FROM MINING TO CIRCULARITY

INSIGHTS FROM FUTURE STUDIO RHINE MEUSE

must

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Date of Publication
February 2024

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“From Mining to Circularity” addresses the pressing issues of climate change and Europe’s reliance on rare material imports. As a solution to both challenges, it presents a strategy for the cross-border area of South Limburg and Region Aachen to make a transition towards a more circular and sustainable future. The strategy focuses on three chances for circular systems: urban renovation, forestry management, and the recycling of technological waste. Each of these circular systems is being elaborated by a description of production cycles, local stakeholders, and a development path with tipping points and key projects. The proposed systems are tailored to specific ressources in the cross-border region. They are conceived to take advantages of local specificities regardless of the administrative borders.

This document was produced in the framework of the Future Studio Rhine Meuse, that was initiated by the College van Rijksadviseurs in the Netherlands and the Bundesinstitut für Bau-, Stadt- und Raumforschung in Germany. It is based on desktop research, interviews with experts and a three-day workshop. In this workshop the findings of the preliminary research were being discussed and deepened with actors from the cross-border area. The document does not contain a chronological documentation of the research and the workshop results. Instead, these have been merged in one storyline.

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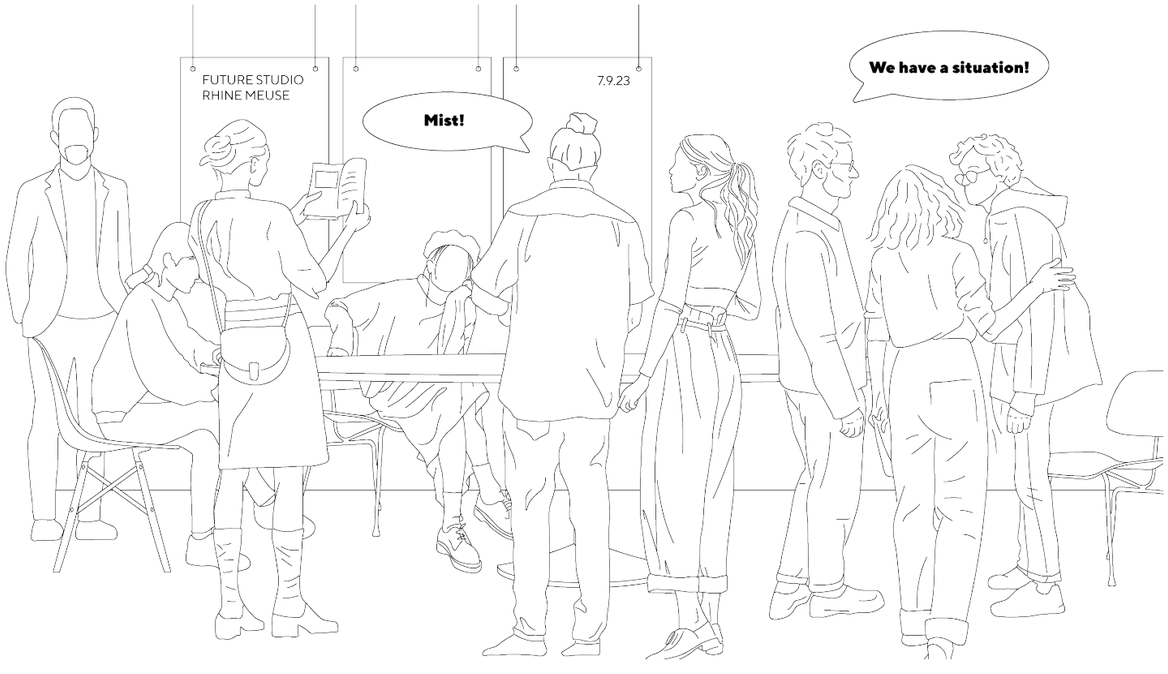
TROUBLING FACTS

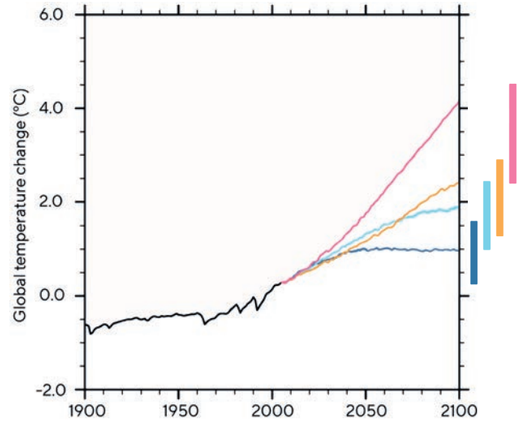


What would be the consequence... if we take troubling facts serious as a starting point for thinking about our future? ...if we accept that our future is partly determined by developments outside our territorial borders? ...if we look far ahead and then look back at what should happen now? These thoughts could fuel a new line of thinking for the cross-border region that comprises South Limburg and the Region Aachen. But will they lead to a positive perspective? Let's give it a try!

Climate Change

In 2013, the Intergovernmental Panel on Climate Change (IPCC) published a report with a clear message:

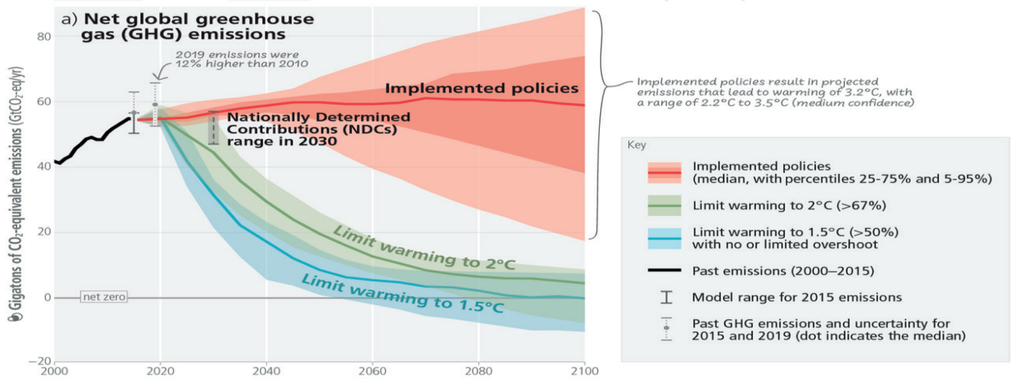
„Climate change is a long-term challenge, but one that requires urgent action given the pace and the scale by which greenhouse gases are



Scenarios of global surface temperature change, based on: IPCC, 2013, MUST Städtebau

accumulating in the atmosphere and the risks of a more than 2 degree Celsius temperature rise. Today we need to focus on the fundamentalsand on the actions otherwise the risks we run will get higher with every year."

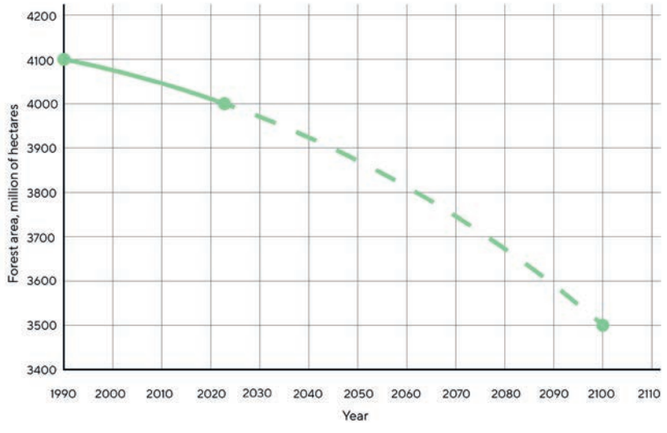
The Paris climate agreement set a goal of limiting global warming to well below 2 degrees Celsius, and ideally no more than 1.5 degrees Celsius, compared to average temperatures in the late 1800s. Despite the 2015 Paris Agreement, **annual CO2 emissions rise each year** with no significant sign of decrease.



ESA, 2023

Forest starvation

The forests are the lungs of our lkiving planet. They play an essential role in storing CO2. However, over the past 30 years, **forest areas have shrunk by 100 million hectares**. Without changes in the global economy, an additional 500 million hectares of trees could be lost by 2100.

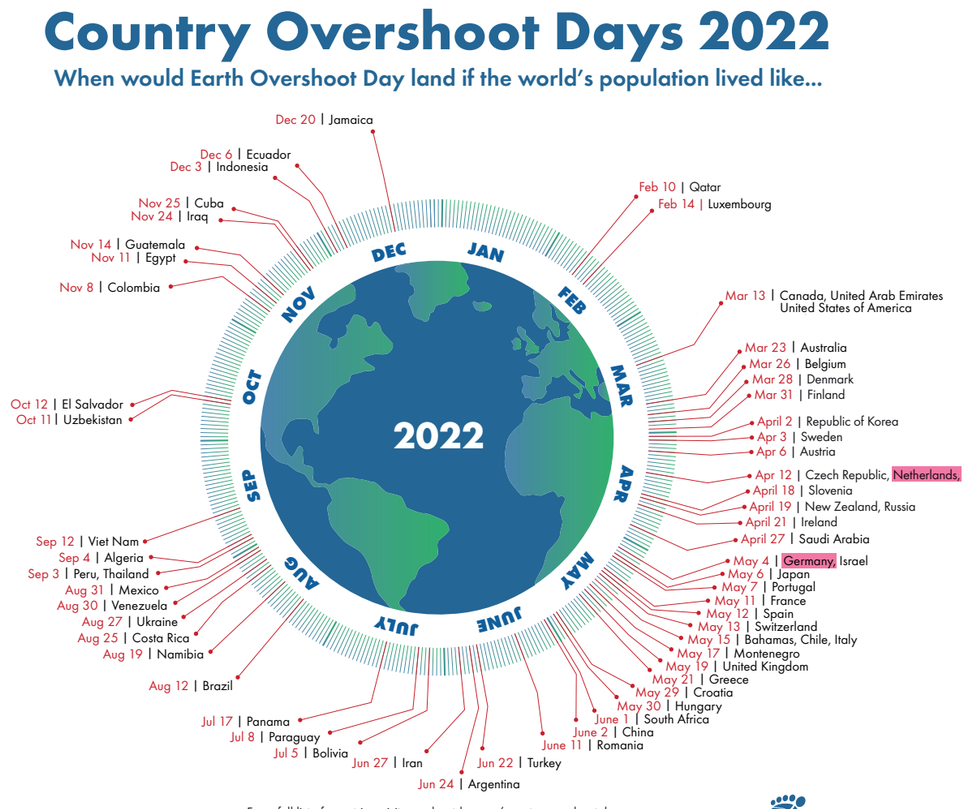


Global forest area forecast, based on: „A climate risk analysis of Earth's forests in the 21st century", MUST Städtebau

Shrinking resources

Overshoot Day marks the date when humanity's demand for ecological resources and services in a given year exceeds what Earth can regenerate in that year. It highlights the unsustainable use of natural resources, emphasizing the need for more sustainable practices to combat climate change. **With the rate at which we areusing our resources now, we would need 1,75 earths.**

When would Earth Overshoot Day land if the world's population lived like...



EARTH OVERSHOOT DAY

For a full list of countries, visit overshootday.org/country-overshoot-days

Source: National Footprint and Biocapacity Accounts, 2022 Edition
data.footprintnetwork.org

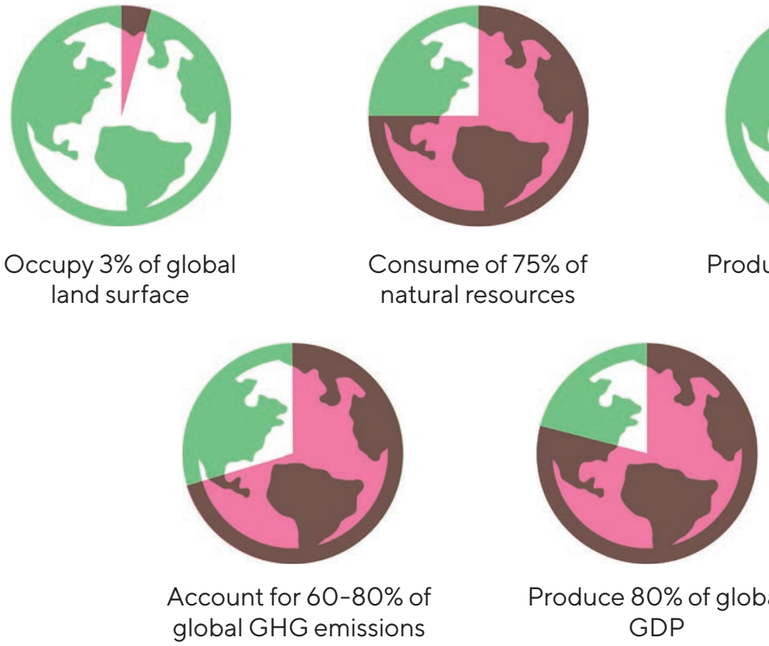
Global Footprint Network
Advancing the Science of Sustainability

Source: National Footprint and Biocapacity Accounts, 2022 Edition

The crucial role of the city

Cities are the „white elephant“ in the discussion about climate change, raw materials and waste. They occupy only a small area of our planet, yet they generate 80% of global GDP and are responsible for most of the waste and emissions.

Cities....



Occupy 3% of global land surface

Consume of 75% of natural resources

Produce 50% of global waste

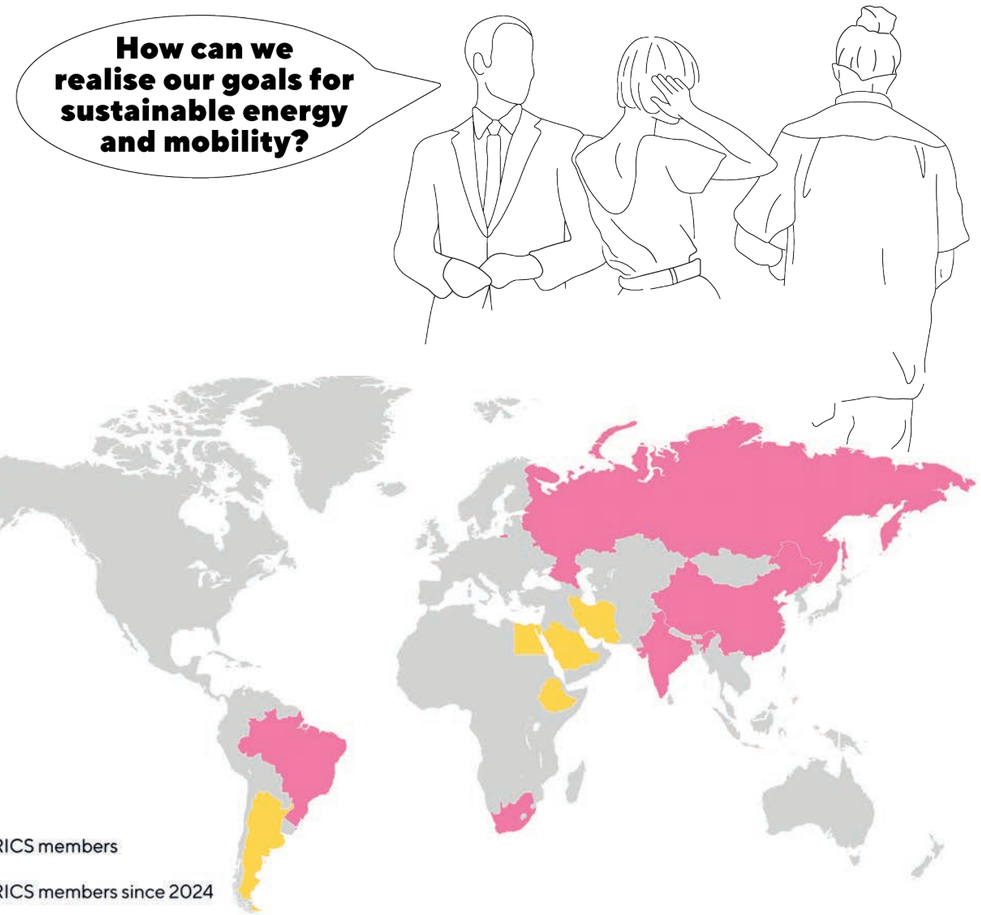
Account for 60-80% of global GHG emissions

Produce 80% of global GDP

Cities influence on the environment, based on UN Data, MUST Städtebau

Rare and raw materials

The technologies needed for a green transition, make use of rare materials like litium, nikkel and cobalt. **The overwhelming part of these rare materials is located in countries outside of the European Union**. Hence, for our green transition, we are dependend on countries that are not per definition our trade partners. Furthermore, rare materials are also finite ressouces. This situation may lead to strong geopolitical tensions: the Ukrain crisis has shown how gas can be used as a geopolitical weapon.



BRICS countries, based on: BRICS data, MUST Städtebau

BRICS countries hold a 72% share of the Earth‘s total raw materials, including rare materials essential for renewable energy technologies and high-tech industries.

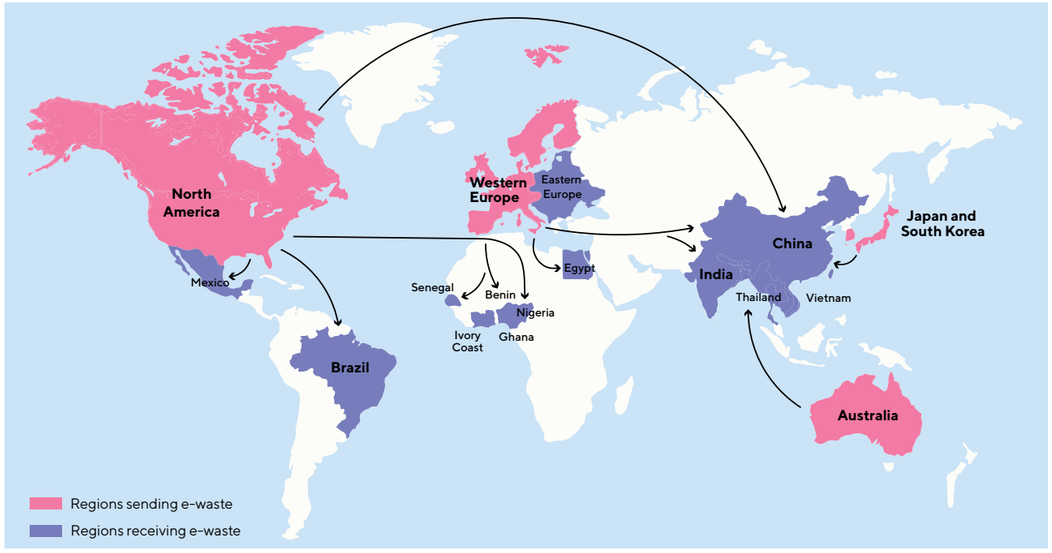
Batteries for E cars:
- o Lithium
- o Nikkel
- o Kobalt

Solarpanels:
- o Silicium
- o Indium
- o Gallium

Wind turbines:
- o Neodymium

(magnets, 90% in China)

High Tech Chips:
- o Silicium



Technological waste flow, based on: IT Recycle, MUST Städtebau

Electronic waste

Electronic devices are rich in rare materials. The world produced a record 53.6 million tons of electronic waste in 2019, the weight of 350 big cruise ship. The e-waste – discarded products with a battery or plug – surged 21% over the past five years, predicting that it will reach 74 million tons by 2030, almost a doubling of electronic waste in just 16 years; Only 17.4% of 2019's e-waste was collected and recycled. Gold, silver, copper, platinum, and other high-value, recoverable materials conservatively valued at $57 billion -- higher than the gross domestic product of most countries – were mostly dumped or burned rather than being collected for treatment and reuse.

