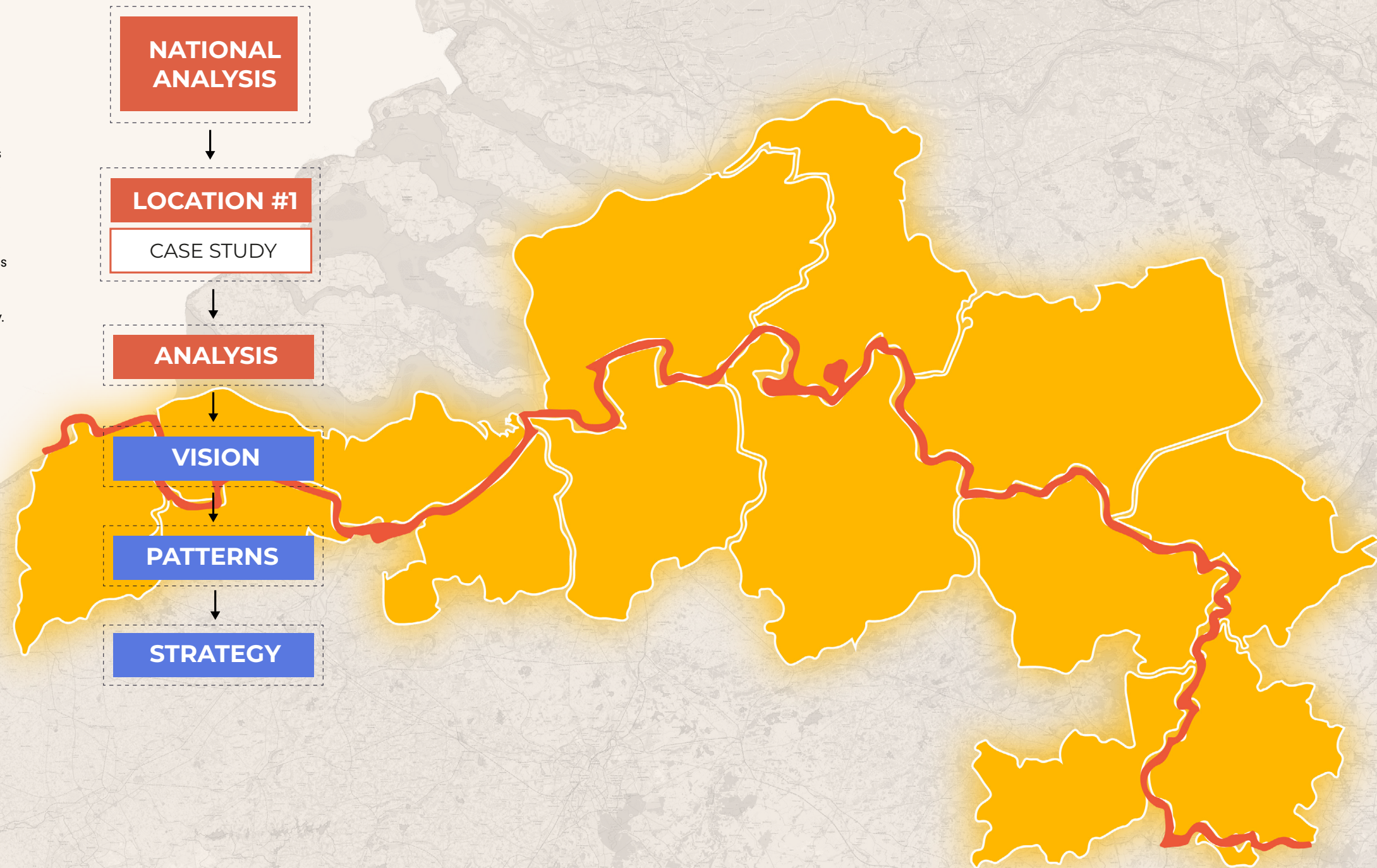
4.1.2 Border Commuters
This map (fig 4.2.) includes the percentage of daily commuters crossing the border in order to reach their job. There are two regions that show a significant high percentage, which is the region towards the coast and Scheldedelta as well as the Limburg region. In both regions the percentage of commuters crossing the border is >3% (CBS, 2017).

Legend
% of commuters
crossing the border

> 3%

1-3%

0,25-1%

0,1-0,25%

> 3%

1-3%

0,25-1%

0,1-0,25%
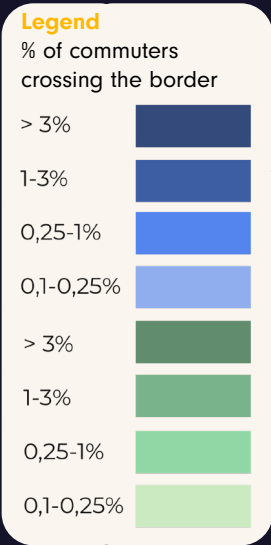
Figure 4.2. Percentage of commuters crossing the border on a daily basis (based on CBS, 2017)
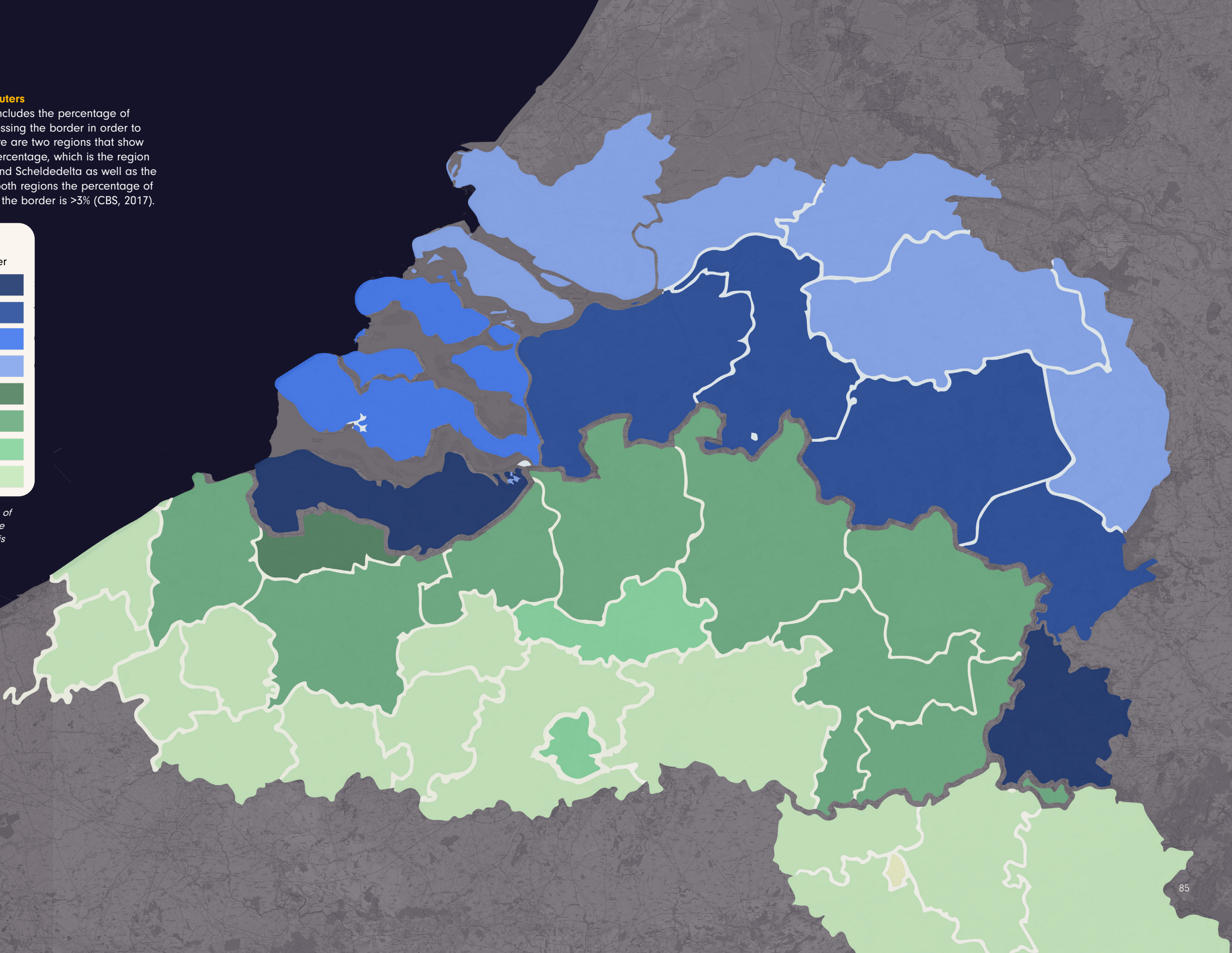
4.1.3 Distribution of Jobs

Based on the previous map showing the number of citizens commuting across the border on a daily basis the working environments of both The Netherlands and Belgium are explored. The similarities between the two countries, regarding the distribution of jobs between the 5 main sectors: (1) Primary Sector, (2) Industry, (3) Construction, (4) Commercial services, and (5) Public services, are striking (fig. 4.3). Both countries have a similar distribution of jobs (CBS, 2017).

When we take a closer look at the difference between the population living in Netherlands and working in Belgium and the population living and working in the Netherlands (fig. 4.4), we see a difference in the distribution. There are on average more border commuters working in the industry than residents that work in the Netherlands. A similar trend is visible when we look at it from the Belgian side. There are more border commuters working in the Dutch industry sector than there are in the Belgian industry. Another difference is the number of jobs that border commuters perform in the public services sector. In the Netherlands this is almost equal for border commuters and residents, whereas in Belgium there is a significantly lower percentage of border commuters working in the Public services sector than on average (CBS, 2017).

Border Region Belgium

Border Region Belgium pie chart: 0,8%, 17%, 6,1%, 40,7%, 35,3%

Incoming commutes from the neighbouring country according to economic activity
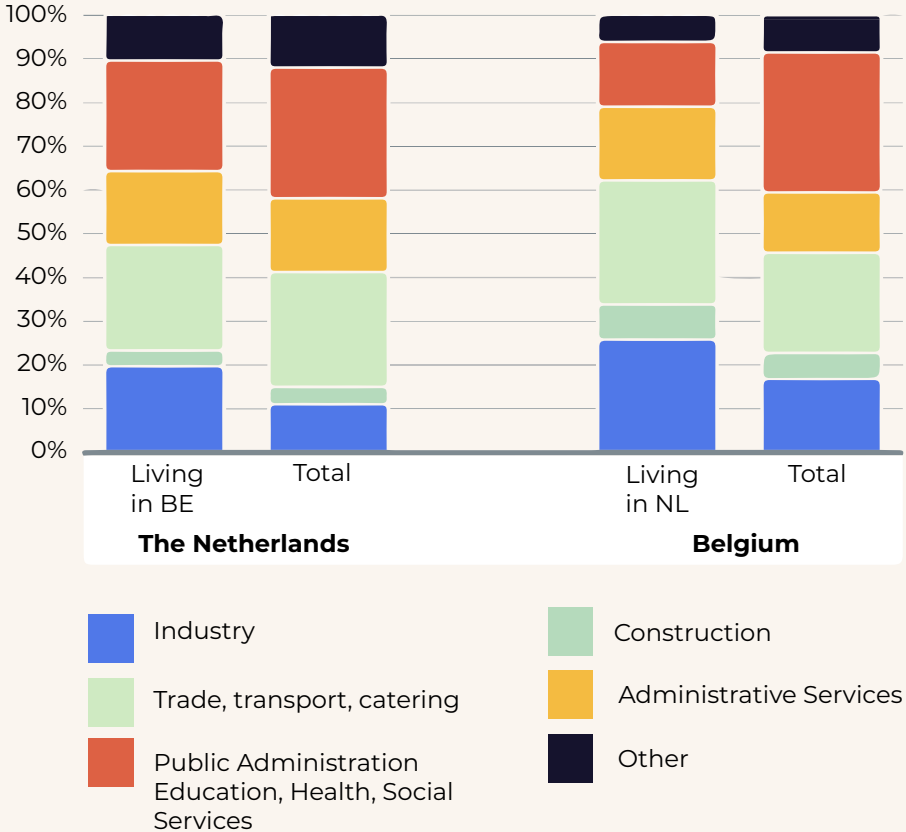
Figure 4.4. Comparison between the economic activity of border commuters and the total economic activity of the labour force.

Legend:
- Industry
- Trade, transport, catering
- Public Administration Education, Health, Social Services
- Construction
- Administrative Services
- Other

Border Region The Netherlands

Border Region The Netherlands pie chart: 0,8%, 14,4%, 3,7%, 49,6%, 31,1%
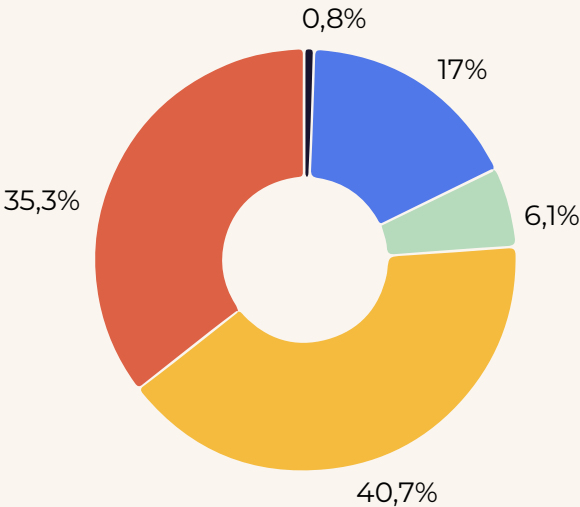
Main sector
- Primary Sector
- Industry
- Construction
- Commercial Services
- Public Services

Figure 4.3. Percentage of Jobs based on main sectors in the Border Region.

4.1.4 Language

There are many cultural similarities between The Netherlands and Belgium. One of them is the similar languages. In The Netherlands most citizens speak Dutch where as in Belgium citizens speak either Flemmish, close to Dutch, or French. The Vlaanderen region has a population that generally speaks Flemmish. The region of Wallonia on the other hand speaks French. Then there are some smaller regions, along the German border, where German is the most common language. Along most of the border on both sides similar languages are spoken. The exclusion to this rule is Limburg (NL), where in the regions bordering the south French or German are the most spoken languages. This difference in language could make it more difficult to travel accros the border for a job. The base layer of figure 4.5 shows the percentage of border commuters as earlier introduced and it becomes clear that the french speaking regions have less border commuters than the Dutch speaking regions.

Legend
Most spoken language

Dutch

French

German

Figure 4.5. Most spoken language

4.1.5 GDP per Capita

This map shows how each NUTS-3 region performs when it comes to GDP/Capita (CBS, 2019; Eurostat, 2019). What stands out is that the Brabant Region is performing well when compared to the national average in both the Netherlands and Belgium. On the Otherhand the regions of Zeeuws-Vlaanderen (NL) and the arrondissements (BE) directly south of the border are below average. When looking at the Limburg (NL) region we see a similar trend except that the arrondissements (BE) bordering Limburg (NL) have an even lower GDP per capita when compared to the natiaonal average (fig. 4.6).

Legend

GDP per capita
100% = average

- 120-130%
- 110-120%
- 100-110%
- 90-100%
- 80-90%
- 70-80%
- 60-70%
- <60%
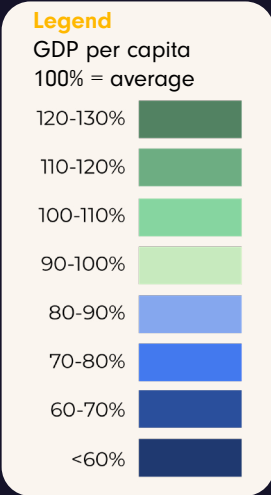
Figure 4.6 GDP/capita compared to the national average
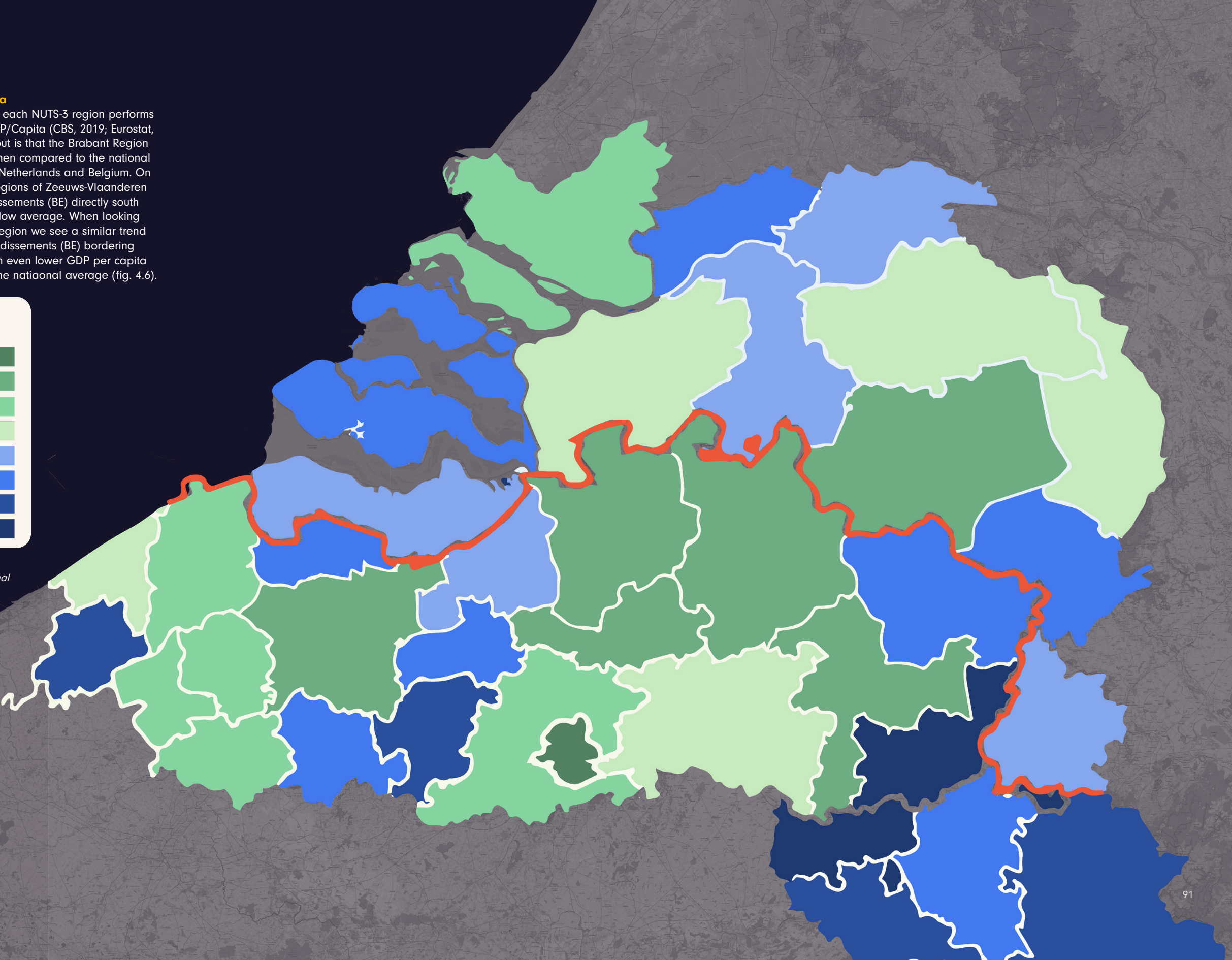
4.1.6 Interesting Locations

Based on the previous maps and data there are two areas that are worth looking into (fig. 4.7). The first region is the most western region of the border, Zeeuws-Vlaanderen | Oost-Vlaanderen. This region shows the most border commuters as well as a lower regional average when it comes to GDP per Capita. A similar situation is found in the most eastern side of the border the Limburg | Limburg region.

Figure 4.7. Interesting locations for further analysis

Zeeuws-Vlaanderen | Oost-Vlaanderen
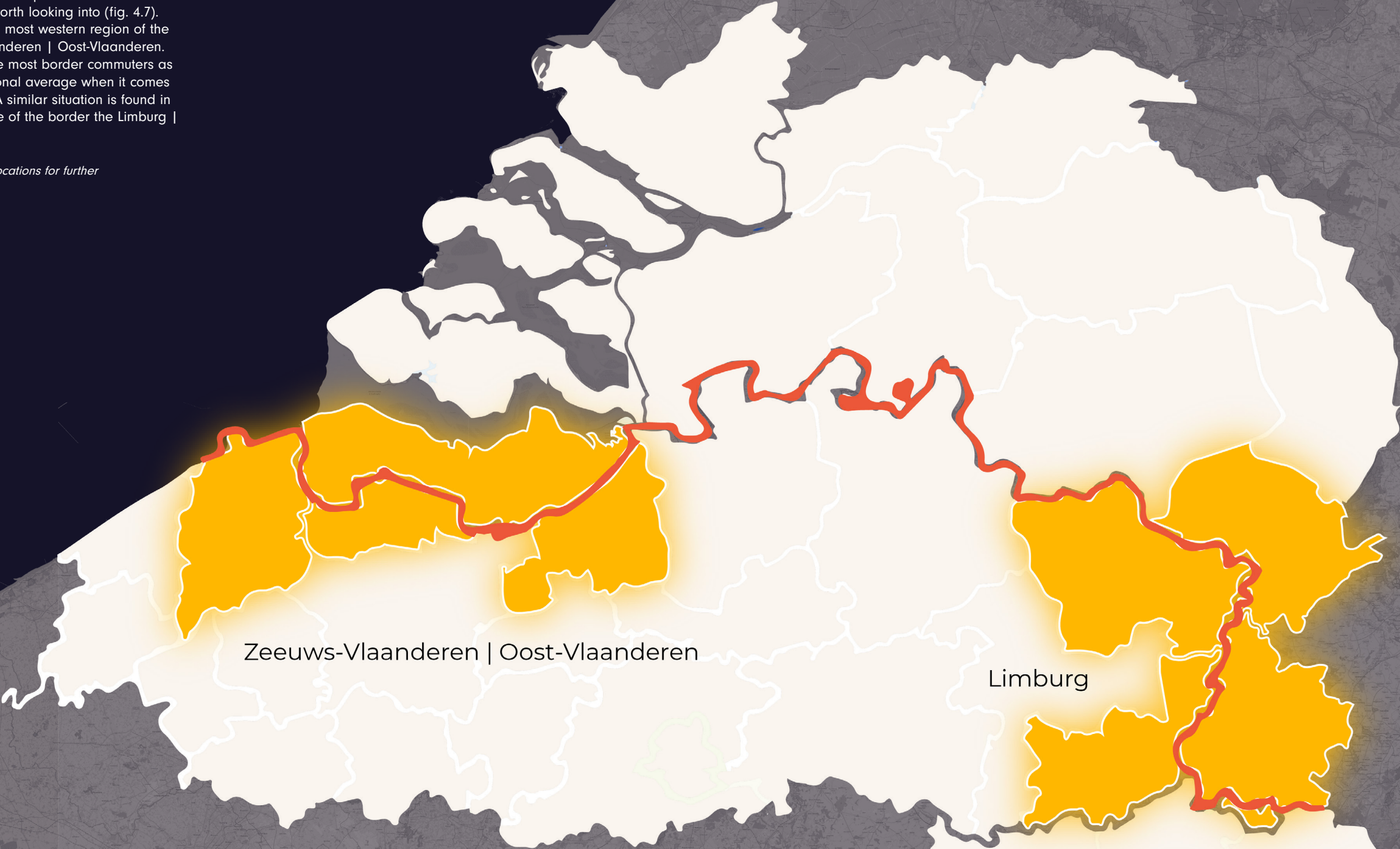
Limburg

4.2 | LIMBURG | LIMBURG

As explained in chapter 3 the Dupuy Networks of Urbanism approach is used to analyse the region. The region of Dutch and Belgian Limburg is still rather large. This means that a further reduction of scale must take place before a more in-depth analysis can be carried out.

Layer 5
Social Networks

Layer 4
Economic Networks

Layer 3
Infrastructure

Layer 2
Governance & Policies

Layer 1
Historical Evolution
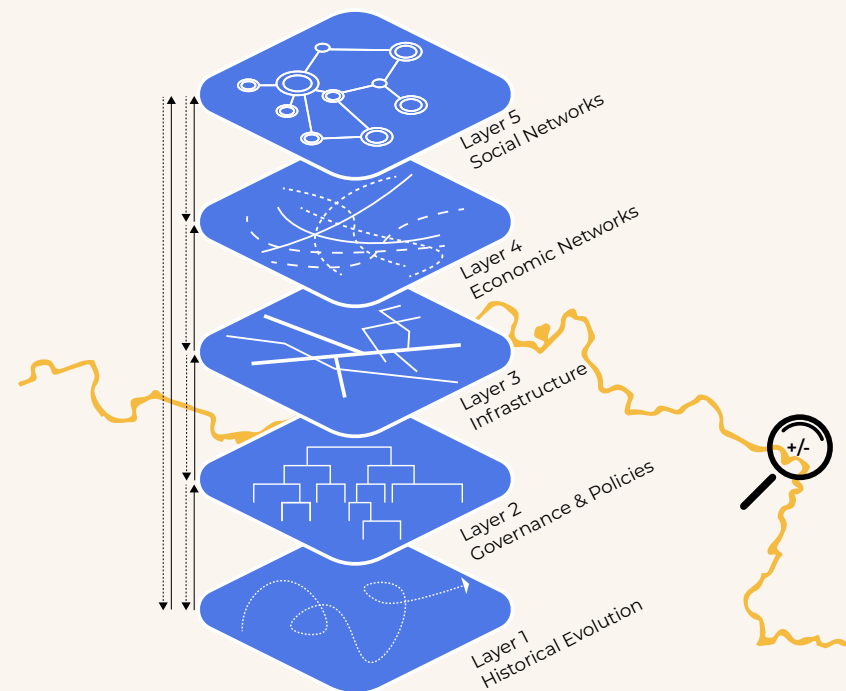
Figure 4.8. Operationalisation of Urbanism of Networks approach
(Based on Dupuy, 2008; Rocco 2008)

Figure 4.9. (right) The Limburg Region showing the directly bordering NUTS 3 regions. Ferry between The Netherlands and Belgium in Berg aan de Maas Photo: Siebe Swart, 2010
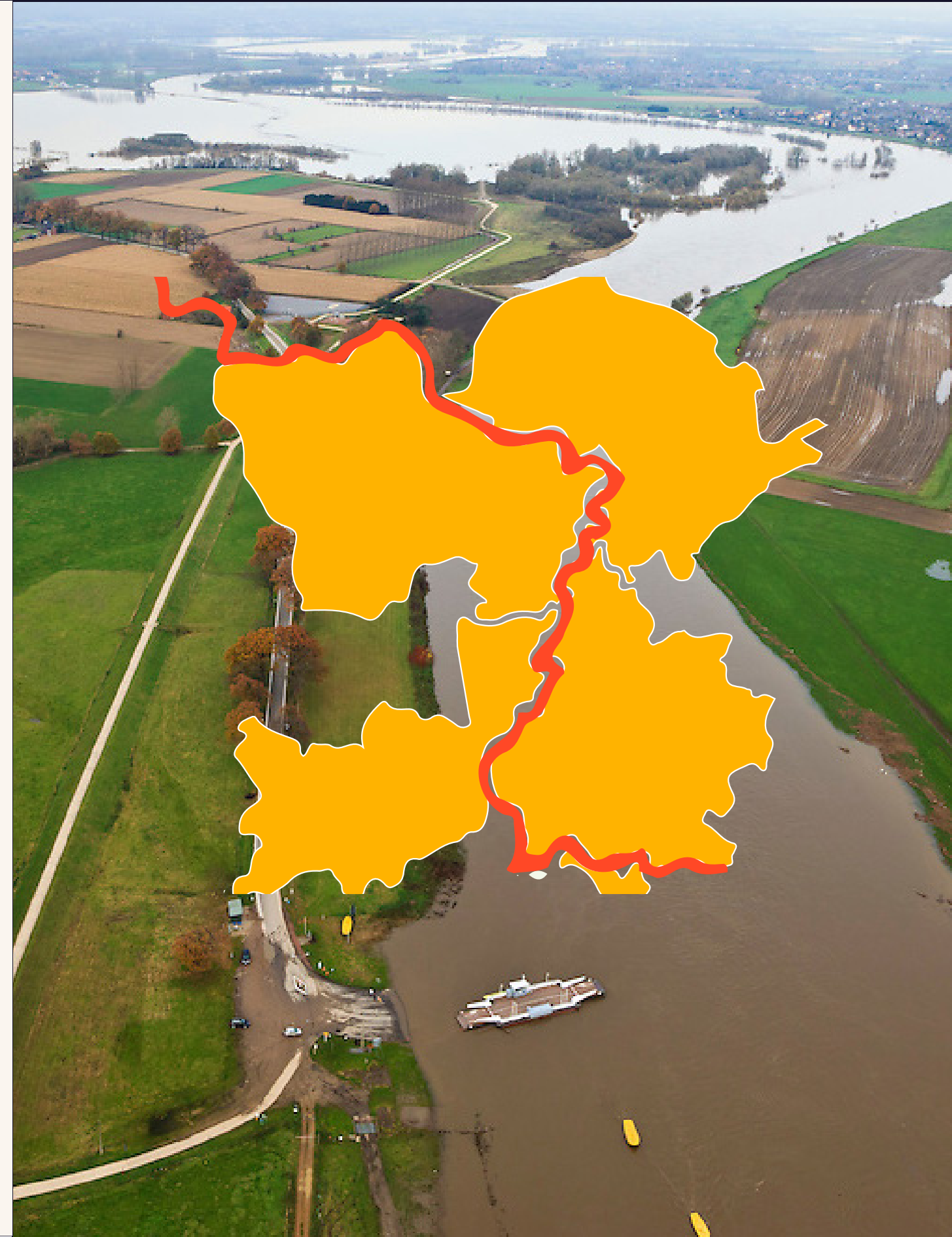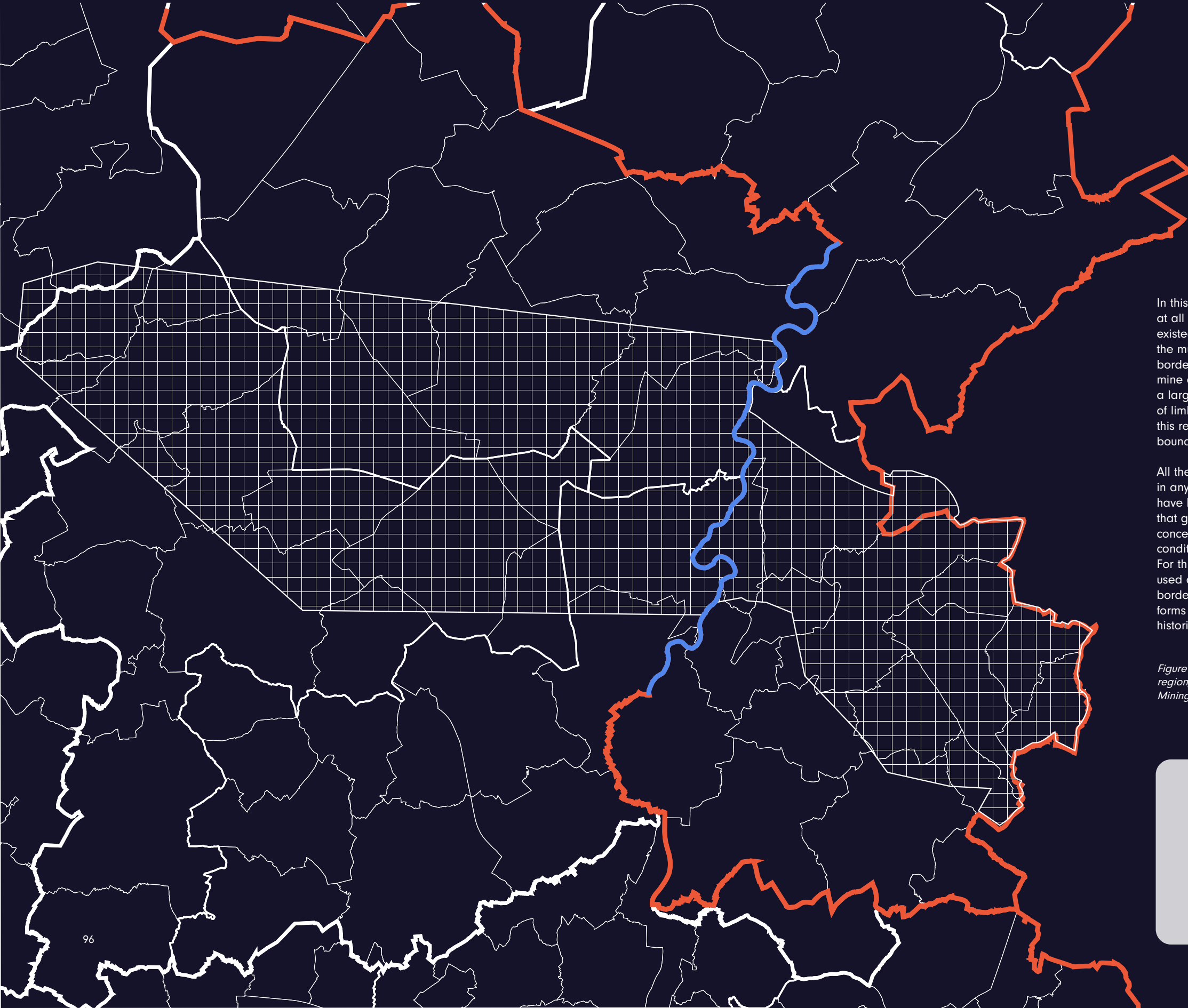
In this case one way to reduce the scale was to look at all the administrative borders that exist or have existed in Limburg (fig. 4.10). These borders include the municipalities, the NUTS-3 regions, the provincial border, the national border and the outline of the mine concessions. Furthermore it is worth noticing that a large portion of the national border in the south of limburg is made up by the Maas river. Therefore, this region does not only have an administrative boundary but is also physically separated by water.

