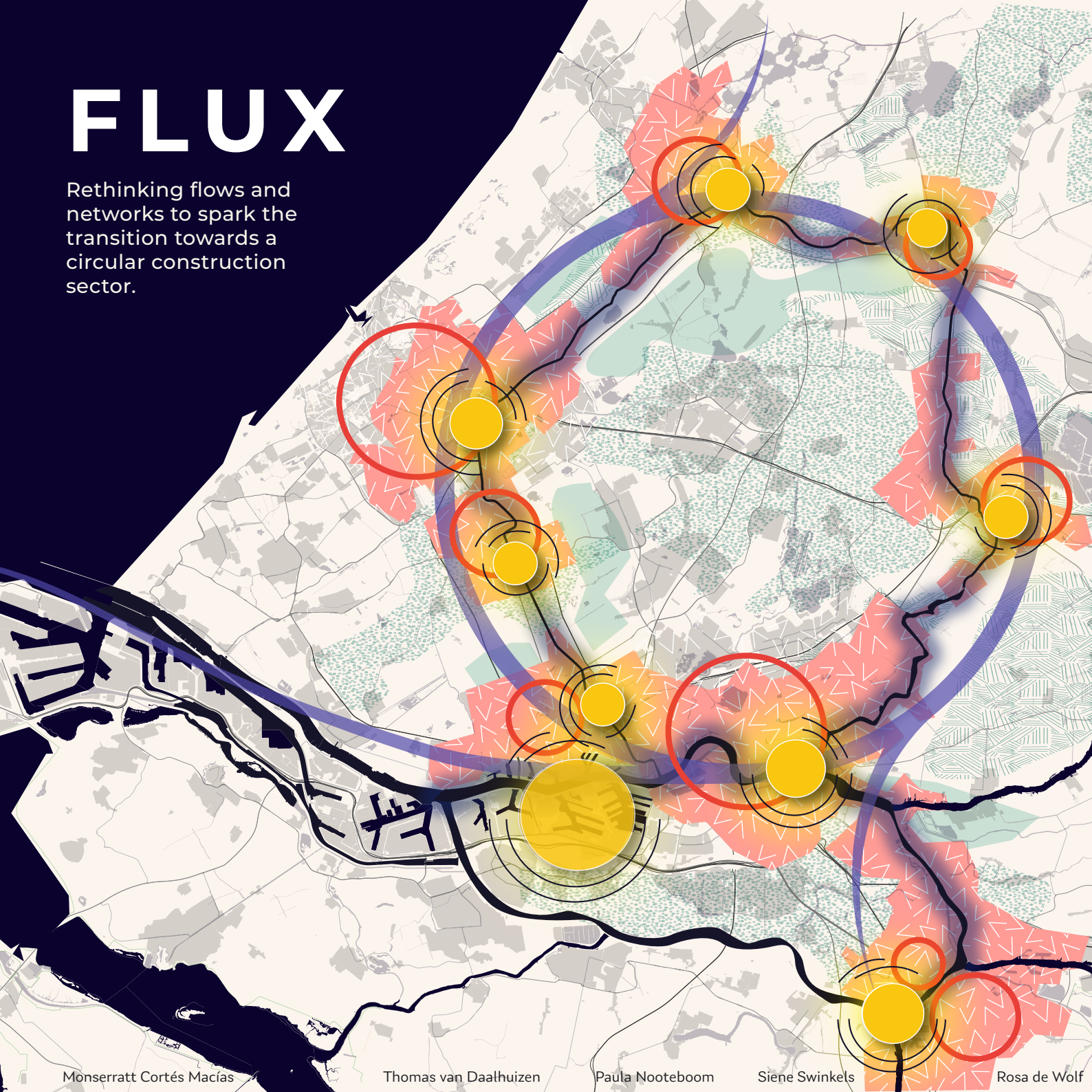
FLUX

Rethinking flows and networks to spark the transition towards a circular construction sector.



Monserratt Cortés Macías
Thomas van Daalhuizen
Paula Nooteboom
Siene Swinkels
Rosa de Wolf

COLOPHON

Monserratt Cortés Macías	5221595
Thomas van Daalhuizen	4598105
Paula Nooteboom	4558901
Siene Swinkels	4575946
Rosa de Wolf	4663322

The 7th of April, 2021

AR2U086 Spatial Strategies for the Global Metropolis
MSc Urbanism I Q3 2020-2021
TU Delft Faculty of Architecture and the Built Environment
Department of Urbanism, Julianalaan 134, 2628 BL, Delft, The Netherlands.

AR2U086 tutors: Dr. Caroline Newton, Dr. Lei Qu and Dr. Alexander Wandl
AR2U088 tutors: Dr. Marcin Dabrowski and Dr. Roberto Rocco.