Gravel and sand

The problem of a lack of raw materials is not only due to the dependency on foreign countries. **The problem is partly homemade.** Due to restrictions on the extraction of gravel and sand in both the Netherlands and Germany, already in 2023 we are noticing a shortage of building materials for houses and infrastructure.

Niederrhein-Kommunen wollen gegen Kiesabbau klagen

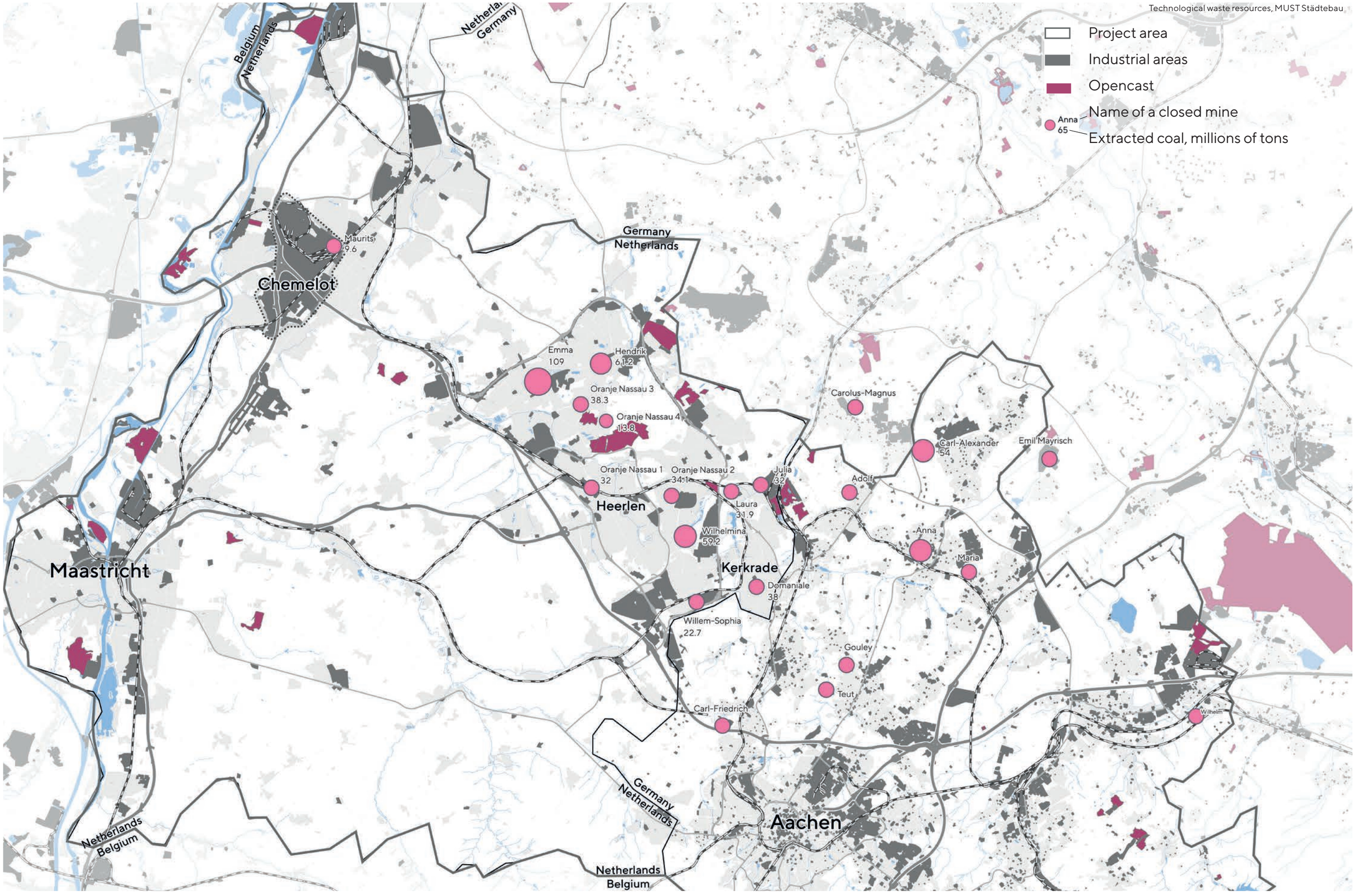
Düsseldorf/Wesel · Gegen den immer weiteren Abbau von Kies wehren sich viele Kommunen am Niederrhein wie Kamp-Lintfort. Nun bereiten sie mit dem Kreis Wesel eine Klage vor, weil im neuen Regionalplan viel zu große Gebiete ausgewiesen würden.

Is er in Nederland straks nog genoeg beton om al die huizen te bouwen?

De ontgrinding van de Grensmaas bij Grevenbicht en Schipperskerk in 2018. — © archief Ermindo Armino

Born - **Zand- en grindbedrijven slaan alarm over een gebrek aan winvergunningen Er dreigen de komende jaren grote tekorten aan primaire bouwmaterialen als er geen vergunningen komen voor nieuwe winprojecten. Provincies zien zich gebonden aan duurzaamheidseisen.**

Technological waste resources, MUST Städtebau



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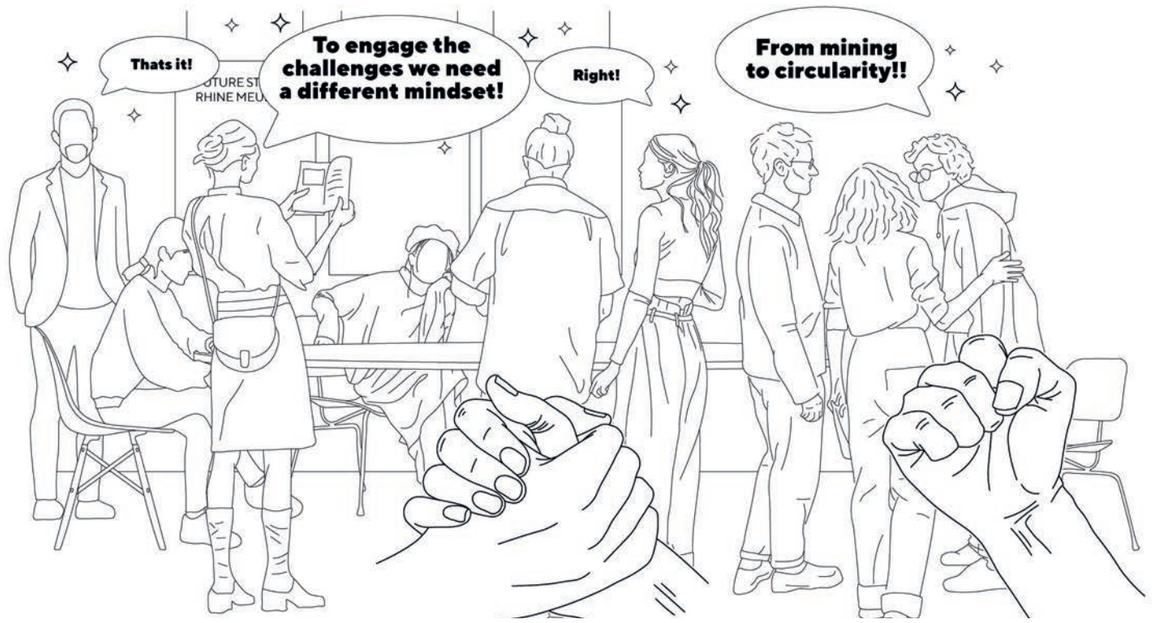
From mining to circularity!



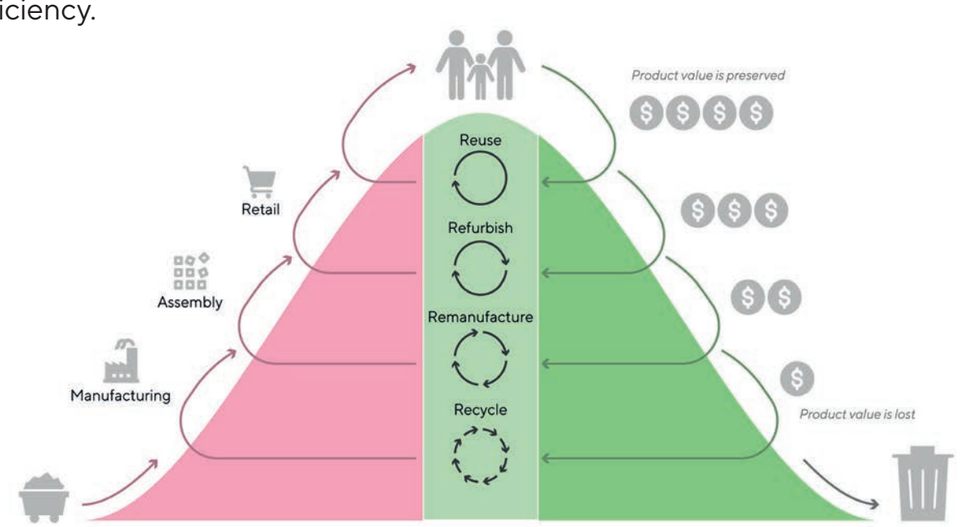
A different mindset

In 1972 the Club of Rome published a ground-breaking report „The limits to growth“. The message of this book still holds today: The earth’s interlocking resources probably cannot support present rates of economic and population growth much beyond the year 2100, This message has become even more urgent due to the consequences of climate change and Europe’s dependency on other countries for rare materials. Hence, we need a different mindset: instead of a continuous exploitation of new resources we must make a shift towards creating circular systems.

The main feature of circular systems is that they treat waste as a resource. This can significantly mitigate climate change and lessen dependence on import of rare material imports. This model promotes the recovery and reuse of materials, reducing the need for new extractions, and therefore lowering carbon emissions.

Circular economy cycle, based on: European Commission (n.d.), MUST Städtebau

In circular economy principles, **the goal is to keep product cycles as small as possible** to maintain product value. Larger cycles often lead to decreased product value and increased costs, as resources are less efficiently utilized and more energy is consumed in reprocessing. This model emphasizes minimizing waste and maximizing resource efficiency.



Cycle of a product chain, based on: Metabolic's materials, MUST Städtebau

Adopting a circular economy requires a transition to what can be termed a „**post-growth metabolism**." This involves a fundamental societal shift in thinking and values, prioritizing sustainability and long-term resource efficiency over traditional growth-focused economic models.

	Economic Principles	Social-ecological Principles	Allocative Principles	Institutional Principles	Relation Principles
Growth metabolism	Efficiency	Extraction	Accumulation	Private ownership	Control
Post-growth metabolism	Sufficiency	Regeneration	Distribution	Commons	Care

Growth Metabolism principles versus Post Growth Metabolism principles based on Foodicons.org, MUST Städtebau

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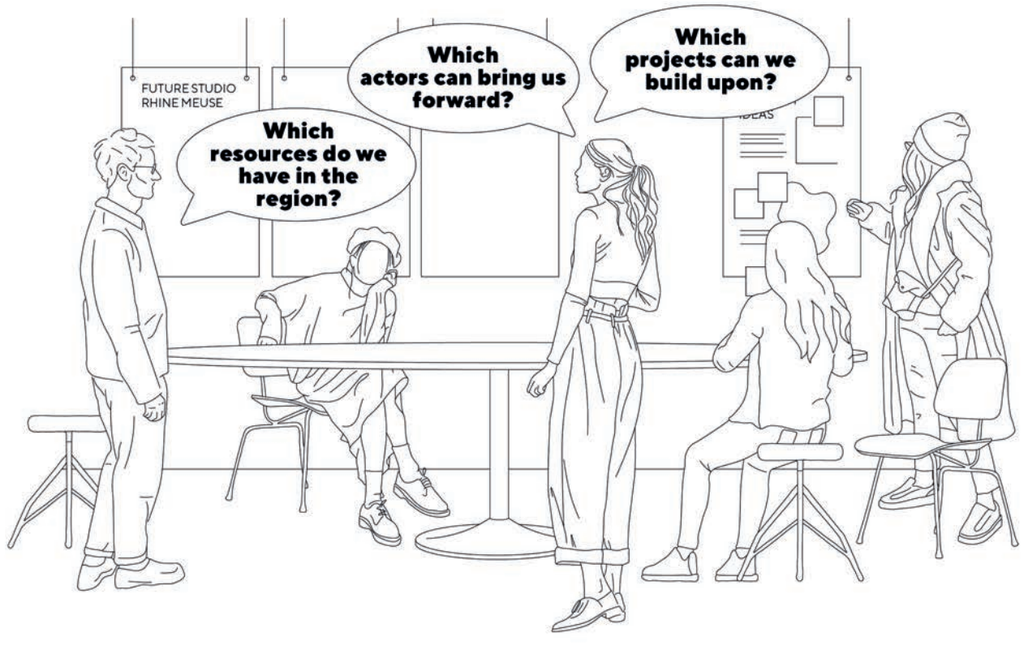
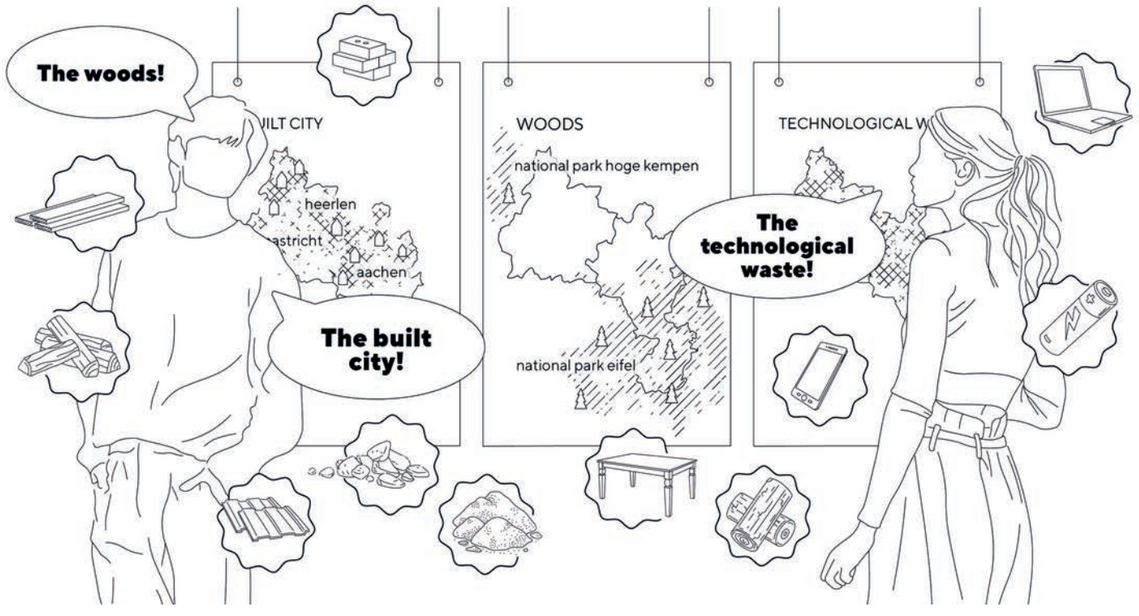
Towards a circular and sustainable cross-border region!



Specific chances for the cross-border region

The area that covers South Limburg and the Region Aachen has a long history of extracting resources from the soil. Especially the coal mining activities have shaped the identity of the region, boosted the economy, offered jobs for its inhabitants and shaped the landscape. The question is: which resources does the area offer for circular and sustainable systems? How can we shape the **raw material transition** in this area? At least three resources seem to offer hughe potentials:



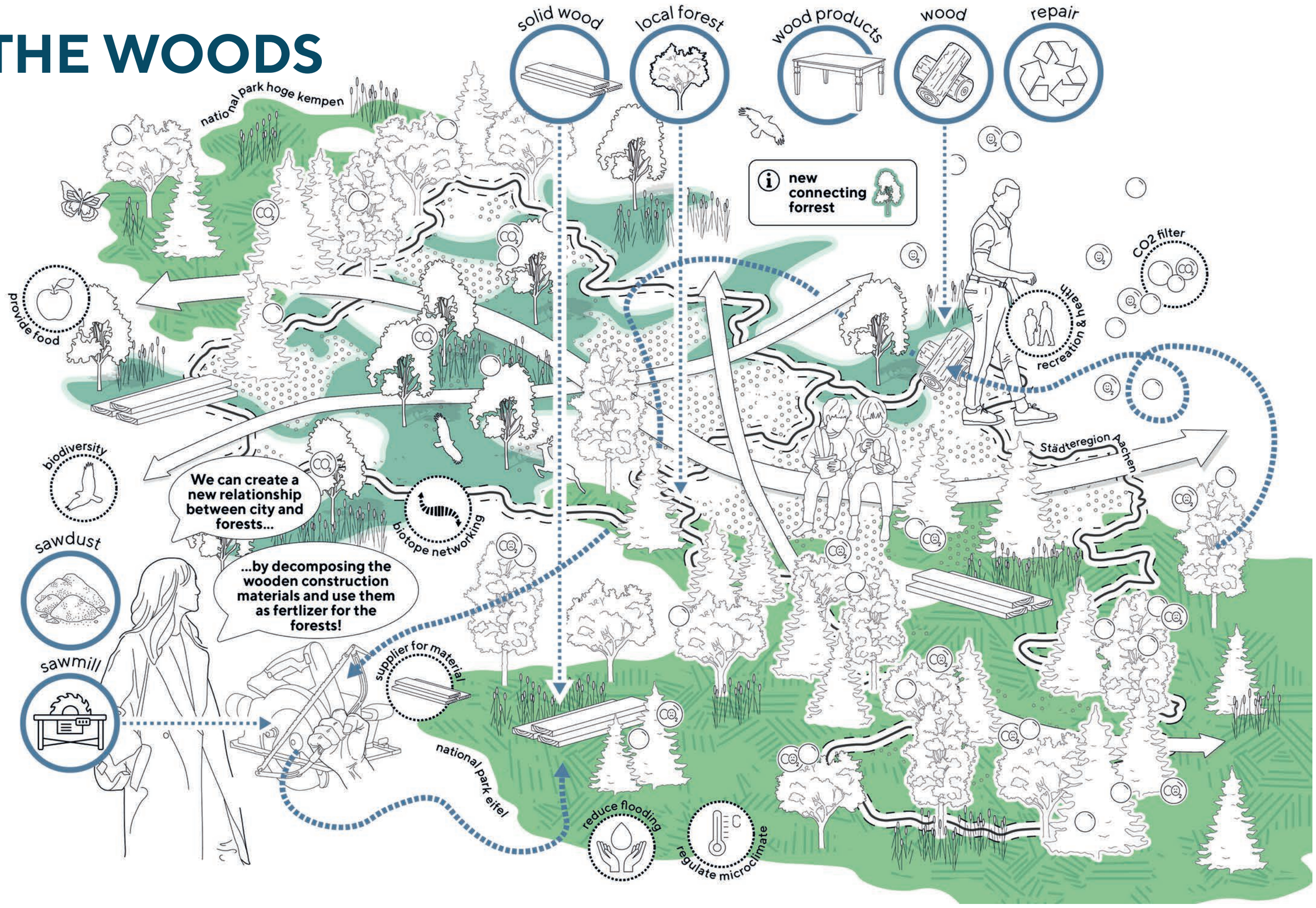
The Woods: The area is partly covered by large forests. Trees have extensive benefits for human health and environmental well-being. Expanding tree coverage can significantly enhance the regional biotope network and increase the abilities to infiltrate water in the ground. Additionally, new forests are recognized as a valuable renewable resource for construction, meeting a critical need in the region. And finally: they can add to the value of the region as tourism destination. New forest management in terms of rotation and avoidance of soil acidification is a necessary condition to make the shift towards increasing the tree coverage.

The Built City: Approximately 32% of the building stock in the region must be renovated in the coming two decades. This is a big challenge. At the same time urban renovation is also a unique winndow of opportunity to make the shift towards a circular and sustainable future, emphasising the importance of recycling, deconstruction and re-use in the building construction sector.