All these borders do not cross the national border in any way. However, when looking at borders that have been in place in the last century there is one that goes beyond the national border, the mine concessions. This border is based on the ground conditions of having easy access to coal (fig 4.11). For this thesis the mine concession border will be used as the area of the case study as it is the only border that crosses national borders and therefore forms a transnational region that shares similar historical, economical and social context.

Figure 4.10. All borders in the Limburg region, National, Provincial, Municipal and Mining Concessions (based on SOURCE)

_____ municipality border

_____ NUTS-3 region border

_____ province border

_____ national border

_____ national (water) border

▦▦▦ mining concessions

4.3 | HISTORY

4.3.1 Introduction

The region of Limburg has seen many different forms, cultures and types of settlements. This dates back to the first traces of urbanization by the roman empire, building bridges over the Maas river and paving roads such as the Via Belgica and Via Traiana (Tichelman, 2016). Whilst the border of Limburg changed many times there was a brief period where both Belgian and Dutch Limburg existed as one. They split in 1839, only nine years after Belgium separated from the Netherlands, finally settling on the border we know today (Provincie Limburg, 2018).

Over the years Limburg always remained a mainly agricultural region with a few main settlements such as Maastricht, Heerlen, Hasselt and Genk. However, this all changed when the first large scale coal mines opened in the region. The mining of coal in the region can be dated back to as early as the 12th century all be it on a much smaller scale. The increase in mining activity was caused by the growing need for coal to 'power' the industrial revelution (Rijckheyt, n.d.). Besides that, the region had relatively easy access to coal as many of the coal fields could be found above 1200 meters (fig. 4.11) (Stichting Wetenschappelijke Atlas van Nederland, 1985). As the mining activities had a large impact on the built environment of which most still be seen today the first level of Dupuy's analysis will focus on roughly the last 150 years of history. These were also the years that many inventions regarding transportation methods were done.

4.3.2 Limburg in the last 150 years

We can distinguish 5 distinctive periods in the Limburg Region over the last 150 years, an overview can be seen in fig 4.13 on the next page (Coenen & IBA Parkstad (Heerlen), 2015).

1. Agricultural landscape (before 1890)
Many of the inhabitants of the region were farmers and lived in agricultural communities. The region had forests and some small villages with ribbon developments, meaning that most of the villages structures where centered around one or two roads. Besides these more place related changes

we also see a shift in travel behaviour from long distance travel to commuting.

2. Shift to industrial landscape (1893 – 1924)
The first mine opened in the Netherlands, Oranje Nassau I in 1893 and many more opened after that. In Belgium the first mine opened in 1914. The new opportunities for work sparked an increase in population due to migration. Not only attracting workers from within the national borders but also internationals. In a way the mining sites became the cradle of multi-cultural society in both Belgium and the Netherlands. During this period a lot of rail infrastructure was developed to transport the coal and workers. There is a shift towards more individual transport by for instance bike and an increase in public transport in larger cities. Furthermore, a housing association 'Ons Limburg' was founded to improve the poor living conditions of the employees.

3. Modern Developments (1924 – 1968)
To improve the housing conditions new neighourhoods were developed surrounding the mining sites known in Dutch as 'Tuindorpen' or 'Tuinwijken' (fig 4.12). These neighbourhoods were modelled after the famous design of the Garden City by Ebenezer Howard. During this period a lot of the previously made connections by rail start to disappear due to a new upcoming vehicle 'the car'. This results in the discontuation of many train and tram lines including the last rail link between the Dutch and Belgian mining region between Maastricht and Hasselt. This is also a pivotal moment in the history of Limburg as in 1965 the closure of the Dutch mines is announced.

Figure 4.11. Map of Coal Fields above 1200 in Belgium, The Netherlands and Germany (based on Stichting Wetenschappelijke Atlas van Nederland, 1985)
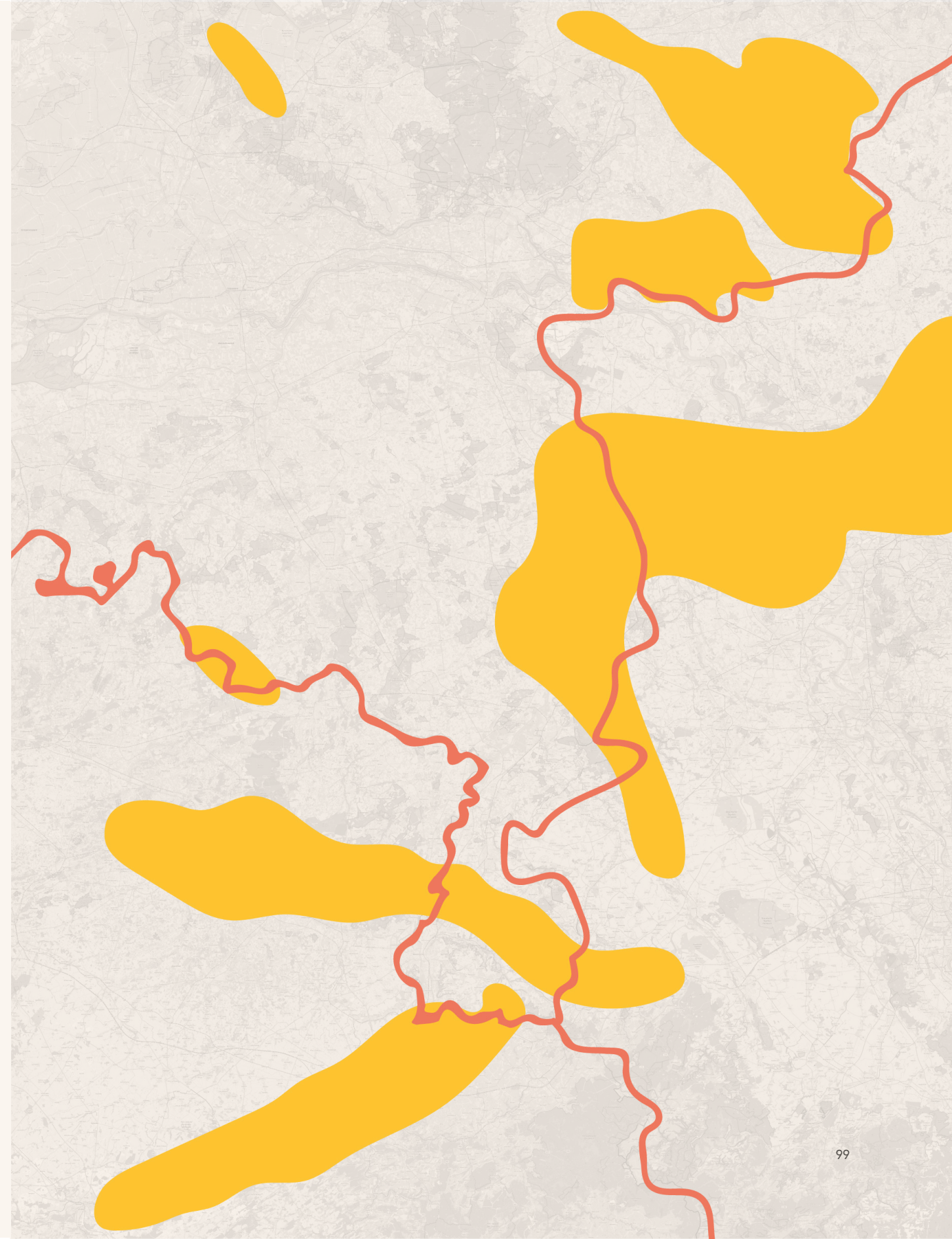
4. The business park (1968 – 1989)
With closing of the mines accompanied by the disappearance of jobs the government was looking for a way to prevent a high unemployment rate. This was done by introducing new industries with subsidies of the government. In both Belgium and the Netherlands large car factories were established. These types of factories were built in business parks on the edges of existing towns. To support the increase in car traffic many new arterial roads are built in favour of rail infrastructure. During this period the social cohesion and identity of the region slowly fades away.

5. Microplanning (1989 – present)
Where the last Dutch mine closed already in 1974, the last mine in Belgium closed in 1992 in Zolder. With all the mines now closed the results of the decrease in jobs becomes visible. The unemployment rate in Limburg increases drastically. The subsidies to attract new businesses didn't have the outcome they were hoping for. Where the mining district used to be a cohesive region it now becomes a more polymorph and polycentric area due to individual interventions and microplans from municipalities.

One of the most interesting finds of this historical analysis is the existence of garden cities in the region. As can be seen in fig. 4.12 below these garden cities were established throughout the region in close vicinity to the mining sites and could therefore play a valuable role in the development of a further vision, strategy on mobility and starting a new era in the history of Limburg.

Figure 4.12. (below) Map of developed garden cities in the Limburg Region

Figure 4.13 (next page) Visualisation of the last 150 years in Limburg (based on Coenen & IBA Parkstad (Heerlen), 2015)

1839
Limburg splits in two and thus Belgian Limburg is seperated from the largest city Maastricht

1970 onwards
More arterial roads are build in favour of rail infrastructure social cohesion dissapears and identity is lost

1911
Foundation of 'Ons Limburg' Housing association to improve poor living conditions. Mainly process-steering preservindg rural character & social-cultural homogenity

1950
Many public transport connections start to dissapear due to upcoming cars.

Many train and tramlines discontinued

1974
Last Dutch mine Oranje Nassau I closes

1965
Den Uyl announces closure of Dutch mines

1830
Belgium seperates from The Netherlands

1896
Infrastructure development for mines First mine trains start operating also used for regional transport

1970
New industries introduced in the region with government subsidies to prevent high unemployment rate

Before 1890
Agricultural landscape & forests with ribbon development

1914
Opening of Winterslag first Belgian mine

1992
Last Belgian mine in Zolder closes

1968 - 1989
Business parks start appearing and many new roads are built to support car traffic

1900
Shift to individual transport & public transport in cities

1952
Foundation of European Coal and Steel Community started a process of integration which ultimately led to the creation of the European Union.

2002
Euro is introduced first time there are no tangible borders between Belgium and The Netherlands while using same currency since 1830

1880 onwards
Shift from long distance travel to commuters

1944
Foundation of Benelux Unie, free transport of goods and people within Netherlands, Belgium and Luxembourg

1924 - 1968
More modern developments surrounding mining sites. Belgium develops tuinwijken

1989 - Present
Individual interventions and microplans. Industrial subsidies didn't always work. Mining district became a patchwork. Polymorph and polycentric area lacking visible or tangible cohesion

1894
Opening of Oranje Nassau I first Dutch mine

1901
Dutch Housing Act

1954
Closure of passenger service between Hasselt & Maastricht

2011
Last train between Hasselt & Maastricht

1885
Bikes are introduced as transport mode and become more widely used

1893 - 1924
Fast changing landscape from agricultural to industrial Population growth due to migration Cradle of multi-cultural society

2020
The Lanaken-Maastricht rail line was permanently decommissioned.

4.3.3 The garden cities

The concept of the garden city was first introduced by Ebenezer Howard as a response to the social and environmental problems of rapidly growing industrial cities of the 19th century. In his first book "To-Morrow: A Peaceful Path to Real Reform" published in 1989 (Howard, 2010) he briefly describes the three magnets (1) Town, (2) Country and (3) Town-Country that determine the question on where would people decide to go. The third magnet is a combination of the best features of urban and rural life and is the start of Howard's vison for an new type of city.

This new type of city would be the best solution to rising problems such as overcrowding, pollution and social unrest that were getting increasingly worse in industrial cities. Similar trends were visible in the surroundings of the mines in Limburg. It is therefore not a surprise that his vision was adapted and used to create the Tuinwijken in Limburg. The goal remained the same: designing, neighborhoods that were self-contained and surrounded by green space eventually leading to a healthier and more harmonious environment for people to live in.

Howard pictured the garden cities as satellites of a central city (fig 4.15). All these cities were connected by public transportation and thus became part of a constellation. Within the garden city itself there was space for pedestrians and cyclist, always aiming to promote a healthy lifestyle. (Howard, 1902). The principles of a Garden City were adapted by the Town and Country Planning Association and articulated for the 21st century (TCPA, n.d.).

While the origins of the development of the original garden cities and the ones built in Limburg is similar there are some key differences. First of all the size of the city itself is different. Ebenezer concept sees the ideal garden city housing up to 32,000 people (Howard, 1902) where the Dutch and Belgian garden cities were a lot smaller with a population between 10,00 and 20,000. This was because these garden cities were specifically developed to house the workers of the mine and thus were based on the number of employees.

Furthermore, the Dutch garden cities were built in a more functionalist style with a focus on efficiency and practicality, with the Belgian garden cities

Walkable, vibrant sociable neighbourhoods	Integrated and accesible public transport & biking system
Community engagement & strong vision	Mixed tenure homes & affordable housing
Local jobs	Strong cultural, recreational and shopping facilities
Homes in green environment	Green infrastructure

Figure 4.14 The principles of a Garden City (based on TCPA, n.d.)

Figure 4.15 Garden city as satelite of central city (Howard, 1902)

leaning more towards the original principles of incorporating a lot of green space and emphasis on nature (fig 4.17).

Despite the differences between the original garden cities and the ones build in Limburg they do still share the same ideology of providing a high quality of life for their residents, with a focus on health, education and community.

4.3.4 Garden City of the Mines

An example of a garden city developed for employees of the mine can be seen in fig. 4.16. It is the Waterschei garden city in the city of Genk developed for the Waterschei mine. The street pattern is very recognisable due to its rounded shapes. There is a lot of open spaces and green facilities. The neighbourhood itself had many amenities and services such as a cloister, school,
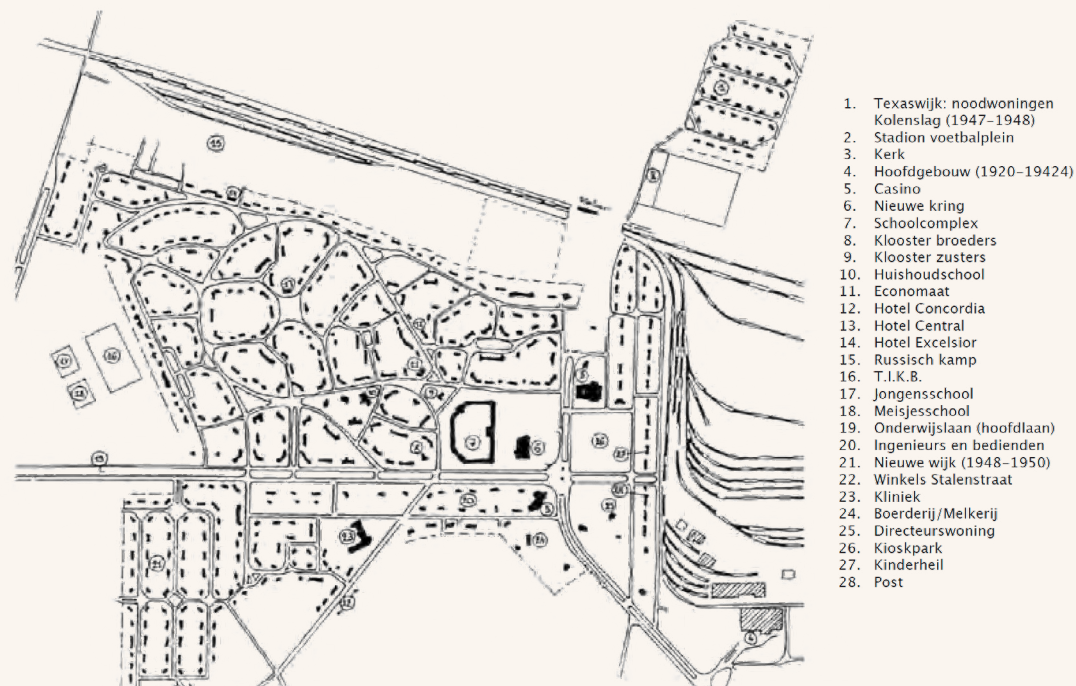
Figure 4.16. (above) Example of a Garden City in Genk, Belgium built for the workers of the Waterschei mine (Keunen, 2010)

1. Texaswijk: noodwoningen Kolenslag (1947–1948)
2. Stadion voetbalplein
3. Kerk
4. Hoofdgebouw (1920–19424)
5. Casino
6. Nieuwe kring
7. Schoolcomplex
8. Klooster broeders
9. Klooster zusters
10. Huishoudschool
11. Economaat
12. Hotel Concordia
13. Hotel Central
14. Hotel Excelsior
15. Russisch kamp
16. T.I.K.B.
17. Jongensschool
18. Meisjesschool
19. Onderwijslaan (hoofdlaan)
20. Ingenieurs en bedienden
21. Nieuwe wijk (1948–1950)
22. Winkels Stalenstraat
23. Kliniek
24. Boerderij/Melkerij
25. Directeurswoning
26. Kioskpark
27. Kinderheil
28. Post

shops, church, casino and much more. This again shows the principle of the neighbourhood being self-contained. It was conveniently located next to the entrance of the mines promoting the use of slow transport methods such as walking and biking to get to work (Keunen, 2010). What must be noted is the absence of the central city as Ebenezer Howard envisioned. In this case the mine itself could be regarded as the central city, however there were never any other garden cities developed to create the network that Howard envisioned.

Even though the mine is now closed and the area it occupied has been redeveloped into an Research and Design Campus the garden city has kept most of its original form. This is the case for almost all other garden cities throughout the region. The mines that caused the development of the garden cities may have disappeared but the garden cities in their original form persisted, showing that there has always been a need for this type of neighbourhoods that promote healthy living. What has changed is the space reserved

for slow transport. Nowadays a lot of space is reserved for cars and as the job opportunities in close vicinity disappeared, so did the incentive to use a sustainable transportation methods such as walking and biking.

4.3.5. Conclusion
The existence of the garden cities gives the opportunity to use them in the strategy making as they are embedded in the landscape and have been built according to principles that match mobility justice. Furthermore they have never been part of a network as there was usually only one garden city related to the central activity. This creates the opportunity to finally connect these neighbourhoods and start working together as a network promoting mobility and supporting a shift to a multi-modal network that does not rely on cars.

Figure 4.17. (right) Impression of the houses in the Waterschei garden city (Keunen, 2010)

106

4.4 POLICY & GOVERNANCE

4.4.1 Introduction

The second layer of the analysis focusses on governance styles and policies in Belgium and the Netherlands. First there will be a look at the government structure before diving into the differences in culture and finally integration of different policies in spatial planning.

4.4.2 Government & Governance

The government structures of the Netherlands and Belgium differ greatly (fig. 4.18). The Netherlands has a constitutional monarchy with a parliamentary system. On the other hand Belgium operates under a consistutional monarchy with a federal parliamentary democracy. In The Netherlands the monarch plays mostly a ceremonial role whereas in Belgium the monarch has more significant executive powers. The federal system in Belgium results in very complex structure with powers divided between federal government government, regional governments of Flanders, Wallonia and Brussels and the Dutch, French and German language communities. This results in 4 institutional layers from federal government all the way down to municipalities. The Netherlands has a unitary state where powers are concentrated in the central government resulting in only 3 institutional layers. Looking at these institutional layers and their planning competences another differences shows. Where in The Netherlands the National government has planning powers, the federal Government in Belgium doesn't (Belgische Federale Overheidsdiensten, n.d.; Rijksoverheid, n.d.).

The governance styles in both countries also differ. The Netherlands has a long history of participatory democracy with citizens actively involved in the decision-making process. Therefore, the Netherlands has a governance style that leans to network and market governance. Belgium relies on a more representative democracy with in general a hierarchical governance style (Swenden, 2006).

Figure 4.18. Organisational diagrom of the Dutch and Belgian Governments, showing planning competences. In orange it shows the departments in charge of infrastructure and transport (Belgische Federale Overheidsdiensten, n.d.; Rijksoverheid, n.d.).
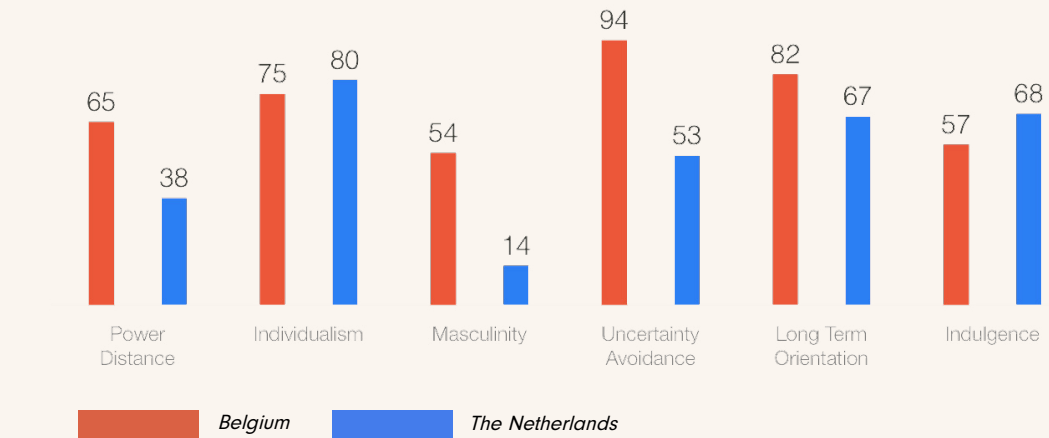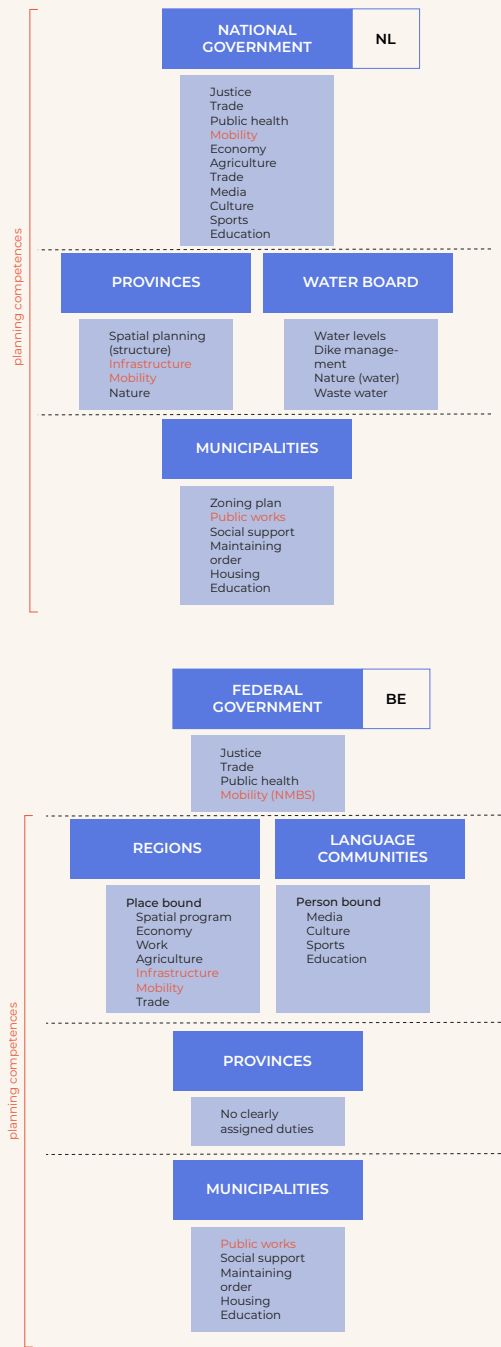
planning competences

NATIONAL GOVERNMENT — NL
Justice
Trade
Public health
Mobility
Economy
Agriculture
Trade
Media
Culture
Sports
Education

PROVINCES
Spatial planning (structure)
Infrastructure
Mobility
Nature

WATER BOARD
Water levels
Dike management
Nature (water)
Waste water

MUNICIPALITIES
Zoning plan
Public works
Social support
Maintaining order
Housing
Education

planning competences

FEDERAL GOVERNMENT — BE
Justice
Trade
Public health
Mobility (NMBS)

REGIONS
Place bound
Spatial program
Economy
Work
Agriculture
Infrastructure
Mobility
Trade

LANGUAGE COMMUNITIES
Person bound
Media
Culture
Sports
Education

PROVINCES
No clearly assigned duties

MUNICIPALITIES
Public works
Social support
Maintaining order
Housing
Education

Figure 4.19. Diagram showing the difference scores of The Netherlands and Belgium In Hofstedes Cutural Dimensions Model (Hofstede Insights, n.d.)

4.4.3 Culture

One way to compare two countries' culture when it comes to international management is Hofstedes cultural dimension model. Hofstede introduces six different dimensions, (1) Power Distance, (2) Individualism, (3) Masculinity, (4) Uncertainty Avoidance, (5) Long Term Orientation and (6) Indulgence (Hofstede, 1980).

The first dimension, Power Distance, already shows a significant difference. In Belgium acceptance of power distance is higher. This can be related to the governance style mainly being hierarchical. The Netherlands on the other scores lower and with power being decentralised and a participative character. When it comes to the second dimension of Individualism both countries score very high, meaning that they both prioritise individual interests over group interests. This cultural trait could make it difficult to shift to a different method of transportation where personal transport is no longer the standard. Belgium also scores relatively high on the third dimension of masculinity. In general Belgian accept more competition, and value achievement and assertiveness. Comprimising or 'Polderen' as the Netherlands is known for is thus less practiced. The Netherlands on the other hand scores very low and is a more feminine society.

The fourth dimension of uncertainty avoidance also shows a big difference. Belgium scores very high where the Netherlands stays in the middle. Making changes is thus very difficult in Belgium as generally they won't easily move away from the current rules and policies. The Netherlands scores lower but also values rules and certainty. Belgium scores very high on the fifth dimension of long term orientation closely followed by The Netherlands. This means that both cultures value long-term planning and perseverance. The last dimension of indulgence is one where The Netherlands scores a little higher. Both countries tend to have a positive attitude and are optimistic, they also value their free time and spend it as they wish (Hofstede Insights, n.d.).

The biggest difference can be found in the power distance, masculinity and uncertainty avoidance, meaning that for these dimensions solutions have to be found to persuade to aim for a change while keeping in mind the cultural norms and values.
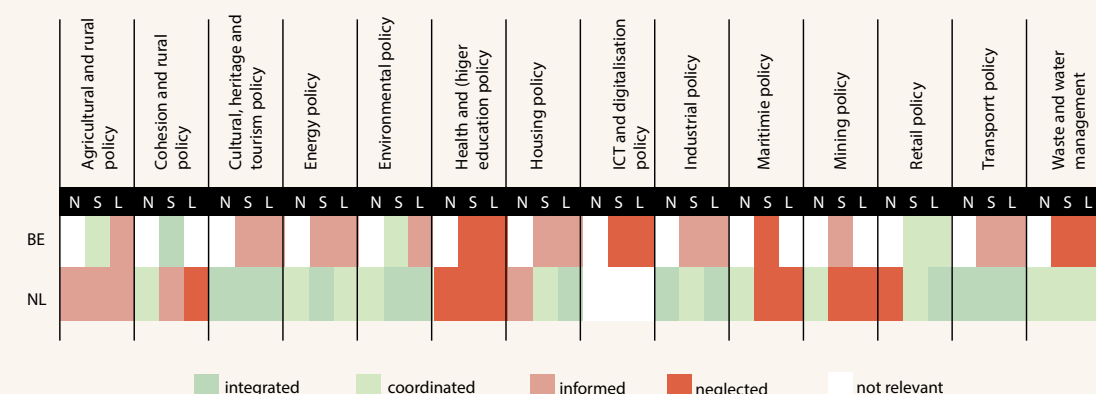
Figure 4.20 Integration of different policy sectors and spatial planning (Nadin et al., 2018) n=national, s=subnational l=local

4.4.4 Policy Integration in Spatial Planning

A comparative analysis of territorial governance and spatial planning systems was done by Nadin et al. (2018). This analysis provides valuable insights on the integration of different policies both regional, and international in spatial planning. An overview given in fig. 4.20 shows the differences between Belgium and The Netherlands. Overall, The Netherlands has more integrated approach when it comes to spatial planning. The most notable policy not being integrated yet is the Cohesion and rural policy which plays a crucial role for large scale system transitions. Belgium has integrated this policy better but lacks integration on almost all other sectors.
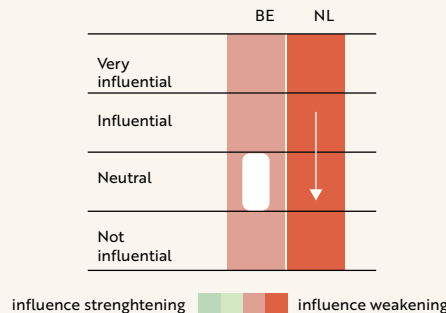

Figure 4.21 .Change in the influence of cohesion and rural policy on spatial planning debates between 2000 and 2016 (Nadin et al., 2018)
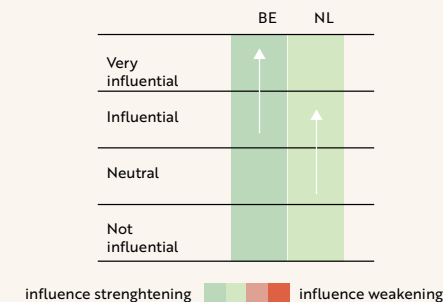

Figure 4.22. Change in the influence of transport policy on spatial planning debates between 2000 and 2016 (Nadin et al., 2018)

For each of these policies the changes influence was documented (Nadin et al., 2018). There are some sectors that are worth looking into for a mobility transition. First the forementioned Cohesion and rural policy. Both countries show a low level of influence which is even decreasing in The Netherlands (fig. 4.21). When it comes the Transport policy both countries are strengthening the influence on spatial planning debates (fig 4.22). Lastly, we can look at the change in citizen engagement in relation to spatial planning and teritiorial governance processes. Both countries show a movement towards more engagement, but Belgium is currently performing lower than the Netherlands (fig. 4.23). This all together creates the need for a better integration of cohesion and rural policies and citizen engagement in future mobility strategies. Both of these aspects are
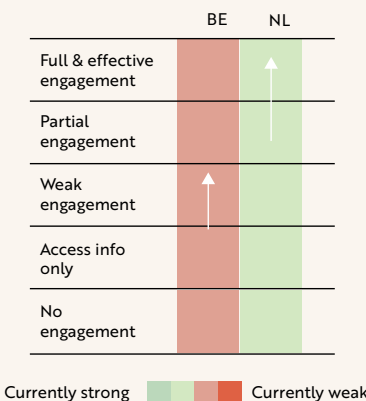
Figure 4.23. Change in citizen engagement in spatial planning and territorial governance processes 2000 - 2016 (Nadin et al., 2018)

of importance as the rural areas will be highly impacted and systemic changes need the support of citizens to succeed. Involving them in the process can create the necessary support.