Cover image: Visionmap

TU Delft Department of Urbanism
BK Bouwkunde

THE TEAM

Figure 1, The student team

PREFACE

FLUX is a proposal for a symbiosis of resources and flows to establish a circular construction sector in the province of Zuid-Holland by 2050. This proposal is made by Monserratt Cortés Macías, Thomas van Daalhuizen, Paula Nooteboom, Siene Swinkels and Rosa de Wolf during the 2020-2021 MSc2 courses AR2U086 R&D studio Spatial Strategies for the Global Metropolis and AR2U088 Research and Design Methodology for Urbanism. These courses are part of the Mastertrack of Urbanism at the Faculty of Architecture and the Built Environment at Delft University of Technology.

A special thanks goes out to our AR2U086 tutors: Dr. Caroline Newton, Dr. Lei Qu and Dr. Alexander Wandl, the course coordinators: Dr. Lei Qu and Dr. Verena Balz and to the AR2U088 tutors Dr. Marcin Dabrowski and Dr. Roberto Rocco. All of them provided us with tools, insights and support, as this report was written during the COVID-19 pandemic, this was quite a task.

ABSTRACT

The large demand for homes in the province of Zuid-Holland, population growth and urbanisation result in a huge demand for raw materials to be used in the construction sector. The next 20 years many new buildings will have to be built to support current trends. Given the fact that 50 percent of all extracted non-renewable resources is accounted by the construction sector, a shift towards a bio-based circular system is necessary. In the province Zuid-Holland, one of the fastest growing urban areas within the Netherlands, there is a missing link between circular initiatives, knowledge and data.

The question that comes up is; how can a symbiosis of stakeholders and resources contribute to a circular construction sector?

An analysis of the current situation of stakeholders and flows of resources has been made and potential spatial conflicts were understood. Whereafter the analysis of trends and requirements to transition into a circular construction sector has been made. This results in a new understanding of the spatial structure of the province, focussing on the use of waterways as a backbone to support the transition. This will lead to circular neighbourhoods connected by the water.

With Flux we try to reform the current construction sector into a circular one by the year of 2050, while taking into account social and spatial justice. The shift to this new structure, supported by the waterways, can facilitate a change to a circular construction sector. Besides this it will also give the Province a new identity and structural element for future improvements toward a circular economy, lifting the idea of circularity to a territorial level.

Keywords: construction sector, bio-based materials, Circular Neighbourhood, waterscape, maker industries, Zuid-Holland

CONTENT

Figure 2, Location of the province of Zuid-Holland within the Netherlands.

INTRODUCING FLUX

1

CHAPTERS' CONTENT

In this first chapter, FLUX: a proposal for achieving a circular construction and demolition sector in the province of Zuid-Holland by 2050, will be introduced.

The problem statement included in this chapter shows the current challenges and opportunities of the province of Zuid-Holland.

Furthermore, the United Nations Sustainable Development Goals and European Green Deal are discussed. The goals are set to, with FLUX, achieve a greener, more inclusive economy including a more sustainable and resilient society.

With this in mind, research questions are formulated and the methodology and conceptual framework for FLUX is explained.

1.1 Introduction

Flux is a proposal for achieving a circular construction and demolition sector in the province of Zuid-Holland by 2050. Zuid-Holland is part of the south wing of the Randstad, which is a strong economical region. It is the biggest province of the Netherlands with a population size of 3.7 million. Two of the four biggest cities are located here: The Hague houses the government of the Netherlands and the port of Rotterdam is the biggest of Europe. Furthermore three universities are located in Zuid Holland: TU Delft, Leiden university and Erasmus university. The typical Dutch polder landscape surrounds the cities.

With climate change and the finiteness of resources, big challenges await future generations. A shift towards a circular economy is becoming more and more urgent. In 2017 the central government set a goal for itself to fully transition the Dutch economy towards circularity by 2050.

The circular economy focuses on reusing products and raw materials. Circularity aims to minimize waste and to keep materials in the chain as much as possible. New raw materials are preferably of natural and renewable resources. Five sectors within this transition were established: The manufacturing industry, plastics, consumer goods, construction and biomass & food (PZH, 2019).

Flux will focus on two of these sectors: construction and the manufacturing industry. 40% of resources used in Zuid-Holland are within the construction sector. This sector also produces a big part of waste and CO_2 emissions. This in combination with the increasing demand for housing poses a big challenge (de Wit, Hoogzaad, Ramkumar, Friedl & Douma, 2018). The manufacturing industry plays a major role in the economy of South Holland with 10.000 companies within this sector. These companies differ from small startups to large industries. Since they process raw materials into products, these are important stakeholders to heavily involve on the way to circularity and could be part of a solution.