Electronic Waste: The strategic geographical positioning of the Rhine-Meuse region makes it an ideal candidate to emerge as a key hub for the re-use of electronic waste in Europe. The cross-border region could contribute significantly to a circular economy on a continental scale and decrease dependency from the small numbers of countries sourcing raw materials for green technologies.

Each of these circular systems builds on existing local resource and actors, e.g. companies and knowledge institutes. For each circular system a development path is being described that shows key projects in the region (existing and new ones; local ones and cross-border projects), crucial tipping points and the circular production cycles. The development of the three circular systems can deliver a major push for achieving the green transition, creating a new balance between human production and the environment, and contribute to local, regional and European goals in the field of sustainability and circular economy.

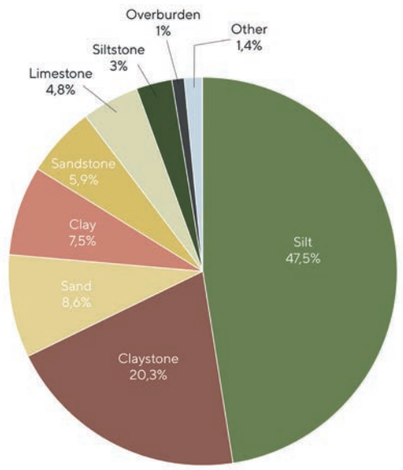
THE WOODS



xxx, MUST Städtebau

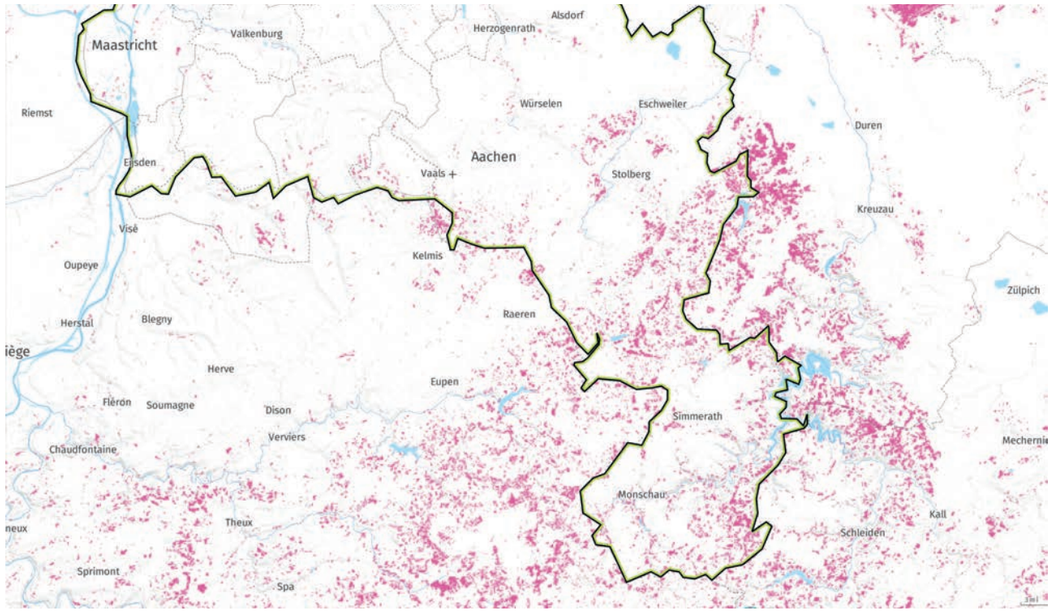
The soil

The soil in the area is rich in silt and clay, which both are beneficial for trees growth. Still, there is a clear difference between the coverage of both soil types. In the south, on the clay and claystone soils, towards the Eifel, the landscape is dominated by vast forests. In the north a vast amount of the silt soil is not covered with trees. Striking is however, that in the forested areas there was a total loss of 900 hectares of trees between the year 2000 and 2020. The main reason for tree starving nowadays are the effects of climate change. Rising temperatures and persistent drought in Germany are particularly affecting the forests. Less rainfall leads to dry soil and, as a result, a greater risk of forest fires. The damaged trees are less able to withstand storms. The drought also increases the biotic threats to the forest: the lack of water supply makes the trees more susceptible to fungi, insects and pests such as bark beetles.

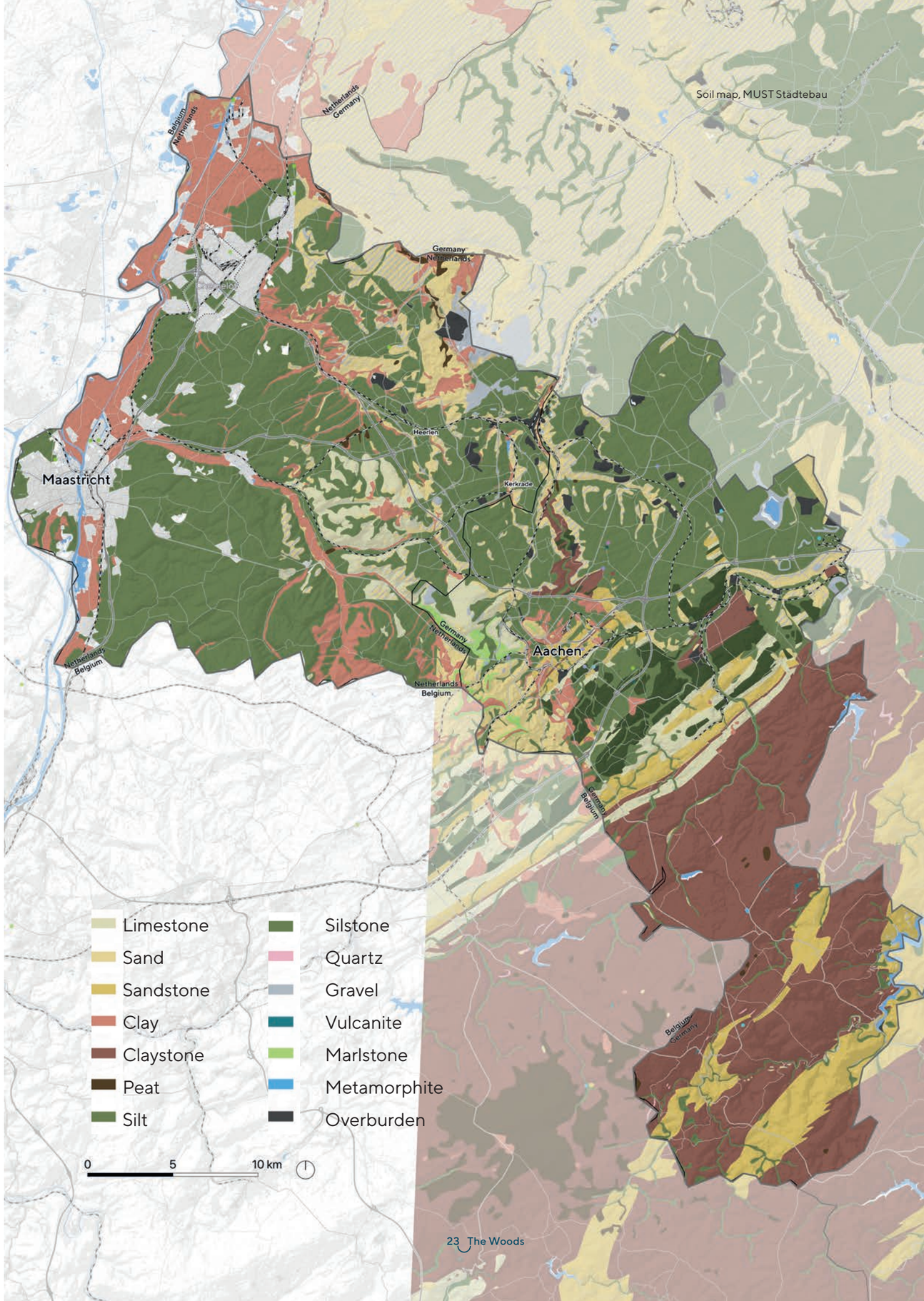


Prevailing soil material

Lost of woods between 2000 and 2020, Source: Global Forest Watch



Soil map, MUST Städtebau



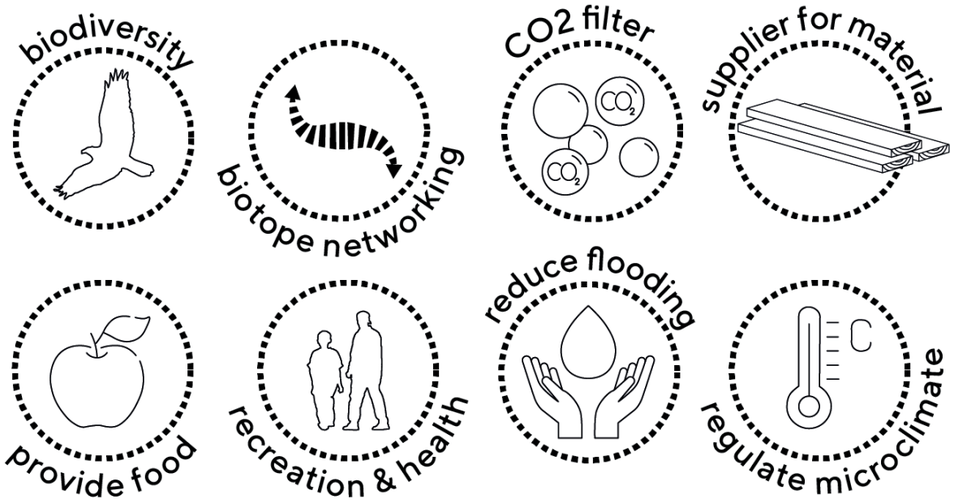
The forest as a resource

The existing forests cover a significant part of the land use: 46.622 ha (34%). They are in three ways a crucial resource for a sustainable environment.

Protective function: the forest has a stabilising effect on the natural environment for water circulation, air circulation, global and micro-climate and soil erosion prevention. Trees are crucial in capturing CO2. Hence, the forest creates the conditions for sustaining biodiversity.

Productive function: timber is a basic raw, renewable material coming from the forest. Currently, timber has more than 30,000 applications worldwide. Other products that people harvest in the forest are forest fruit, mushrooms, many species of herbs used in medicine and the meat of game animals.

Social function: the forest creates the environment favourable to the health and recreation of society and improves environmental awareness and culture of society.



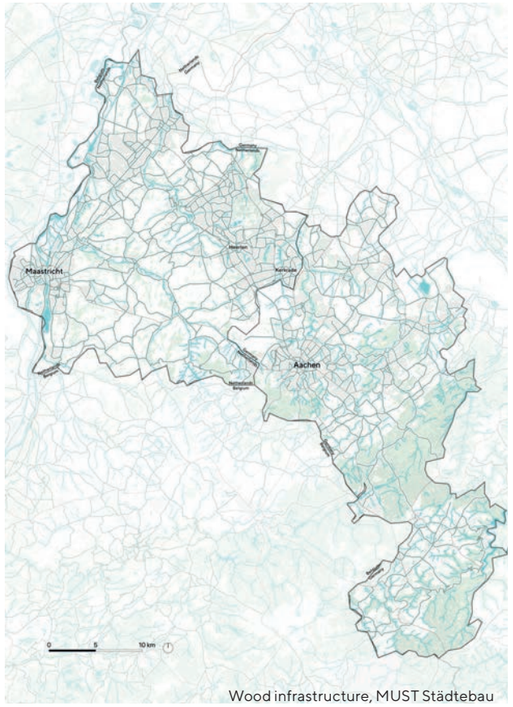
Tree benefits, MUST Städtebau

Wood resources (on the right), MUST Städtebau

The Woods: a cross-border project

The soil in the area offers good conditions to extend and connect the existing forests by new woods. By connecting the forests of the Eifel to the forests of the Nationaal Park Hoge Kempen, a new nature system could be created that would function as the green lung of the cross-border area. On a regional level, the project „The Woods“ could enhance the biotope network and contribute to the capturing of CO2. As woods offer favourable conditions for the infiltration of rainwater, they could strengthen the regional ground water system. This would improve the conditions for agriculture. Furthermore, by capturing rainwater, the Woods could help reduce the flooding of rivers during extreme rainfall situations. Parts of both the existing woods and the new woods could be used to produce timber. In this way, the long transport ways for construction wood could be reduced.

The new woods would mainly be created around the existing cities, thus offering new living qualities in the direct surrounding. They would help regulate the (micro) climate around the cities and create new areas for spending the free time.



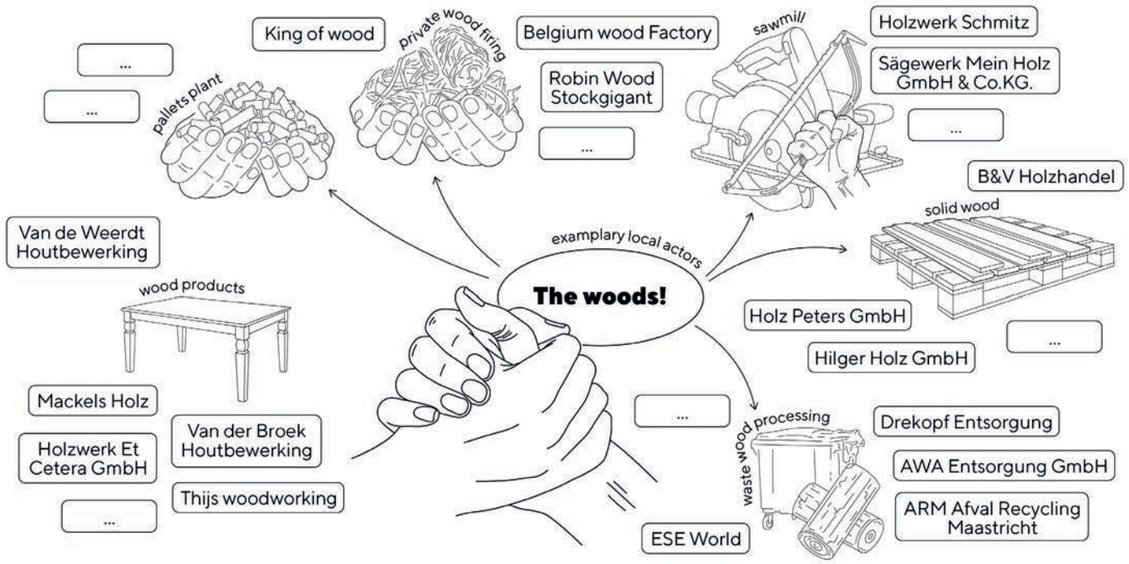
Project area
Water
Regional roads

Wood infrastructure, MUST Städtebau

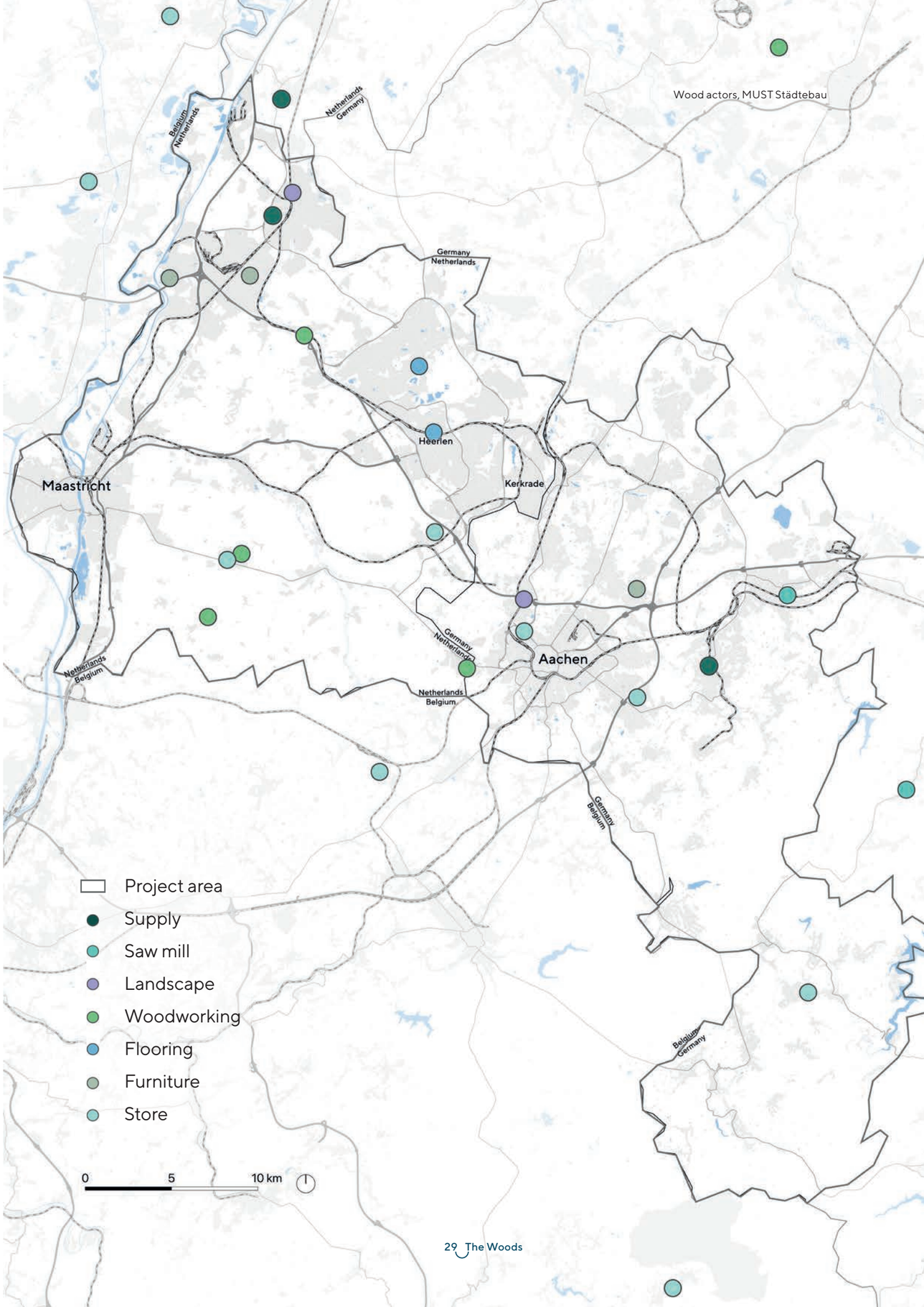
Proposal for development of woods, MUST Städtebau

Actors

The primary actors for the project The Woods are the regional administrative bodies of both South Limburg and the Region Aachen. Together, they could take the lead in creating the necessary legal conditions for the project. Furthermore, they could start a process, involving actors from different sectors to create a common vision and strategy. For the specific issue of wood as a renewable building material, there are already companies in the region that are engaged in key aspects of a circular wood economy, such as construction companies, recycling companies and saw mill companies..