4.4.5. Public Transport Systems

The public transport systems in the Netherlands and Belgium differ in several ways, including market type, operators, and infrastructure

companies (table 4.1). In the Netherlands, the public transport system is characterised by a semi-open market with concessions except for the main train network and the largest cities (Ministerie van Infrastructuur en Waterstaat, 2021). In contrast, the public transport system in Belgium is more centralized, with state-owned companies holding a monopoly on most public transport services (Belgische Federale Overheidsdiensten, n.d.-b). In the Netherlands, the main operators of public transport services are private companies such as Connexxion, Arriva, and Keolis, as well as the state-owned Nederlandse Spoorwegen (NS) railway company. In Belgium, the main operators of public transport services are state-owned companies, including the National Spoorwegen Maatschappij België (NSMB) for trains services and De Lijn buses, and trams in the Flanders region (Belgische Federale Overheidsdiensten, n.d.-b). Both countries have a separate company that is responsible for the rail infrastructure and these are state-owned.

These two different approaches lead to a more competitive environment in the Netherlands with a diverse range of services. In Belgium there is greater coordination between modes, but less innovation.

Table 4.1 Comparison between Dutch and Belgian public transport systems based on (Ministerie van Infrastructuur en Waterstaat, 2021 & Belgische Federale Overheidsdiensten, n.d.-b.)

	The Netherlands	Belgium
Market type	Semi-open market Concessions (expections for main train network and cities of The Hague, Rotterdam and Amsterdam)	Closed market Monopoly (exceptions for international services)
Train operators	NS, Arriva, QBuzz, Connexion, etc.	NSMB
Tram, Metro, Bus operators	Arriva, QBuzz, Connexion, EBS, RET, GVB, HTM	De Lijn - Flanders TEC - Wallonia MIVB - Brussels
Infrastructure (rail)	Prorail	Infrabel

4.5 | INFRASTRUCTURE

4.5.1 Introduction
This next part of the Dupuy's networks of urbanism analysis will explore the various layers of infrastructure that have been developed in the mine district, from the soft transport networks of pedestrian and bicycle paths to the more traditional modes of transportation such as rail and road. Additionally the level of services provided by this infrastructure is considered.

4.5.2 Soft Transport Networks
The development of the vast network of biking and walking trails in the region of Dutch and Belgian Limburg, as well as the German state of North Rhine-Westphalia, is the result of collaborative efforts, including the Interreg program Cycling Connects that started in 2019 (Interreg Euregio Meuse-Rhine, 2020). This program aims to improve cycling infrastructure and connectivity across borders and connect different communities and regions. Funded by the European Union under the auspices of the European Regional Development Fund, Cycling Connects has been successful in achieving its goals (Cycling Connects, n.d.-b).

One of the program's notable successes is the creation of a cohesive and integrated network of cycling routes that spans across borders, such as the "Fietsen door Drie Landen" route. This cross-border cycling route connects the Netherlands, Belgium, and Germany, spanning over 130 kilometers and taking cyclists through some of the most scenic and culturally significant areas of the region (Cycling Connects, n.d.-a)

The success of Cycling Connects is due in large part to the collaborative efforts of various stakeholders, including local governments, cycling organizations, and community groups. These groups have worked together to identify areas in need of improvement and to implement solutions that enhance the cycling infrastructure and promote sustainable transportation options (Cycling Connects, n.d.-b; Interreg Euregio Meuse-Rhine, n.d.)

Lastly when we look at the border crossings themselves there are currently 6 in close vicinity

of the mine district of which 3 are a ferry and thus not always accessible (fig. 4.24). These ferry don't operate in winter and only operate daily in the months of June, July and August (RivierPark Maasvallei, n.d.). The other crossings are always accessible but exist of busy bridges. With one sharing space with the only highway connection in the Mining district (fig 4.26).

Figure 4.26. Border crossing with the highway and biking paths on both sides. Photo: Hans Hinssen, 2021

Despite the success of Cycling Connects, there is still a lack of infrastructure when it comes to commuting across the border. While the network of biking and walking trails has been highly successful in promoting recreational cycling and walking, it has not yet fully addressed the needs of those who need to commute across the border for work or other purposes. This is because many of the existing trails are designed primarily for recreational use, with limited options for those who need to commute. As such, there is a need for continued collaboration and investment to ensure that the infrastructure is in place to support sustainable transportation options for all, including those who need to commute across the border.

Figure 4.24. (right) Walking and biking routes in the border region (based on OpenStreetMap Contributors, 2023a).

Figure 4.25 (next page) Full network of walking and biking routes in the Mine District (OpenStreetMap Contributors, 2023a)

cross border connection
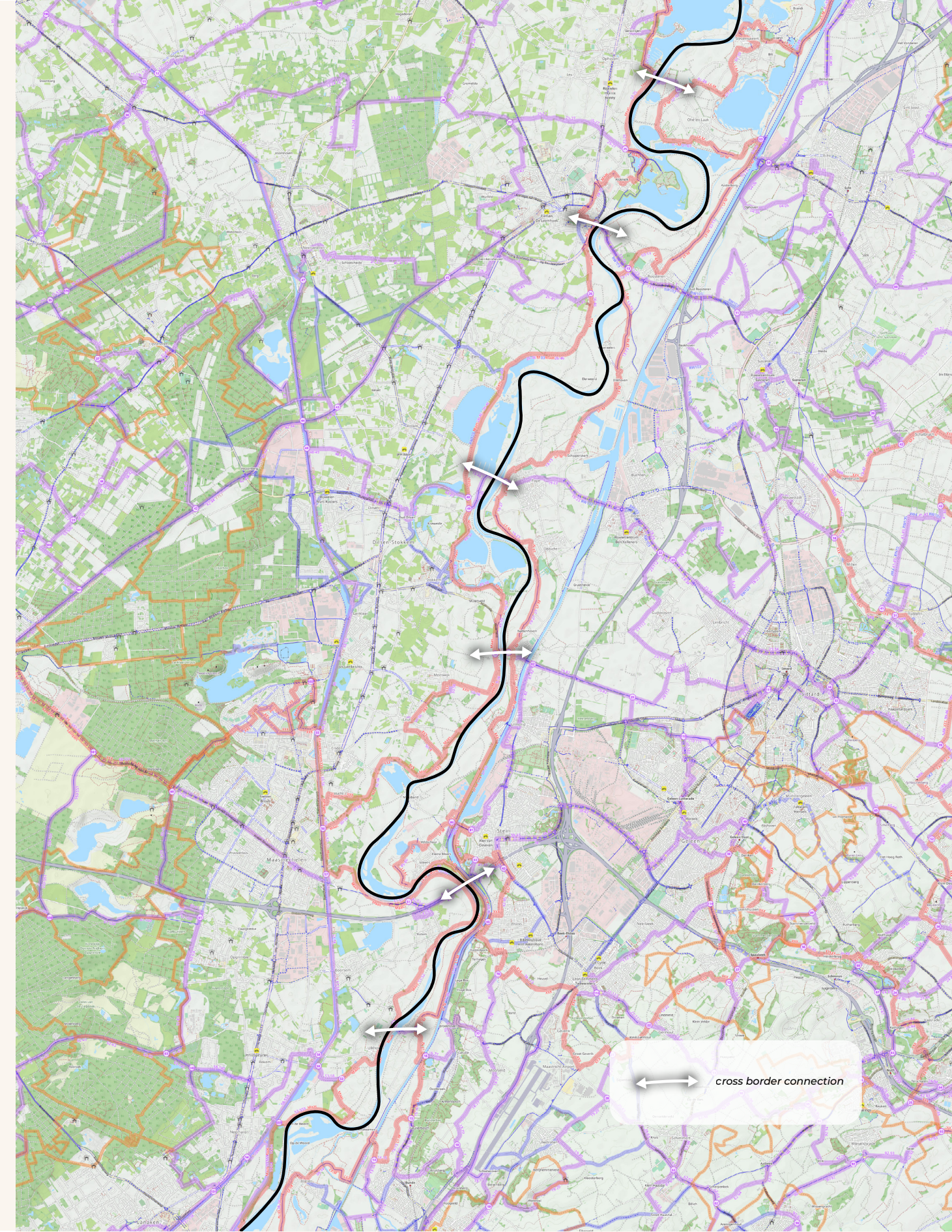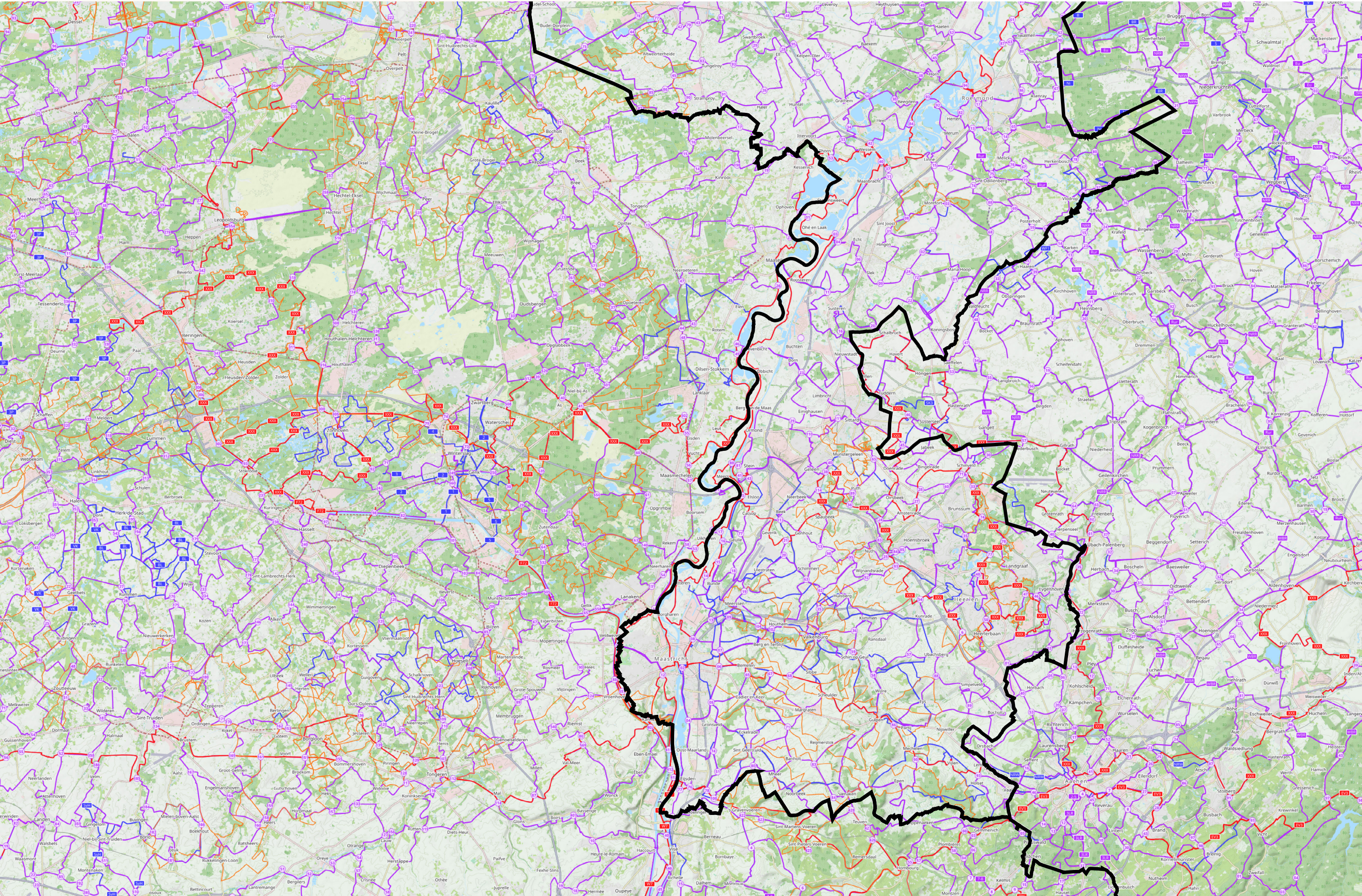
4.5.3 Road Network

Besides the soft transport networks, the only physical connection in the region is one made by the highway and thus part of the road network. A full size map of the road and rail network is available on the next page (fig. 4.27) This connection was previously mentioned as the bridge is also used as part of the cycling network. Furthermore there is one highway that connects the entirety of the mine region. This highway runs in an east-west direction, crossing the borders of Belgium, the Netherlands, and Germany (OpenStreetMap Contributors, 2023b). While this highway plays a vital role in connecting the region and facilitating trade and transportation, its singular nature means that there are few other options for road travel within the district's borders. On both sides of the border the highway has good connection to regional roads.

4.5.4. Rail Infrastructure

Rail infrastructure has always played a crucial role in the transportation of goods and people in the mine district of Limburg. The development of rail infrastructure in the region is closely linked to the mining industry which was the main driver of economic growth in the area (Coenen & IBA Parkstad (Heerlen), 2015). The rail network was primarily used for the transportation of goods, such as coal, but also played a crucial role in the transportation of people in the region. Especially the mine workers used special commuter trains 'Joepetrein' to get to the mines (fig. 4.28.).
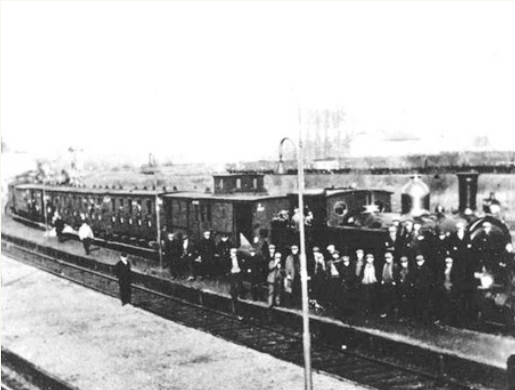
Figure 4.28. Last Joepetrein leaving the station in Nuth, NL in 1932. Photo: Rijckheyt

As the mining industry grew, so did the rail network. New rail lines were built to support the expanding mine operations, and the network continued to evolve throughout the 20th century. In the early years, the rail network was primarily operated by private companies, but in the mid-20th century, nationalisation led to the creation of state-owned railway companies in both Belgium and the Netherlands.

The railway companies continued to invest in the rail infrastructure, adding new lines and upgrading existing tracks. However, the decline of the mining industry in the latter half of the 20th century led to a reduction in the demand for rail transportation. Many rail lines were closed or abandoned as the mines shut down, and the rail network was reconfigured to support other industries.

Despite these changes, the rail network in the Limburg region remains an essential part of the transportation infrastructure, with the Dutch and Belgian networks operating independently of each other.

The overall layout of the rail network is split into a Dutch and Belgian part. The Dutch network is connected to Germany at the eastern border of the mine district. However, there are currently no direct connections between the Dutch and Belgian networks. The last connection that was lost was the Maastricht-Hasselt line in 2011, which severed the direct connection between the two countries. In the Netherlands, the region is generally well-serviced by the rail infrastructure, with frequent trains running between the cities in the region. However, in Belgium, the rail infrastructure is only accessible in the western part of the mine district.

Despite the loss of some connections, there are still many traces left that reveal the past of how the rail network was developed. Especially in Belgium, a lot of the infrastructure that was built during the mining era is still there. The tracks have been overgrown (fig 4.29) and are no longer used, but some have been replaced with bicycle

Figure 4.27. (next page) Map of road and rail infrastructure in the mine district (based on OpenStreetMap Contributors, 2023b).

Figure 4.29. (right) Example of disused rail infrastructure (Smit, n.d.).
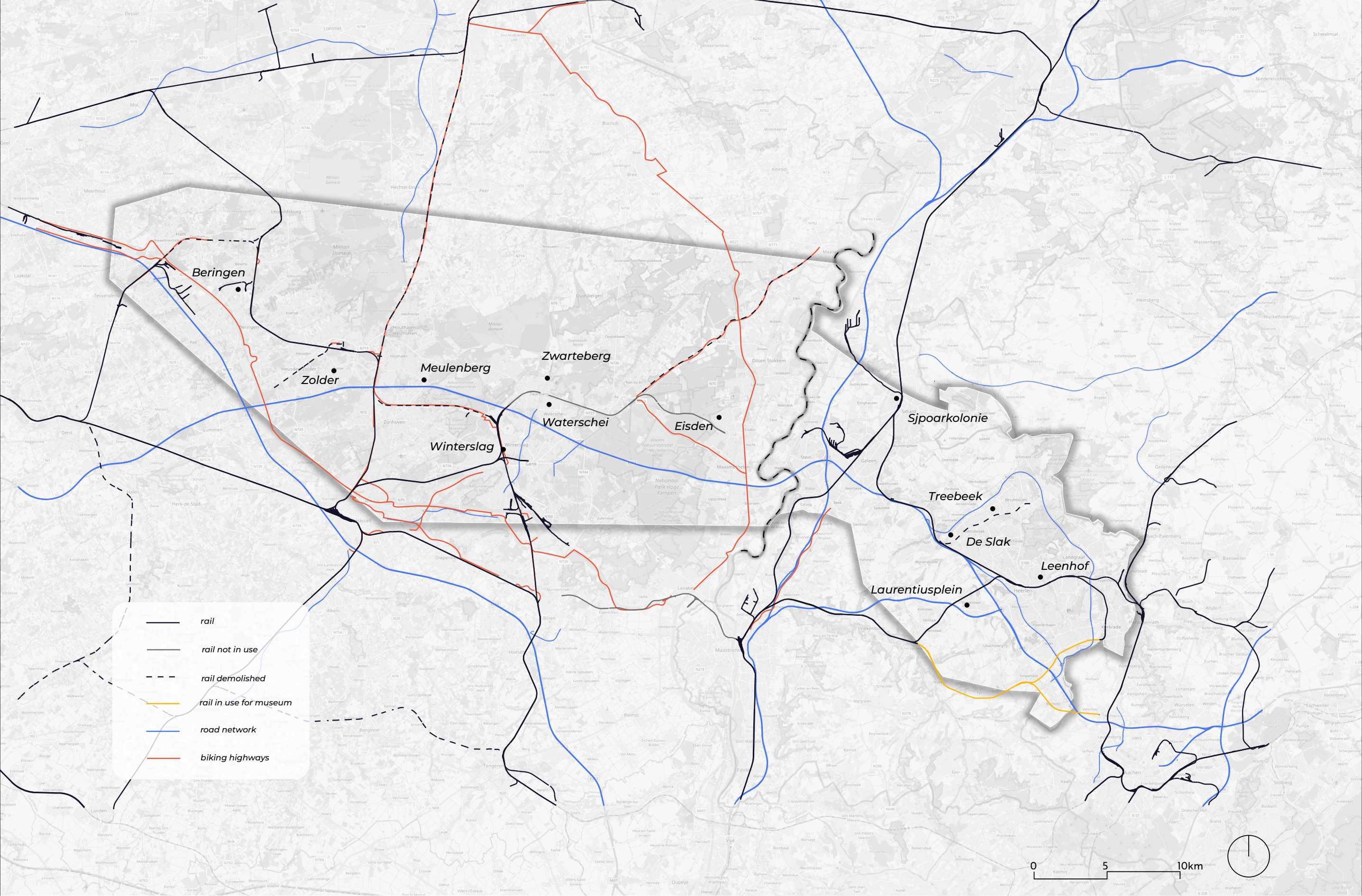
Legend:
- rail
- rail not in use
- rail demolished
- rail in use for museum
- road network
- biking highways

Beringen

Meulenberg

Zwarteberg

Zolder

Waterschei

Eisden

Winterslag

Sjpoarkolonie

Treebeek

De Slak

Leenhof

Laurentiusplein

0   5   10km

highways, such as the rail trail connecting Hasselt to Genk. In The Netherlands parts of the old mine infrastructure are now in use as tourist attraction and became part of a museum.

This repurposing of rail infrastructure for recreational purposes is a growing trend, and it provides an opportunity for communities to re-envision the role of rail infrastructure in the region.

Figure 4.30 (right). Bicycle highway that replaced some of the old railway tracks. Photo: Google Maps

The rail infrastructure in the Limburg mining district has always been a crucial part of the region's development, and it has the potential to play a vital role in its future. The existence of these mine rail remnants (fig. 4.31) creates opportunities to reactivate the network and to provide better cross-border connections. The development of these connections could have a significant impact on the economy of the region and could lead to increased mobility for people living in the area. The lack of direct connections between the Dutch and Belgian networks is a significant obstacle to

cross-border transportation, and the reactivation of these connections could be a game-changer for the region. Besides that it also creates the opportunity to develop a multimodal backbone. A multimodal–backbone is able to promote inclusive mobility and limit car-dominance (Tsigdinos et al., 2021).

Figure 4.31 (below). Rail infrastructure used for mining operations (based on OpenStreetMap Contributors, 2023b)

rail

rail not in use

rail demolished

rail used for mining

rail used for mining not in use

rail used for mining demolished

0   5   10km
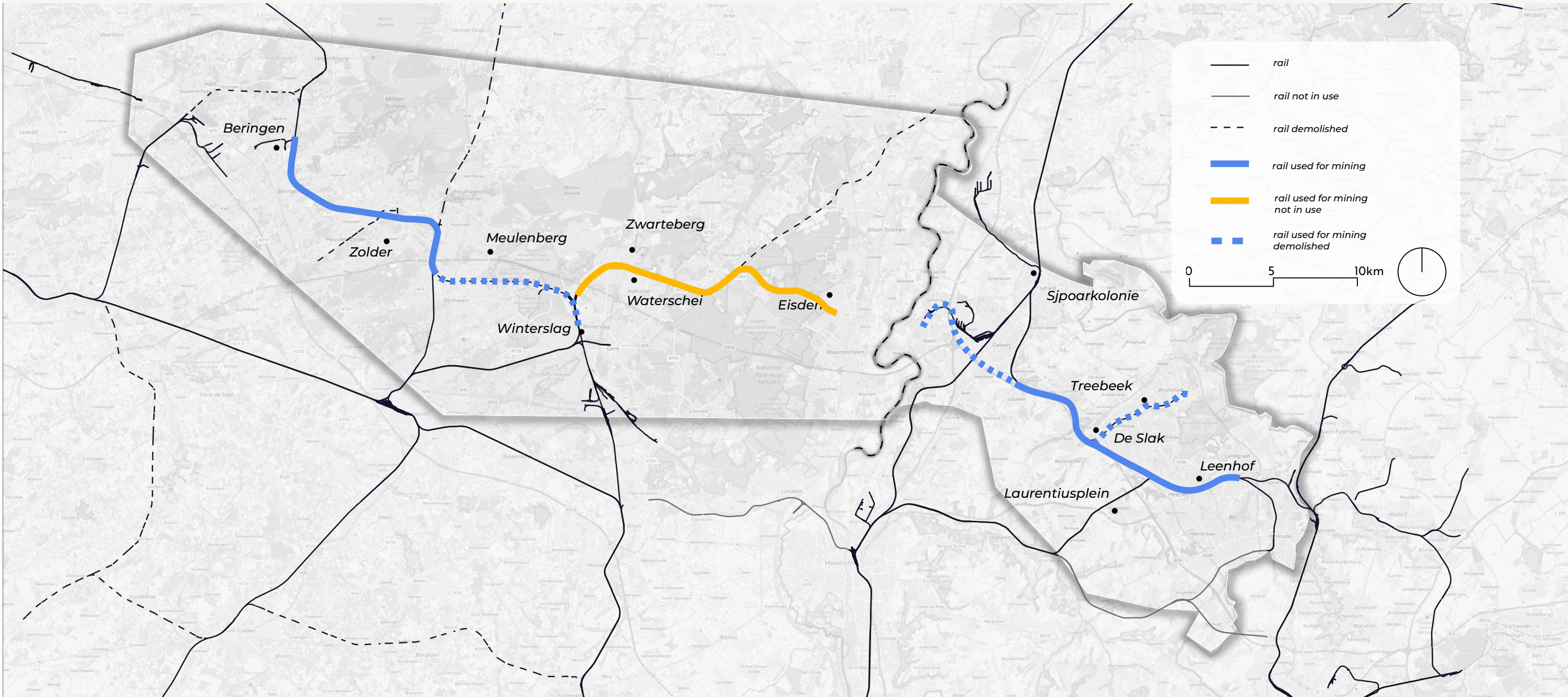
4.5.5 Public transport services

In the world of mobility, physical infrastructure is just one part of the equation. Equally important are the services that operate on this infrastructure. Unfortunately, in the mine region, the services are limited, with many bus and rail services not crossing the border. The only services that do cross the border are low-level bus services, which operate only once an hour and are mainly focussed on Maastricht all operated by 'De Lijn' (fig 4.32). All cross-border services into the mining district are bus services with a low service level, only one time per hour (fig. 4.33). There is only one bus crossing the border withing the mine district but this is a direct bus operated by private operator Flixbus between Antwerp and Roermond and doesn't have any intermediate stops (fig. 4.32, Call Out). Besides the low level of services the distance to a public transport stop is also importance. The distance beyond which ridership falls off drastically is about 400m for a local-stop service, and about 1000m for a very fast, frequent,

and reliable rapid transit service (Walker, 2010). Furthermore, all stations should be accessible for citizens with a mobility disability.

Interviews with volunteers of passenger organisations Rover from the Netherlands and TTB from Belgium give more insights into the matter. Interviews were conducted with Kees Braam (personal communication, 24 February 2023) from Rover and Peter Meukens (personal communication, 13 March 2023) from TTB (TramTreinBus). Both organisations have expressed their desire for more cross-border connections

Figure 4.32 (below). Public transport hubs in the mine district and imediate surroundings (based on OpenStreetMap Contributors, 2023c)

Figure 4.33 (page 122). Public transport services in the mine district and imediate surroundings, highlighting the cross-border services (based on OpenStreetMap Contributors, 2023c)

Figure 4.34. Spartacus Plan for better public transport connections in the Limburg Region (Focus op Hasselt, 2014)

and believe that the lack of connections and high costs of bus and train tickets are dissuading people from using public transport. The costs of crossing the border are also significantly higher due to European Law. Cross-border services cannot be subsidised with national funds and there are also many administrative barriers such as the difference in the markets. Meukens adds that when operators are looking for cost reductions, they will cut in the services that fall outside of their concession, which in the Limburg region automatically mean that those are cross-border connections. There is a need to think on a larger, more regional/transnational, scale as many decisions are made in Brussels which is relatively far away from the border. Another factor that limits cross-border connections is the unwillingness of Belgium to have private operators providing services.

An attempt was done by Peter Meukens to increase the connectivity of the Belgian Limburg

by public transport. He initiated the Spartacus-plan (fig. 4.34), an ambitious project aimed at improving public transport in the Limburg region of Belgium. The plan aims to make the region less car-dependent by providing high-quality public transport options, including a network of tram and bus rapid transit (BRT) lines (Focus op Hasselt, 2014). It was designed to improve access to education, employment, and other opportunities in the region. The plan also includes multiple cross-border connections to the Netherlands, making it easier for people to travel between the two countries. Despite the ambitious goals of the plan, it has faced significant challenges in implementation due to administrative barriers, including differences in market regulations and funding mechanisms between Belgium and the Netherlands (P. Meukens, personal communication, 13 March 2023).

Both organisations aim for a reduction in travel time and suggest building new services and infrastructure with light rail to increase connectivity. A rail

train service

bus service

cross border service

national border

125
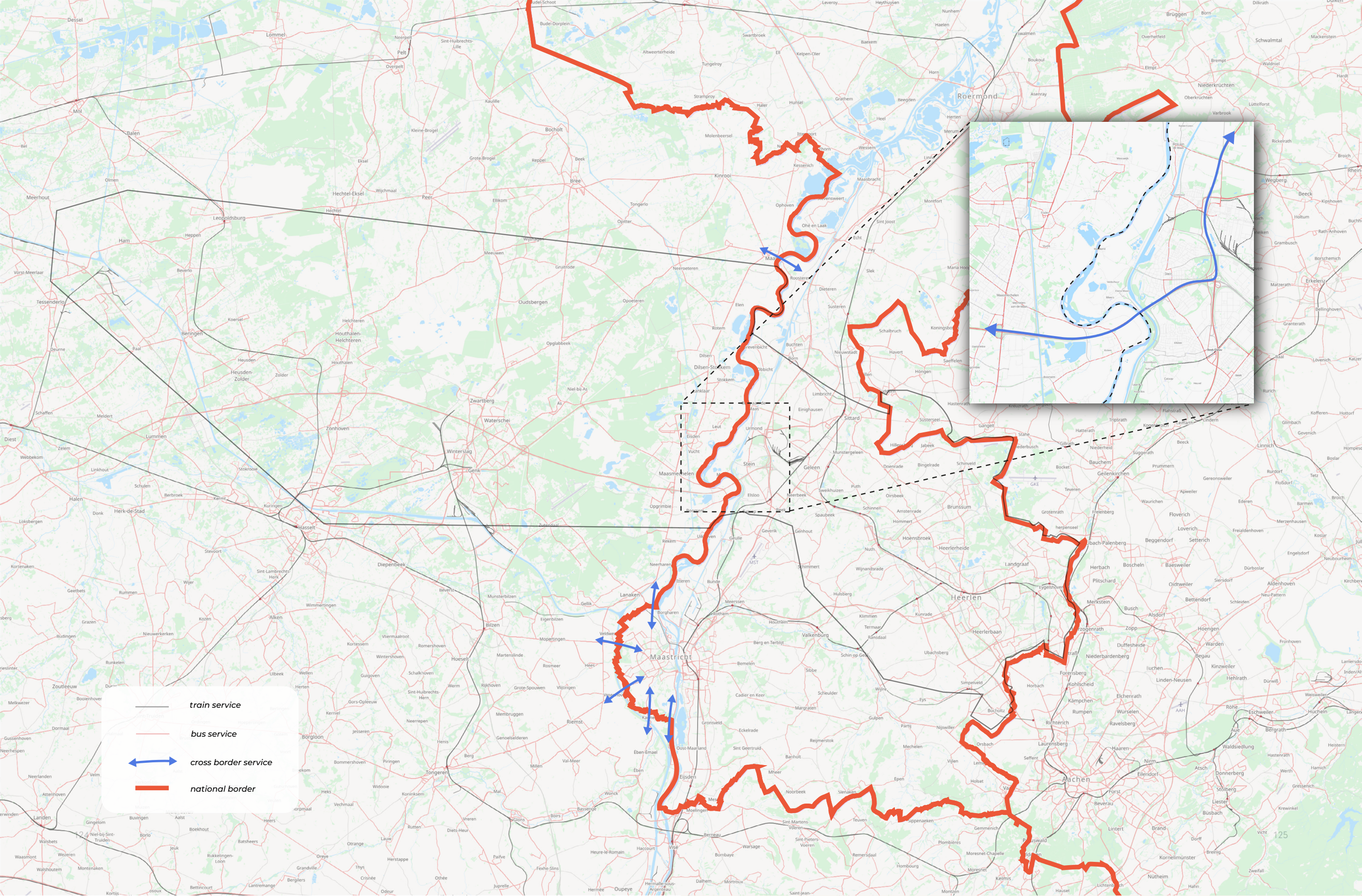
connection is more reliable than a bus connection, and it also brings a rail bonus. Passengers place a higher value on rail links than bus connections, as found by Rover. Meukens also explains that the fact that passengers can see a rail conection gives better insurance that this connection will still be there tomorrow as a bus can easily be redirected.