Another player in our project will be the makers industry. Makers are local stakeholders that aim to tackle social and environmental issues that are part of the supply chain of ‘making’. They can drive innovation within the manufacturing sector (Cities of making, 2018).

1.2 Problem Statement

Due to the population growth and urbanization, (Roser, Ritchie & Ortiz-Ospina 2013) The Netherlands is in need of 1 million new homes to supply the growing demand, most of it in urban regions (TU Delft, 2021, p. 21). Figure 3 on the right shows the prognosis of population growth in the Netherlands between 2018 and 2035 in percentage. This demand is mainly focussing on smaller households (Centraal Bureau voor de statistiek, 2019c). Added to this, all the other sectors would also need new buildings and new infrastructures to connect them, resulting in a higher demand for new construction materials. Therefore, new building typologies could be the answer to decrease the amount of the demand that is necessary. It would be interesting to see what the impact would be on the spatial and social quality within the cities.

All these homes, buildings and new infrastructure need to be constructed in the next 20 years. In figure 4 on the right, the demand for homes in the province of Zuid-Holland is shown. The province of Zuid-Holland, especially within the Metropolitan Region of Den Haag - Rotterdam, is facing challenges given the fact that the construction sector has a big environmental impact; by extracting raw materials, and also by manufacturing

POPULATION GROWTH IN THE NETHERLANDS BETWEEN 2018 & 2035 (PROGNOSIS)

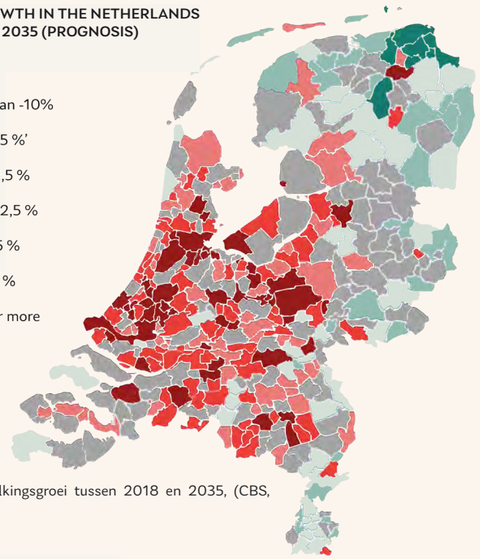


Figure 3, Bevolkingsgroei tussen 2018 en 2035, (CBS, 2019c).

ESTIMATED DWELLINGS X1000 NEEDED PER REGION IN 2015-2019, 2020-2029 & 2030-2039

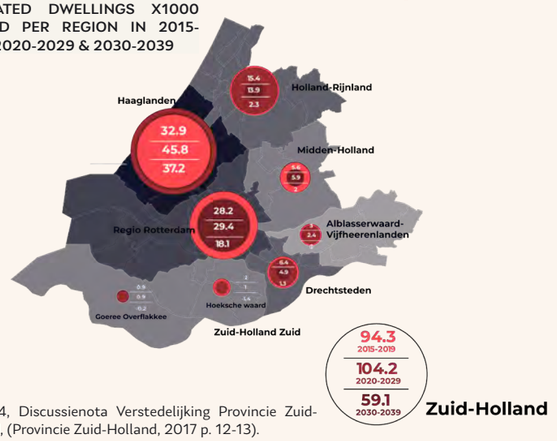


Figure 4, Discussienota Verstedelijking Provincie Zuid-Holland, (Provincie Zuid-Holland, 2017 p. 12-13).

those materials into construction materials (Arnoldussen, Errami, Semenov, Roemers, Blok, Kamps, & Faes, 2020).

As shown in figure 5, 50% of all extracted resources within the world are used for the construction and demolition sector (de Wit et al., 2018, p. 16-17).

Therefore it is necessary to rethink current stocks, processes, systems, and networks and find alternatives for raw materials. One alternative for the construction sector could be a shift to bio-based materials, however the infrastructure needed does not exist yet in the Netherlands (Government of The Netherlands, 2019a).

However, to tackle these problems many visions have been made, initiatives have started and circular makers industries are popping-up. Strengths of the Province of South of Holland are its strategic position, its harbour, and well developed infrastructure that connects it to the rest of the world (Gladek, van Exter, Roemers, Schlueter, de Winter, Galle & Dufourmont, 2019). There are many educational institutions in the region and the harbour of Rotterdam might be a huge urban mine. Economically, the transition towards a circular construction sector is attractive due to its great demand for building volumes. There are many opportunities in the region but there is still a missing link among these opportunities, initiatives, knowledge and data together. Achieving a circular construction sector by 2050 is still very challenging, but bridging the missing link might be the solution.

In figure 6, these strengths, opportunities, weaknesses and threats are visualised.