Actors of wood infrastructure, MUST Städtebau

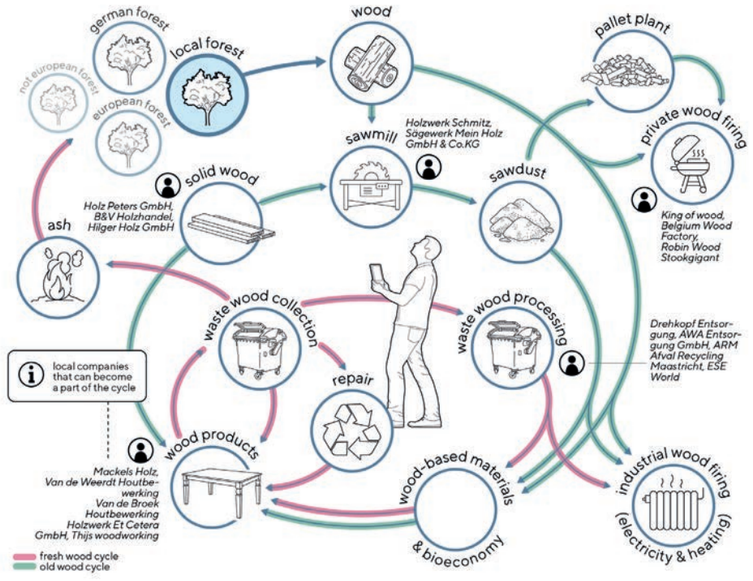


Woods as part of the circular construction system

At the moment, the building sector accounts for:

- 50% of all extracted materials;
- 50% of the total energy consumption;
- 33% of water consumption;
- 33% of waste generation.

A significant contribution to reach the sustainability goals can be made by making the construction sector more circular, considering the enormous amount of waste generated over a building's lifecycle. To achieve this, we must connect the different dots of the construction sector. This includes the relationship between the city and the woods. When trees are extracted from the woods for construction purposes, this should be compensated. This could be achieved by decomposing the leftovers of wooden constructions and turn them into fertilizer. This fertilizer could be used in the woods to improve the growth of trees and thus closing the circular circle.



Wood production cycle, based on: Strohmeyer (VHI), Meinlschmidt (WKI), Lüdtke (Thünen-Institut), 2020, MUST Städtebau

Development path & Tipping Points

The development path towards an extended, cross-border wood structure will contain several phases. The step towards a next phase is a tipping point (see scheme on p. 32-33).

Tipping Point 1: The first step is a decision by policy makers to make the existing woods fit for the future.

Phase 1: testing. This phase focusses on testing a new management of existing woods. The new management aims at a diversification of the wood structure and the possibility to use parts of the forests as resource for construction materials. Around a quarter of all forests in the area are unprotected and can be used for this purpose.

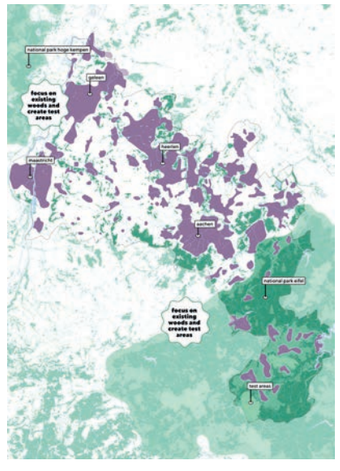
Tipping Point 2: The second important moment is the decision to extend the existing woods, thus initializing a new, long-term process of forestation.

Phase 2: In this phase, new woods will be realized by creating green belts around the cities.

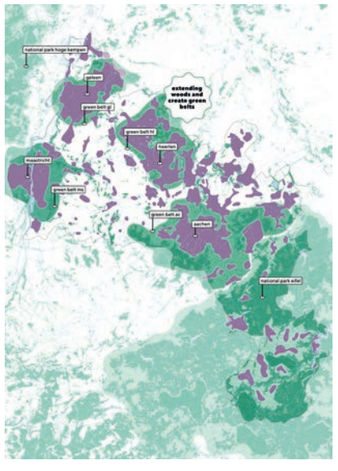
Tipping point 3: To complete the new green lung, an agreement is being signed by policy makers to fill the missing links between the forests.

Phase 3: This phase focuses on a radical new use of large parts of the area. Connecting the Eifel with the Nationaal Park Hoge Kempen, enables the creation of a new biotope network on an interregional scale.

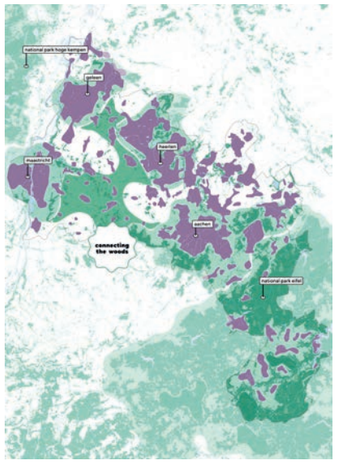
Phase 1: testing



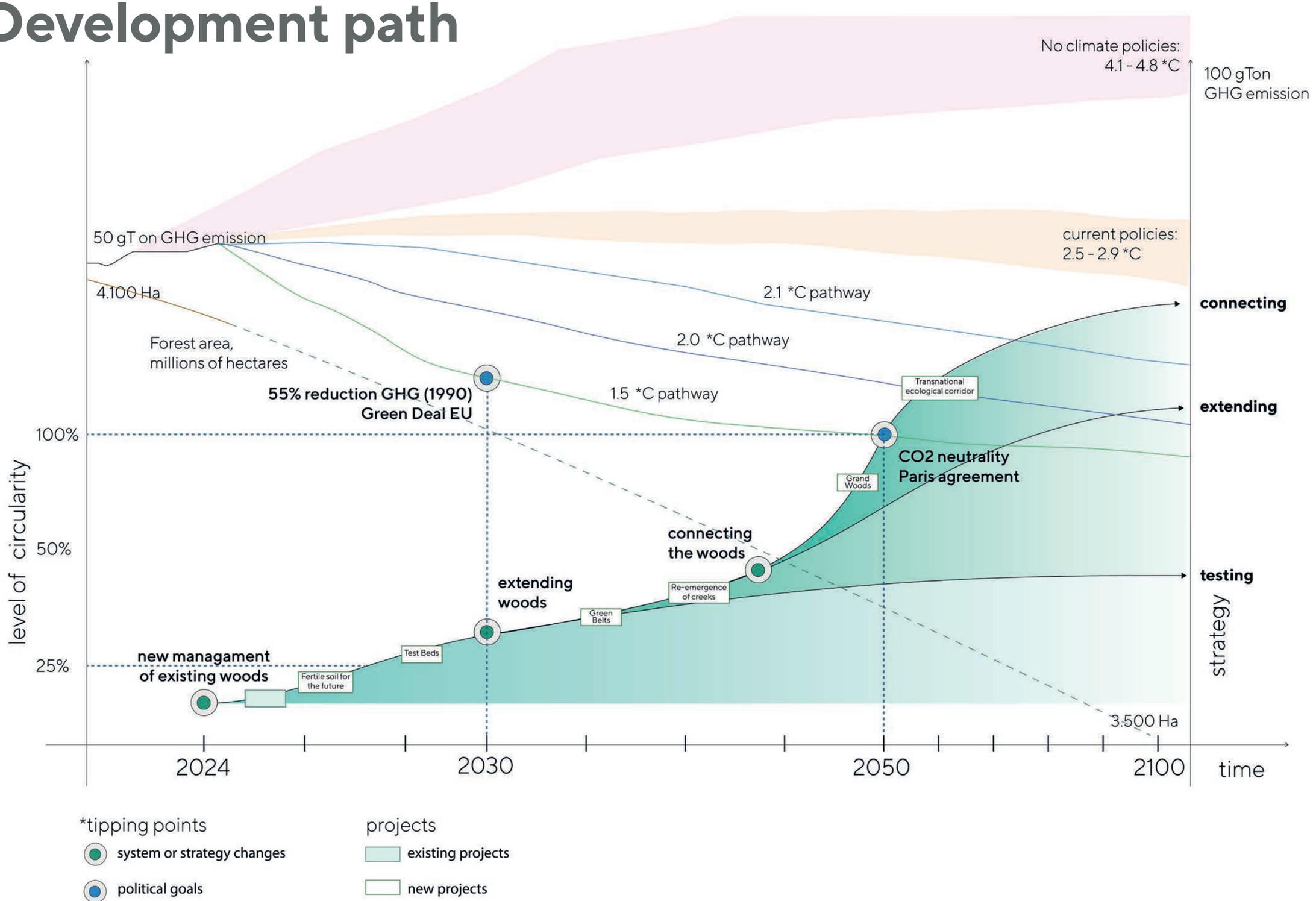
Phase 2: extending



Phase 3: connecting

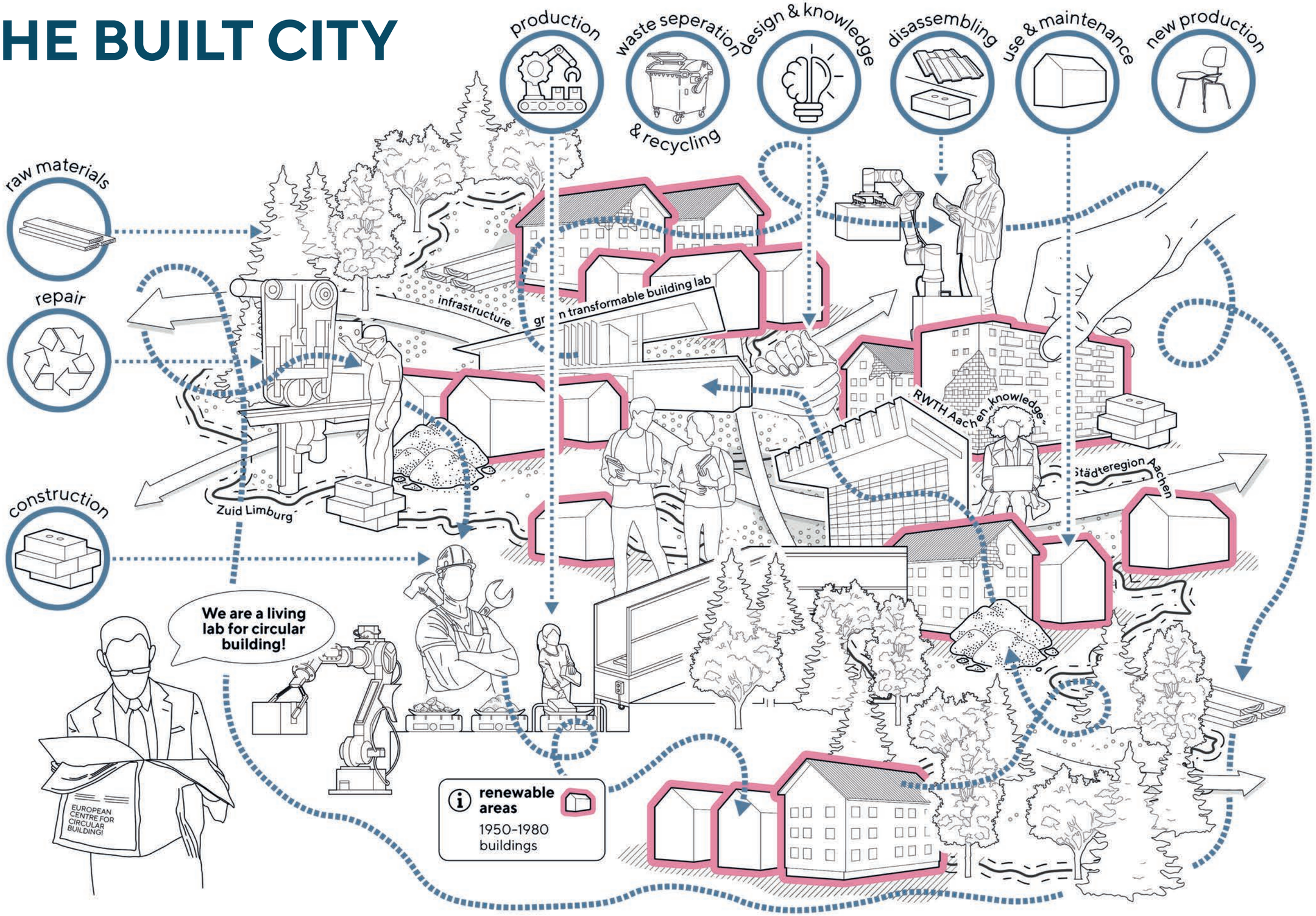


Development path



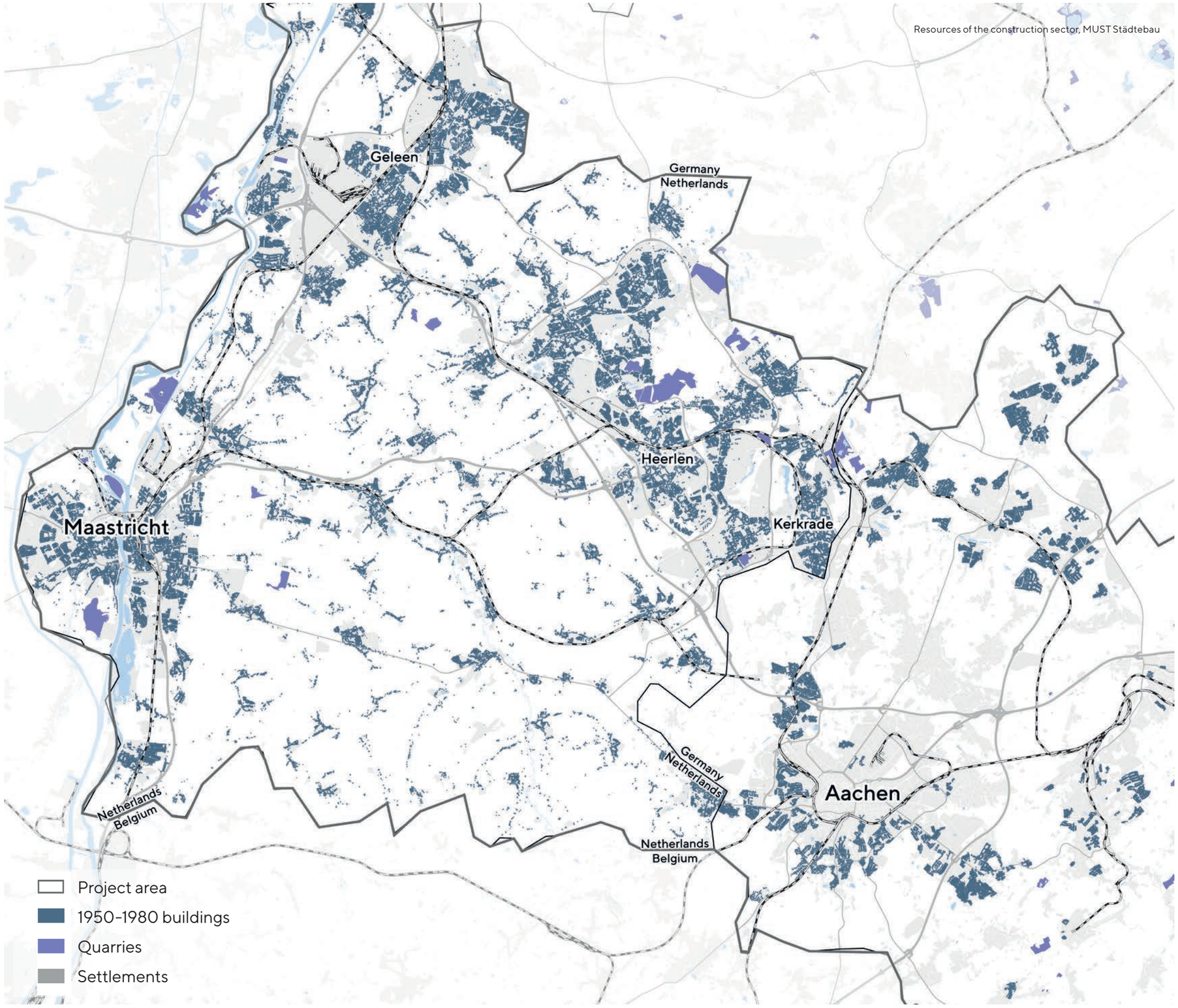
Woods Development Path, MUST Städtebau

THE BUILT CITY



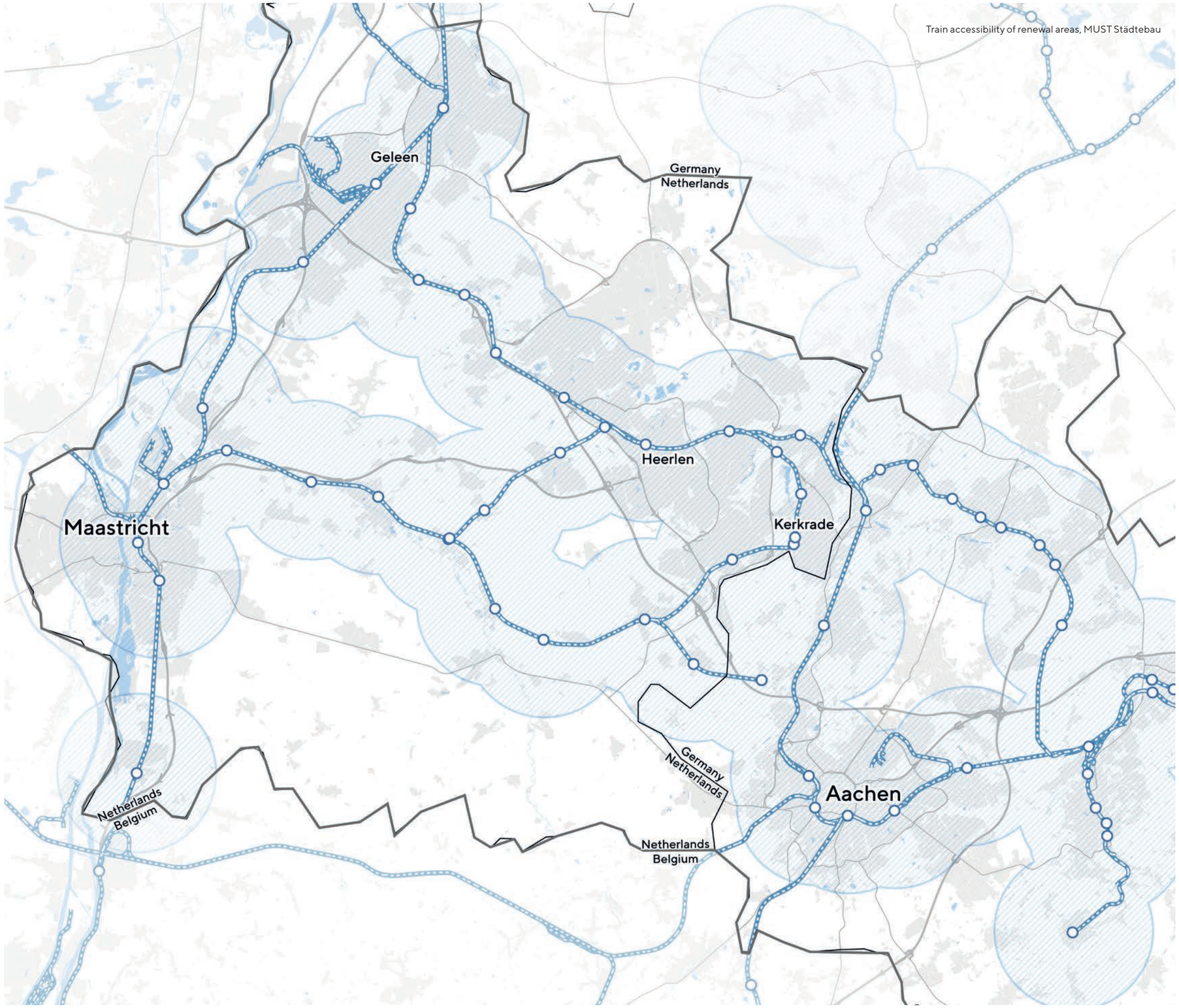
The built city as a resource

The existing built area is a huge resource. Around 30% of all built-up area was constructed in the 1950s-1980s. The technical quality of housing of that time is nowadays considered as quite poor and is amongst others not adapted to energy efficiency and decarbonisation requirements. In the coming two decades, the renovation of this buidling stock will be both a necessity and at the same time a chance to make a shift towards circular building. When renewing these areas, the primary emphasis should be placed on the re-use of the materials from the existing buildings and infrastructure. New building materials should be sustainable, like wood from the region. Here a connection to the circular system of „The Woods“. could be made. What kind of housing areas will be developed and in which density, will depend on the location of each neighbourhood and its specific characteristics. In the cross border region as a whole, a densification with 25.000 dwellings seems possible.