Collaboration between the two countries is the most crucial part to create cross-border connection. Other recommendations include the overlap of concessions instead of them stopping at the border, introducing one common payment system and providing faster travel times (K. Braam, personal communication, 24 February 2023; P. Meukens, personal communication, 13 March 2023).

4.5.6 Centrality of the Mine Region
The mining region is strategically located between major urban centers with an important economic and cultural significance such as Brussels with the seat of the EU, Antwerpen with a major harbor, and Cologne as a large cultural hub, all within a one-hour drive by car. However, the current rail connections double the travel time, making it less attractive for commuters and tourists to use public transport. Having no connections between the Dutch and Belgian mine district severely limits the accessibility of the regions surroundings.

4.5.7 Conclusion
Improving public transport connections in the mining region is crucial to decrease car dependency and has a positive impact not only on a local scale but also on a regional and international level. The lack of existing cross-border connections and the administrative barriers involved in creating them show the need for collaboration between all parties involved with creating infrastructure and providing passenger services. Therefore, the old mine infrastructure could be used as an opportunity to start functioning as a backbone for the new cross-border network of the mine district.
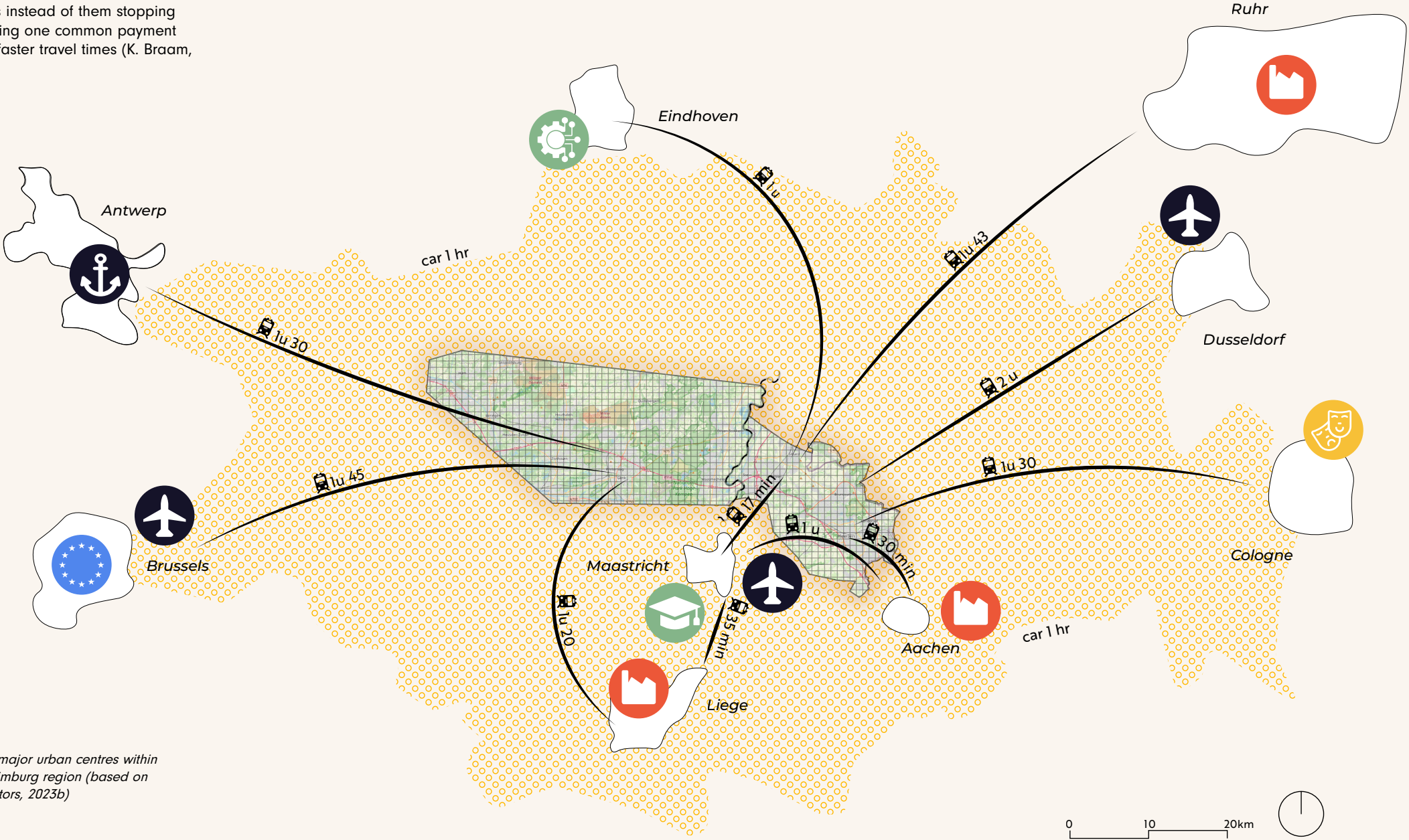
Figure 4.35. Overview of major urban centres within a one hour drive of the Limburg region (based on OpenStreetMap Contributors, 2023b)

4.6 | ECONOMY

This next part will explore the economic activities in the Mine District by looking at the different land uses. For a long time, the main economic activities were related to the mining industry which had a big impact on the landscape (fig. 4.36). The mines formed immense industrial complexes and were spread all throughout the region. Now that these industrial complexes have been dismantled or repurposed it is worth to investigate how different land uses are spread throughout the region. The garden cities have already been identified as locations that provide opportunities that could help with a mobility transition. This analysis will therefore also take a closer look at the surroundings of the garden cities.

The following pages will include maps focussing on 4 main types of land use.
1. Agriculture
2. Green space
3. Industry
4. Urban areas

The maps are all based on the Corine Land Cover dataset provided by the European Environment Agency (EEA) (2020).

Lastly an additional layer will be introduced mapping the educational and recreational sites throughout the region. This helps to get a better understanding of possible opportunities for network integration.

Figure 4.36. Aerial view of the Waterschei Mine in Genk, Belgium. The Waterschei Garden City is also visible in the back (Vandekerckhove, 2019).
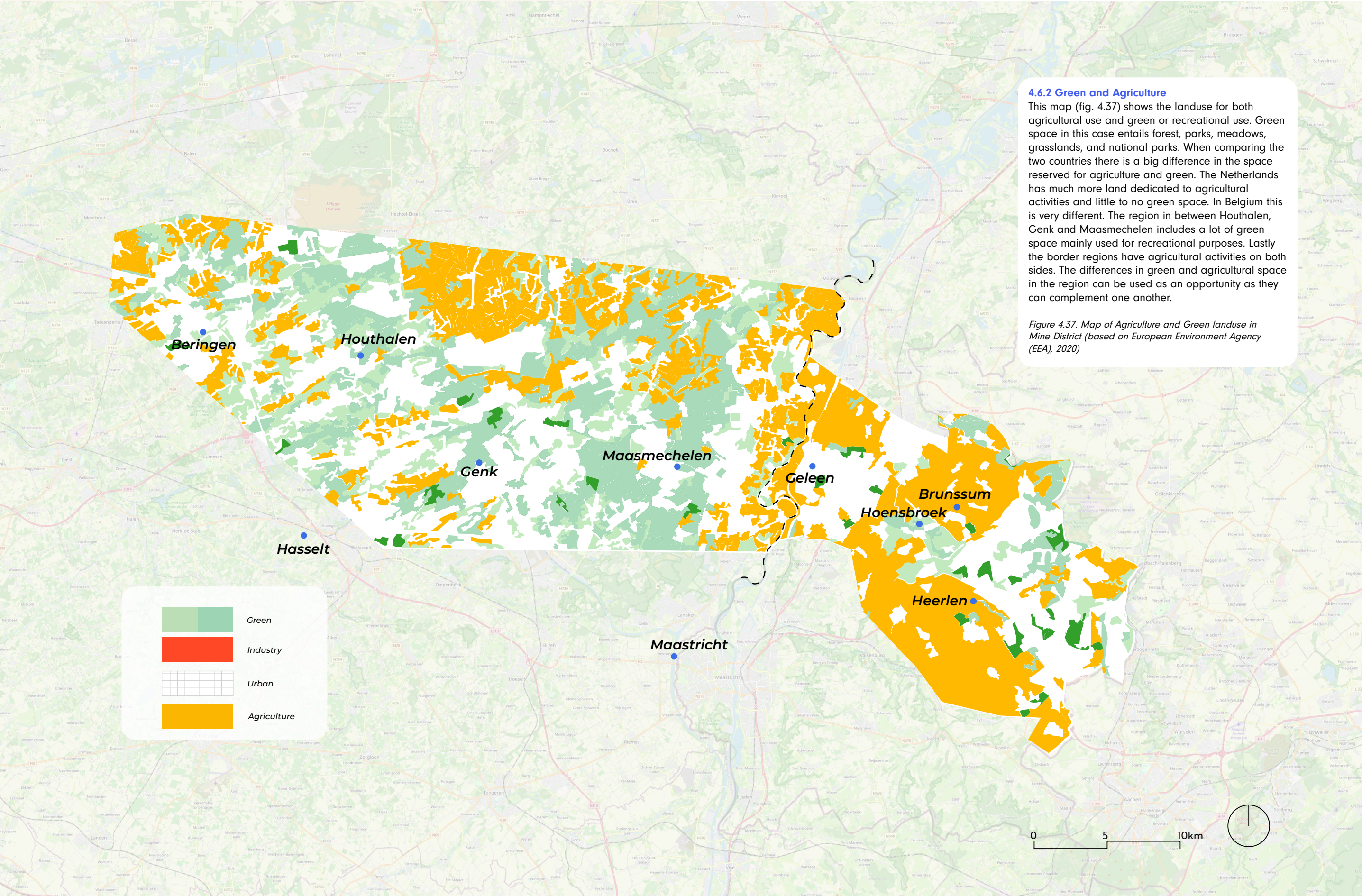
4.6.2 Green and Agriculture
This map (fig. 4.37) shows the landuse for both agricultural use and green or recreational use. Green space in this case entails forest, parks, meadows, grasslands, and national parks. When comparing the two countries there is a big difference in the space reserved for agriculture and green. The Netherlands has much more land dedicated to agricultural activities and little to no green space. In Belgium this is very different. The region in between Houthalen, Genk and Maasmechelen includes a lot of green space mainly used for recreational purposes. Lastly the border regions have agricultural activities on both sides. The differences in green and agricultural space in the region can be used as an opportunity as they can complement one another.

Figure 4.37. Map of Agriculture and Green landuse in Mine District (based on European Environment Agency (EEA), 2020)

Green

Industry

Urban

Agriculture

Beringen
Houthalen
Genk
Maasmechelen
Geleen
Brunssum
Hoensbroek
Hasselt
Heerlen
Maastricht

0   5   10km
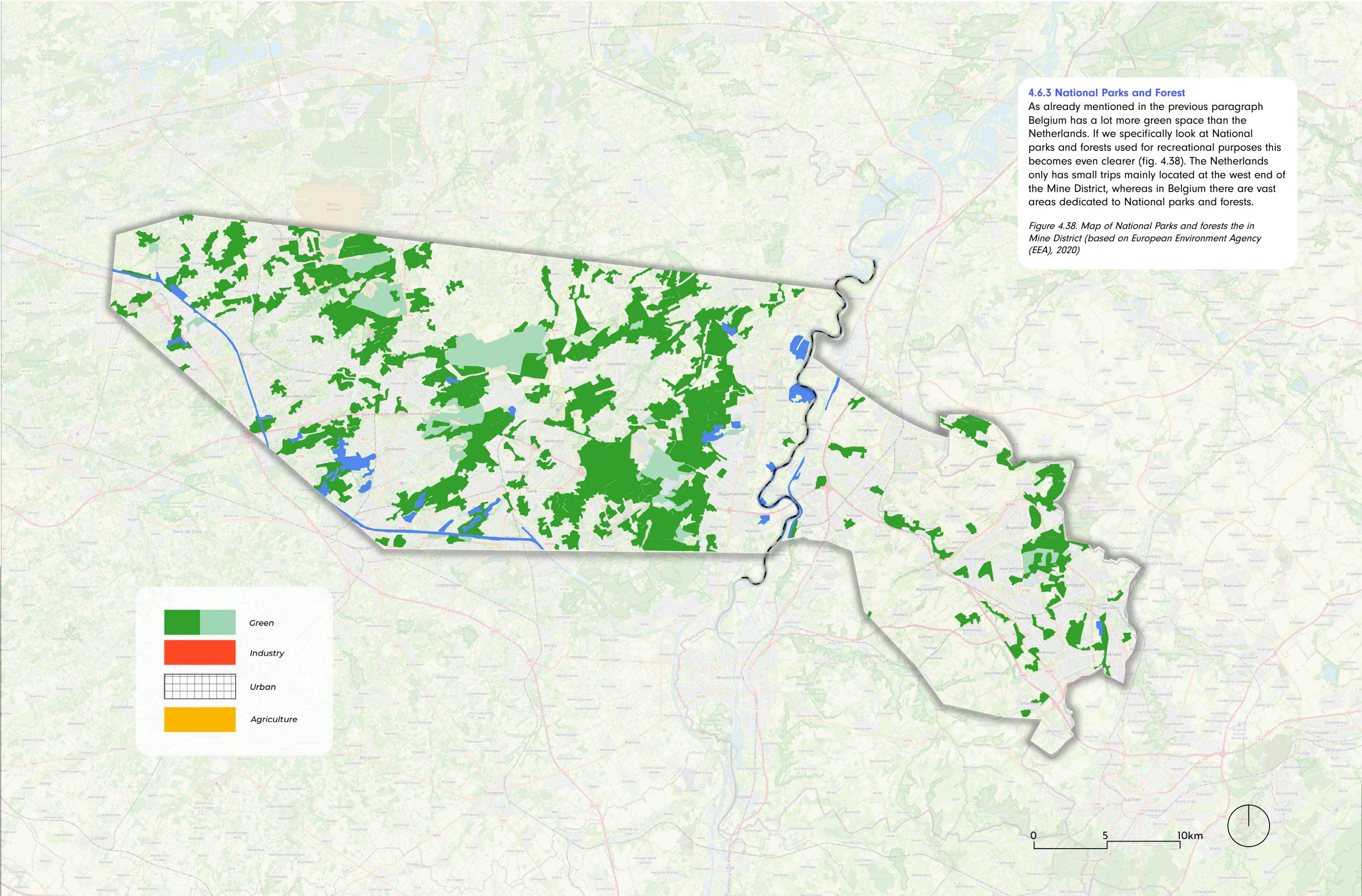
4.6.3 National Parks and Forest
As already mentioned in the previous paragraph Belgium has a lot more green space than the Netherlands. If we specifically look at National parks and forests used for recreational purposes this becomes even clearer (fig. 4.38). The Netherlands only has small trips mainly located at the west end of the Mine District, whereas in Belgium there are vast areas dedicated to National parks and forests.

Figure 4.38. Map of National Parks and forests the in Mine District (based on European Environment Agency (EEA), 2020)

Green

Industry

Urban

Agriculture

0   5   10km

4.6.4. Industry and Cities

Looking at the next landuses of industry and urban area there are two observations to be made. Firstly the footprint of cities in Belgium and the Netherlands are contrasting (fig. 4.39). Where The Netherlands has urban areas that are very compact, Belgium has more spread out urban areas. This shows that even though ribbon development in the Netherlands slowly disappeared in the early 1900s it persisted in Beglium. Furthermore, the cities of Geleen, Genk and Beringen have large industrial complexes. The industrial complex in Geleen is The Chemelot Campus, a leading institute when it comes the chemical sciences and application. In Genk and Beringen the industrial complexes have formed around harbours. If we compare the industrial complexes with the old mine sites there is a lot of overlap. Only in a few locations the industrial character fully disappeared, mainly around the garden cities of Zwarteberg and Waterschei as well as the Oranje Nassau II and IV mines in Heerlen.

Figure 4.39. Map of Industrial Complexes and Urban Areas the in Mine District (based on European Environment Agency (EEA), 2020)

Legend:
- Green
- Industry
- Urban
- Agriculture
- • Eisden — Mine

0   5   10km

Zolder

Meulenberg

Zwarteberg

Eisden

Sjpoarkolonie

Treebeek

Beringen

Winterslag

Waterschei

De Slak

Leenhof

Laurentiusplein

0   5   10km
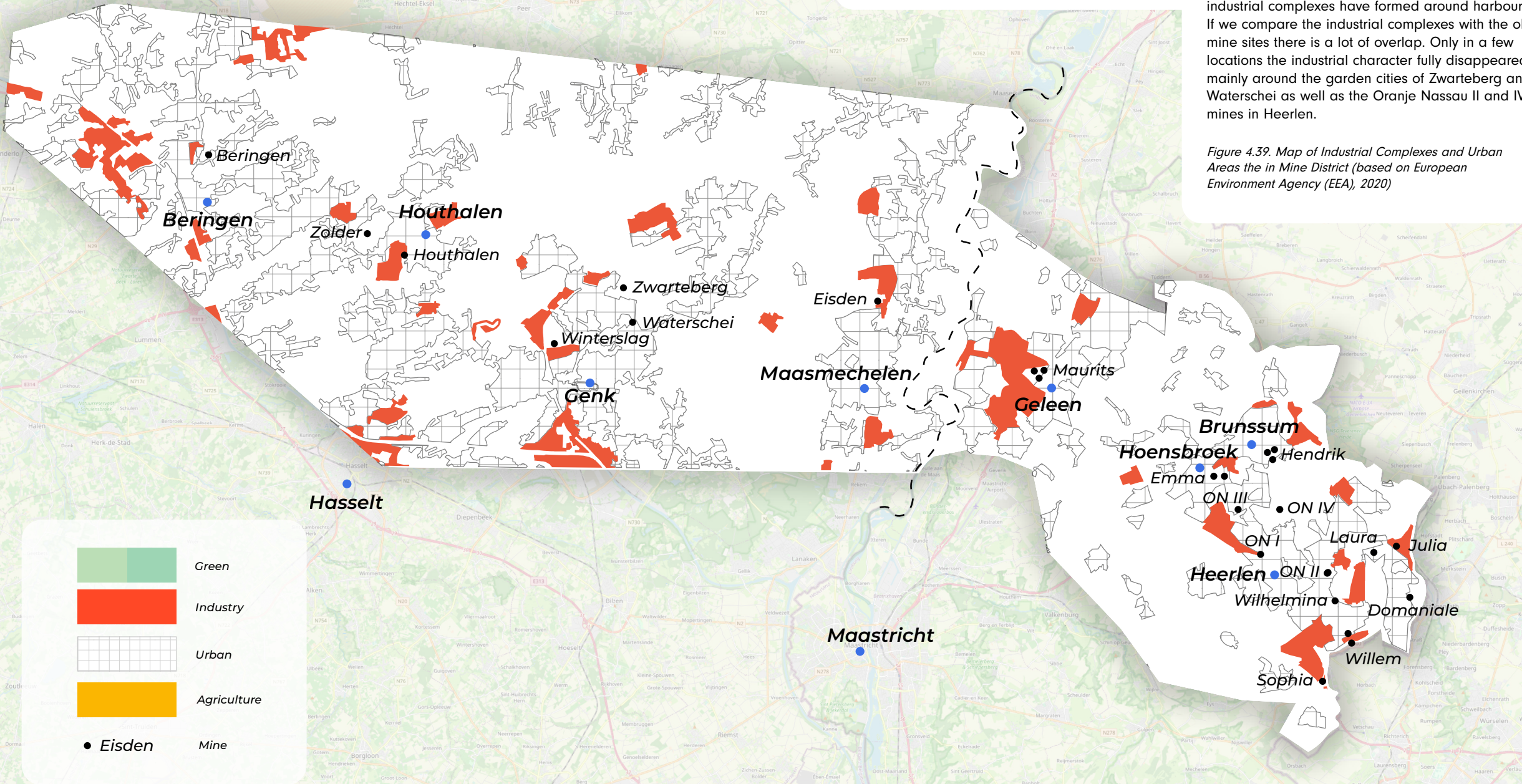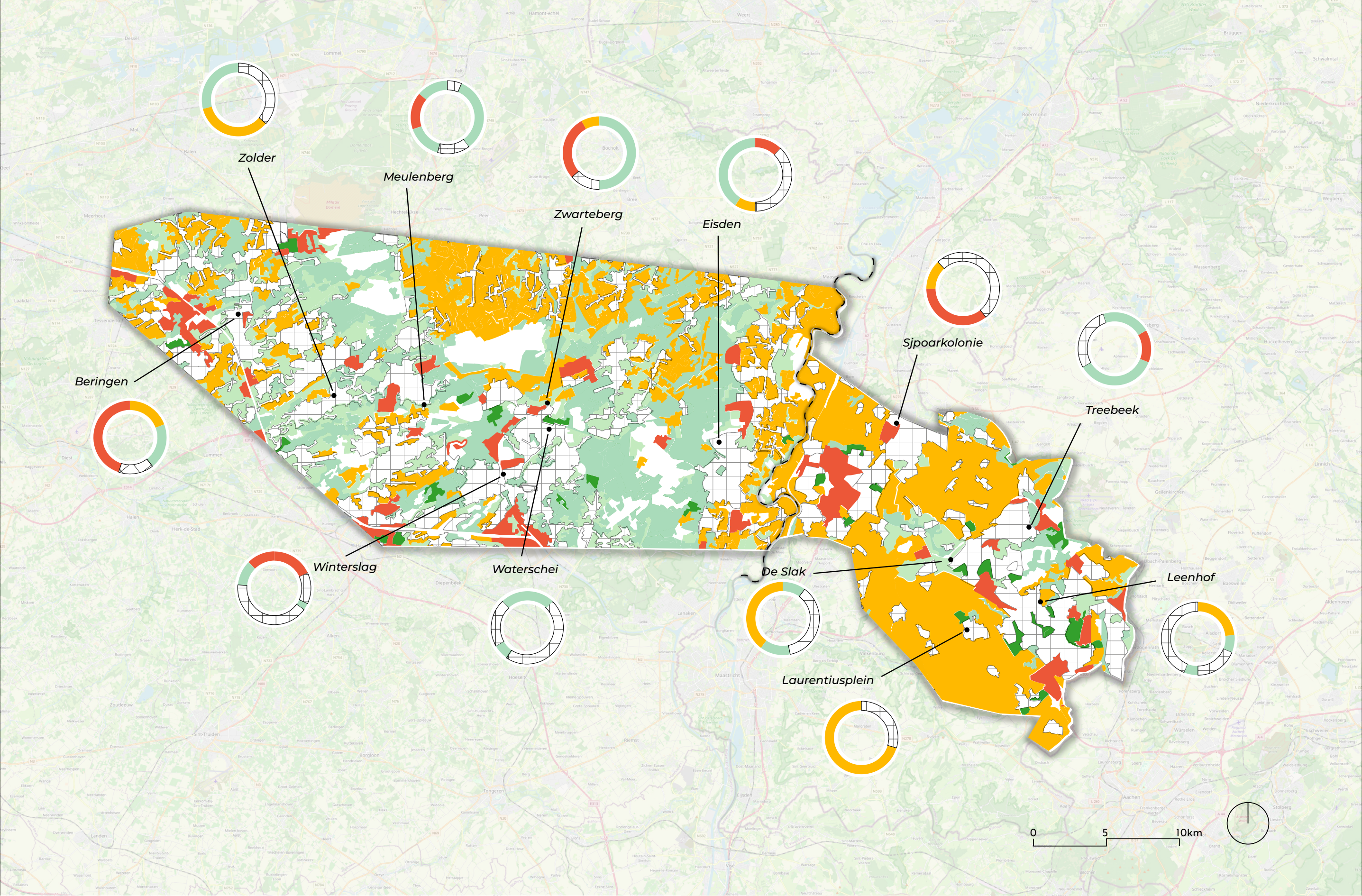
4.6.5 Education and Leisure

After a look at all the land uses it is useful to add one more additional layer to this level of Dupuy's networks of urbanism analysis, educational and leisure facilities (fig 4.41). When projecting all educational facilities in the region, it becomes clear that Belgium offers more education facilities spread throughout the district. This due the different educational system in Belgium where a lot of practical education is taught by the same

educational institution as secondary education. The Netherlands has clustered their educational facilities more. Furthermore, there are only three universities in or in proximity to the district in Heerlen, Maastricht and Hasselt. Based on all this information some Garden cities can become an educational hub such as Leenhof and Waterschei. Other garden cities such as Eisden and Beringen have more leisure activities surrounding them and could therefore act as an entrance to more recreational facilities. Both garden cities offer leisure activities that are linked to the mining history.

Figure 4.41. Map of Educational facilities and Leisure activities (based on European Environment Agency (EEA), 2020)

Legend:
- ● university
- ● college
- ● practical education
- ● leisure (theme park, musea)
- ● leisure connected to mining history

0   5   10km
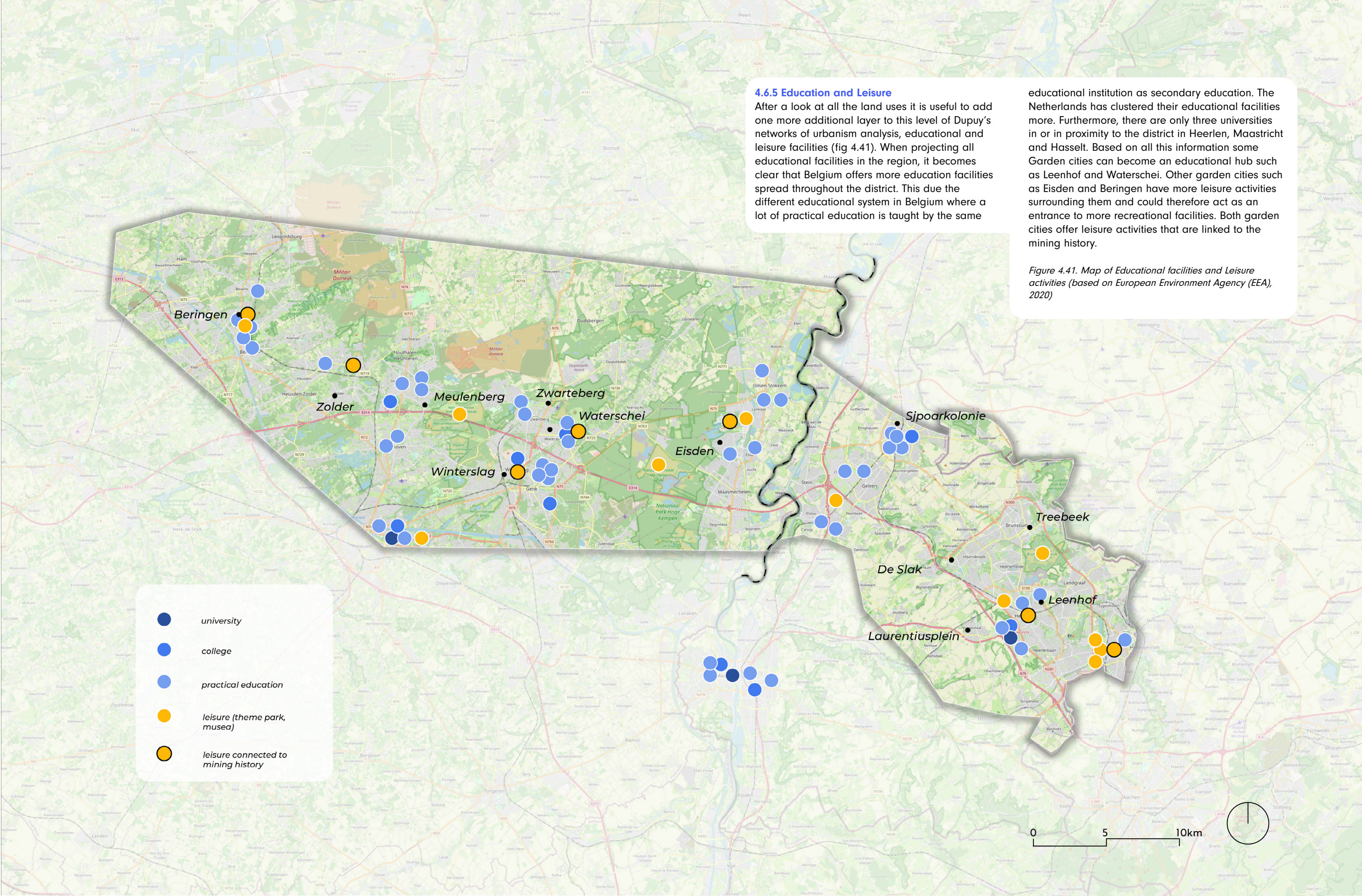
4.7 | SOCIAL

The last layer to analyse is the social layer. This layer will look different lives of fictional citizens in the border region showing the social aspect and reasons to travel across border.

There are multiple reasons for citizens to cross the border. They can be divided into 5 main typologies:

1. Work or business opportunities
Individuals may cross the border to get to work or conduct business in another country, as there may be more job or economic opportunities available.

2. Family or social connections
People may have family or social connections in another country, and may cross the border to visit or maintain those relationships.

3. Education
Some individuals may cross the border to attend school or pursue higher education in another country.

4. Health care
Some individuals may cross the border to access better quality or more affordable health care services.

5. Shopping or tourism
Some people may cross the border for shopping or tourism, as prices or products may be cheaper or more desirable in another country.

Taking into account the different typologies the profiles for the fictional citizens were made. This resulted in four different life stories that show off a variety of activities and are dependent on different travel modes. All life stories can be found on the next pages (134 – 137), these show a more in depth schedule of the characters and map their movement in a border setting.

Hans

Hans is 63 years old and works in a factory and cares for his elderly mother. To travel around he is dependent on public transport and his bike. As his work is closeby he can bike there in the moring. However to get to his elderly mother he has to catch a train. His mobility options limit him to get a job on the other side of the border.

Linda
Linda is 35, married and has one son she cares for. Her family owns a car and this is the reason that she is able to work at a marketing firm on the other side of the border. Her husband is bound to use public transport to get to work as Linda has no other travel options than to use their family car.

Fleur
Fleur is a student and still lives at her parents' place. As she is a student she can't afford a car and is thus dependent on public transport to get to class. This means that she is not able to follow education at a school on the other side of the border as there is a lack of public transport connections or the travel time is too long.

Max
Max is a kid that is dependent on his parents to get around. His family owns a car and regularly travels across the border to go shopping or go out in nature.

Taking into account these different typologies the profiles for the fictional citizens were made

Looking at all profiles it becomes clear that each transport method has an impact on the mobility of an individual. Not owning a car drastically limits job opportunities and access to education and recreational facilities. Creating a new cross-border link for public transport will help with the mobility shift of this region and provide more equal opportunities to all of its inhabitants.

HANS

age: 63
family unit: cares for mother (86)
background: Dutch
works at: factory worker
home: apartment
mobility: bike & public transport

07:00 - 07:45
Wake up & get ready

07:45 - 08:00
Bike to work

08:00 - 16:00
Work

16:00 - 16:15
Bike to station

16:15 - 16:40
Catch train to elderly home

16:45 - 17:45
Walk in the park with mother

17:45 - 19:00
Catch train home and do grocery shopping

19:00-20:30
Have dinner

20:30 - 22:30
Drinks with friends in the city centre

Suburban
Urban
City Centre
Border
Elderly home
Park
Highway
Station
Bar
Work
Rail
Grocery store
Home

LINDA

age: 35
family unit: husband (37) and son (7)
background: Belgian
works at: marketing office
home: detachted house
mobility: car & bike

07:10
wake up

08:10 - 08:25
bring son to school

08:30 - 09:00
drive to work

08:30 - 16:30
work

16:30 - 17:00
pick up son from school

17:00 - 17:30
go to the grocery store

17:30 - 18:30
cook and eat dinner

18:45 - 19:00
bring son to soccer

20:00 - 20:15
go home

20:30 - 22:00
take a painting class

Work
Suburban
Urban
City Centre
Border
School
Grocery store
Work
Highway
Station
Sports
Rail
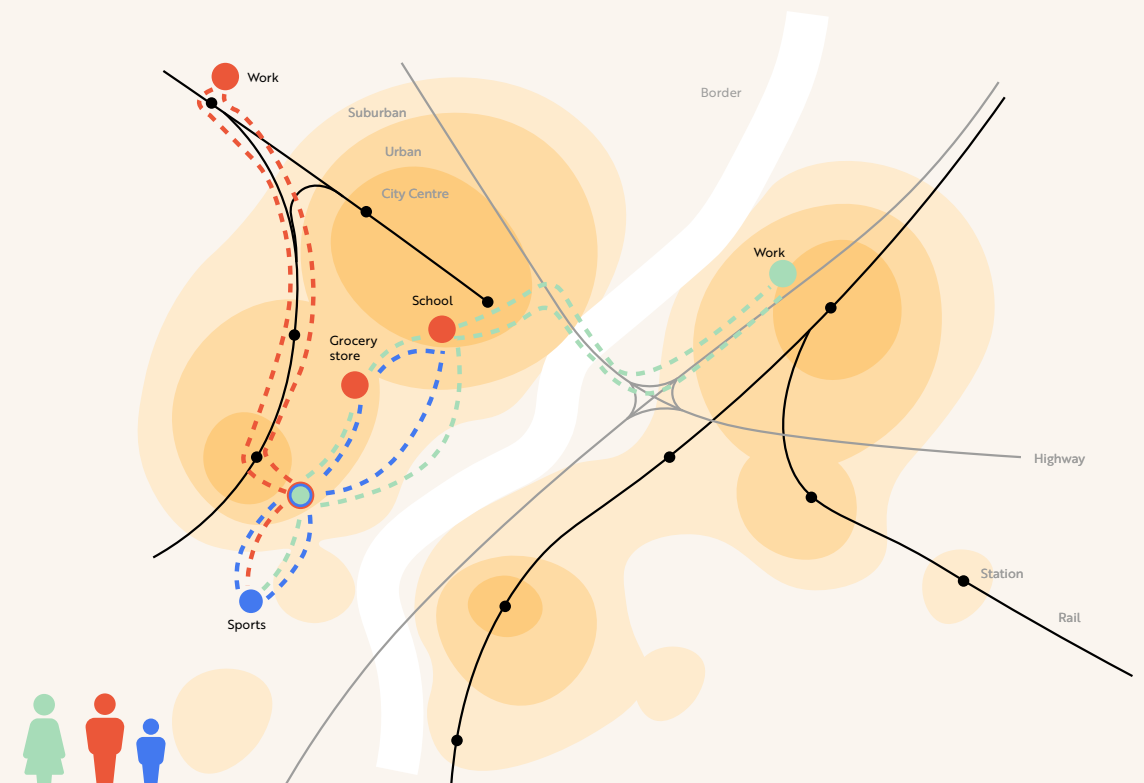
FLEUR

age: 21
family unit: mother (51) and father (54)
background: Dutch
studies at: College
home: rowhouse
mobility: bike & public transport

07:10
wake up

08:00 - 09:30
bike to station &
catch train to college

09:30 - 12:30
attend classes

12:30 - 13:30
grab lunch in town

13:30 - 15:00
attend classes

15:00 - 17:30
Catch train & bike home

17:30 - 18:30
eat dinner

18:30 - 20:00
study

20:00 - 23:00
hang out with friends

Suburban
Urban
City Centre
Border
Lunch
College
Highway
Friends
Station
Rail
Home
Daycare
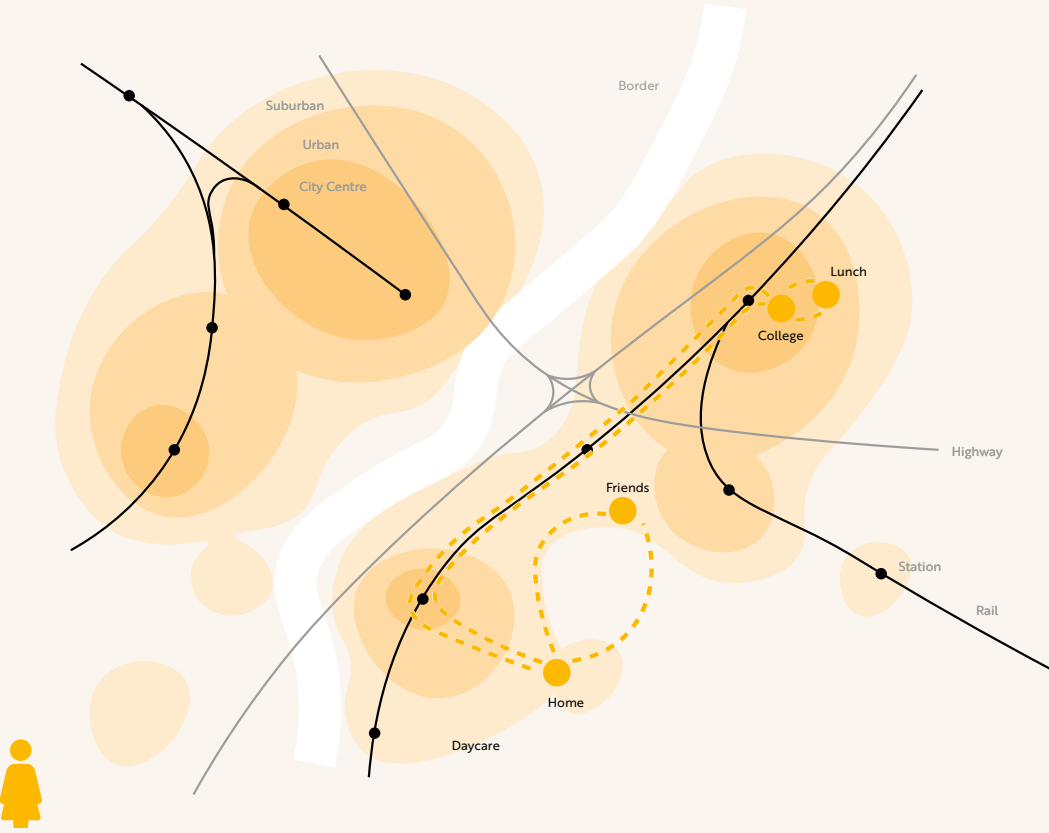
MAX

age: 5
family unit: mother (34) father (35), sister (3)
background: Belgian
Studies at: primary school
home: detachted house
mobility: car & bike

09:00
wake up

10:00 - 11:00
drive to forest

11:00 - 13:00
walk & play in the forest

13:00 - 13:15
drive to restaurant

13:15 - 13:45
grab lunch

13:45 - 14:15
drive to shopping centre

14:15 - 16:00
shopping with parents

16:00 - 17:00
drive home

17:00 - 18:00
have dinner

Suburban
Urban
City Centre
Border
Shops
Home
Forest
Lunch
Highway
Station
Rail
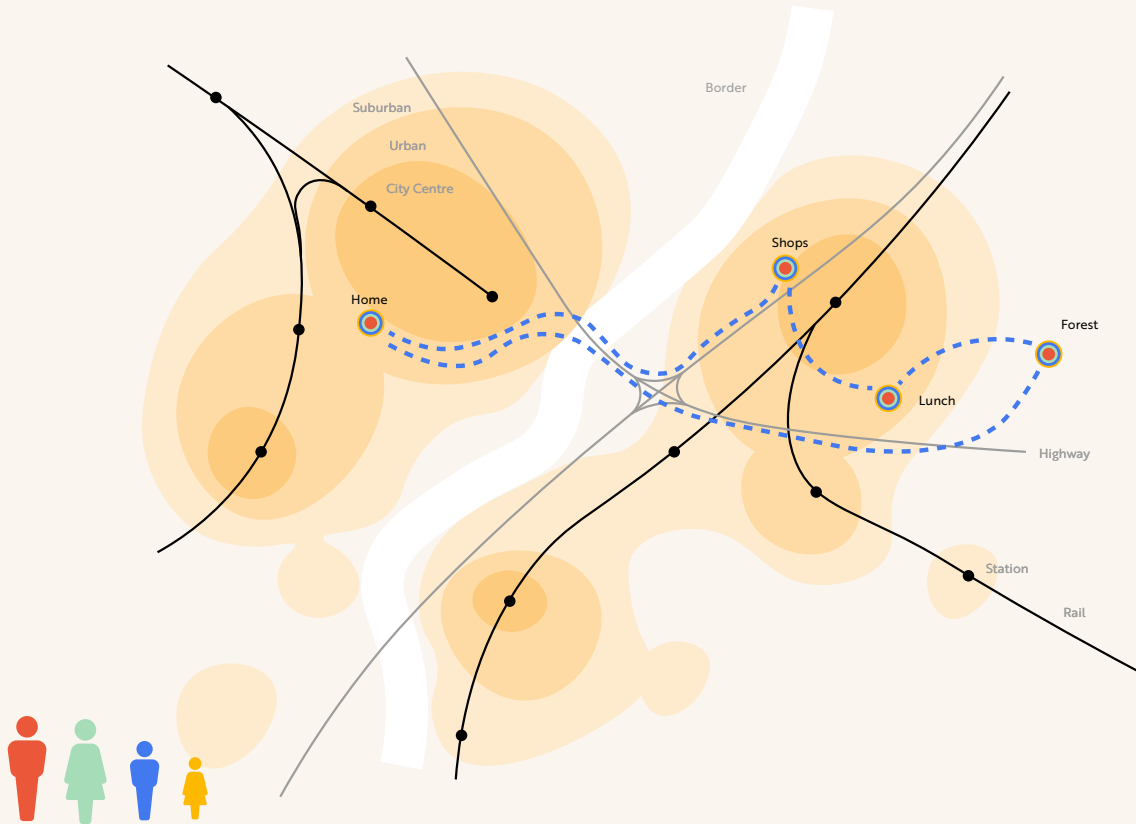
4.8 | CONCLUSION

4.8.1 Sustainable Mobility Opportunities

The existence of the garden cities gives the opportunity to use them in the strategy making as they are embedded in the landscape and have been built according to principles that match mobility justice. Furthermore, they have never been part of a network as there was usually only one garden city related to the central activity, creating the opportunity to finally connect these neighbourhoods and start working together as a network promoting mobility and supporting a shift to a multi-modal network that does not rely on cars.

Improving public transport connections in the mining region is crucial to decrease car dependency and have a positive impact not only on a local scale but also on a regional and international level. The lack of existing cross-border connections and the administrative barriers involved in creating them show the need for collaboration between all parties involved with creating infrastructure and providing passenger services. Therefore, the old mine infrastructure could be used as an opportunity to start functioning as a backbone for the new cross-border network of the mine district.

The garden cities that are closely linked to the mine rail network in the region possess distinctive qualities that are shaped by their surroundings (fig. 4.42). This makes them ideal candidates to function as local hubs, providing access to the larger region, and enriching the overall transportation network due to their unique features.

Having access to a comprehensive transportation network is crucial for ensuring equal opportunities and mobility for all individuals. When examining the various transportation options available, it becomes apparent that each mode of transportation has a significant impact on an individual's mobility. For example, not owning a car can drastically limit one's employment prospects, as well as access to education and recreational facilities.

Creating a new cross-border link for public transport in the region can serve as a catalyst for the mobility shift and promote equal opportunities for all residents. Ultimately, a comprehensive and well-connected transportation network is essential for the region's sustainable growth and development, ensuring that all residents can benefit from the opportunities available.

4.8.2 Strategic Locations

Considering all this information, the history of the region and the existence of garden cities as well as all their unique characters based on landuse and access to educational and leisure facilities leads to 4 strategic locations or zones that are all located along the old mine rail infrastructure (fig. 4.43).

On the most western side of the mining district Beringen is a place of interest due to all the facilities and its more industrial character. Further down the mine infrastructure are Zwarteberg and Waterschei that have a more green character and offer lots of educational facilities, besides that they are also conveniently located close to the bigger city of Genk. Next is the most important location the area consisting of Eisden and Sjpoarkolonie. Even though the Sjpoarkolonie is a bit further away from the mine rail it is located on the national rail network. The old entrance of the Maurits mine was located on the grounds of the chemelot campus where the mine infrastructure used to pass through. This part of the region is the only section where no previous physical links in the form of public transport infrastructure existed but is highly desirable. Lastly in the west we have the Leenhof garden city which is closely located to the city centre of Heerlen. This garden city has a more urban character and is near many educational facilities including a university.

Figure 4.43. (next page) Map with unique locations in the mining district.
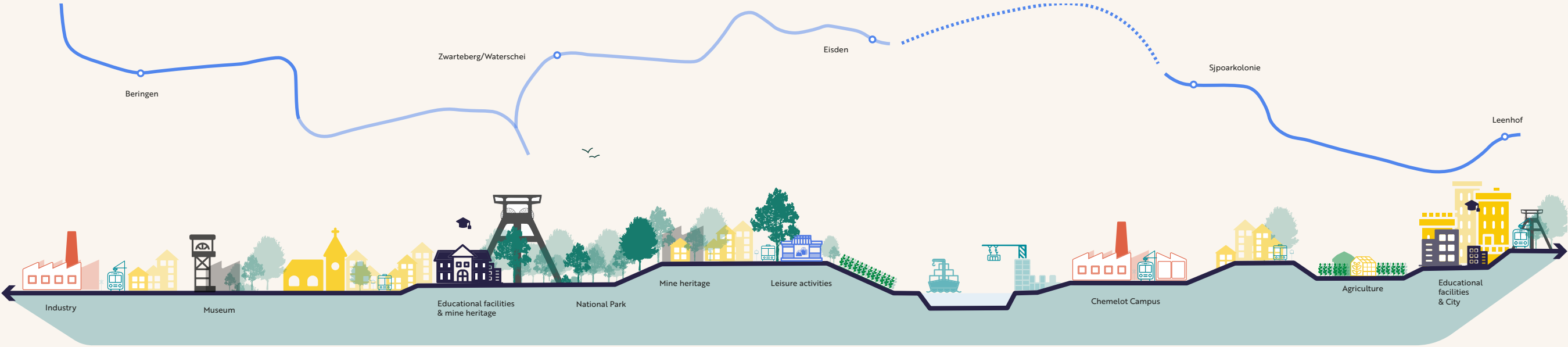
Figure 4.42. System section of unique garden cities linked to the mine infrastructure

Legend:

- university
- college
- practical education
- leisure (theme park, musea)
- leisure connected to mining history
- mining infrastructure
- Industry
- Urban
- Agriculture
- Green
- strategic location

Map labels: Beringen, Zolder, Meulenberg, Zwarteberg, Eisden, Sjpoarkolonie, Treebeek, Waterschei, Winterslag, De Slak, Leenhof, Laurentiusplein

05 |

VISION

Content

Border station with employees, Reusel around 1910.
Photo: Unknown, Collection RHce, nr. 5416

5.1 | VISION

In 2050 the region of Limburg will provide **mobility justice** by connecting the Dutch and Belgian provinces. The provinces of Limburg will reconnect with their shared history of mining. The **old mining infrastructure** will play a crucial role for the new transport network and will act as **multi-modal backbone** to **revitalise the garden cities**. By repurposing the old mining sites and garden cities and **rethinking the regional system**, the new just mobility network will be lifted to an **intra-territorial level**.

In 2050 the old infrastructure of the mining operations will be reactivated to serve as a backbone for a new transport network in the region (fig. 5.1 & 5.2). This backbone will not only be used for fast services such as rail or bus connections, instead it will become a multi-modal corridor that supports both slower and faster paced movements.

Maybe the most important part of the vision is bridging the current gap between the provinces. This vision calls for a physical link (fig. 5.1 & 5.2) to finally connect the mine infrastructure in both countries and create the backbone that is needed to support a mobility change. Without this link the backbone won't be able to function to its full potential and will still limit the job opportunities and access to services of the residents. By creating a new physical link the symbol for integration is manifested in space.

Lastly, along the new backbone multiple garden cities are located that will act as hubs, providing access point to their surroundings (fig. 5.1 & 5.2). Each garden city will contribute to the diversity of reachable destinations in the region. Creating these access point around neighbourhoods that were already designed to promote a healthy lifestyle providing sustainable transportation modes helps to integrate the network on a more local scale. Furthermore, the different unique character that each garden cities has, contributes to a complementing networks enabling citizens to share knowledge and ideas and learn from one another. All whilst being granted equal opportunities due to the increased connectivity of the region provided by transport methods that are accessible to all citizens. This, coupled with the opportunities provided by these garden cities when it comes to having access to education facilities and leisure activities, ensures that all residents have equal access to resources and can participate in a wide range of social and cultural experiences. As a result, the garden cities contribute to the creation of a more inclusive and cohesive community within the region, fostering a sense of belonging and collective identity.

Figure 5.1. (below) System section showing the new network and role of the garden cities.

Figure 5.2 (next page) Vision Sustainable Mobility in Limburg 2050

Map labels (place names):

Beringen
Meulenberg
Zolder
Zwarteberg
Eisden
Sipoarkolonie
Winterslag
Waterschei
Treebeek
De Slak
Leenhof
Laurentiusplein

Legend

Symbol	Description
⤢🔗	Connector / new infrastructure
⌒	Connection to railnetworks
🏗	Heritage site
〜	Repurposed mine infrastructure
• Zwarteberg	Garden city
◎	Reconnection
Green	Green
Industry	Industry
Urban	Urban
Agriculture	Agriculture

5.2

STRATEGIC PROJECTS

Based on the vision three strategic projects were extracted. Without these three projects the vision won't be able to come to fruition. These projects are:

1. Bridging the Gap
Creating a physical link for pedestrians, cyclists and public transport between the cities of Geleen and Maasmechelen (fig. 5.3).

2. Garden City as a Hub
Revitalisation of the garden city and using their potential to become car free neighbourhoods. Creating connections to their surroundings will ensure their role as a hub and help contribute to the network (fig. 5.4).

3. Multi-Modal Backbone (Activating Old Infrastructure)
Using the existing tracks of the infrastructure used for transporting goods and people in relation to the mining industry as well as rebuilding demolished infrastructure. Besides rail infrastructure additional space will have to be created to allow for other transportation modes (fig. 5.5).

Figure 5.3. (left). Aerial view of the border where there a physical link will have to be made (Swart, 2013)

Figure 5.4 (middle). Aerial view of the Waterschei Garden City in Genk, Belgium in (Vandekerckhove, 2019).

Figure 5.5 (right). Disused rail tracks in Waterschei, Belgium (Di Pietrantonio, 2014)

BRIDGING THE GAP

GARDEN CITY AS HUB

MULTIMODAL BACKBONE

06 |

STRATEGY

Content

Border crossing in Reusel, 1915
Photo: P. van Hoppe, Collection RHce,
nr. 251779

6.1 | PATTERN LANGUAGE

6.1.1 Introduction
As introduced in chapter 2 the development of a pattern language is one of the methods used throughout this research. A pattern language is a method of describing good design practices for a particular problem field, such as addressing mobility transitions in cross-border regions. It is a set of interconnected patterns, each of which describes a problem and a solution that can be applied in a variety of contexts (Alexander et al., 1977). The thought behind a pattern language is that the patterns can be used together to create a coherent and holistic design, rather than just a collection of isolated solutions.

6.1.2 The Original Pattern Language
The term pattern language was introduced in the book "A Pattern Language: Towns, Buildings, Construction" written by Christopher Alexander, Sara Ishikawa, and Murray Silverstein, and published in 1977. The book is an exploration of good design practices across a wide range of scales, from the design of individual buildings to the layout of entire towns and cities. It presents a set of 253 patterns, each of which describes a problem and a solution that can be applied in a variety of contexts. The authors argue that by using these patterns, designers can create environments that are more livable, sustainable, and functional.

Over the years the pattern language has been adapted by many urban planners using it to describe for instance the layout and organisation of a city or neighbourhood. Each pattern language can be tailored to the goal or vision of the project. One example of a tailored pattern language is the Cities of Making, which was specifically developed to help transition to more urban manufacturing (Cities of Making, 2018)

6.1.3 Value of using a pattern language
Using a pattern language can give structure to the design process and allows the designer to think of the city or region as a whole system, rather than just a collection of unrelated parts (Jacobs, 1992). It introduces a way to break up a very complex transition into smaller pieces that are understandable for a multitude of actors. By doing this the pattern language can become much more than a design tool. It can become a tool for communication, discussion and co-creation. This makes the development of a pattern language an open process where not only the designer develops the solutions, but other interested parties are welcomed to add to the body of knowledge.

6.1.4 Process of using the pattern language
The pattern language in this research will be used for the full strategy making process. Based on the analysis of the mine district a pattern language has been developed that aims for a mobility transition. With these patterns a strategy was created that considers practice and theory. The strategy consists of:

1. Pattern fields, showing the relations between each pattern,
2. A pattern toolbox, showing how each of the patterns help to achieve one or more of the strategic projects as introduced in chapter 5
3. A phasing or sequence of how to 'play' the patterns,
4. A workshop testing the functionality of the patterns
5. A visualisation of the transition, based on the practical implications that are part of the pattern language and the outcome of the workshop, called the synthesis.
6. Policy recommendations based on analysis, pattern language and the workshop
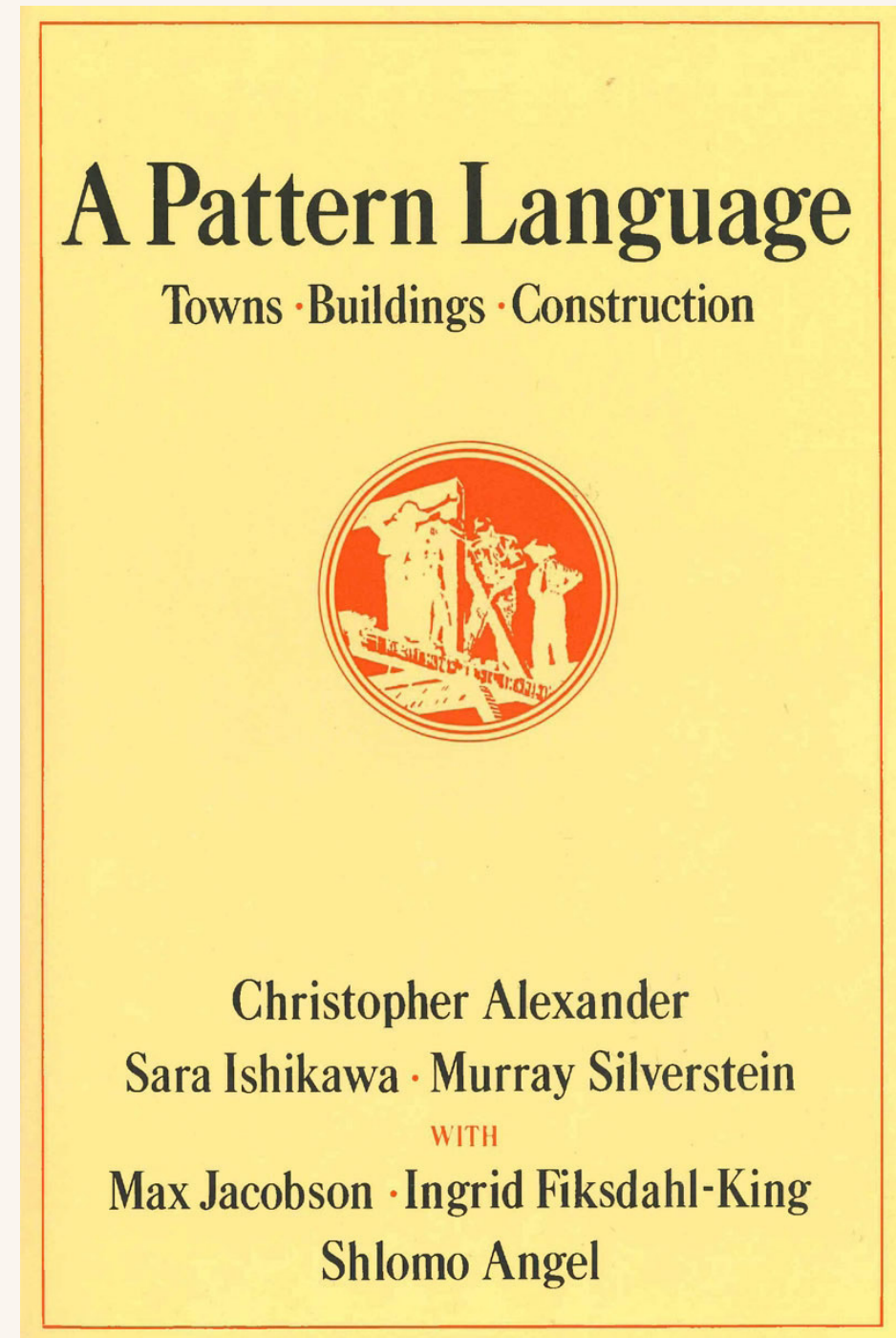
Figure 6.1. Cover of the original book introducing the pattern languaage method and the first pattern language (Alexander et al., 1977).

6.2 | THE PATTERNS

| GOVERNANCE & POLICIES | NETWORKS & INFRASTRUCTURE | EMBRACING HERITAGE (OF THE MINES) | REGENERATING THE GARDEN CITY |
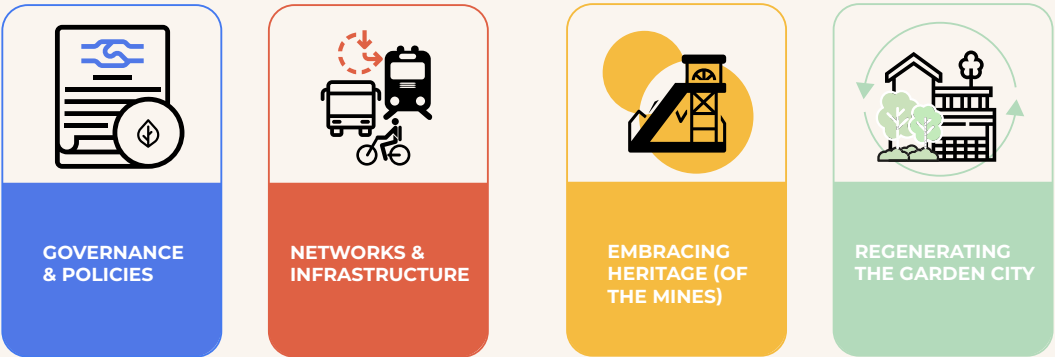
Figure 6.2. Pathways used in the pattern language

6.2.1 Introduction

The pattern language is categorised in 4 pathways each based on the analysis. The colours of the pattern indicate which category they are a part of (fig. 6.2).

Each pattern card consists of a title, description/hypothesis including the context it is embedded in, the problem that it tackles and the possible solutions. These solutions are generic and can be interpreted and adapted for a specific place. Patterns never stand on their own, each pattern is linked to another and can form a pattern language. This way the pattern language can help to provide a systemic approach, develop place-based solutions and support the transition process (Cortes Macias et al., 2021; Hill, 2020).

Each pattern also includes a scale in which it is most likely to manifest. The scales used in this pattern language are based on the nature of the mobility transition which happens in a cross-border context, therefore the scales used are:

1. Public space
2. Neighbourhood
3. City
4. Region
5. Transnational
6. Transcalar

6.2.2 Integrating Theory

Chapter two has introduced multiple theories

that together form the theoretical framework that supports this research. These theories are (1) Mobility Justice (Sheller, 2018), (2) Socio-Technical Systems (Davis et al., 2014), (3) Multi-Level Perspective (Geels, 2011) and (4) Metagovernance (Meuleman, 2019). The Mobility Justice theory and Metagovernance theory have been implemented in the pattern language by translating them into different patterns. As the Social-Technical Systems theory and Multi Level Perspective are more focussed on the transition itself they have been integrated into each pattern. The bottom of the card suggests which of the 6 parts of the socio-technical system the pattern is trying to influence. On the other page it will indicate in what level of the Multi-Level Perspective the pattern is most likely to operate, with either being Landscape or Innovations. By adding these theories to the pattern cards, theory and practice can integrate and help steer the mobility transition, while leaving room for discussion and interpretation.

6.2.3 Pattern Catalogue

Some examples of patterns can be found on page 164 and 165.
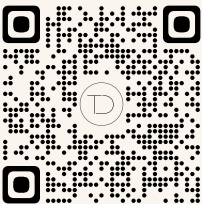
For all patterns see the Pattern Catalogue or scan this QR code

G1 REBOOTING THE PLANNING SYSTEM

ALLOWING DIFFERENT TYPES OF LAND USE IN RESIDENTIAL AREAS CREATES THE POSSIBILITY TO PROVIDE MORE SERVICES CLOSE BY DECREASING THE NEED TO TRAVEL WITH A PRIVATE VEHICLE.

CONNECTED TO
G2, G7, R1, R2, R6

Figure 6.3. (above) Explanation showing how to read the patterns

Figure 6.4. (below) Example of a full Pattern card

N6 CLOSING THE GAP/ NEW CONNECTOR

CLOSING THE GAP BETWEEN THE TWO BORDER REGIONS WITH A NEW CONNECTOR IN TERMS OF SERVICES AND INFRASTRUCTURE WILL INCREASE THE ACCESSIBILITY TO SERVICES AND AMENITIES FOR CITIZENS ON BOTH SIDES OF THE BORDER.

CONNECTED TO
G4, G5, G6, G7, G8, N5, N7, N8, N9, E1, E2, E3, E4, R4, R5

Freepik by Storyset (edited)
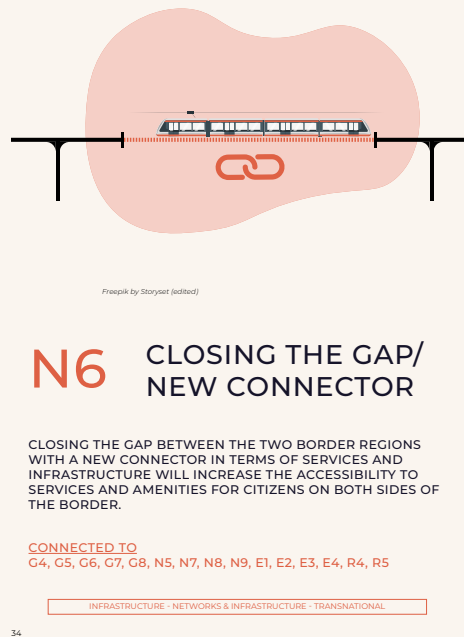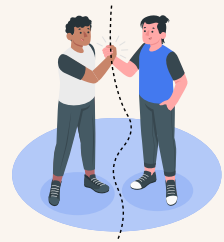
G6 INTERNATIONAL COMMITMENT

INTERNATIONAL COLLABORATION CAN INCREASE MOBILITY OPTIONS BY MEANS OF KNOWLEDGE-SHARING, DEVELOPMENT OF MORE EFFICIENT AND SUSTAINABLE TRANSPORT SYSTEMS, AND PROMOTING GREATER COOPERATION BETWEEN TRANSPORT OPERATORS AND AUTHORITIES.