Sustainable accessibility

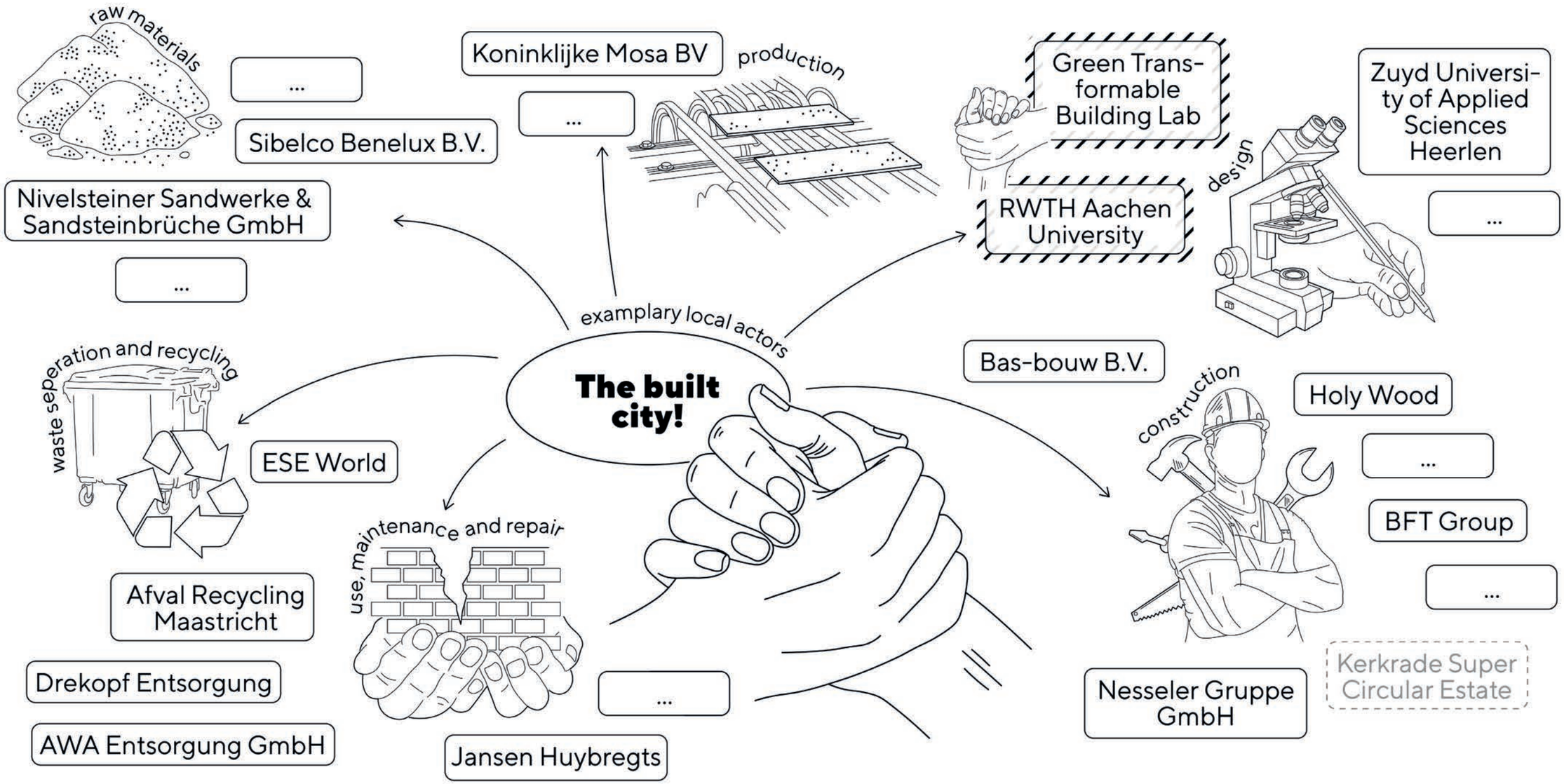
73,6% of the renewal areas are in cycling distance from train stations (3 km). This means, the renewal areas have a splendid sustainable transport accessibility. This feature makes them highly attractive for residential re-development with a higher density.



Actors

The cross-border region already possesses over many different actors to make the shift towards a circular building. They are spread over different sectors that should be connected in a circular building system (see p. 28). Most of the building projects can be realised on a local scale. A unique selling point of the cross-border region are the knowledge institutes on circular building at the RWTH Aachen and the Green Transformable Building Lab in Heerlen.

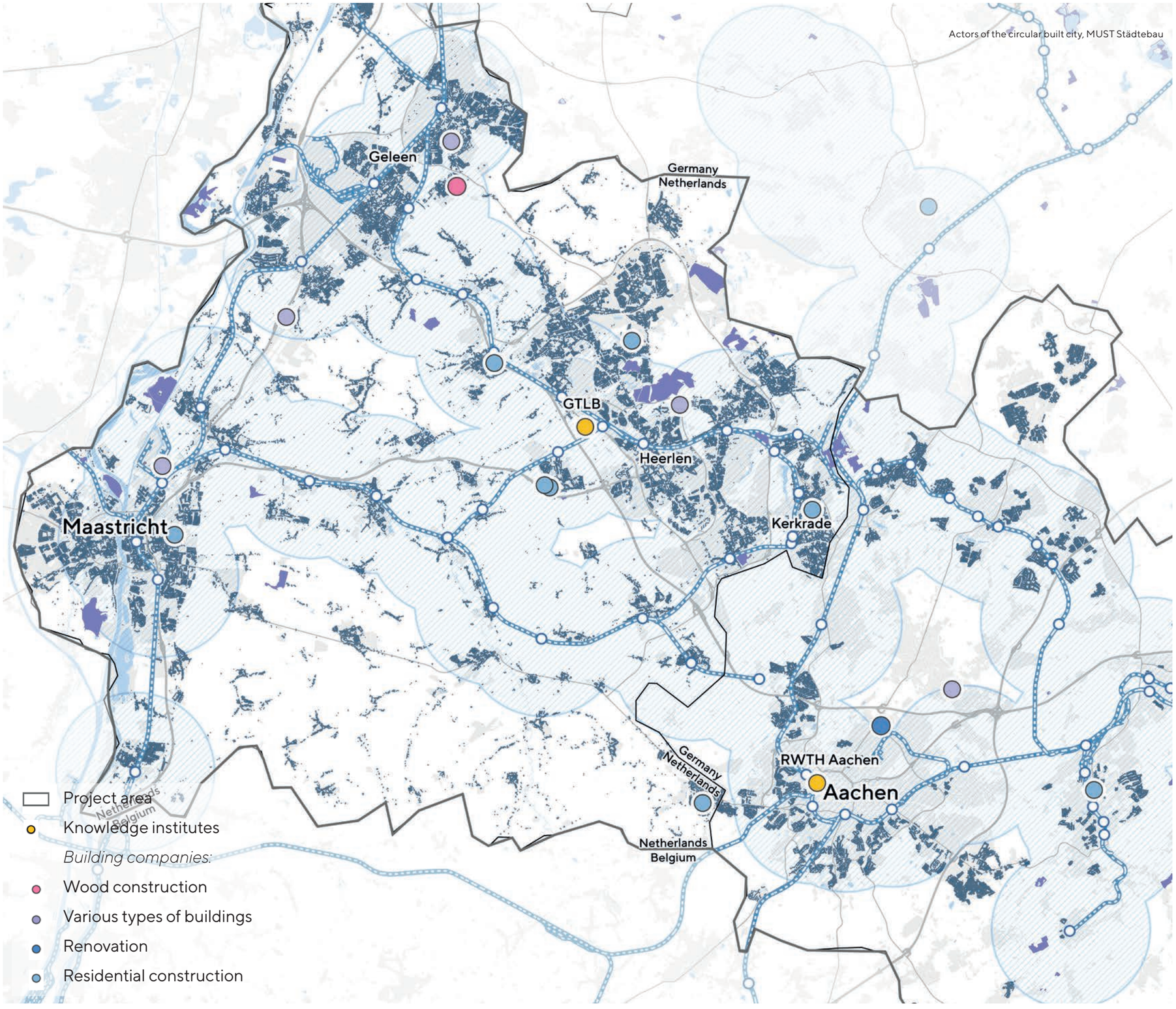
Actors of the building sector in the cross-border region. The selection of actors was done by internet research and is not representative nor complete. MUST Städtebau.



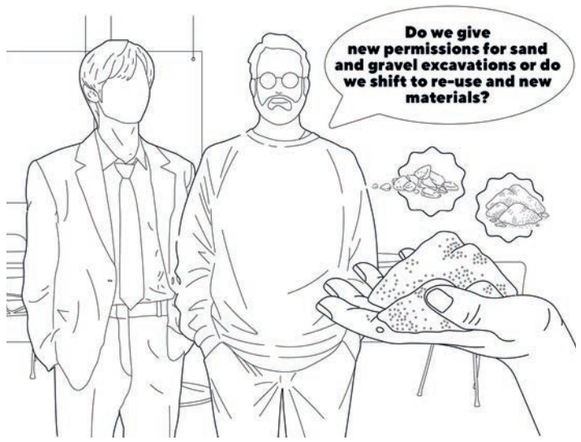
Cross-border project: living lab for circular building

The local actors in the building sector have already begun adopting practices aligned with the circular building concept. **A cross-border project** could build upon existing actors and experiences in the area. A first step could be to set up an intensive knowledge exchange between the Rheinisch-Westfälische Technische Hochschule Aachen and the Green Transformable Building Lab in Heerlen, involving housing corporations and the the eco-system of companies involved in circular construction supply chains. This way, scientific research can be implemented in practise and support innovation. Furtermore, it is necessary to create a local eco-system of supply chains and manufacturers, as well as to extensively map and asses what needs to be preserved and which materials are available where in the buidling stock.

Successive neighbourhoods renewals in the region could create a true cross-border living lab for circular building, by progressively building up the techniques, networks, supply chains and knowledge (or data) bases needed to reach circularity in construction and renovation.



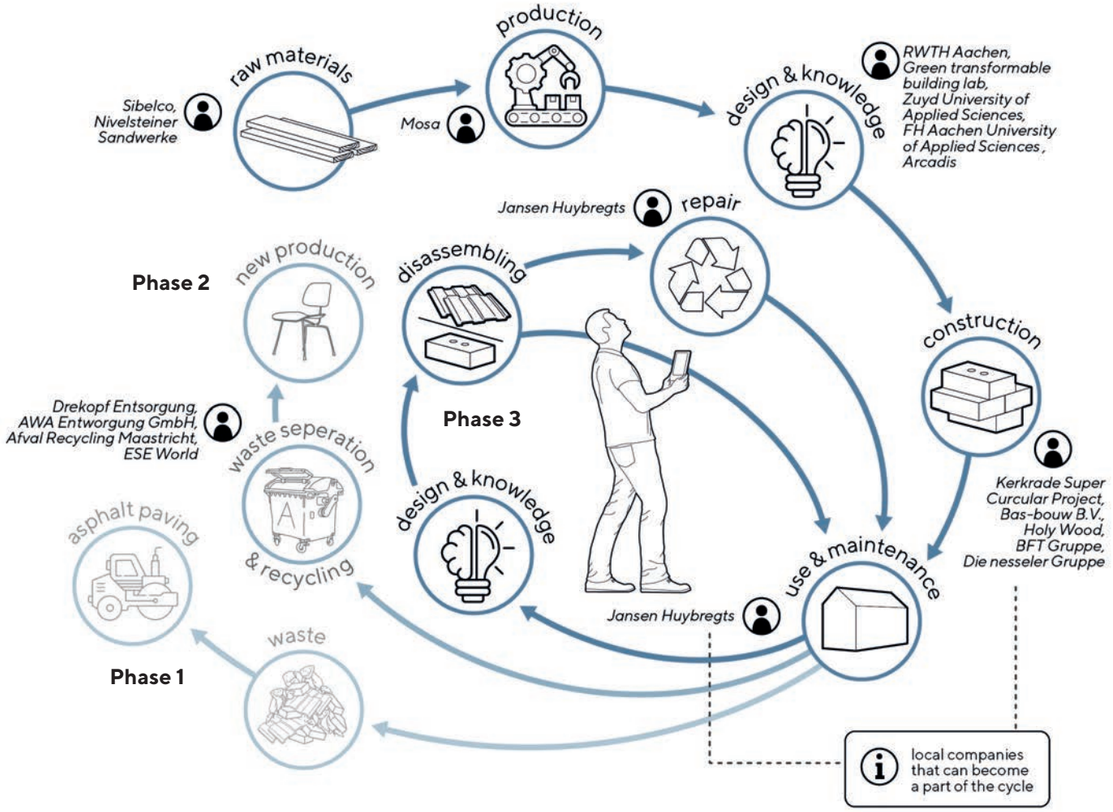
Circular building system



At the moment, the building sector accounts for:

- 1/2 of all extracted materials
- 1/2 of the total energy consumption
- 1/3 of water consumption
- 1/3 of waste generation

Considering the enormous amount of resources consumed and waste generated over a buidling's lifecycle, making the construction sector more circular will have a significant impact on the sustainable transformation of the region. To achieve this, different sectors must be connected and work together (see the scheme below).



Construction material cycle, MUST Städtebau

Development path & Tipping Points

To reach full circulariy in the built environement, it is neccessary to progresss through several phases, each one requiring conscious choices and interventions towards change. These are tipping points, understood as pivotal moments, in the development path. (see scheme on page 46-47)

Phase 1: passive re-use. This is the current practice: re-using building materials is not widespread.

Tipping Point 1: A decision is being taken to switch towards active re-use of existing building materials and thus reduce the excavation raw materials like sand and gravel.

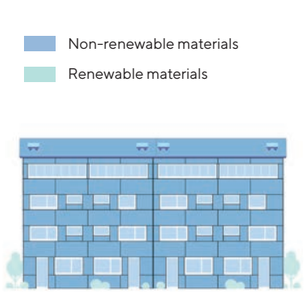
Phase 2: Active re-use. The building sector (architects, commissioners, and different companies in the building sector) systematically re-use materials from existing buildings in renovation projects. New material is only sourced through renewable materials.

Tipping Point 2: Switch to 100% renewables. From this moment on, materials that cannot be successively re-used are phased out as builing ressources.

Phase 3: The building sector only uses 100% renewably sourced materials like wood. The wood material preferably comes from the region. Here the connection can be made to the project „The Woods".

Tipping point 3: 100% circularity. in 2050, the building process is 100% circular, thus supporting the CO2 neutrality agreement from Paris.

Phase 1: passive re-use



Renewable materials are rarely used.

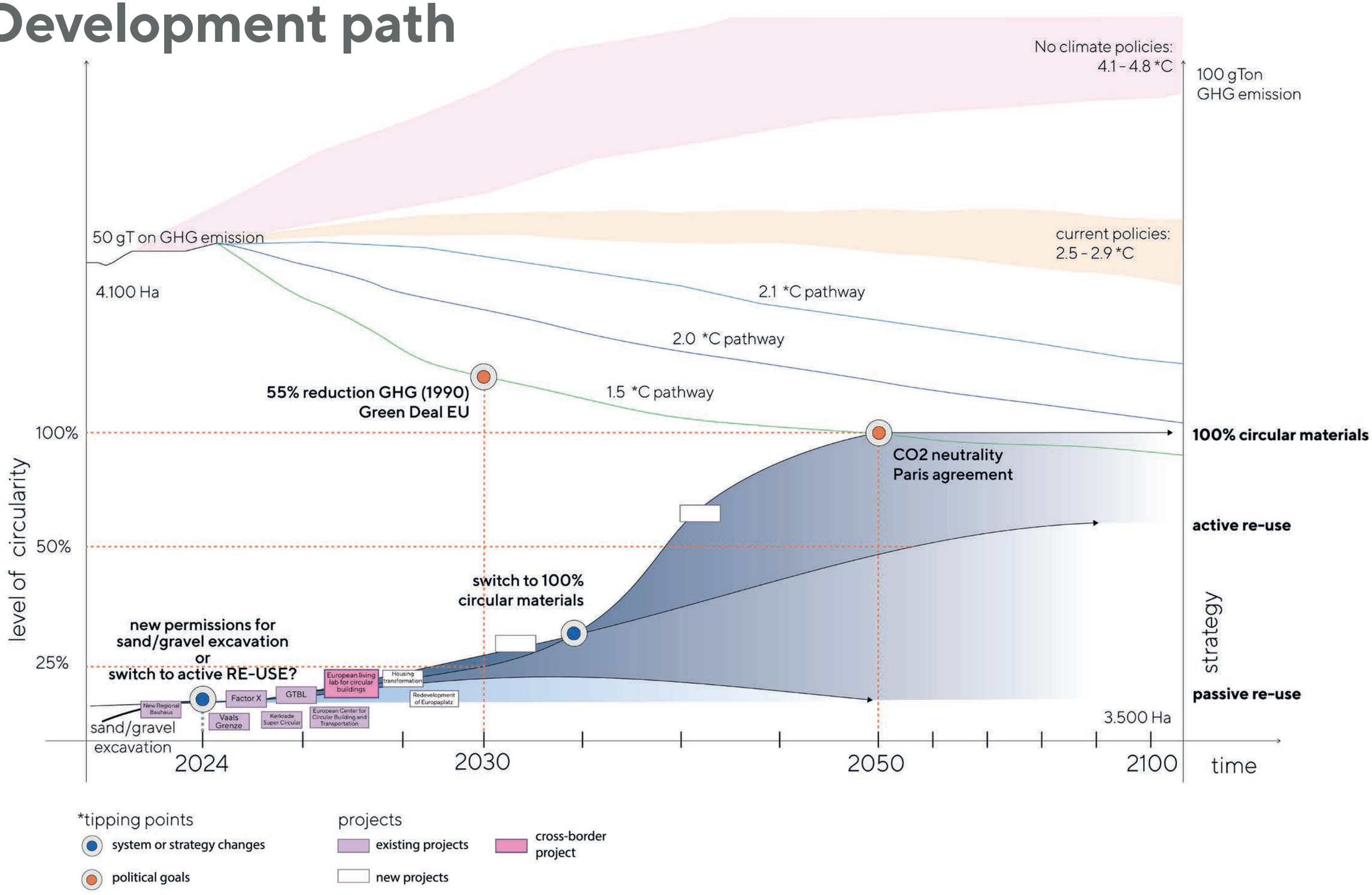
Phase 2: active re-use

Renovation uses only renewable materials. Densification with renewable, light materials.