CONNECTED TO
G2, G4, G5, G7, N5, N6, N7, N8, E1, E2, E3, E4

PROCESSES · GOVERNANCE & POLICIES · TRANSNATIONAL

34

Freepik by Storyset (edited)

G8 ENGAGE THE COMMUNITY

ENGAGING COMMUNITIES IN CROSS-BORDER MOBILITY PLANNING CAN PROMOTE MOBILITY JUSTICE BY ENSURING THAT THE NEEDS AND PERSPECTIVES OF ALL STAKEHOLDERS ARE TAKEN INTO ACCOUNT IN A PARTICIPATORY AND INCLUSIVE MANNER.

CONNECTED TO
G2, G4, G5, G6, G7, N1, N2, N4, N5, E2, E3, E4, R1, R2, R3, R5, R6, R7

PEOPLE · GOVERNANCE & POLICIES · TRANSCALAR

38

Freepik by Storyset (edited)
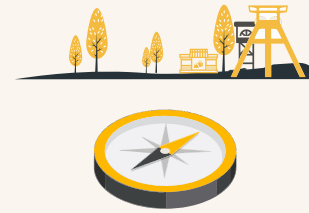
E3 CREATING DESTINATIONS

CREATING DESTINATIONS CAN BOOST HERITAGE TOURISM, COMMUTING AND CONNECTIONS BETWEEN DIFFERENT PARTS OF THE REGION. HAVING DIFFERENT TYPES OF DESTINATIONS WILL CREATE A NETWORK THAT PROMOTES THE EXCHANGE OF PEOPLE, KNOWLEDGE AND CULTURE.

CONNECTED TO
N5, N6, N9, E1, E2, E4, R4, R5

CULTURE · ENHANCING HERITAGE OF THE MINES? · REGIONAL

66

Freepik by Storyset (edited)
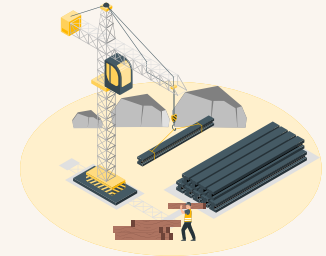
E5 MINE MATERIALS

USING MATERIALS THAT CAN BE TRACED BACK TO THE MINING HISTORY FOR CONSTRUCTING, STATIONS, REST AREAS, ETC. WILL FURTHER ANCHOR THE HERITAGE OF THE REGION INTO THE TRANSPORT NETWORKS.

CONNECTED TO
G2, N4, N8, E1, E4

CULTURE · ENHANCING HERITAGE OF THE MINES · PUBLIC SPACE

70

Freepik by Storyset (edited)
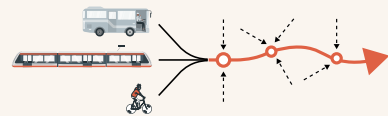
N5 MULTIMODAL BACKBONE

A TRANSPORT NETWORK WITH A MULTIMODAL BACKBONE CAN ENHANCE CONNECTIVITY AND IMPROVE MOBILITY OPTIONS, LEADING TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION.

CONNECTED TO
G5, G6, G7, G8, N1, N4, N6, N8, N9, E1, E2, E3, R3, R4

INFRASTRUCTURE · NETWORKS & INFRASTRUCTURE · TRANSNATIONAL
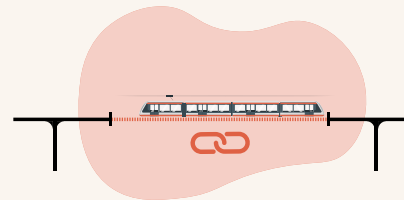
50

Freepik by Storyset (edited)

N6 CLOSING THE GAP/ NEW CONNECTOR

CLOSING THE GAP BETWEEN THE TWO BORDER REGIONS WITH A NEW CONNECTOR IN TERMS OF SERVICES AND INFRASTRUCTURE WILL INCREASE THE ACCESSIBILITY TO SERVICES AND AMENITIES FOR CITIZENS ON BOTH SIDES OF THE BORDER.

CONNECTED TO
G4, G5, G6, G7, G8, N5, N7, N8, N9, E1, E2, E3, E4, R4, R5

INFRASTRUCTURE · NETWORKS & INFRASTRUCTURE · TRANSNATIONAL

52

Freepik by Storyset (edited)

R1 OPTIMISING DENSITY

OPTIMISING DENSITY WITHIN THE GARDEN CITIES WHERE POSSIBLE CREATES MORE DEMAND FOR TRANSIT NETWORKS AND SERVICES.

CONNECTED TO
N1, N9, R6, R7

TECHNOLOGY · REIMAGINING THE GARDEN CITY · NEIGHBOURHOOD

74

Freepik by Storyset (edited)

R7 DIVERSE COMMUNITY

EMPHASIZING DIVERSITY AND CULTIVATING A DIVERSE COMMUNITY AS A FUNDAMENTAL PRINCIPLE IN REIMAGINING THE PHYSICAL AND SOCIAL STRUCTURES OF A GARDEN CITY ENHANCES EQUITY IN MOBILITY.

CONNECTED TO
G7, G8, N1, R1, R4, R5, R6

PEOPLE · REIMAGINING THE GARDEN CITY · NEIGHBOURHOOD

86

Landscape

E1 Activiate Old Mine Infrastructure
G6 International Commitment
G1 Rebooting the Planning System
N7 Eliminate the Edges
N5 Multi Modal Backbone
R4 Become a Node
E4 Tell the Story
G3 Parking as Controlled Substance
N6 Closing the Gap/ New Connector
R5 Connect to Your Surroundings
G4 Easy the Rules
G5 Cross-Border Concessions
G7 Governance Mix & Match

Innovation

N4 Happy Commuting
N1 Accesible Public Transport
R7 Diverse Community
N3 Give Way to PublicTransport
E2 Follow the Trail
R3 Wider Sidewalks
R6 Close by Amenities & Services
N9 Creating Hubs
G8 Engage the Community
N8 Unity in Appearance
R2 Putting People First, Not Cars
E3 Creating Destinations
R1 Optimising Density
N2 Stepless Entering
G2 Accelaration by Exploration
E5 Mine Materials

6.2.4 Pattern Field - Multi-Level Perspective

This first pattern field shows all the connections of each pattern. It has two axes, one for scale and the other showing in what level of the Multi-Level Perspective (Geels, 2011) the pattern is most likely to operate. Based on this pattern field multiple observations can be done.

First of all, there seems to be a relation between the scale of the pattern and the level. Patterns with a larger scale such as region and transnational seem to be concentrating in the landscape level. This could be explained with the notion that interventions in the landscape level usually take more time and have a larger impact. On the other hand, the patterns focussing on public space and neighbourhood tend to operate in the innovation level. These are mostly patterns that could be used as small experiments and are easily implemented. They usually are not dependent on any other patterns and can happen on their own.

If we look at the patterns more closely there are some that have a large number of connections such as '*G8 Engage the Community*' and '*N6 Closing the Gap*'. These patterns are vital to the success of the transition and are therefore very well linked to the other patterns.

The pathways also show that they each have their own spot within the field. The Governance & Policies pathway has almost all of its patterns in the landscape level, mainly because the patterns aim for change by implementing long term strategies and try to make way for new innovations to rise. The Regeneration of the Garden City pathway on the other hand has more of its patterns located in the innovation layer. These patterns try to set examples of how a neighourhood or city could function without the need of cars. The patterns are made up of smaller interventions that set a new standard.

Figure 6.5. Pattern field 1: Scale and Multi-Level Perspective

6.2.5 Pattern field - Socio-Technical System

The second pattern field (fig. 6.6) shows which patterns try to influence which pillar of the Socio-Technical System (STS). The STS as introduced by Davis et al. (2014) consists of 6 pillars (1) Goals/metrics, (2) People, (3) Infrastructure, (4) Technology, (5) Culture and (6) Processes/Procedures. This pattern field also includes the scales of the patterns. The closer to the centre the smaller the scale.

The first pillar Goals and Metrics doesn't have any patterns assigned as the vision is the goal and all patterns work towards this. Therefore, we could argue that all patterns try to achieve the goal in one way or another. The second pillar, 'People' shows that there are many patterns part of the Regeneration of the Garden City pathway (R#) that try to influence this part of the regime. Patterns such as R6 Close by Amenities try to directly influence the travel behaviour of people, where R2 creates the environment necessary to practice this behaviour. Patterns from other pathways such as N4 and G8 are also placed here due to their nature. The third pillar, Infrastructure, has almost all patterns of the Network & Infrastructure pathway (N#). The fourth pillar of Technology has the lowest number of patterns because none of the patters focus specifically on technological innovations. The fifth pillar, Culture, only has patterns of the Embracing Heritage pathway (E#) assigned to it, this is due to the goal of these patterns to strengthen the identity of the region based on its history and culture. Lastly the sixth pillar, Processes/Procedures includes almost all patterns in the Governance and Policies Pathway (G#), most of these patterns aim for a change in this pillar and all happen on a large scale which why none of these patterns are in the inner rings.

It was only after creating the patterns that the different pillars were assigned to each of them. It is intriguing to note that although these patterns operate on different scales, most of the patterns in the same pathway ended up in the same pillar.

Figure 6.6. Pattern field 2: Scale and Socio-Technical System

6.3 | PATTERN STRATEGY

6.3.1 Introduction
The pattern strategy consists of a toolbox and a pattern sequence and is based on three phases in the transition that eventually can lead to the regime change.

1. Preparation
Focussing on laying the ground and necessary policy changes to support the transition.

2. Acceleration
Developing the network that can support the mobility shift.

3. Regime change
Optimising and promoting the network triggering a regime change.

6.3.2 Pattern Toolbox
The patterns are a great tool to use when designing the transition strategy. The toolbox (fig. 6.7) helps to show how the patterns can be used to design the different strategic projects and in which phase they should preferably happen. As can be seen some patterns can be used in different phases. This can be because they take a longer time to be fully implemented or because they are useful for each different phase.

6.3.3 Pattern Sequence
After analysis of all the patterns, pattern fields and the toolbox a sequence was generated that shows how the patterns could work together to form a transition strategy. Each pattern is linked to other patterns in order to solve different problems that overlap, based on complementary needs and/or goals, to solve the same issue in equally valid ways and finally if they share a similar structure. Additionally, the arrows show the relation between the patterns. Some patterns might be a prerequisite for another pattern, or should be played simultaneously for the best result.

Creating this sequence can be described as playing a game. The players, also known as the stakeholders each have all the patterns in their hand before playing them in the most valuable order. Once a pattern is placed in the sequence
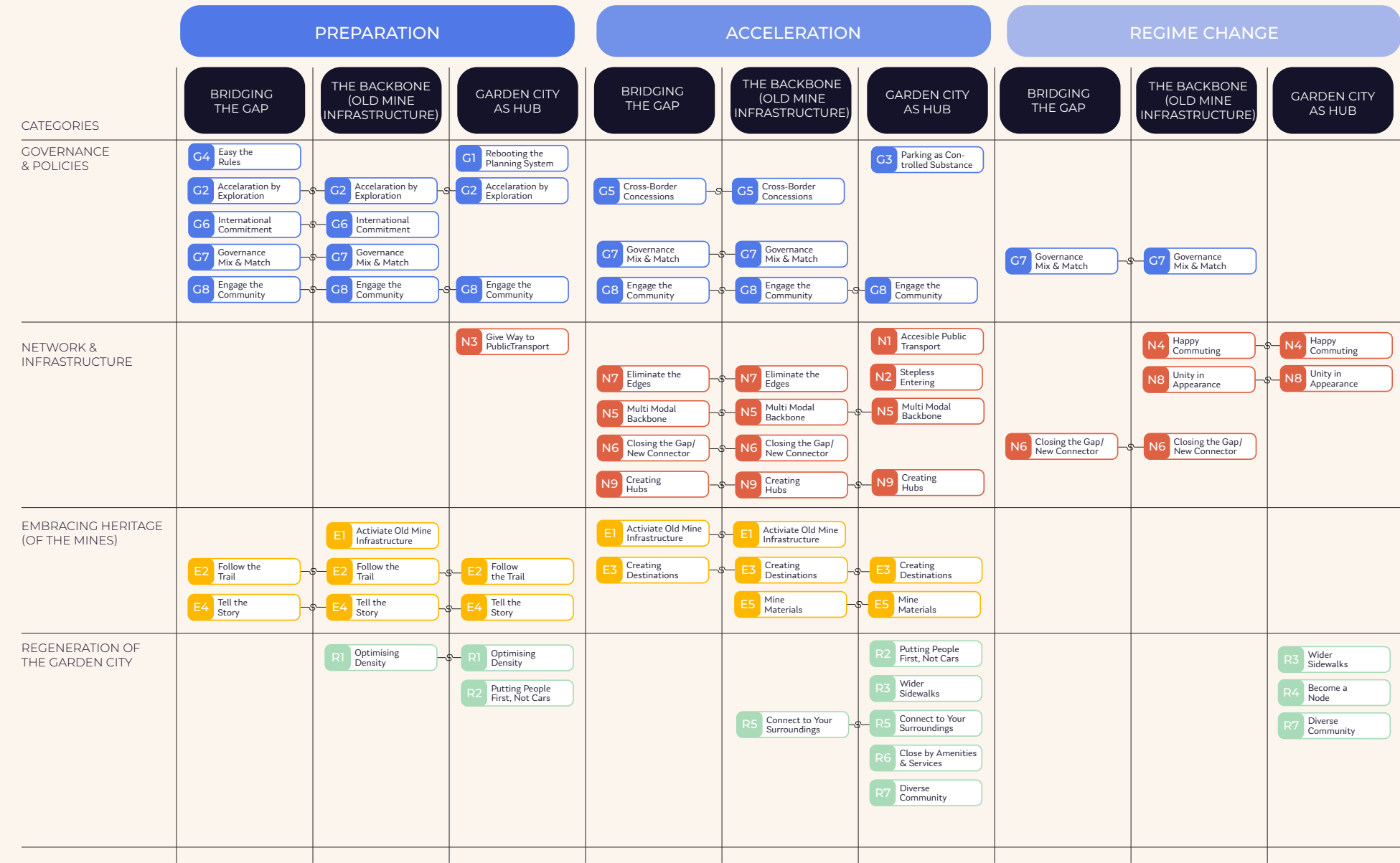
Figure 6.7. Pattern Toolbox

it will stay active for the rest of the sequence still being influential as other patterns will be placed after it. Eventually creating the pattern language for a mobility transition (fig. 6.8).
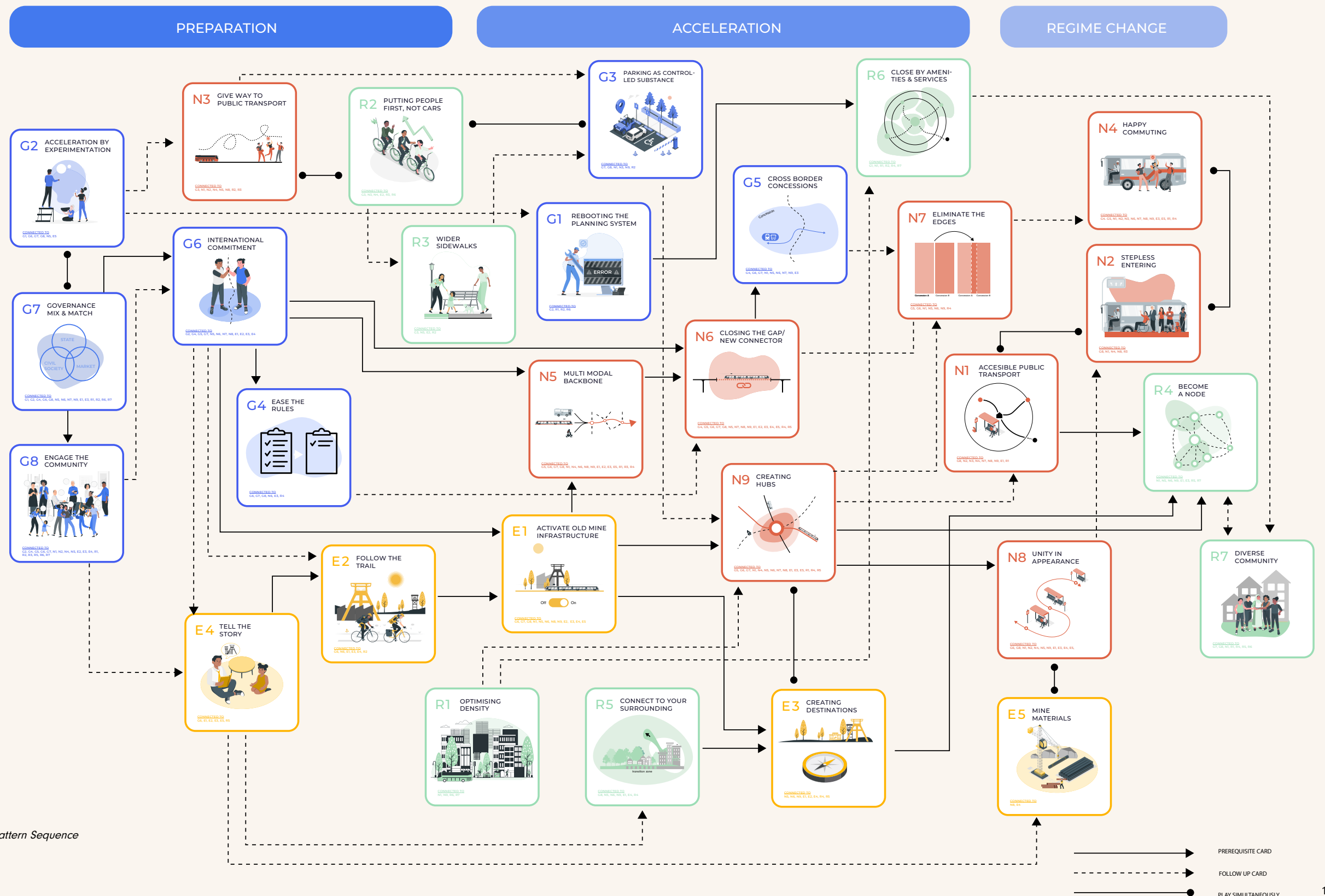
Figure 6.8. Pattern Sequence

PREREQUISITE CARD

FOLLOW UP CARD

PLAY SIMULTANEOUSLY

6.4 | PATTERN WORKSHOP

6.4.1 Introduction
To verify the pattern language and test its usability for strategy and decision-making a workshop was organised. This workshop consisted of a focus group working together with the patterns to create a strategy for one of the three strategic locations. The strategic project chosen was, bridging the gap, working on the connector between The Netherlands and Belgium as it involved parties from both countries and is expected to be the most challenging.

6.4.2 Workshop Set-up
The workshop was set up in order to answer the following question: Create a strategy/planning for the Maasmechelen – Sittard region to bridge the current mobility gap.
The focus group consisted of 6 different stakeholders that would be important in the strategy.
1. Municipality of Maasmechelen
2. Municipality of Sittard/Geleen
3. Ministry of Infrastructure/ department of the province
4. Citizen
5. Operator (NS, Arriva, de Lijn)
6. Infrastructure companies (Prorail, Infrabel)

Preferably these stakeholders were invited to join the workshop themselves. However due to a low response rate of the real stakeholders, students joined the workshop and were all given a specific role description (Appendix B) in order to simulate the discussion. The full workshop program was the following:
1. Introduction of Region (Problem, Analysis, Vision)
2. Explanation of The Pattern language
3. Group discussion on the starting patterns (select 3 out of 6)
4. Create a strategy with all patterns connected to the starting patterns by developing a pattern sequence.
5. Reflecting on the spatial and social impact of using the patterns

6.4.2 Group Discussion on Starting Patterns
The workshop started with a short introduction about the project and the purpose of the session. In general, all participants understood the assignment clearly and were excited to begin with the discussion. To create an interesting starting point for the pattern language 6 patterns were preselected and presented to the group. These preselected patterns were:
- G6 – International Commitment
- G8 – Engage the community
- N1 – Accessible Public Transport
- N6 – Closing the Gap/New Connector
- E1 – Activate Old Mine Infrastructure
- R2 – Putting People First, not Cars

The patterns were selected to introduce a pattern from each pathway as well as part of different levels in the Multi-Level Perspective. This helped to provide patterns that function on both a landscape and innovation level. Furthermore, the patterns selected tried to represent as many pillars of the Socio-Technical System as possible. Lastly the importance of the patterns, based on the previously introduced toolbox (fig. 6.7), to achieve the strategic project of bridging the gap was taken into account.

During the discussion each stakeholder showed their different interests because they preferred to start with different patterns. However, none of the stakeholders picked *G8 – Engaging the Community* as a pattern to start the next step with. It was to be expected that the citizen would include this pattern into its top three, but it favoured patterns N1, N6 and R2 as these would have a direct impact on their life and would make travelling with public transport easier, faster and more convenient. Eventually the group settled on patterns *N6 – Closing the Gap*, as it included the main goal of this workshop. *N1 – Accesible Public Transport*, because they argued this pattern was necessary to get all residents in the area involved and insure accessibility to a new network. Lastly *G6 – International Commitment* was selected as working together in this international context is crucial.

Figure 6.9. (right) Participants creating the pattern sequence during the workshop. Photo: Thomas van Daalhuizen

6.4.3 Sequence

Next up the participants gathered all patterns that were connected to the three patterns they picked during the group discussion. As some patterns have many connections this meant that they had to use almost the entire pattern language to create their pattern sequence with. In order to give the group some tools, they were provided with all maps that are part of the analysis. Furthermore, the only question on the table was to create some sort of logical order that can be described as a strategy. To help with structure they were asked to include the different links between each pattern, deciding between, follow up, prerequisite or play simultaneously. By giving them these conditions,

it is possible to compare their created pattern sequence with the pattern sequence created for the full project. While discussing the best sequence of the pattern, they mainly talked about how to start with the transition. Do you start with signing documents and put *G6 – International commitment* as starting point, or do you need some form of momentum to be able to internationally commit? Eventually the group settled on the latter, which is similar to the original pattern sequence created as a strategy for the entirety of the region (fig. 6.8). After the group thought of the right sequence, they quickly started grouping the patterns in to categories like: initiative, tactical, results, optimising etc. This categorisation was a new

way of grouping the patterns and showed that dependent on the group and setting new ways of interpretation are possible. In the original pattern sequence, there are only three phases distinguished where the workshop pattern sequence grouped them according to their goal.

6.4.4 Conclusion

Even though the workshop was carried out as a simulation it still provided valuable insights. Most of all it showed that the pattern language helped guide a discussion when creating a strategy for one of the strategic projects in the mobility transition. All participants agreed that it helped visualise possible solutions and gave

them valuable information of all different aspect to consider when creating a strategy. Moreover, it exhibited the versatility of the pattern language and that the creating and grouping of patterns can differ dependent on the involved stakeholders, giving them the opportunity to create a new structure for the patterns that helps with their decision-making process. In general feedback was positive and the group didn't think of any additional patterns when doing the workshop. Adding different forms of transport into the pattern language was given back as something that could be improved when developing this pattern further. The grouping of all different transport methods in the pattern *N5 – Multi-Modal Backbone* worked for this project but could be explored in more detail.
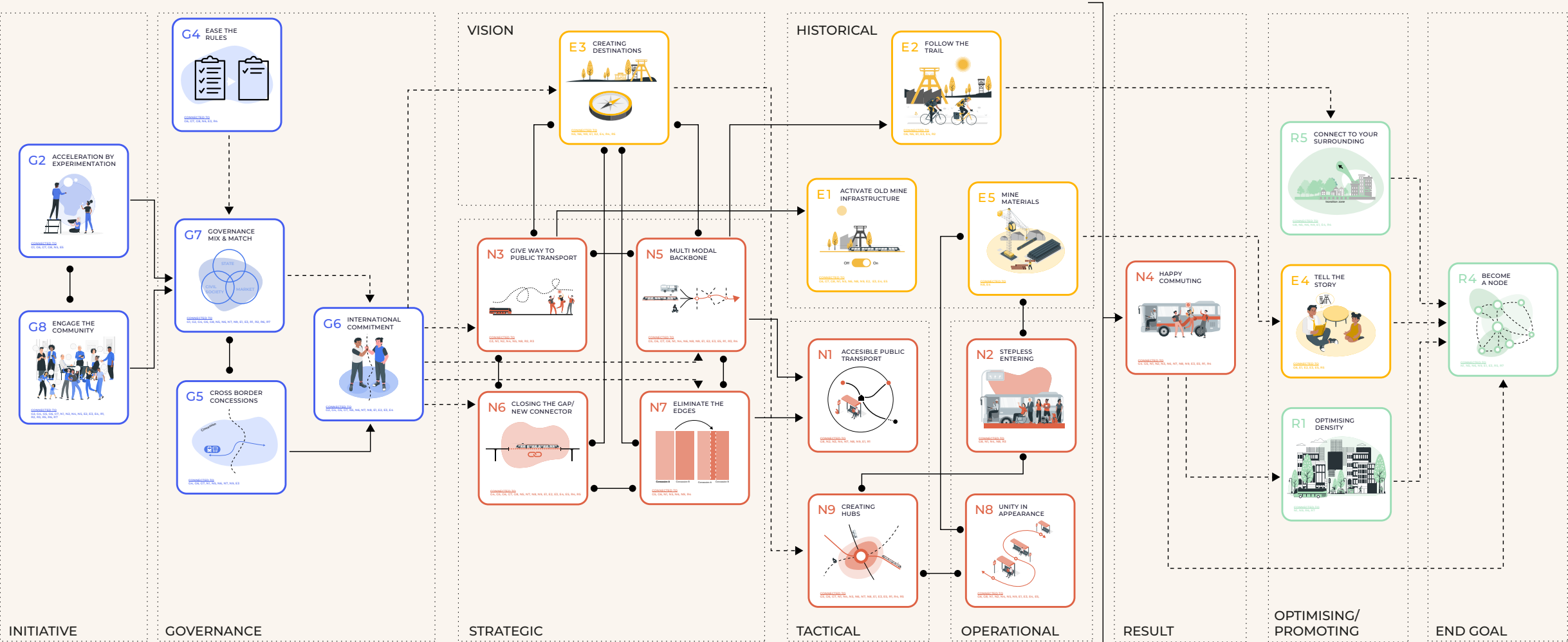
Figure 6.10. (right) Pattern Sequence created during the workshop (edited by author) original can be found in appendix B

6.5

SYNTHESIS

Based on all the information gathered by creating the pattern toolbox, pattern field and pattern sequence the strategy was synthesised and spatialised. The next pages will include one possible iteration of what the pattern language could result into when manifested in space. This synthesis was done for each of the strategic locations and includes a map showing where pattern could manifest in space as well as a collage that shows what the new atmosphere of these spaces could be. On each of the visualisation the manifestation of the patterns is shown, visualising the impact of the patterns in space. The collages and maps for the strategic project bridging the gap were made based on input during the workshop, as participants sketched where they thought the patterns would manifest in space.

Figure 6.11. (left) Collage of Bridging the Gap

Figure 6.12. (middle) Collage of Garden city as a Hub

Figure 6.13. (right) Collage of Activating Old Infrastructure

BRIDGING THE GAP

GARDEN CITY AS HUB

MULTIMODAL BACKBONE

Expanding Leisure Valley

E3 Creating Destinations

N5 Multi Modal Backbone

R5 Connect to Your Surroundings

New Dwellings

R2 Putting People First, Not Cars

Car-Free City Centre

G3 Parking as Controlled Substance

New bridge Connecting Mine Rail

Transfer of Landownership

G8 Engage the Community

N6 Closing the Gap/ New Connector

Bus lane

N3 Give Way to PublicTransport

N1 Accesible Public Transport

Transfer Station

N9 Creating Hubs

Bus Stop

R1 Optimising Density

New Dwellings

Mobility Fieldlab

G2 Accelaration by Exploration

E3 Creating Destinations

Dutch Railway Network

Transition Zone Chemelot Campus

Reinstating Old Infrastructure

Transfer Station

E1 Activate Old Mine Infrastructure

This map shows the border region where the two towns of maasmechelen on the Belgian side (left) and Stein/Geleen on the Dutch side (right) will be connected. The map shows where the new multi modal backbone should be placed, based on the location of the old mine infrastructure. The new connection will go through agricultural land and will need a transfer of landownership in order to be built therefore pattern *G8 – Engage the Community* is visible. The connection itself will be via a bridge as the river Maas is currently separating the region. Furthermore, the patterns *N3 – Give Way to Public Transport* and *N1 – Accessible Public Transport* are visualised with buslanes and catchment areas of each busstop.. Along the hubs and close to the garden cities there are chances to *R1 - Optimise Density*. Finally on both sides of the new connections destinations can be created (E3). In Maasmechelen the Leisure valley can be expanded whereas in Geleen the Chemelot campus is better connected to the network. Moreover, the Chemelot Campus in Geleen has the opportunity to serve as a fieldlab location which is why *G2 – Accelaration by Exploration* is located here.

BRIDGING THE GAP

0   500m   1000m
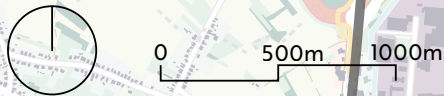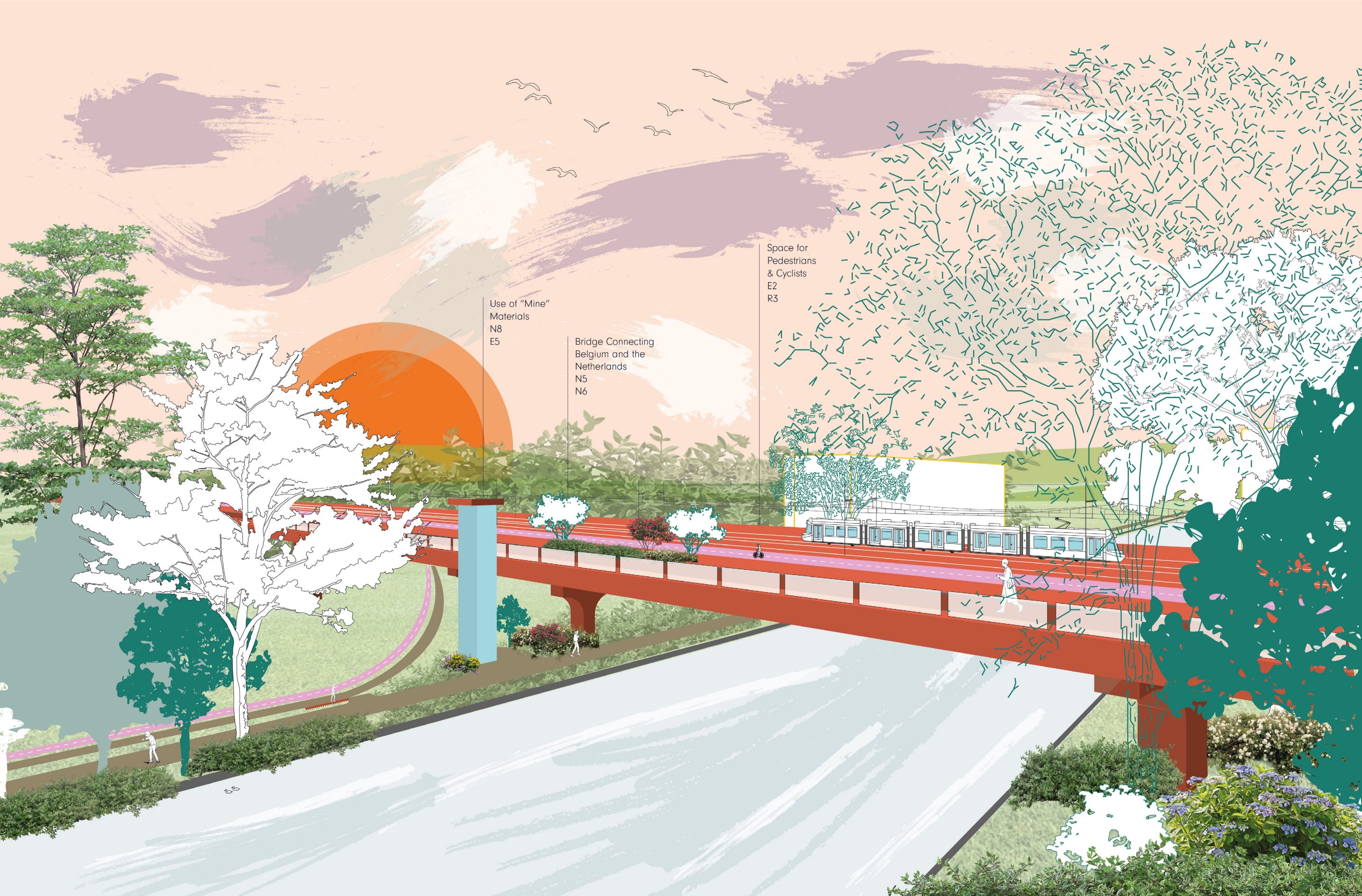
Use of "Mine"
Materials
N8
E5

Bridge Connecting
Belgium and the
Netherlands
N5
N6

Space for
Pedestrians
& Cyclists
E2
R3

GARDEN CITY AS A HUB
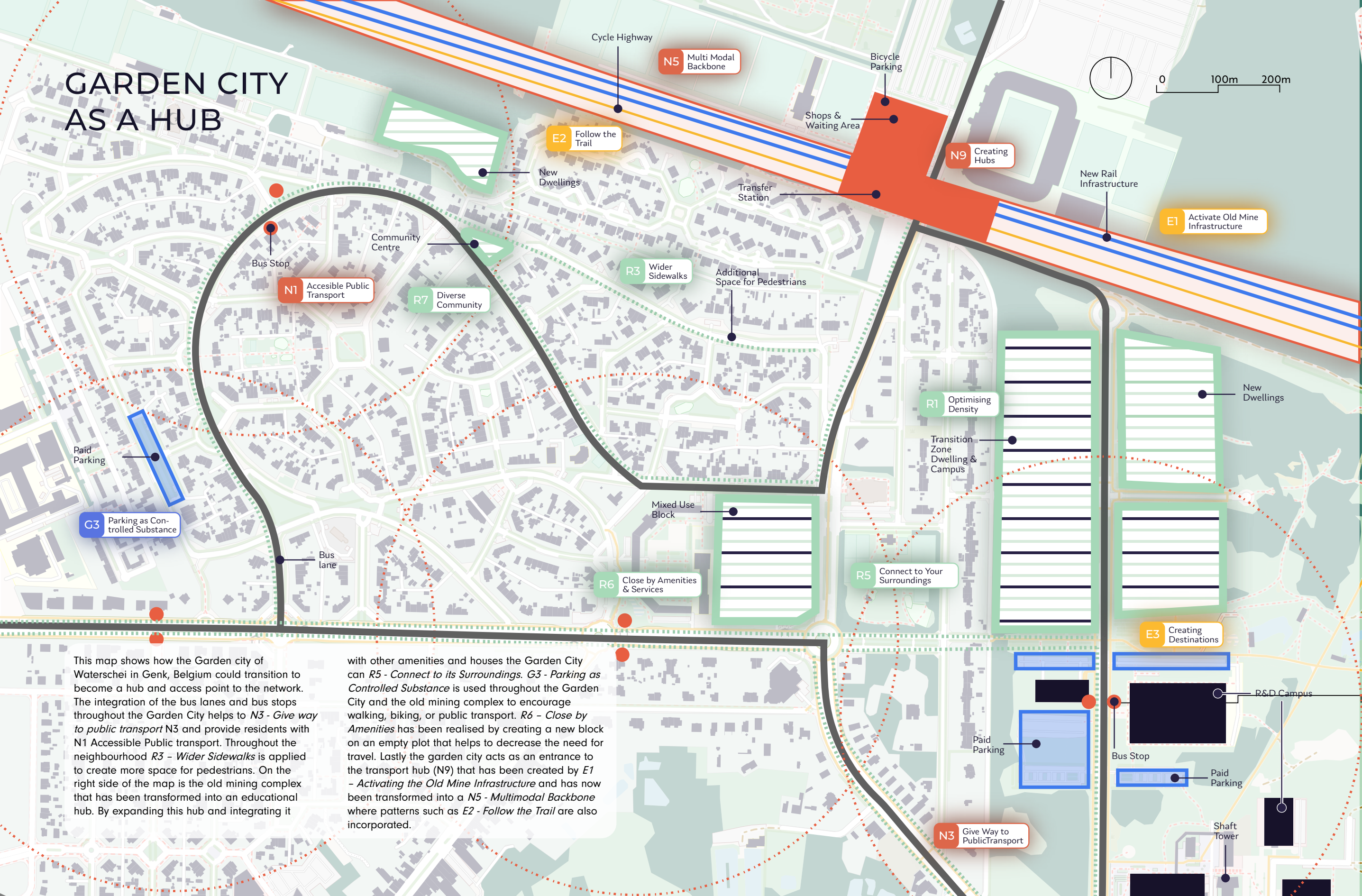
Cycle Highway

N5 Multi Modal Backbone

Bicycle Parking

Shops & Waiting Area

N9 Creating Hubs

E2 Follow the Trail

New Dwellings

Transfer Station

New Rail Infrastructure

E1 Activate Old Mine Infrastructure

Bus Stop

Community Centre

R3 Wider Sidewalks

Additional Space for Pedestrians

N1 Accesible Public Transport

R7 Diverse Community

R1 Optimising Density

New Dwellings

Paid Parking

Transition Zone Dwelling & Campus

G3 Parking as Controlled Substance

Mixed Use Block

Bus lane

R6 Close by Amenities & Services

R5 Connect to Your Surroundings

E3 Creating Destinations

Paid Parking

Bus Stop

Paid Parking

R&D Campus

N3 Give Way to PublicTransport

Shaft Tower

This map shows how the Garden city of Waterschei in Genk, Belgium could transition to become a hub and access point to the network. The integration of the bus lanes and bus stops throughout the Garden City helps to *N3 - Give way to public transport* N3 and provide residents with N1 Accessible Public transport. Throughout the neighbourhood *R3 – Wider Sidewalks* is applied to create more space for pedestrians. On the right side of the map is the old mining complex that has been transformed into an educational hub. By expanding this hub and integrating it

with other amenities and houses the Garden City can *R5 - Connect to its Surroundings. G3 - Parking as Controlled Substance* is used throughout the Garden City and the old mining complex to encourage walking, biking, or public transport. *R6 – Close by Amenities* has been realised by creating a new block on an empty plot that helps to decrease the need for travel. Lastly the garden city acts as an entrance to the transport hub (N9) that has been created by *E1 – Activating the Old Mine Infrastructure* and has now been transformed into a *N5 - Multimodal Backbone* where patterns such as *E2 - Follow the Trail* are also incorporated.

0   100m   200m
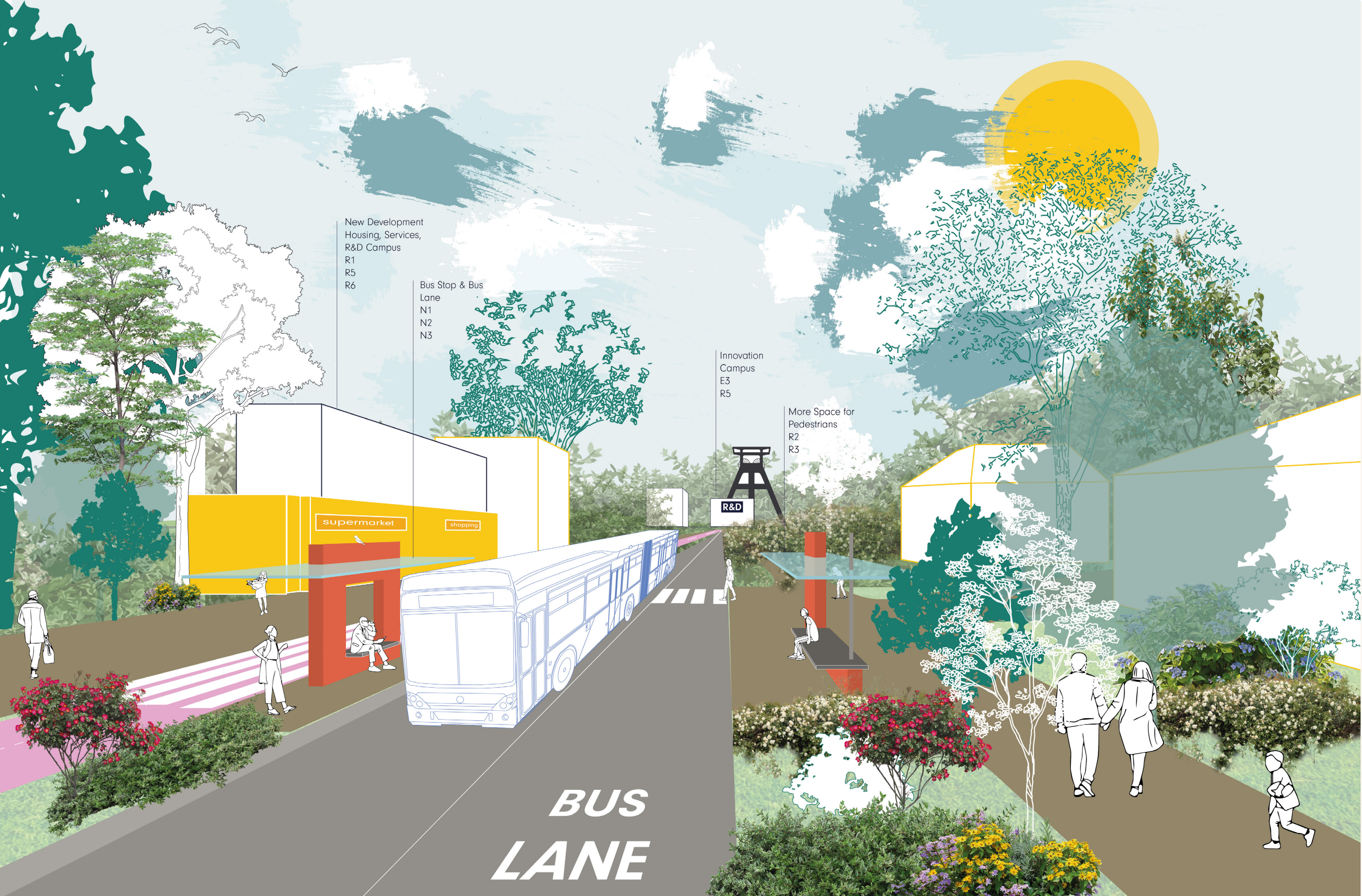
New Development
Housing, Services,
R&D Campus
R1
R5
R6

Bus Stop & Bus
Lane
N1
N2
N3

Innovation
Campus
E3
R5

More Space for
Pedestrians
R2
R3

supermarket   shopping

R&D

BUS
LANE
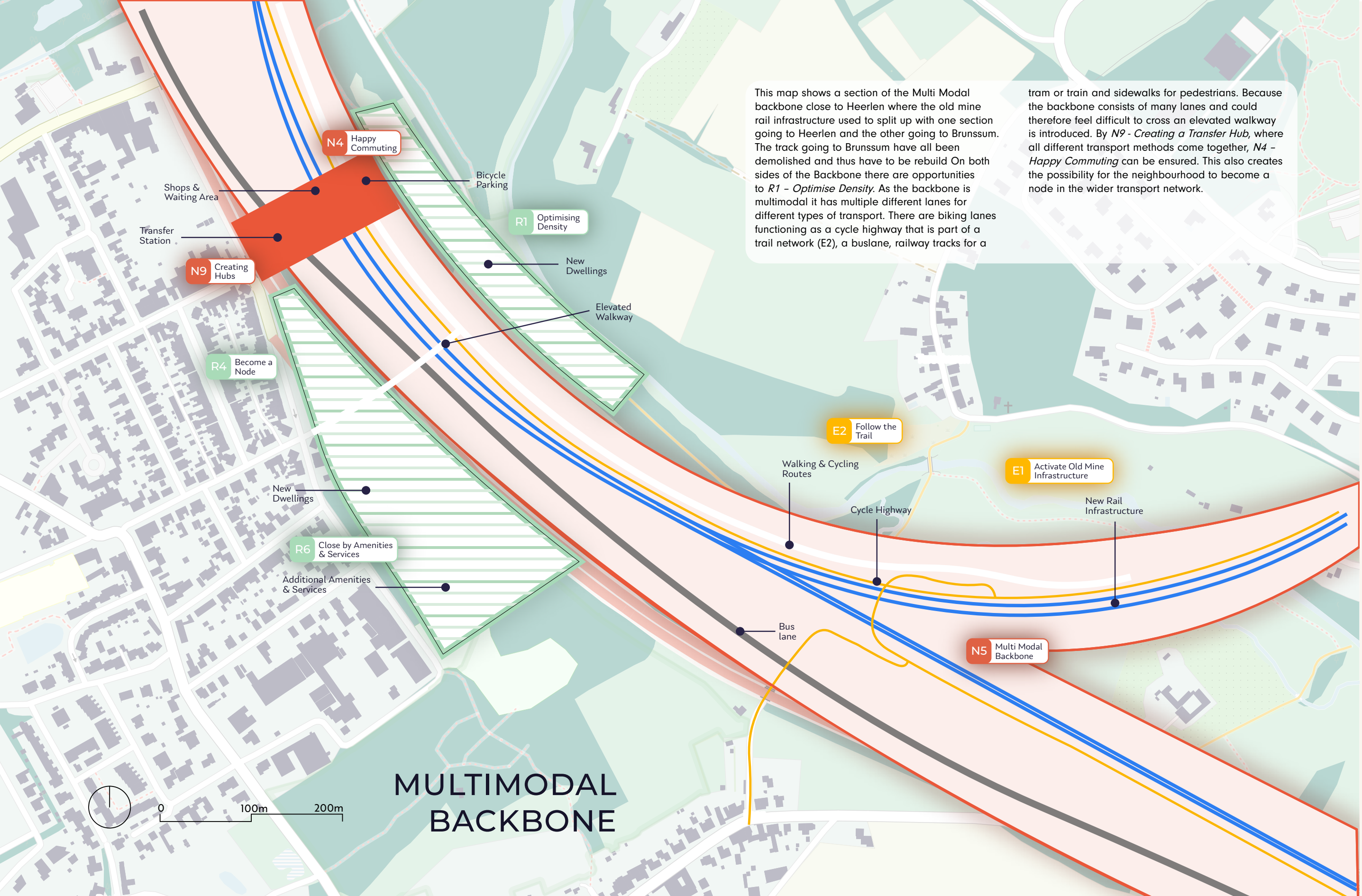
N4 | Happy Commuting

Shops & Waiting Area

Bicycle Parking

Transfer Station

N9 | Creating Hubs

R1 | Optimising Density

New Dwellings

Elevated Walkway

R4 | Become a Node

New Dwellings

R6 | Close by Amenities & Services

Additional Amenities & Services

E2 | Follow the Trail

Walking & Cycling Routes

E1 | Activate Old Mine Infrastructure

Cycle Highway

New Rail Infrastructure

Bus lane

N5 | Multi Modal Backbone

This map shows a section of the Multi Modal backbone close to Heerlen where the old mine rail infrastructure used to split up with one section going to Heerlen and the other going to Brunssum. The track going to Brunssum have all been demolished and thus have to be rebuild On both sides of the Backbone there are opportunities to *R1 – Optimise Density*. As the backbone is multimodal it has multiple different lanes for different types of transport. There are biking lanes functioning as a cycle highway that is part of a trail network (E2), a buslane, railway tracks for a tram or train and sidewalks for pedestrians. Because the backbone consists of many lanes and could therefore feel difficult to cross an elevated walkway is introduced. By *N9 - Creating a Transfer Hub*, where all different transport methods come together, *N4 – Happy Commuting* can be ensured. This also creates the possibility for the neighbourhood to become a node in the wider transport network.

0   100m   200m

MULTIMODAL BACKBONE

Elevated Walkway
Mine Materials
N4
N8
E5

Multi Modal
Network
N5
E1
E2
R3

New Dwellings
Services &
Amenities
R1
R6

6.6 | LOCAL EMPOWERMENT

INITIATE

R2 — PUTTING PEOPLE FIRST, NOT CARS

CONNECTED TO
G3, N3, N4, E2, R3, R6

Introduce car free zones in the city centre and give priority to soft transport modes. Cyclist and pedestrians should get priority at crossings. Additional safety measures at road crossing can also be put in place

G8 — ENGAGE THE COMMUNITY

CONNECTED TO
G3, N1, N2, N4, N5, E2, E3, E4, R1, R2, R3, R5, R6, R7

Start to engage with citizens to build support for a mobility shift. Use focus groups but also more interactive means to get in touch. Think of exhibitions or events.

PREPARE

G3 — PARKING AS CONTROLLED

CONNECTED TO
C7, G8, N1, N3, N6, R2

Start to limit free parking to promote other modes of transport. This can be amplified by decreasing the number of parking spaces.

G2 — ACCELERATION BY EXPERIMENTATION

CONNECTED TO
G1, G6, G7, G8, N5, E5

Allow operators, companies & startups to test new mobility options. Provide a fieldlab to do this. Some larger companies might be able to provide more sustainable transport options for their employees.

N3 — GIVE WAY TO PUBLIC TRANSPORT

CONNECTED TO
G3, N1, N2, N4, N5, N6, R2, R3

Introduce buslanes on busy corridors to ensure better travel times for public transport.

R3 — WIDER SIDEWALKS

CONNECTED TO
G3, N5, E2, R5, R6

Increase the size of sidewalks to show that pedestrians are prioritised in the city. Adding wider bike paths or seperating them form road traffic will also help to promote soft transportation.

EDUCATE & EXPLORE

E4 — TELL THE STORY

CONNECTED TO
G6, E1, E2, E3, E5
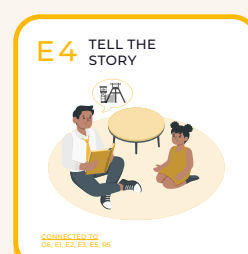
Acknowledge the significance of mining sites by marking them and creating experiences around these. Engage with citizens that can tell these stories from a first hand perspective.

E3 — CREATING DESTINATIONS

CONNECTED TO
N6, N6, N9, E2, E4, R4, R5

Use placemaking around locations that have potential to become new points of interest and that can contribute to the new network. Empower local businesses and residents to start the process and shape 'their' place so it can become a destination.

E2 — FOLLOW THE TRAIL

CONNECTED TO
G6, N6, E1, E3, E4, R6

Activate local cycle clubs and enthousiast to help create new trails that follow the old mining sites.

CONNECT

N6 — CLOSING THE GAP/ NEW CONNECTOR

CONNECTED TO
C4, C5, C6, C7, G8, N5, N7, N8, N9, E1, E2, E3, E4, E5, R4, R5

Instead of large scale connection projects, setting up a ferry or a bus that has a frequent timetable can close the gap. This small addition can connect existing networks and highlights the importance of a cross-border connection.

PROMOTE & OPTIMISE

N4 — HAPPY COMMUTING

CONNECTED TO
C4, C5, N1, N3, N6, N7, N8, N9, E3, R1, R4

Improve public transport stops by providing amenities such as benches, shelter or area's with more traffic a cafe or little kiosk.

N1 — ACCESIBLE PUBLIC TRANSPORT

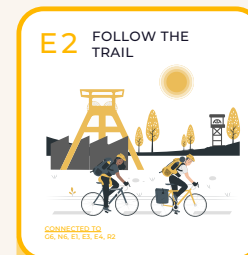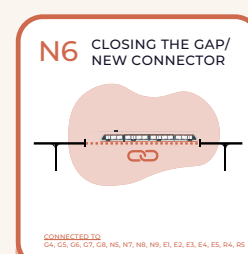CONNECTED TO
G8, N2, N3, R4, N7, N8, N9, E1, R1
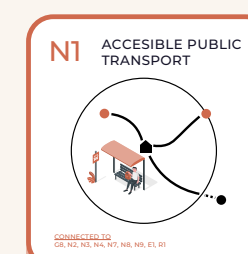
Look for current gaps in accessibility and address these specifically taking into account marginalised citizen groups. Citizens can also be asked to nominate new locations for bus stops.

R7 — DIVERSE COMMUNITY

CONNECTED TO
N5, N6, E3, E4, R4, R6

Allow for a mix of different citizen groups in neighbourhoods that are easily accessed by public transport. This helps to achieve equal access to sustainable mobility options.

N9 — CREATING HUBS

CONNECTED TO
C3, C6, C7, N1, N4, N6, N7, N8, E1, E3, E5, R1, R4, R5
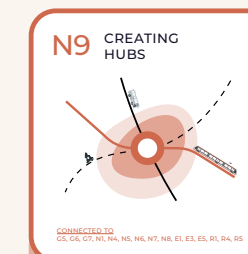
Set up multimodal hubs where passengers can switch between bike, bus and shared mobility options. Placing these along the old mine infrastructure will ensure future usability.

N2 — STEPLESS ENTERING

CONNECTED TO
G8, N1, N4, N9, R3

Show off an inclusive approach by investing in making all public transport stops accesible to those who are immobilised.

6.6.1 Introduction

Thus far the strategy has been used mostly from a top-down perspective and is based on the fact that provincial and national governments are both cooperative and proactive. However, this is not always the case and therefore the applicability of patterns to empower local governments is highly valuable. A selection of patterns was made based on their practical implications and their contribution to sustainable mobility on a local scale (fig. 6.14). These patterns can be

categorised into multiple activities. Some patterns can be used to initiate the mobility transition on a local scale and other can be used to educate and explore the past identity of the region. For each pattern there is a small box explaining how it could be used on a local scale. Together they create a local empowerment toolbox showing what municipalities can do to get their city ready for the transition and secure for instance funding from the national government.

Figure 6.14 (right). Toolbox for Local Empowerment.

6.6.2 From Local Empowerment to Regional Impact

The diagram on the right (fig. 6.15) shows how the different categories can have a regional impact. For instance, the implementation of patterns that promote and optimize a sustainable mobility network at the local level can have a significant impact by generating positive travel experiences and fostering a greater willingness for a regional transition. Additionally, the inclusion of patterns categorised under the "prepare" category demonstrates the active involvement of local governments in prioritizing public and soft transport options. By utilising these patterns, there is an increased likelihood of national and provincial governments becoming engaged and providing support, including securing necessary funding for the mobility transition. This process effectively expands the influence of local empowerment, enabling it to drive regional impact and create a more sustainable and inclusive mobility system.

Furthermore it must also be noted that there is no specific order in which these patterns can be used. They should be seen a toolbox available for local governments from which they can pick and choose. What could help to amplify the effects of using the patterns is taking into account which patterns are related and could strengthen one another.

A map on the next page shows what the spatial impact of using these patterns would be if they were applied from a local empowerment perspective. They have been projected on the same map as the previously shown "Bridging the Gap' project. Differences include the absence of a rail connection, which has been replaced with a reliable ferry connection and the scaled down version of buslanes, busstops and tranfer station.
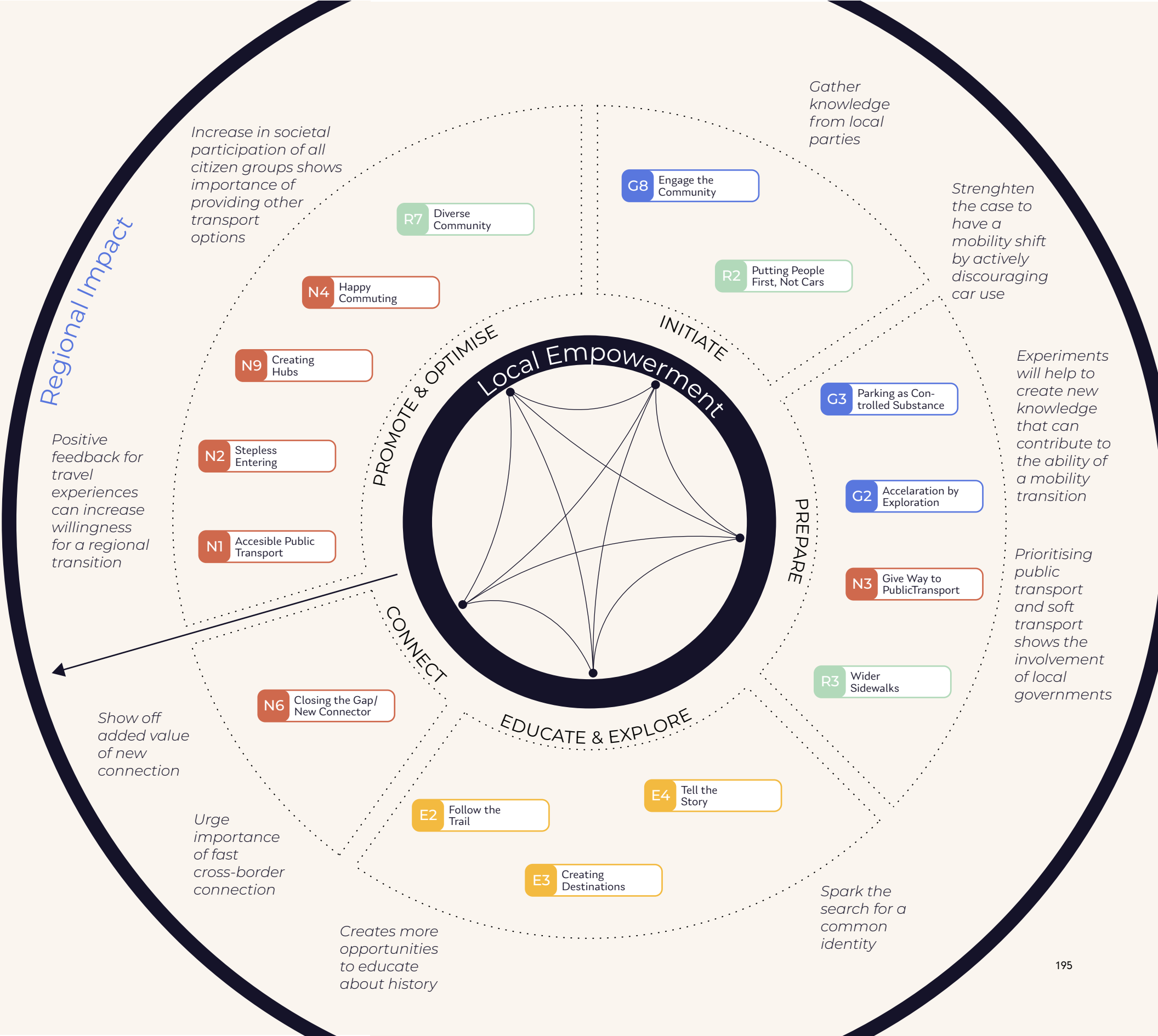
Figure 6.15 (right). Local empowerment can lead to regional impact

Regional Impact

Increase in societal participation of all citizen groups shows importance of providing other transport options

Gather knowledge from local parties

Strenghten the case to have a mobility shift by actively discouraging car use

Experiments will help to create new knowledge that can contribute to the ability of a mobility transition

Prioritising public transport and soft transport shows the involvement of local governments

Positive feedback for travel experiences can increase willingness for a regional transition

Show off added value of new connection

Urge importance of fast cross-border connection

Creates more opportunities to educate about history

Spark the search for a common identity

PROMOTE & OPTIMISE — INITIATE — PREPARE — EDUCATE & EXPLORE — CONNECT

Local Empowerment

R7 Diverse Community
G8 Engage the Community
R2 Putting People First, Not Cars
N4 Happy Commuting
G3 Parking as Controlled Substance
N9 Creating Hubs
G2 Accelaration by Exploration
N2 Stepless Entering
N3 Give Way to PublicTransport
N1 Accesible Public Transport
R3 Wider Sidewalks
N6 Closing the Gap/ New Connector
E4 Tell the Story
E2 Follow the Trail
E3 Creating Destinations

Expanding Leisure Valley

E3 Creating Destinations

New cycle/hike connection

Frequent Ferry Connections

Bus Stop

N6 Closing the Gap/ New Connector

Transfer Station

R2 Putting People First, Not Cars

R7 Diverse Community

Car-Free City Centre

G3 Parking as Controlled Substance

New Dwellings

Transfer Station

N9 Creating Hubs

E3 Creating Destinations

Bus lane

Redeveloping old mine sites

E4 Tell the Story

N3 Give Way to PublicTransport

N1 Accesible Public Transport

Dutch Railway Network

Mobility Fieldlab

G8 Engage the Community

G2 Accelaration by Exploration

New bus connection

N6 Closing the Gap/ New Connector

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6.7 | POLICY RECOMMENDATIONS

Now that the approach to the strategy is clear and more is known about how the pattern language can contribute to a strategy-making process the following policy recommendations can be given. The policy recommendations don't include specific policies but rather gives advice on the process of creating a strategy for a mobility transition. These policy recommendations also function as a conlusion for this chapter as they summarise all findings.

1. Establish a Cross-Border Sustainable Mobility Focus Group:
Create a task force comprising representatives from both countries to collaboratively develop and implement a comprehensive mobility transition strategy. This ensures that all stakeholders are involved and their perspectives are considered. Stakeholders that should be included are, Citizens, Municipalities, the Dutch and Belgian Province of Limburg, the network operators such as NS, Arriva, NSMB, De Lijn, etc., Prorail and infrabel, the companies that are in charge of the infrastructure. Besides these, other parties such as large employers or Interreg Euregio Meuse Rhine could be invited as well.

2. Develop a Common Vision and Goals:
Facilitate dialogue amongst stakeholders to establish a shared vision and goals for the mobility transition. The pattern language can help to facilitate this dialogue. This will help align efforts and create a unified approach towards sustainable transportation.

3. Allow for Changes and Flexibility:
A mobility transition will take a long time and plans might change. Establish a robust monitoring and evaluation framework to track the progress of the mobility transition strategy. Regularly assess the effectiveness of implemented measures, identify challenges, and adapt strategies accordingly to ensure continuous improvement.

4. Invest in Co-creation
Create a level playing field for all stakeholders by ensuring information is understandable and available. This will foster smooth collaboration. Each stakeholders needs a lot of information to understand the project, however the knowledge each stakeholder has will be extremely valuable to the project. Ask all relevant parties to partake in discussions and help shape for instance a pattern sequence. By doing this all parties feel included and also responsible for the success of the project. This way of strategy-making can also help to increase support from residents that will have to change their travel behaviour. The pattern workshop showed that co-creation added valuable knowledge and helped all stakeholders express their needs.

5. Conduct Cross-Border Data Sharing:
Encourage the sharing of relevant data and research findings between the two countries to foster a better understanding of mobility patterns, challenges, and opportunities. This will provide a solid foundation for evidence-based decision-making and can help to improve the patterns.

6. Harmonise Policy Frameworks:
Work towards harmonising policy frameworks, regulations, and standards related to sustainable mobility across both countries. This will streamline efforts, avoid duplication, and facilitate a smoother transition process. Besides policies frameworks directly related to sustainable mobility, policies regarding cross-border working and living should be simplified.

7. Implement Pilot Projects:
Initiate small-scale pilot projects on locations throughout the region to foster innovation. This enables testing and evaluating innovative mobility solutions and allows stakeholders to gain hands-on experience, assess feasibility, and generate valuable insights for scaling up the transition. This

can help to create support on both a local and international scale to eventually start implementing a transition.

8. Start Working Together:
Look for solutions instead of problems and keep the discussion going. This is relevant on all scale levels as we need all of society to make a mobility transition a success. One way to achieve this is by signing declarations of intent and setting up new collaborations that could provide cross-border transport services.

9. Show Where the Road Ends:
Having tactile solutions that are easy for all stakeholders to envision helps get a better understanding of the task at hand. The pattern language can be a tool to help do this. It can also help to visualise the impact of the transition.