Phase 3: 100% circularity

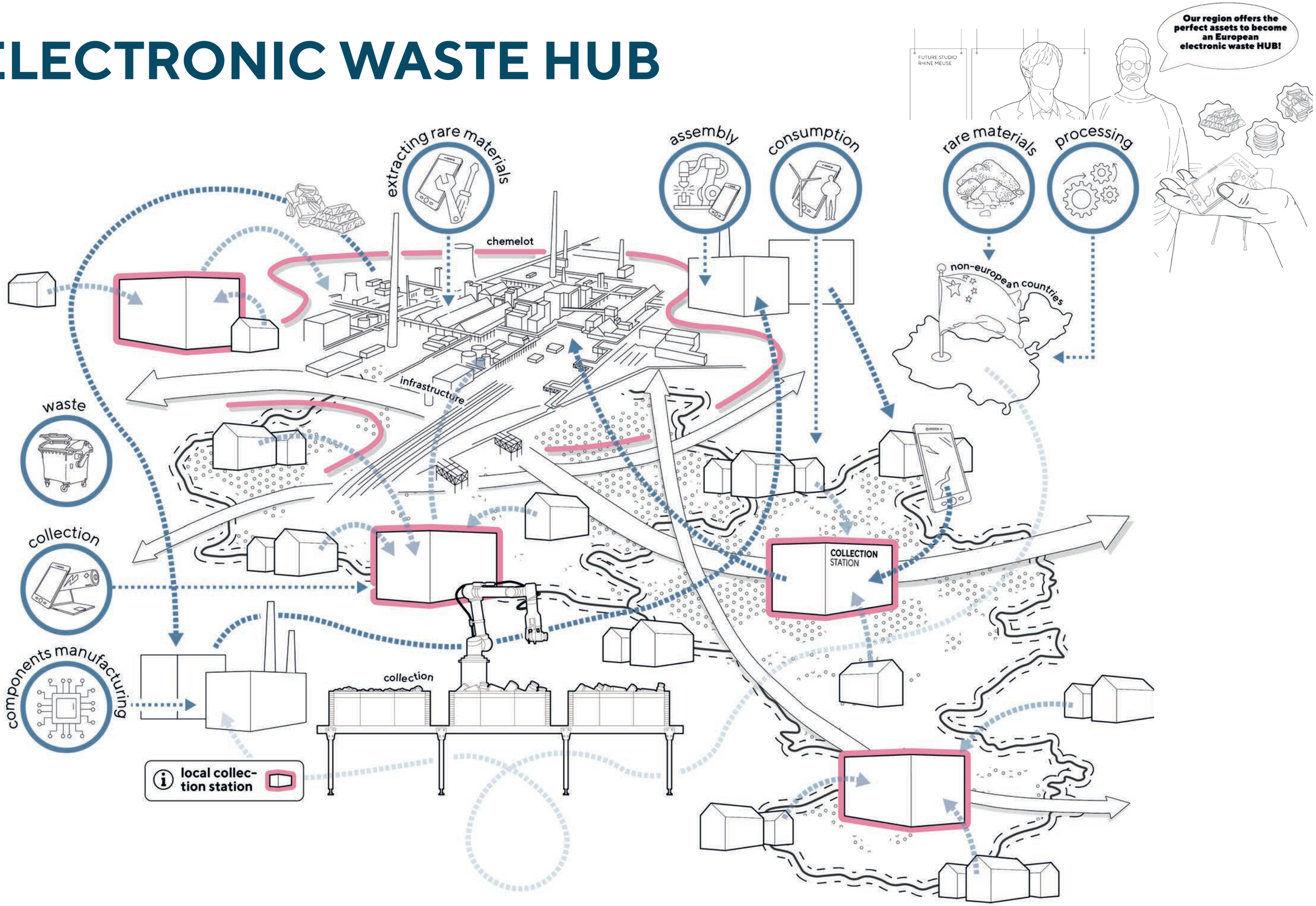
New construction is made of renewable local materials. Old buildings' basements are reused.

Development path



Development path, MUST Städtebau

ELECTRONIC WASTE HUB



E-waste as a resource

The European Union has defined clear goals concerning critical raw materials (Critical Raw Material Act, 2023): by 2030 we must produce 10% of the critical raw materials needed through mining in Europe and 15% through recycling. Old coal mines probably still contain a lot of critical materials that could be re-mined. However, due to regulations and procedures, it will take at least 15 years to reopen a mine. On the short term, re-use seems to be a quicker win. The world produced a record 53.6 million tons of electronic waste in 2019. The value of these materials is estimated to be 57 billion USD, which is 6.3% of the Dutch GDP and about 9.7% of the GPD of North Rhein Westphalia in the same year. In 2023, in Europe only 1% of the electronic waste is being recycled. Especially Germany and The Netherlands are frontrunners in the field of recycling and re-use. An important source for the critical raw materials is urban mining. Existing landfill deposits are richer in ore (which contains critical materials) than a (coal) mine. And by actively collecting and recycling the electronic waste from cities here, a second source becomes available.

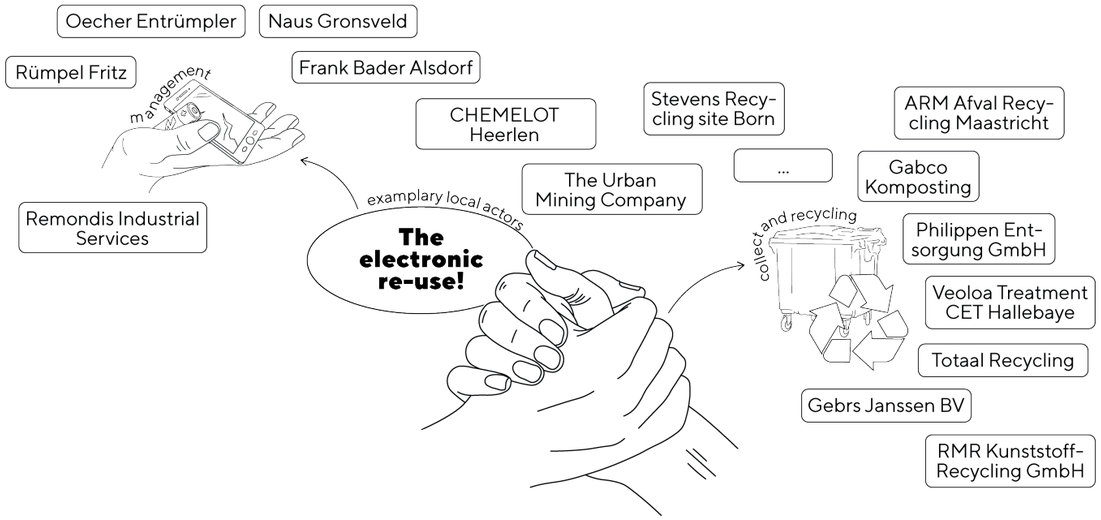
Technological waste, image by Pete Linforth from Pixabay

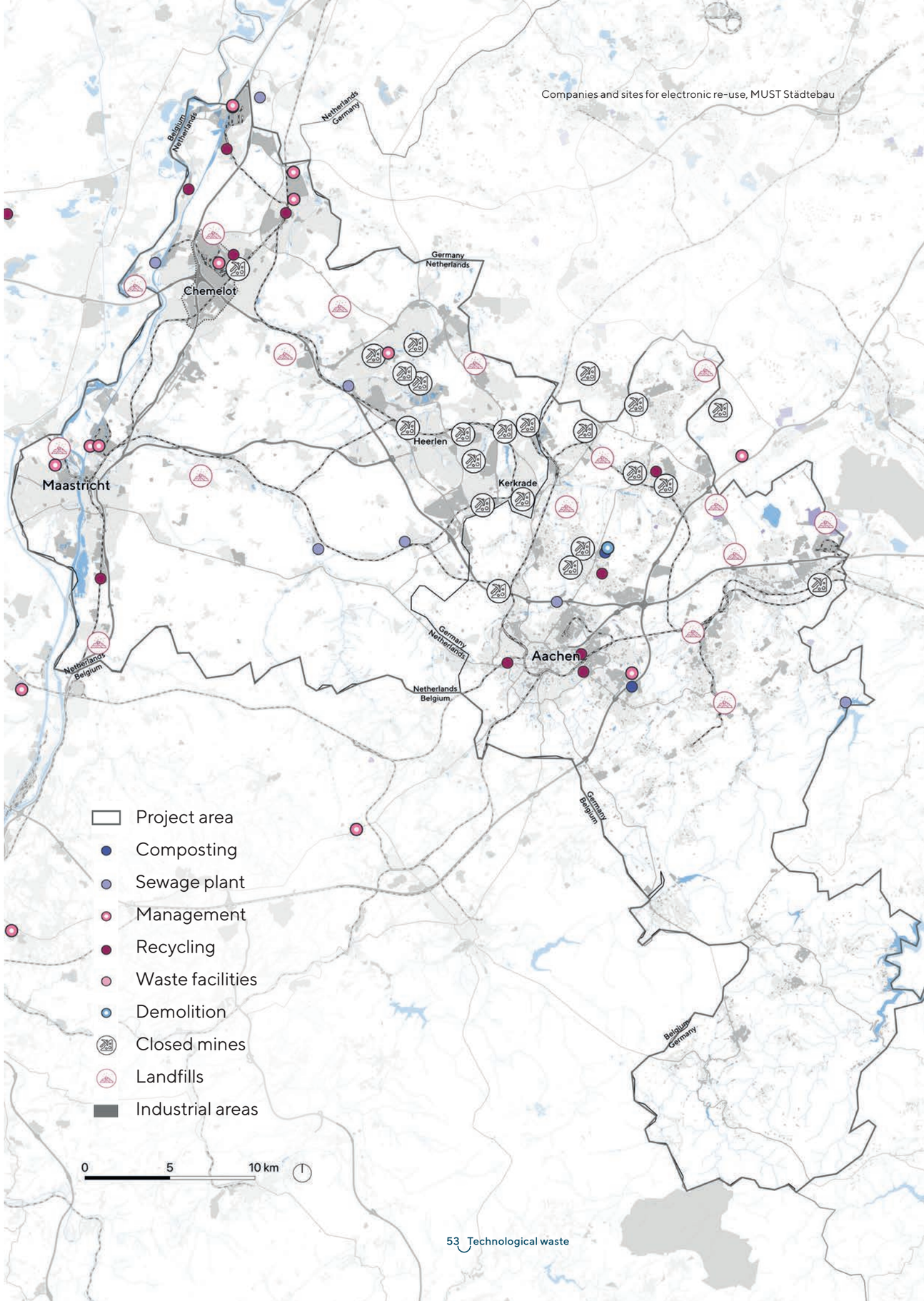
Companies and sites

Waste treatment facilities and companies in the field of recycling are well-distributed across the entire cross-border region. The knowledge of these actors is a first important asset to exploit the potentials of electronic waste mining.

The landfill deposits in the region can be re-opened and serve as urban mines of electronic waste. On the long term, the former coal mines might be re-opened for the exploitation of critical materials.

The storage and the production processes to re-use electronic waste require large sites. These sites will not be the fancy, high-end, clean working environments. Fortunately, the area has a long industrial and mining history. This cultural background and a large reservoir of low labour force in the region may help to establish the sites needed for re-use.

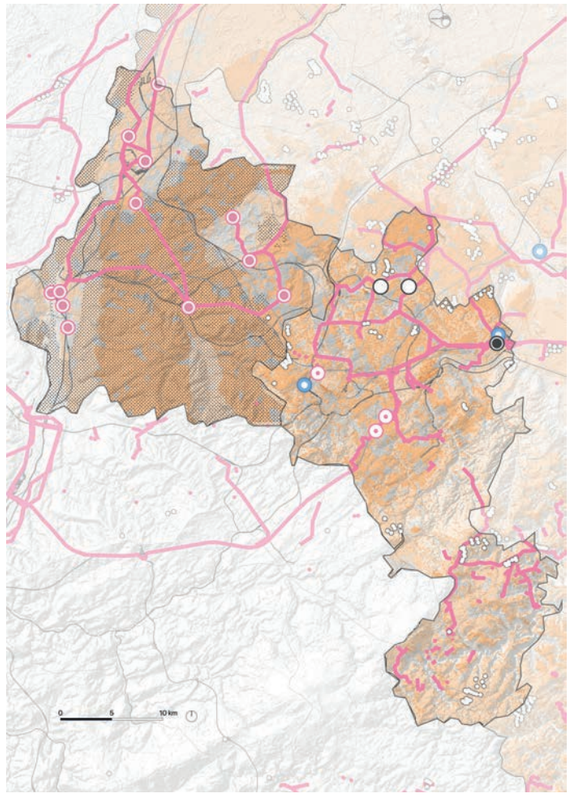




Transport and energy infrastructure

For the collection of E-waste in the region, a good road infrastructure is needed. Especially in the central and northern parts of the territory, around the urban agglomerations, this is provided. To make the processing of re-use economically interesting, the catchment area for e-waste should extend outside the cross-border region, featuring a variety of transport modes. Especially the water and rail infrastructure in the region provide sustainable transport modes. New locations for the storage and processing should be allocated along these infrastructures.

The re-use processing of electronic waste requires high amounts of electricity. This can probably not be provided by renewable enery sources in the region. A solution might be connecting the sites to an (inter) national hydrogen pipeline network.



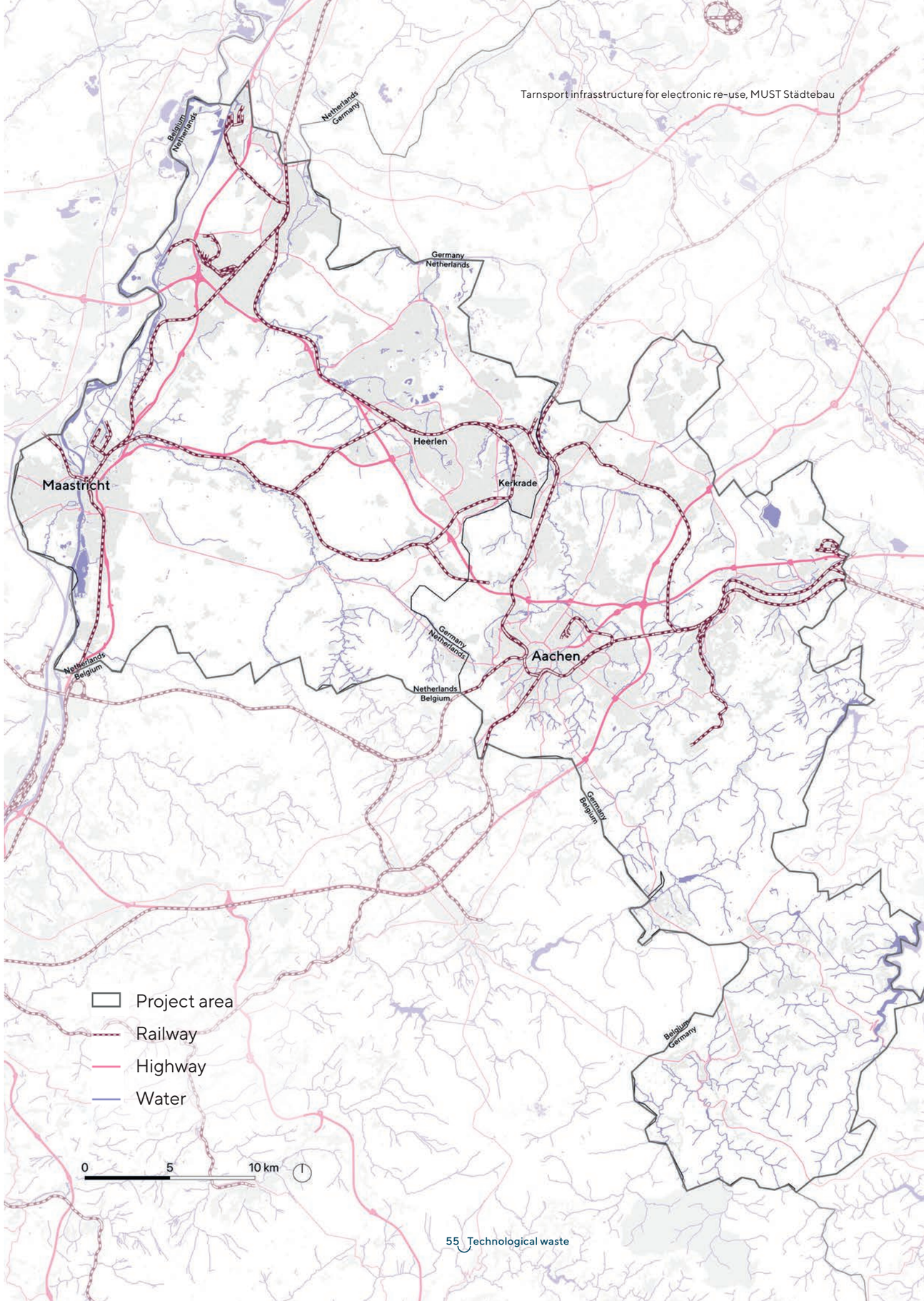
Power station source

- Wind
- Gas
- Coal
- Others (non renewable)
- Source is not known

- Wind turbines

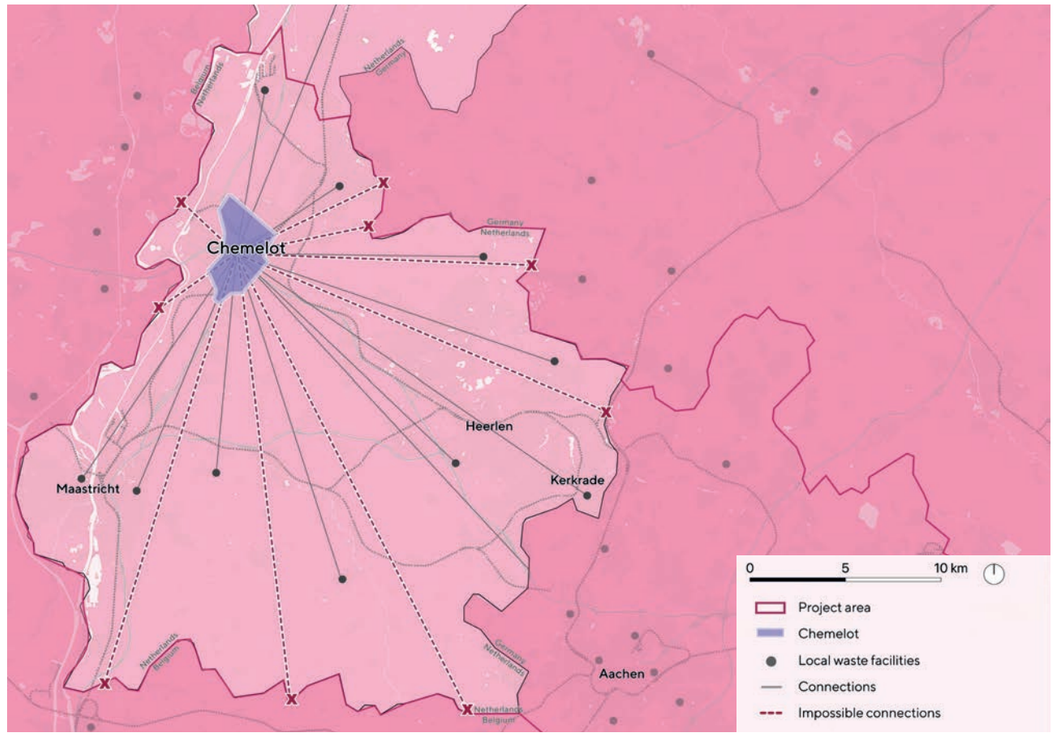
Wind energy potential

- Wind turbine closure area
- Energy lines

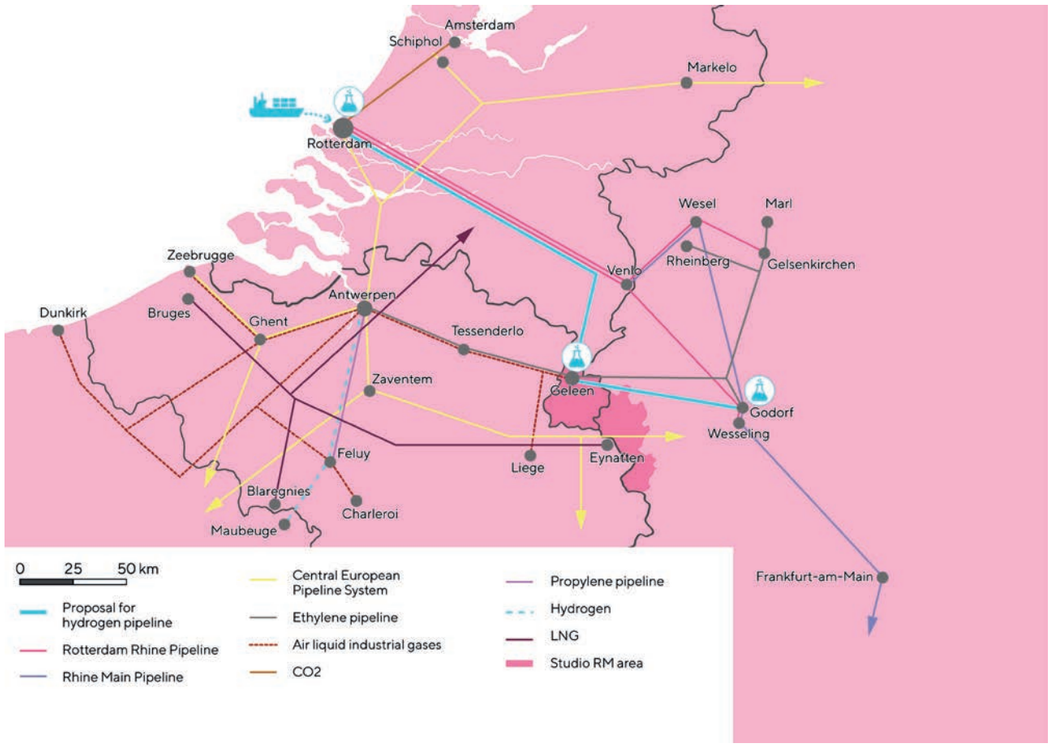


Cross-border project:
A European Re-Use Hub for electronic waste

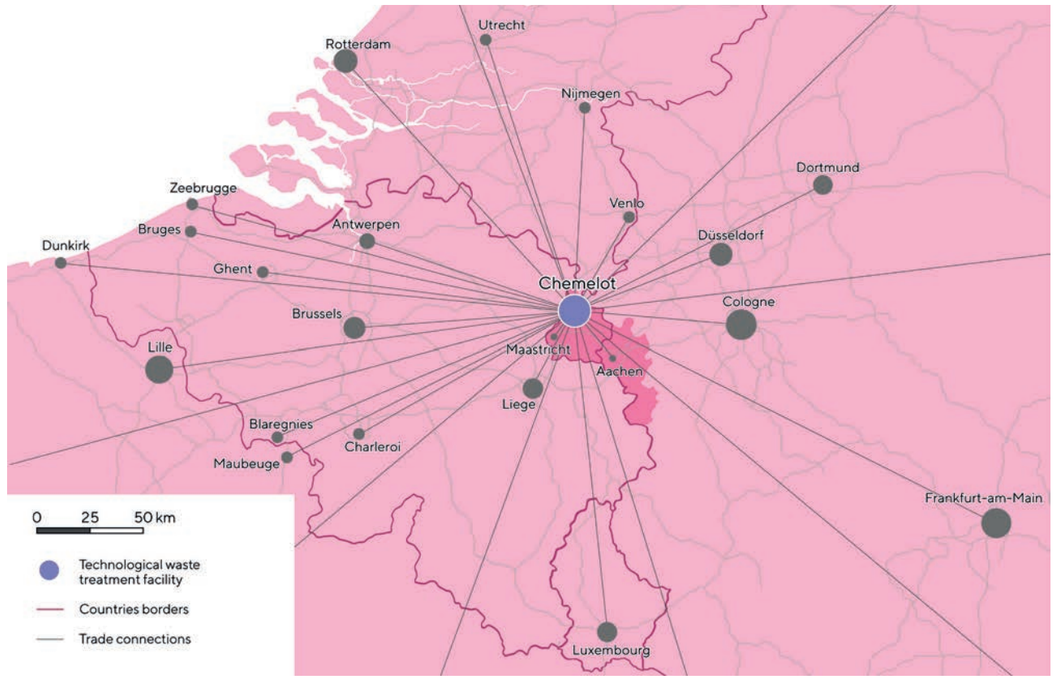
The cross-border region of South-Limburg and Region Aachen is geographically in the centre of the major urban agglomerations in North Rhine Westphalia, The Netherlands and Belgium. This central position and the availability of knowledge in the field of recycling, makes it the perfect location for a European Re-Use Hub for electronic waste. With around 87 million smartphone users just in Germany, the Netherlands, and Belgium, the potential for recovering valuable materials is substantial, amounting to an estimated 555 tons of copper, 12 tons of silver, 1.2 tons of gold, and 521 kilograms of palladium each year. The processing of the waste could take place at Chemelot in Heerlen. For the collection and storage, a network of smaller hubs is needed throughout the whole region and beyond. To provide the energy needed, Chemelot should be connected to the hydrogen pipeline that is being planned between Rotterdam the industrial sites in the region around Cologne.



Re-Use Hub for E-waste within national borders, MUST Städtebau



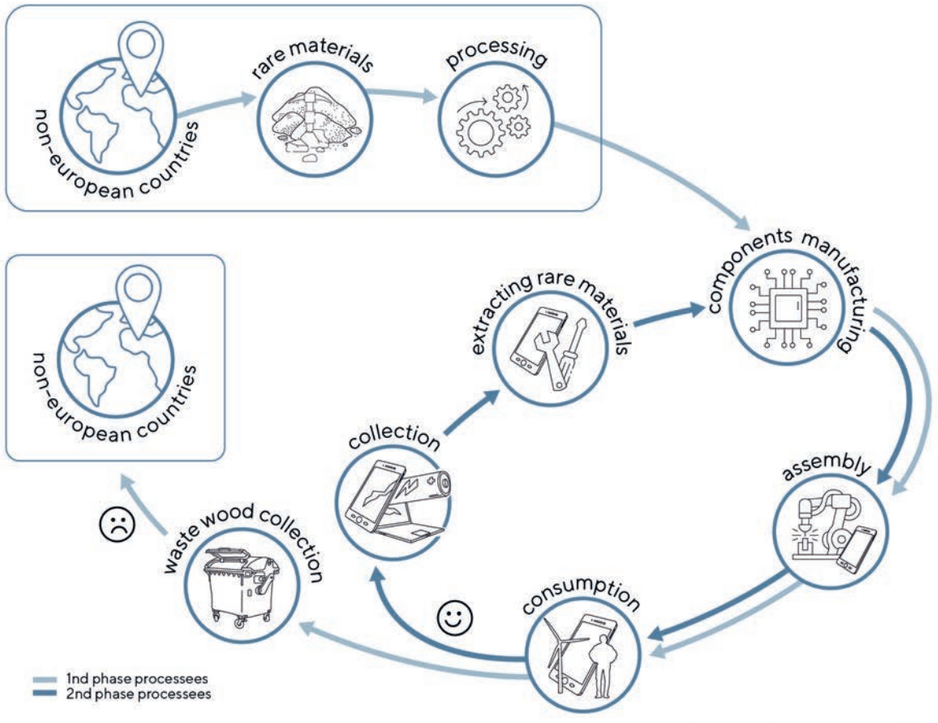
Proposal for the route of the hydrogen pipeline, MUST Städtebau



Possible coverage area of the potential e-waste Re-Use Hub, MUST Städtebau

Circular E-waste system

Nowadays, e-waste is being shipped to countries outside Europe, causing environmental problems when being transported by ship and being processed under low standards. The aim of the circular E-waste system is to have as many components of the cycle as possible in the region (see scheme below). For many of these components, the companies are already located in the region. The challenge is to connect them. Nowadays national regulations complicate and partially even prevent the transport of E-waste over national borders. An adjustment of these regulations is needed to create a cross-border network. This would enable a bigger catchment area for collecting e-waste and thus creating a true European Re-Use Hub.



Electronic E-waste cycle, MUST Städtebau

Development path & Tipping Points

„In 2023, the circular E-waste system is still in a embryonal phase“ (Lucia van Geuns, The Hague Centre for Strategic Studies). This implies, the development path to reach a 100% circular system has to pass a series of difficult barriers.

Tipping Point 1: a decision is being taken to switch towards active re-use and thus reduce the export of e-waste.

Phase 1: active re-use. In this phase, e-waste is collected from cities and landfill deposits on a national scale. Export of transport to countries outside Europe is being reduced as much as possible.

Tipping Point 2A: the legislation is being changed, enabling the cross-border transport of electronic waste.

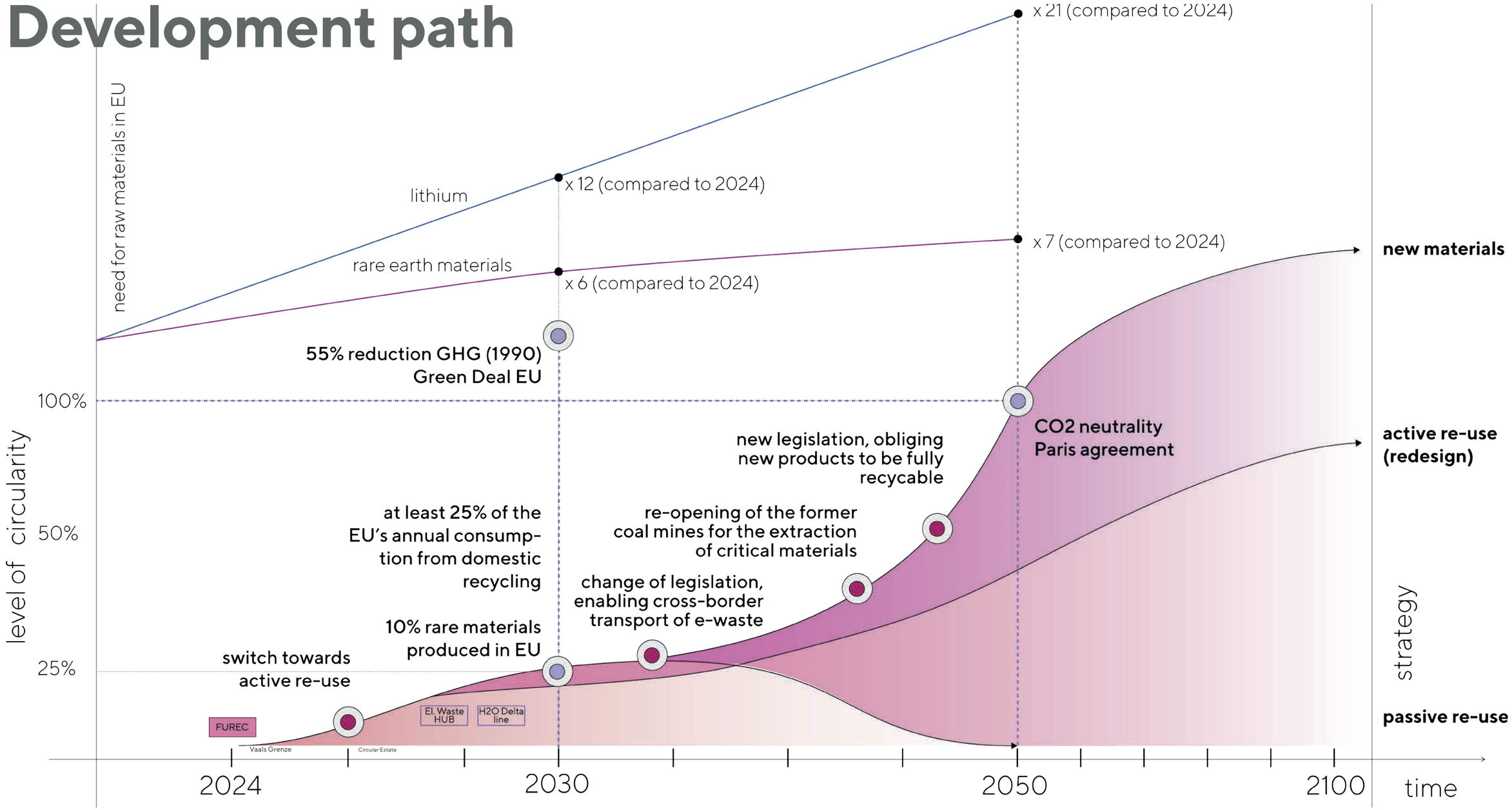
Tipping Point 2B: a political decision is taken to re-open the former coal mines for the extraction of critical materials.

Phase 2: **crossing borders**. The circular E-waste system can be extended over national borders creating scale advantages. active re-use. The building sector (architects, commissioners, and different companies in the building sector) re-use materials from existing buildings in renovation projects. If extra materials are needed, only renewable materials will be applied.

Tipping point 3: a legislation is being implemented obliging new products to be fully recycable.

Phase 3: Circularity by design. The technological sector design products in such a way, that they can be fully re-used. Alternative raw materials will be developed and applied in products, thus reducing the dependancy on countries oiutside Europe and making the scale of the circular system smaller.

Development path



*tipping points

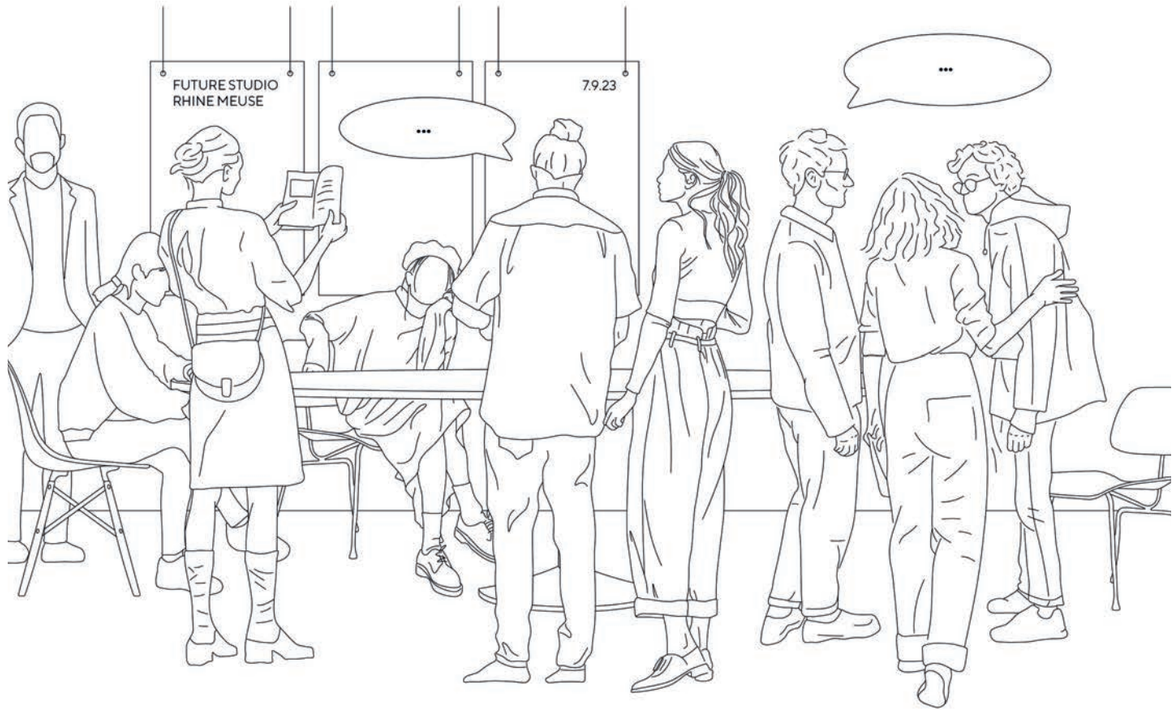
- system or strategy changes
- political goals

projects

- existing projects
- new projects

Technological waste development Path, MUST Städtebau

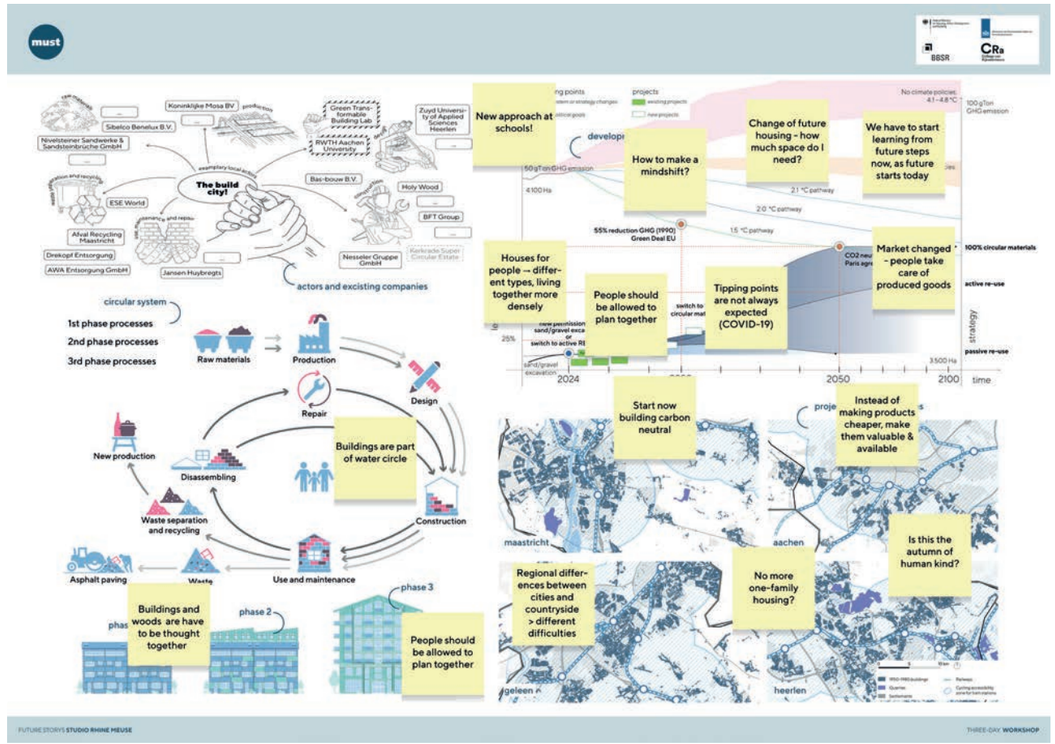
ADDITIONAL MATERIALS: THE WORKSHOP

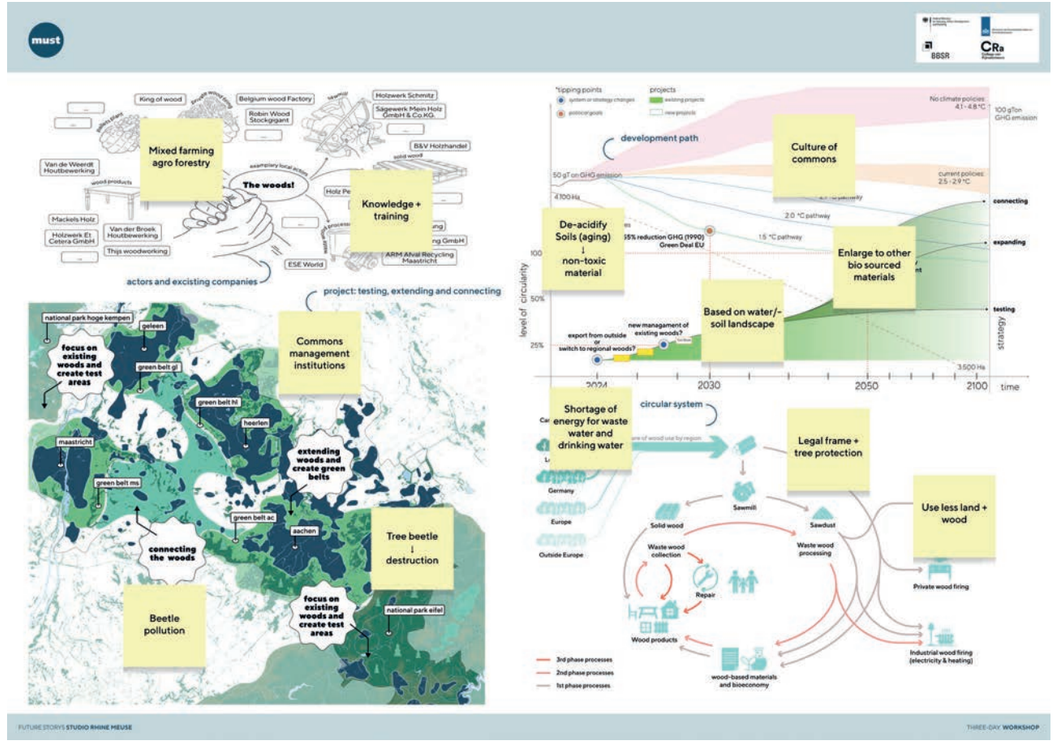


During the 3-day workshop, experts, urban planners, and politicians engaged in discussions about the region's development possibilities. As a result of this event, the list of key projects was expanded, and a draft manifesto was created.