6.8 | ASSESSMENT

6.8.1 Introduction
The pattern language strategy was developed to achieve the goal of mobility justice within the planetary boundaries. According to Sheller (2018) mobility justice was developed to address several injustices or challenges that we can reflect on. The mobility justice theory seeks to address various forms of injustices related to gender, race, age, disability, sexuality, as well as historical struggles such as enslavement, resistance, and class struggle. As the strategy focusses on mobility justice as well as reaching the sustainable goal to reduce car traffic with 75 percent not all challenges were addressed as they were not the focus of this thesis. In general, the pattern language acknowledges these challenges and aims to overcome these injustices by promoting inclusive, equitable and sustainable mobility.

6.8.2 Solutions
One of the challenges addressed by the pattern language is the concept of "the right to the city" and freedom of movement. It recognises that unequal mobility and uneven development of urban, regional, national, and global spaces contribute to social and spatial inequalities. The strategy emphasises the need to challenge these disparities and create opportunities for all individuals to exercise their right to assemble and move freely within cities. The patterns concerning *'Engaging the Community (G8)'* as well as *'Diverse Community (R7)'* are an example of this. Furthermore, by incorporating the pattern language approach, the strategy provides a framework to identify and address specific mobility-related issues faced by marginalised communities.

Furthermore, the strategy acknowledges the importance of addressing issues related to borders, migration, and transnational mobility. Unlike the mobility justice theory that focusses largely on human trafficking, deportation systems and the treatment of undocumented migrants (Sheller, 2018) it has a more nuanced approach. The cross-border region of Limburg doesn't have challenges as severe as the ones that Sheller describes, however even with the borders being

'open' administrative and intuitional boundaries still prevent border communities to have the same opportunities as those more land inwards (Marlet et al., 2014; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2019). The pattern language approach helped to identify interventions that can mitigate these challenges by advocating to bridge these differences and promoting inclusive policies related to cross-border transport and migration. Patterns *'Ease th Rules (G4)'* and *'Closing the Gap (N6)'* are just two of many pattens that contribute address these challenges.

The strategy and the pattern language primarily focus on addressing the movement of people and do not explicitly encompass politics surrounding the circulation of goods, resources, energy, pollution, and waste. These politics highlight the lack of procedural justice in the distribution of planetary matter and the impacts of logistics infrastructures on local communities (Sheller, 2018). The pattern language does aim for procedural justice. The use of a pattern language creates a favourable environment for co-creation and participation. A pattern language is a powerful communication tool and can therefore contribute to incorporating procedural justice in the strategy. Marginalised communities can use the pattern language to voice their concerns and priorities as it will help to make the complex transition understandable. That said, the language can be expanded to include the distribution and logistics of goods and address logistic infrastructures.

Furthermore, the pattern language addresses the main challenge of achieving a sustainable mobility network. Although achieving mobility justice is seen as way to also address the climate crisis (Sheller, 2018) it is not specifically mentioned as one of the challenges it addresses. Achieving sustainable goals have as main challenge to get the governance right (Meadowcroft, 2011, p.536) and see difficulties of policy development that support mobility transitions (Nikulina et al., 2019). The pattern language lays the groundworks to overcome these challenges by aiming for a mixed governance approach (Meuleman, 2019). Since 2001 this type of approach was included in Dutch

legislation but we haven't seen an accelerate systemic and disruptive changes (Bosch-Ohlenschlager, 2010). Raising the question on the effectiveness of such approaches.

6.8.3 Challenges
While the strategy developed based on the pattern language approach demonstrates a comprehensive understanding of mobility justice and attempts to address its challenges, there may be some aspects that did not work as effectively as intended. It is thus important to critically reflect on the strategy to identify areas that may require improvement.

Implementation Challenges
Developing a strategy is one thing, but implementing it effectively is another. It is important to critically assess whether the strategy faced any significant barriers during implementation. Factors such as limited resources, bureaucratic hurdles, and conflicting interests among stakeholders can hinder the successful execution of the strategy. Reflecting on these challenges shows that the pattern language currently doesn't include solutions to help identify these areas that require additional support or alternative approaches to ensure effective implementation.

Stakeholder Engagement
The strategy emphasises the involvement of various stakeholders, including marginalized communities, in the decision-making process. However, it is crucial to evaluate if the engagement process was truly inclusive and if the perspectives of all relevant stakeholders were adequately considered. This suggests that patterns relating to reflection of the stakeholder engagement process should be introduced to account for this. Furthermore, reflecting on the level of engagement and identifying any gaps or limitations can provide insights into improving participatory practices and ensuring that diverse voices are genuinely heard and valued.

Adaptability
Sustainable mobility justice requires long-term commitment and sustained efforts. Considering the dynamic nature of societal and environmental factors, it is important to address that the strategy was not specifically created to adapt to potential changes, future challenges, and evolving needs.

However, the pattern language approach allows to change the strategy at any time and just as any language it is always developing allowing it to be flexible. More emphasis on the flexibility and adaptability of a pattern language approach could have been a part of the strategy.

6.8.4 Conclusion
In conclusion, the strategy based on the pattern language approach demonstrates a commitment to addressing mobility justice challenges and promoting sustainable mobility practices. While it effectively acknowledges social inequalities, the right to the city, and cross-border issues, there are areas for improvement. The strategy should consider incorporating the circulation of goods and logistics infrastructure, enhancing stakeholder engagement, and emphasizing flexibility and adaptability. By addressing these aspects, the strategy can become more comprehensive and effective in achieving sustainable mobility goals.

07 |

DISCUSSION & CONCLUSION

Content

Border crossing in Stramproy

Photo: Archive Heemkunde Strampoy Historic photos of the old city

7.1 | DISCUSSION

7.1.1 Introduction
The analysis conducted in this study and the strategy-making process that followed has provided valuable insights into achieving a just and sustainable multi-modal network in a cross-border context, specifically focusing on the Limburg border region and the mining district. The key findings highlight the potential of garden cities in shaping the strategy, emphasizing their integration into the landscape and adherence to mobility justice principles. Leveraging existing garden cities and their infrastructure can promote alternative modes of transportation and reduce car dependency.

7.1.2 Dependencies
Improving public transport connections within the mining region is identified in this thesis as a crucial step towards reducing reliance on cars and creating a positive impact at the local and regional scales. The lack of cross-border connections and administrative barriers underscore the need for collaboration among all stakeholders involved in infrastructure development and passenger services provision and the passengers travelling. Therefore, successful implementation of any strategy relies on strong cooperation and coordination among all stakeholders to overcome these dependencies and address the challenges associated with sustainable cross-border transportation.

7.1.3 Ethical Considerations
Achieving a just and sustainable multi-modal network raises ethical issues. Promoting equal opportunities for residents, fostering regional integration, and ensuring access to education, leisure facilities, and community-building opportunities are ethical imperatives. However ensuring mobility justice, which encompasses fairness, equity, and accessibility in transportation, could result in potential social or environmental inequities. A lot of the old infrastructure that will be reactivated is located close to homes and could cause nuisance to dwellings directly adjacent to the projected backbone. This nuisance could occur in terms of noise pollution but also a decrease in property value. Furthermore, the new connection

that will bridge the gap between Belgium and The Netherlands will mean that some landowners will have to sell their land. This will impact their future and should be done very carefully. Lastly the mobility shift will mean that many people in the car industry could lose their job. Ensuring a smooth transition on labour markets would help mitigate this risk.

7.1.4 Relevance
This thesis holds significant relevance in several aspects. Firstly, it addresses a topic that is not extensively discussed in current discourse on mobility transitions. While the focus often revolves around electric cars, this thesis sheds light on the need to explore and promote other sustainable transportation options. Secondly, the thesis underscores the relevance of examining border regions. It brings attention to the unique challenges and disadvantages faced by these regions in implementing sustainable mobility strategies. By highlighting the work required to prepare such regions for a mobility shift, the thesis offers valuable insights for policymakers and practitioners seeking to address the specific needs and complexities of border areas. Lastly a multimodal network can help the integration of marginalised groups, particularly those reliant on public and soft transport. This also highlights the importance of inclusivity and accessibility in mobility planning. Ultimately, this thesis starts a crucial conversation and provides a new perspective on sustainable mobility and the transformative possibilities it can bring.

7.1.5 Limitations
The thesis has several limitations that should be acknowledged. Firstly, due to resource constraints, a site visit to the Limburg and mining district region was not conducted. This absence of firsthand observations and interactions with the local context may have limited the depth of understanding of the specific challenges and opportunities unique to the region. Secondly, the focus group discussions relied on simulated scenarios and did not involve real stakeholders from the cross-border region. While efforts were made to gather diverse perspectives, the absence

of actual stakeholders may have restricted the authenticity and representativeness of the discussions. Finally, this thesis only addresses one case, the Limburg region and creates a very place specific strategy which can't be tested in other border regions without adjusting it to the local context. Thus, limiting the generalisability and applicability of the findings. Therefore, caution should be exercised when applying the strategy to other regions, and further testing and adaptation are necessary to ensure its effectiveness and relevance in diverse cross-border settings.

7.1.6 Recommendations
Future research should focus on several key areas to increase our understanding of achieving a just and sustainable multi-modal network in cross-border contexts. First, there is a need for in-depth analysis and comparative studies of other cross-border regions to identify successful strategies and lessons learned that can be applied to border regions in general. Second, further investigation is needed to understand the potential ethical implications and social impacts of implementing multi-modal networks in cross-border regions. This includes examining the distributional effects of mobility interventions on different social groups and ensuring equitable access to transportation options. Additionally, research should explore the role of technology, such as smart transportation systems and digital platforms, in supporting multi-modal networks and enhancing connectivity in cross-border areas. Last of all, future studies should focus on the long-term viability and scalability of the proposed strategies, considering factors such as funding mechanisms. By addressing these research gaps, we can develop a more comprehensive understanding of the challenges and opportunities in achieving a just and sustainable multi-modal network in cross-border contexts.

7.2 | CONCLUSION

This thesis has sought to address the question of achieving a just and sustainable multi-modal network in a cross-border context, specifically focusing on the border region of Limburg and the mining district as a case study. The analysis conducted in this study has revealed valuable insights that can contribute to the development of a comprehensive strategy for the region.

One key finding is the potential of garden cities within the region to play a significant role in shaping the strategy. These garden cities, with their integration into the landscape and adherence to principles of mobility justice, provide a unique opportunity to connect neighbourhoods and foster collaboration within a network. By leveraging the existing garden cities and their infrastructure, the region can promote mobility alternatives and transition away from car dependency.

Improving public transport connections within the mining region emerges as a crucial step towards reducing reliance on cars and creating a positive impact on both local and regional scales. The lack of cross-border connections and administrative barriers underscore the need for collaboration among all stakeholders involved in infrastructure development and passenger services provision. In this regard, repurposing the old mine infrastructure as a backbone for a new cross-border network represents a transformative opportunity. By utilising the existing infrastructure and revitalising it, the region can establish a strong foundation for a sustainable and well-connected transport system.

The vision put forth in this thesis imagines a future where the old mining infrastructure serves as the backbone of a multi-modal transport corridor, accommodating a range of transportation options. The establishment of physical links between the provinces is identified as a crucial element of this vision, as it symbolises integration and unlocks the full potential of the backbone. Additionally, the presence of multiple garden cities along the new backbone enhances the region's connectivity and accessibility, providing residents with equal opportunities, access to education and leisure facilities, and fostering a sense of community. To guide the strategy-making process, a pattern language approach has been adopted. This approach not only provides a structured design process but also facilitates communication, discussion, and co-creation among various stakeholders. By integrating theories such as Mobility Justice, Socio-Technical Systems, Multi-Level Perspective, and Metagovernance into the pattern language, theory and practice can be effectively integrated, steering the mobility transition and allowing for flexibility and adaptation.

The applicability of the pattern language approach has been tested through a workshop simulation, yielding positive feedback from participants. The pattern language proved instrumental in guiding strategy discussions, visualizing solutions, and incorporating diverse perspectives. The workshop highlighted the adaptability and potential of the pattern language, suggesting further exploration of including different forms of transport within the patterns.

Based on the findings and insights, a set of policy recommendations has been put forth to inform the strategy-making process. These recommendations emphasise the establishment of cross-border collaboration, the development of a shared vision and goals, flexibility in adapting to changing circumstances, investment in co-creation, cross-border data sharing, harmonization of policy frameworks, implementation of pilot projects, collaboration among stakeholders, and the use of tactile solutions to enhance understanding.

By following these policy recommendations, the region can embark on a transformative journey towards achieving a just and sustainable multi-modal network. Such a network would provide equal opportunities for residents, foster regional integration, support sustainable growth and development, and ensure access to resources and a wide range of social and cultural experiences.

The pattern language approach, coupled with collaborative efforts, will serve as essential tools in realising this vision and driving the mobility transition in the cross-border context of the Limburg region and the mining district.

All of the information gathered throughout this thesis allows to answer the main research question: *What transitional Strategy can contribute to achieve a just and sustainable multi-modal network in a cross-border context?* with the following statement:

A transitional strategy that incorporates existing infrastructure, enhances public transport connections, fosters collaboration among stakeholders and adopts a systematic approach through for instance a pattern language can contribute to achieving a just and sustainable multi-modal network in any cross-border context. The strategy should promote data sharing and harmonsation of policies as well as encourages pilot projects, and emphasise stakeholder engagement.

By considering local characteristics, involving diverse actors, and promoting inclusive and accessible transportation options, such a transitional strategy can support the system change towards a more equitable and environmentally friendly transportation system in different border regions.

08 |

REFLECTION

Content

Border crossing in Heurne-Hemden

Photo: Leo van der Linde

8.1 Design & Research

With "Reconfiguring travel patterns," I focused on one of the challenges ahead that is not often discussed, a mobility shift away from cars. While the news talks mostly about limiting CO2 emissions and the need for electric cars, I discovered that the use of electric cars creates a new cycle of non-renewable materials that we use for our new tmade by the European Green Deal to limit 75 percent of CO2 emissions by 2050 was therefore an interesting starting point but left me wondering how we can get there? The year 2050 is coming relatively fast so how do we transition in such a short amount of time, with many regions not being able to handle such a big change. To me it was important to look at regions that have the longest way to go to get to a sustainable way of transport. As it turned out these regions concentrate around the border and I therefore settled on the border of The Netherlands and Belgium as my thesis location.

When working on the area for the design, there was a constant struggle to get to the right scale. The entire border region is quite large meaning it was difficult to provide detail but a large scale was also needed to consider the connections to other regions. Before starting the project, I was not looking at the mining history as a way to anchor the transition. Limburg was not even considered as the location for the project. This was based on the national analysis that eventually showed two regions. With already a lot of transport connections in Zeeuws-vlaanderen, I eventually settled on Limburg.

Looking into a border region and the obstacles this brings was new for me. I challenged myself by looking at a location that I was not familiar with yet. This made things more difficult than expected, as Belgium and the Netherlands are two very different countries when it comes to policies, governments, and public transport. Having a border region often meant that I had to do research to get specific dataset twice, sometimes running into the problem of having some data available for one country but not for the other. On the other hand this also created the chance to look for opportunities or lessons that these two countries could take from one another, this is where the idea came from to start looking for a specific region that based on history and culture could be seen as one. For Limburg this turned out

to be the shared mining history that had a huge impact on the region and left traces till this day.

Finding the mining history as an anchor did get me more excited to create a strategy that would feel authentic to the region but still had some generic elements that could work for other border regions too. Therefore, designing the pattern language ensured that even though the patterns were specifically created for the region they could also be easily adapted and used in other projects. Another aspect that proved to be difficult was integrating theory into the strategy design. When creating the theoretical framework in the beginning of the research there was an overwhelming amount of transition theories to use. In my opinion each theory could work, but missed something in order for it to fit rightly within the context of a project, looking at both the social and spatial aspects of a mobility transition. The solution was to create additional layers within the theories itself in order for them to link and create one cohesive theoretical framework. Bringing all these theories together might be one of the biggest achievements as I had never yet created such a theoretical framework.

But what to do with such a theoretical framework? It took me a lot of time to think about the right way to incorporate the theories into the design products. Of course the theories helped analyse the region and shed light on some of the solutions that could be implemented, but I wanted to achieve an ever deeper level of integration. Most theories introduced didn't yet have a spatial lens, therefore I hoped my thesis could provide just that. This is why eventually the pattern language includes links to both the Multi-Level Perspective theory (Geels, 2011) as well as the Socio-Technical Systems theory (Davis et al. 2014).

With my research mainly focusing on process and theory it proved to be a challenge to visualise the results. Visualisation is usually one of the selling points for new projects and I thought it would help to show a possible future for the region. The collages and maps in this research are only one iteration of such a process and provide an example that hopefully sparks discussions on what a future without cars would look like.

8.2 Methodology

At the start of the project, my determination was to involve as many stakeholders as possible to ensure a comprehensive perspective. However, I encountered difficulties in engaging with these stakeholders. Despite reaching out to municipalities, provinces, and various organisations, I received little response, prompting me to reconsider my approach. The focus group that participated in the workshop relied on simulated scenarios, which may have limited the authenticity of the findings and potential applicability in further research. In future studies, I highly recommend gathering these stakeholders together for more direct engagement.

Although a site visit to the Limburg and mining district region was planned, it unfortunately did not materialise. The lack of accessible transport connections was the primary reason. Personally, not owning a car and relying on public transportation highlighted the challenges of crossing the border in this region. The absence of firsthand observations and interactions with the local context may have limited the depth of understanding regarding the specific challenges and opportunities unique to the region. However, this experience underscored the importance of establishing such connections and enhancing cross-border mobility.

8.3 Social Relevance

This thesis holds significant relevance in several aspects. Firstly, it addresses a topic that is not extensively discussed in current discourse on mobility transitions. While the focus often revolves around electric cars, this thesis sheds light on the need to explore and promote other sustainable transportation options. It emphasises the importance of reconfiguring travel patterns and shifting away from car dependency to achieve a just and sustainable multi-modal network.

Secondly, the thesis underscores the relevance of examining border regions. It brings attention to the unique challenges and disadvantages faced by these regions in implementing sustainable mobility strategies. By highlighting the work required to prepare such regions for a mobility shift, the thesis offers valuable insights for policymakers and practitioners seeking to address the specific needs and complexities of border areas.

Lastly, the thesis highlights the potential of a multi-modal network to create equal opportunities for marginalised groups, particularly those reliant on public and soft transport. This underscores the importance of inclusivity and accessibility in mobility planning. Ultimately, this thesis starts a crucial conversation and provides a new perspective on sustainable mobility and the transformative possibilities it can bring.

8.4 Transferability

The transferability of this thesis lies in its comprehensive approach and the utilisation of a pattern language methodology. The integration of theories such as Mobility Justice, Socio-Technical Systems, Multi-Level Perspective, and Metagovernance into the pattern language provides a flexible and adaptable framework for other contexts. This methodology encourages stakeholder engagement, fosters collaboration, and facilitates the visualisation of solutions. Therefore, other regions can adopt this approach to guide their own strategy-making processes and effectively address the complex challenges associated with achieving a just and sustainable multi-modal network.

By leveraging the insights and findings from this thesis, policymakers and practitioners can develop context-specific strategies that promote sustainable transportation alternatives, enhance connectivity, and create inclusive urban environments.

8.5 Further Research

Future research should focus on several key areas to increase our understanding of achieving a just and sustainable multi-modal network in cross-border contexts. First, there is a need for in-depth analysis and comparative studies of other cross-border regions to identify successful strategies and lessons learned that can be applied to border regions in general. By examining different contexts and their specific challenges, researchers can expand the knowledge base and identify effective approaches for sustainable mobility transitions. Second, further investigation is needed to understand the potential ethical implications and social impacts of implementing multi-modal networks in cross-border regions. This includes examining the distributional effects of mobility interventions on different social groups and ensuring equitable access to transportation options.

Additionally, research should explore the role of technology, such as smart transportation systems and digital platforms, in supporting multi-modal networks and enhancing connectivity in cross-border areas.

Last of all, future studies should focus on the long-term viability and scalability of the proposed strategies, considering factors such as funding mechanisms. By addressing these research gaps, we can develop a more comprehensive understanding of the challenges and opportunities in achieving a just and sustainable multi-modal network in cross-border contexts. This knowledge will inform future policy-making and urban planning efforts, contributing to the creation of more sustainable and inclusive cities.

8.6 Personal growth

This thesis holds great significance for me as it aligns closely with the themes and goals of my master's program in Urbanism. As an aspiring urbanist, I am deeply passionate about studying cities, their development, and the design of urban spaces with a strong focus on sustainability and social equity. Engaging in this thesis allowed me to delve into the complex and multifaceted challenges faced by urban transportation systems, shedding light on the need for comprehensive strategies that consider environmental, social, and economic factors.

Through exploring concepts such as Mobility Justice, Metagovernance, and the integration of diverse transportation modes, this thesis resonates with the core principles of urbanism. It underscores the importance of creating inclusive and livable urban environments where all members of society have equal access to transportation options and opportunities. By undertaking this research, I believe that I have grown significantly as an urbanist, gaining valuable insights and perspectives that will shape my approach to creating sustainable and equitable cities of the future.

Furthermore, this thesis presented a unique opportunity for personal growth as it ventured into an area that I was not familiar with. By challenging myself to study a border region and get acquainted with its complexities, I aimed to expand my knowledge and skills as a professional. This experience allowed me to explore unfamiliar environments, adapt to different policies and systems, and navigate the complexities of cross-border collaboration.

One of the most valuable lessons I learned throughout this journey was the importance to never underestimate the knowledge and input of the community. While my project did not involve a large number of stakeholders, the interviews I conducted and the workshop I organised emphasised the significance of involving the right parties. The community's insights and perspectives proved to be invaluable to the success of the project. Engaging stakeholders firsthand not only provided a better understanding of their needs but also made the project more enjoyable and rewarding. It reinforced the importance of collaboration and the inclusion of diverse voices in shaping urban interventions.

In conclusion, this thesis has not only contributed to my personal growth as an urbanist but also deepened my understanding of the challenges and opportunities in sustainable mobility planning. By venturing into unfamiliar territory and engaging with stakeholders, I have expanded my skills, broadened my perspective, and gained valuable experience in addressing the complex issues of urban transportation. This journey has reinforced my commitment to creating sustainable and equitable cities and has equipped me with the insights and lessons necessary to make a positive impact in my future endeavors.

09 |

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Border crossing in the middle of the small town of Galder in Noord-Brabant.

Photo: Rolf van den Broek

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A |

APPENDIX

Content

A1 | WORKSHOP

Introduction
An informaiton sheet with the following text about the workshop was given to each participant. This included the set up of the workshop, the design task, an overview of all roles and one role desription. Each participant only got one role desription in order simulate the focus group the best.

Set up
1. Introduction of the problem (5 min)
2. Quick walk through the analysis of the area (5 min)
3. Introduction of the vision (5 min)
4. Pick patterns together with group. (10 min)
   - 6 patterns have been preselected.
   - Select the 3 most important patterns with the group
5. Look at the patterns these connect with (10 min)
6. Form a strategy/planning with all patterns on the table (30 min)
   - Think about the sequence of patterns
7. Where would these patterns manifest in space, (10 min)
   - what is the impact?
8. What is the social impact of using these patterns? (10 min)
9. Patterns missing? (10 min)

Design task
Create a strategy/planning for the Maasmechelen – Sittard region to bridge the current mobility gap.

You can use the pattern cards to create a strategy. For information regarding the current infrastructure networks, land use and more you can use the results of the analysis that was done for the region.

Roles
- Municipality of Maasmechelen
- Municipality of Sittard/Geleen
- Ministry of Infrastructure/ department of the province
- Citizen
- Operator (NS, Arriva, de Lijn)
- Infrastructure companies (Prorail, Infrabel)

Role desriptions
Municipality of Maasmechelen
The Flemish government started with its plan to create space for a trambus connection between Hasselt and Maasmechelen. However, the opposition in Maasmechelen is not too fond of this plan as this would decrease the number of lanes for cars which will lead to more congestion on the main road of the town. Furthermore, Maasmechelen has a large recreational industry with attractions such as Maasmechelen Village Outlet Centre and a large cinema in the old mining buildings. Furthermore, the old mining site has been redeveloped into a national park currently the city doesn't have any rail connection, even though it used to have them and is not connected to the Netherlands when it comes to public transport. Research by the TU Delft shows that a connection to Sittard is viable and desirable. You want to collaborate with Sittard and are looking for a way to create a cohesive transport system as a connection to the dutch public transport network will also create better job opportunities and easier access to education.

Municipality of Sittard-Geleen
Sittard-Geleen used to be the location where much of the coal mined in the Dutch mining region was transferred to boats. Nowadays the city is characterized by a mostly industrial landscape with its main industrial complex being the Chemelot Campus. The main focus of the Chemelot Campus are chemical processes. This campus also houses a Brightland educational facility which is an initiative from the Province of Limburg and works together with four other Brightland campuses. Political parties such as D66 have stressed that connections to Belgium and especially in the Maasmechelen-Genk-Hasselt corridor are very valuable. As opposed to Maasmechelen the mining history in Sittard isn't as visible anymore, you therefore want to reconnect with the past and are looking for a way to create more attention for the mining heritage.

Figure A.1. Participants discussing the 6 starting patterns

Ministry of Infrastructure/ department of transport of the province

The ministry and the department of transport of the province are in the lead when it comes to developing new infrastructure such as rail, buslanes and bridges to cross the Maas river. Previous attempts where the government helped to create an international connection didn't work and cost a lot of money, because Belgium backed out of the deal. Therefore you want to ensure that that doesn't happen this time.

Citizen

As a citizen of Maasmechelen who is reliant on public transport to get around you are bound to jobs and services within Belgium and especially Maasmechelen as the connections to other cities in the region could be better. You hope to have a cross-border connection to finally be able to access more services and have more job opportunities in Sittard-Geleen and closeby cities. Furthermore, the large roads in Maasmechelen and the lack of infrastructure for soft transport modes are bothering you. You would like to achieve a connection to the Netherlands as fast

as possible with as much comfort as possible. For you good transfer possibilities and inclusivity for all kinds of travellers are important.

Operator

As NS/Arriva you are a Dutch based company. The dutch concession model to provide public transport in different regions from the 'best' operator is largly based on profit. This means that less profitable lines, or lines that extend beyond the concession border are less attractive. In Belgium concessions don't exist as there is just one state operator 'De Lijn', currently most cross-border services are run by this company. You are willing to provide services but only when the area of the concession matches this service. Furthermore to increase profit a fast connection is necessary as this will increase ridership, having buslanes and dedicated railcorridors will help to achieve this goal.

Figure A.2. (below) Drawing of pattern sequence made by participants

Figure A.3. (right) Laying out the patterns to form the pattern sequence and grouping them
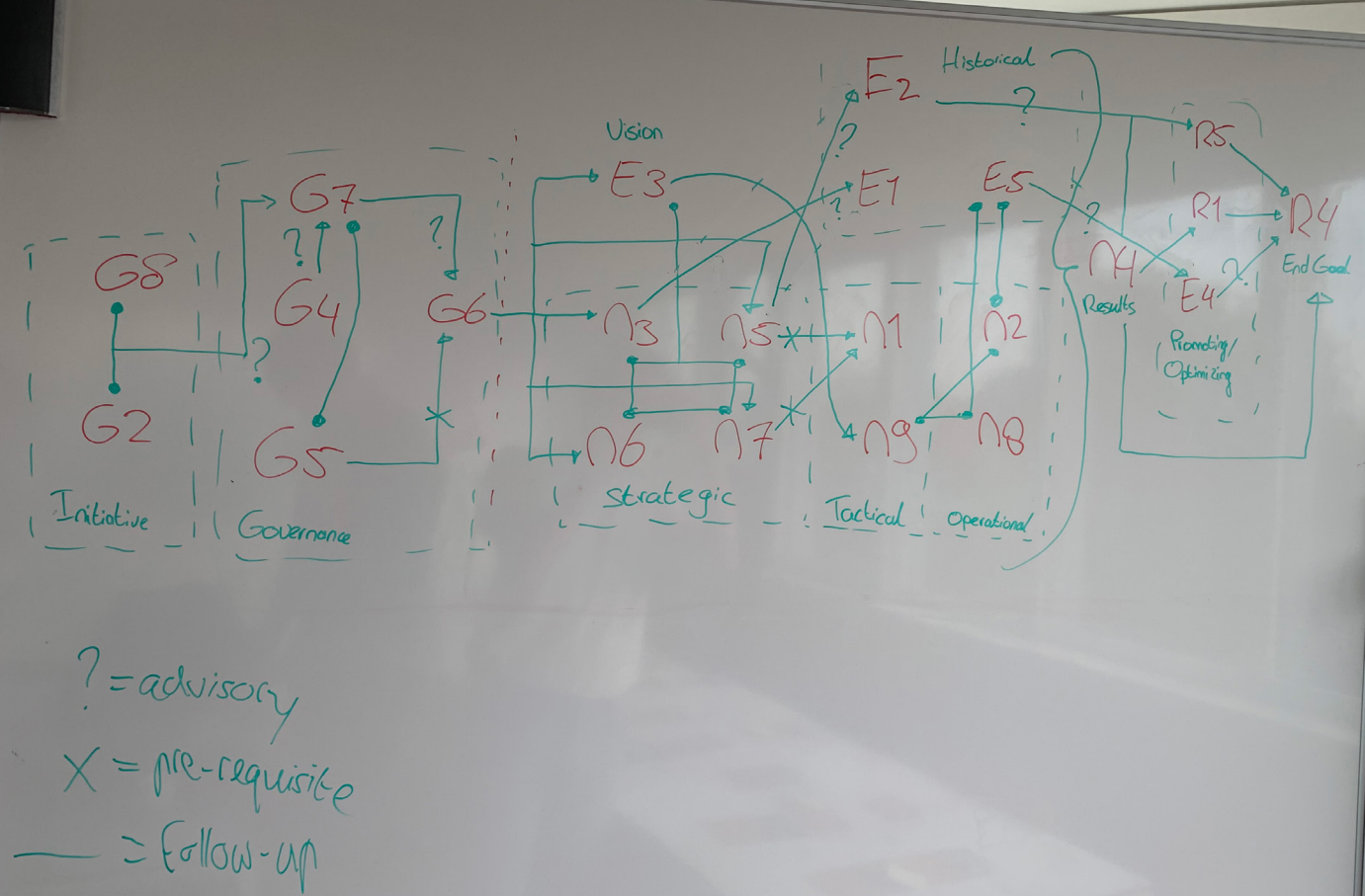
RECONFIGURING TRAVEL PATTERNS

The Necessary Rapid Just Transition to Car-Free Urban Planning in a Cross-Border Context

THOMAS VAN DAALHUIZEN

There is a need to broaden discussions on sustainable mobility beyond electric cars and addresses the challenges faced by border regions and marginalised groups dependent on public and soft transport. This thesis explores how a transition strategy can support the creation a just and sustainable multi-modal network in a cross-border context.

The provinces of Limburg and the mining district were used as a case study. Valuable insights are derived from comprehensive analyses, contributing to a holistic strategy for the region. Key findings emphasise the role of garden cities in shaping the strategy, connecting neighborhoods and promoting mobility alternatives. Improving public transport connections within the mining region is crucial for reducing car dependency and generating positive impacts. Collaboration among stakeholders is essential due to the lack of cross-border connections and administrative barriers. Repurposing the old mine infrastructure offers a transformative opportunity to establish a sustainable transport system. The envisioned future sees opportunities for the old mining infrastructure to act as a multi-modal transport backbone, integrated with multiple garden cities for enhanced connectivity and community.

A pattern language approach guides the strategy-making process, tested through a workshop simulation. Policy recommendations stress cross-border collaboration, flexibility, co-creation, and data sharing. By following these recommendations, the region can achieve a just and sustainable multi-modal network, fostering regional integration, equal opportunities, and access to resources.

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