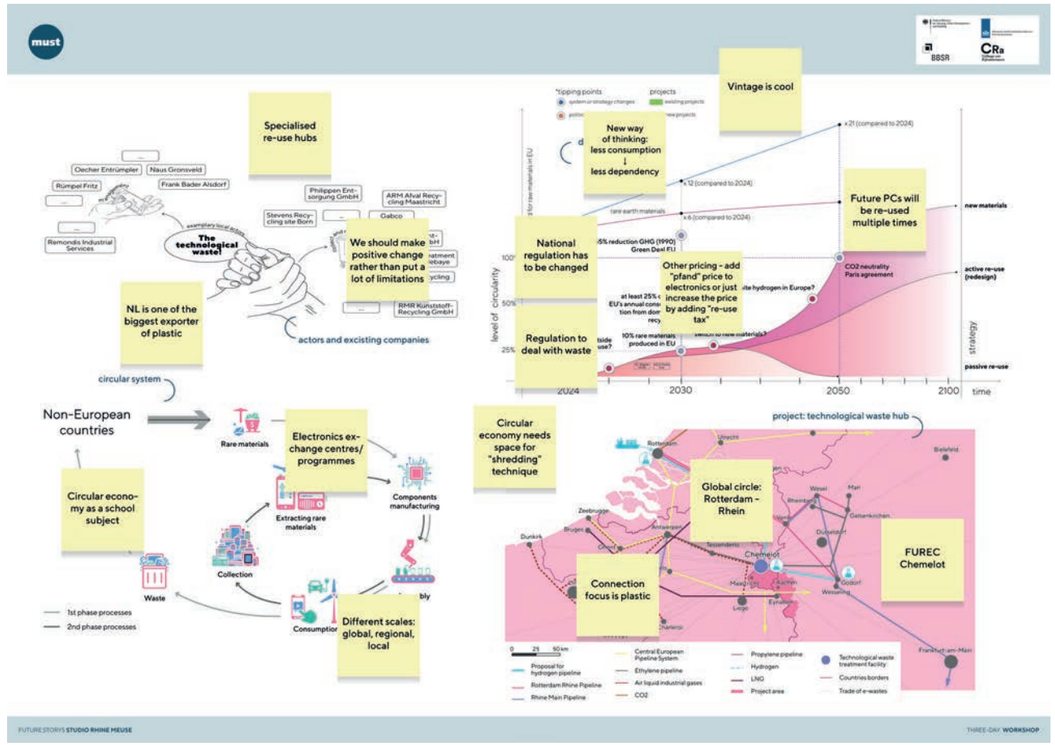
During the workshop, the first day was dedicated to foundational presentations by MUST Städtebau and Atelier Fischbach. Participants were introduced to the concept of the circular economy, illustrated through the stories of two protagonists, Jona and Eva, making it a day rich in inputs and learning.

The second day shifted focus to practical problem-solving. Attendees were divided into groups, each tackling a different aspect of the circular economy. With guidance from local experts, these groups delved into their respective topics, developing detailed projects and strategies.





On the third and final day, the workshop reached its climax with participants presenting the results and innovative ideas they had formulated. This day was a showcase of the collaborative efforts and creative solutions proposed to advance the circular economy in the discussed areas.



Key principles:

- Think borderless
- The shift has to be joyful
- Shared infrastructure
- Identity = Europe
- Culture of commons

Projects:

- Kerkrade Super Circular Estate
- FUREC Chemelot
- Vaals Grenze

Proposed projects:

- Fertile soil for the future
- Cross-border internships
- Transnational ecological corridor

GLOBAL

2023
humans have degraded 40% of all land and altered 70% of land and 87% of the ocean

68% population loss of animals since 1970 and 94% in tropical central and south America
UN and WWF report

2050
to reach a maximum of 2°C of global warming all countries would have to be energy-neutral and nature-inclusive
WUR

2050
40cm expected SLR
KNMI

2085
80cm expected SLR
KNMI

PUBLIC

2030
DE: end of browncoal extraction

2030
NL: expected drinking water shortages - rise of drinking water prices
RIVM

ca. 2025
NL: filling mineshafts with cement
De Limburger

ca. 2025
ZL: extending Natura2000 along worm
De Limburger

2050
NL: 50% of Limburg is nature (now 25%; 100.000 ha extra)
Natuur en Milieufederatie Limburg

ca. 2050-2080
DE: resettling drinkingwater stations around Hambach and Inden
RWE Power AG

ca. 2050
ZL: rising minewater stabilizing (rising 2-3m per year since 1994)
De Limburger

ca. 2070
NL: return of fresh-water mussels
Chat GPT

ca. 2100
regional groundwater table restored
RWE Power AG

PRIVATE

farmers
waterboard
chemelot

2023
NL: dutch ground owners are responsible for -100 meters below ground (problem as more ground is sinking)
De Limburger

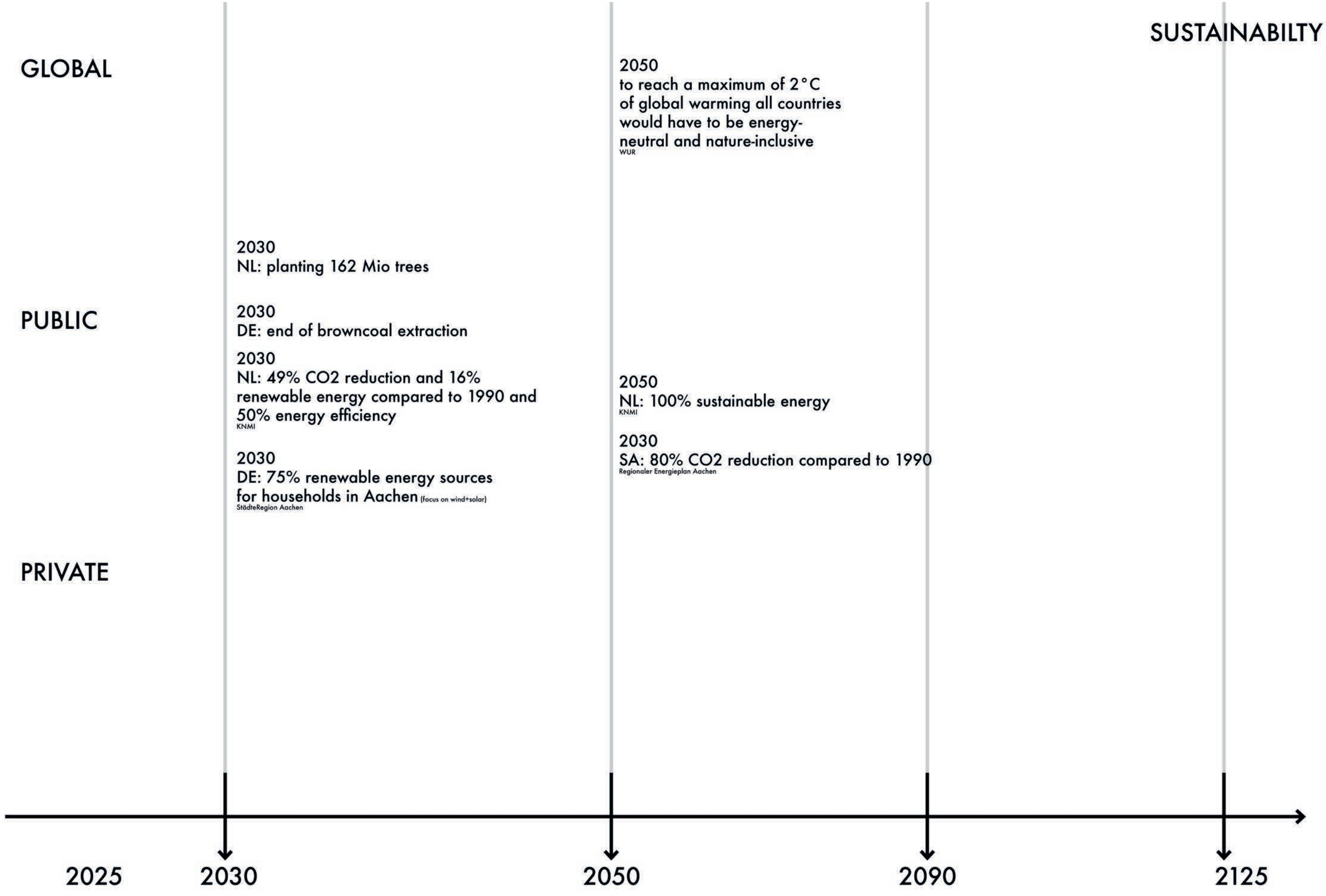
ca. 2030
RWE finishes construction of Rhine-water-pipeline
RWE Power AG

ca. 2070
RWE finishes construction of Inden See and Hambach See
RWE Power AG

ca. 2090
RWE stops infiltrating ground-water into wetlands
RWE Power AG

ca. 2110
RWE finishes construction of Hambacher See
RWE Power AG

2025 2030 2050 2090 2125


GLOBAL
PUBLIC
PRIVATE
2050
to reach a maximum of 2°C
of global warming all countries
would have to be energy-
neutral and nature-inclusive
WUR
2030
NL: planting 162 Mio trees
2030
DE: end of browncoal extraction
2030
NL: 49% CO2 reduction and 16%
renewable energy compared to 1990 and
50% energy efficiency
KNMI
2050
NL: 100% sustainable energy
KNMI
2030
SA: 80% CO2 reduction compared to 1990
Regionaler Energieplan Aachen
2030
DE: 75% renewable energy sources
for households in Aachen (focus on wind+solar)
StädteRegion Aachen
2025
2030
2050
2090
2125

DEMOGRAPHY

GLOBAL

ca. 2050
expected population growth to
9.7 billion people
UN

ca. 2085
expected population growth to
10.4 billion people
UN

PUBLIC

2038
NRW: 14 Mia. Euros subsidie for
brown coal region
BMWK

ca. 2050
NL: 30-40% of population will
have migration background
CBS

ca. 2050
DE: 50% of population will be of
working age (significant increase in 70+)
total population is expected to
drop to 81.6 Mio.
Bundesamt für Statistik

ca. 2050
ZL: 10% expected decline in
population growth (more, smaller households)
CPB

ca. 2050
ZL: ca. 5% decrease in space for
agriculture, ca. 3% more space for
nature and settlement
CPB

ca. 2050
NRW: increasing population decline (without migration)
and 42% above 67
Wirtschaft.NRW

2025 2030 2050 2090 2125

BASE MAPS OF THE REGION

Geographical characteristics

This area is characterized by its hilly landscape, abundant agricultural land, and stream valleys. Approximately three-quarters of the forested area is legally protected.

The population density is unevenly distributed, with urban areas primarily forming a linear pattern from Aachen along the territory's northern border to Maastricht.

A notable feature of the area is the intersection of borders where three countries meet.

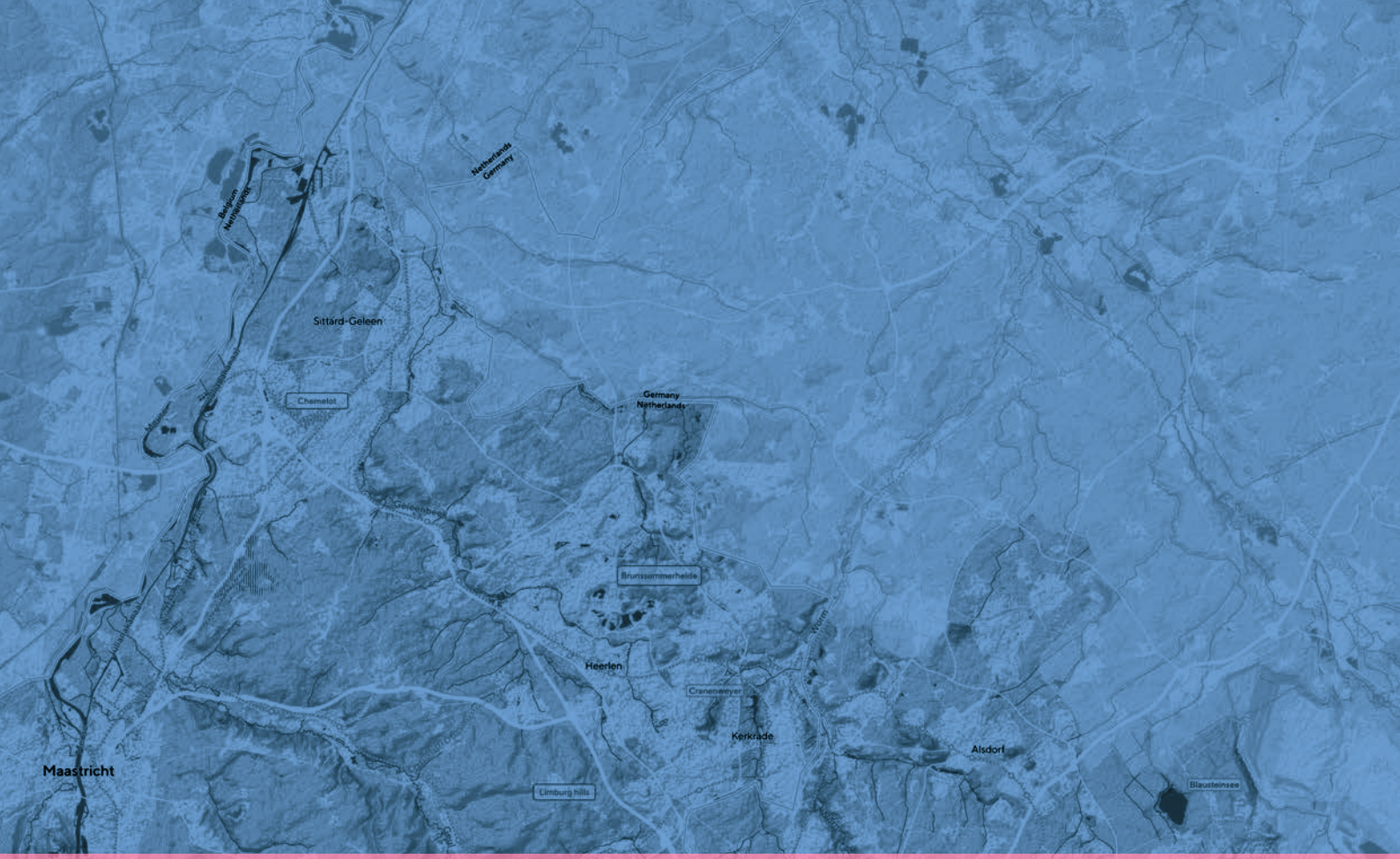
Geographical characteristics, MUST Städtebau

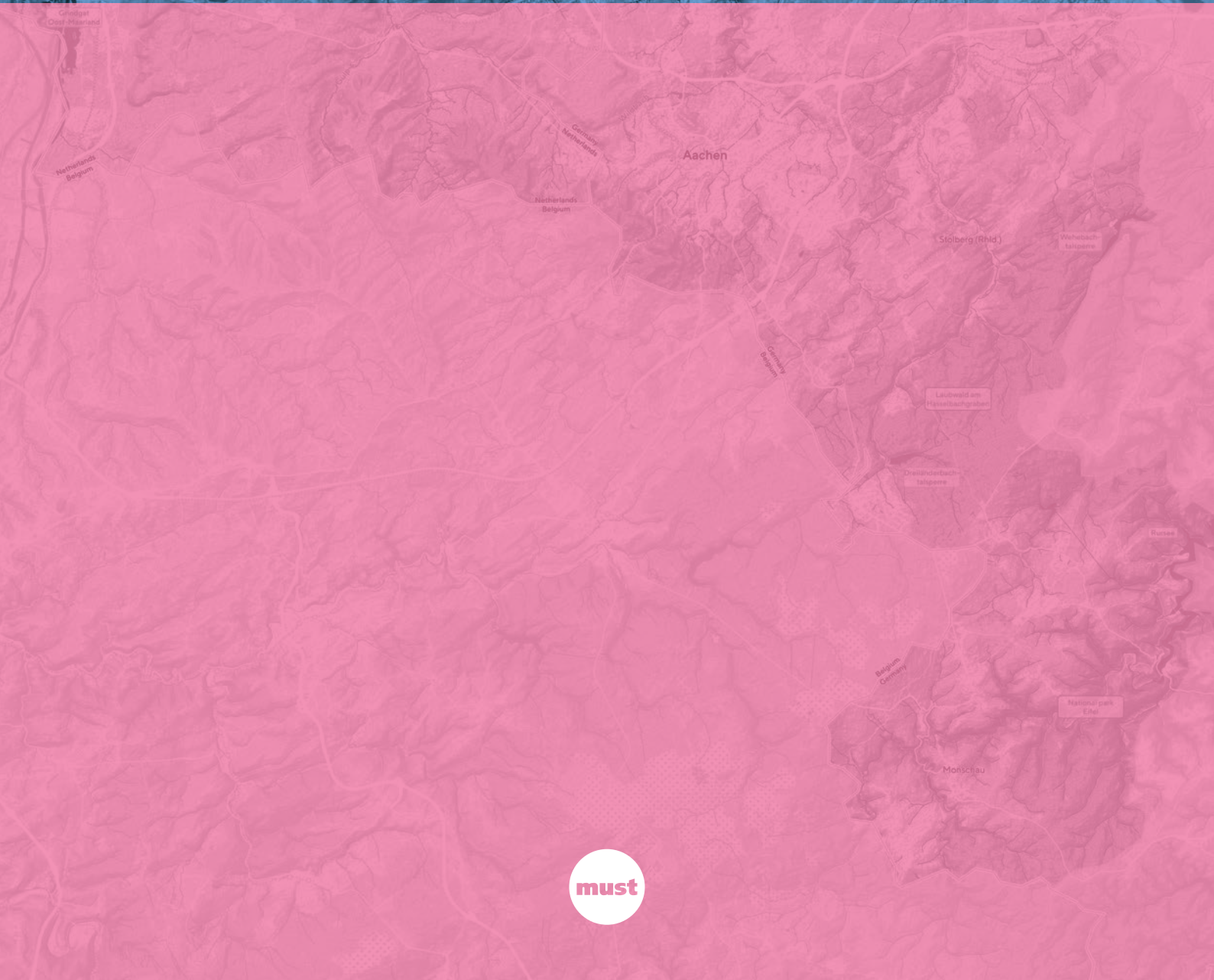
Transport infrastructure

The transport infrastructure is well-developed, particularly remarkable is the high density of highways surrounding Heerlen.

However, the southern part of the area is less connected, primarily due to the landscape

Transport infrastructure, MUST Städtebau


Netherlands
Germany
Belgium
Netherlands
Sittard-Geleen
Chemelot
Germany
Netherlands
Brunssummerheide
Heerlen
Cranenweyer
Kerkrade
Alsdorf
Blausteinsee
Maastricht
Limburg hills


Aachen
Stolberg (Rhld.)
Monschau

must