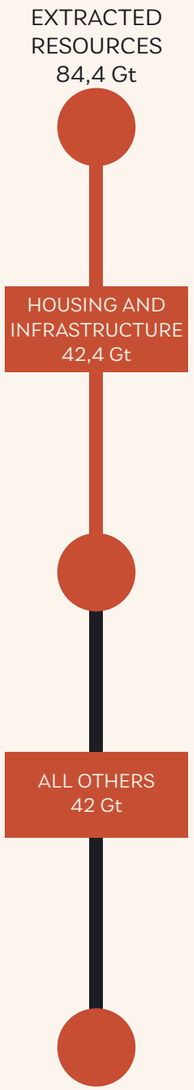


Figure 5, Extracted resources, by author based on (de Wit, Hoogzaad, Ramkumar, Friedl & Douma, 2018, p.17)

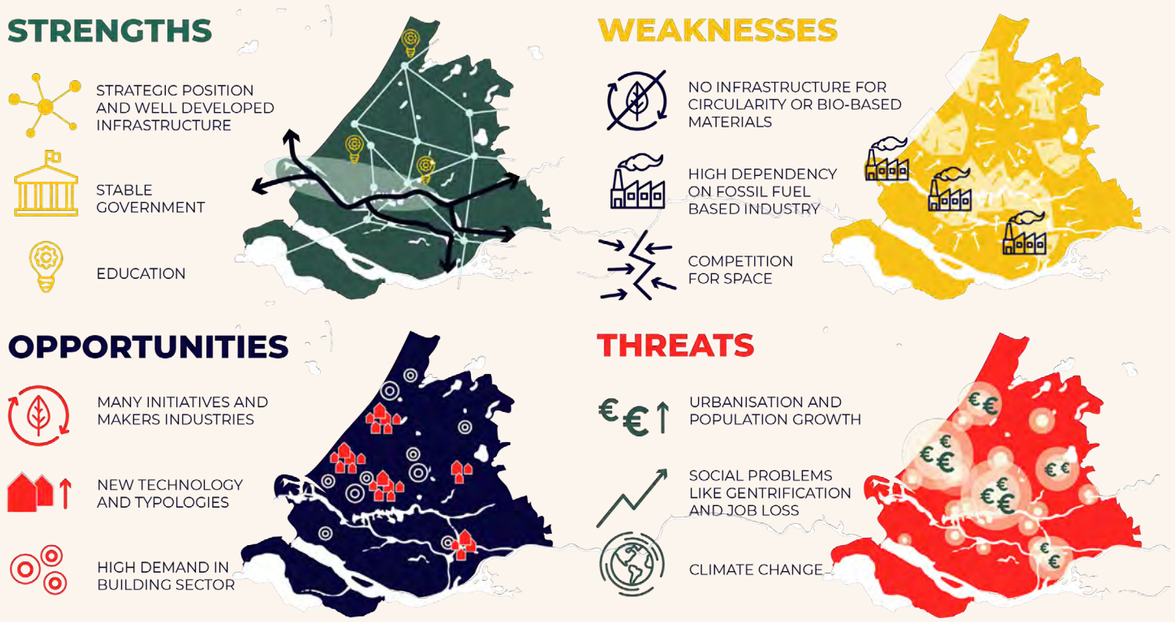


Figure 6, Visualization strengths, opportunities, weaknesses and threats

1.3 Goals

1.3.1 Sustainable Development Goals

The Sustainable Development Goals are part of the 2030 Agenda for Sustainable Development created by the UN. These goals aim to promote prosperity while at the same protecting the planet by bringing together civil society, private sector and governments. There are 17 goals in total that address a range of social needs including education, health, social protection, job opportunities, while tackling climate change and environmental protection. These goals, see figure 7, can be translated into visions and strategies for national development to achieve a greener, more inclusive economy and more sustainable and resilient societies (UN, 2021). As future planners, we are aware of the importance of including these global common goals as part of our regional strategy. It would be difficult to address every single one with our vision, but we have selected the most relevant ones that will help us guide and result in a sustainable vision and strategy. Their importance and connection to our project is explained per goal. For the following text, all information in 'UN Goal' and 'Why it matters' is based on the report Sustainable Development Goals, written by the UN in 2021.

Figure 7, Sustainable Development Goals, (UN, 2021).
** icons in figure 4 will be used in pages 13 - 15.*

No poverty
UN Goal: end poverty in all its forms everywhere by 2030.

Why it matters: growing inequality is detrimental to economic growth and undermines social cohesion, increasing political and social tensions and, in some circumstances, driving instability and conflicts.

Quality of education
UN Goal: Ensure inclusive and quality education for all and promote lifelong learning.
Why it matters: Education enables upward socioeconomic mobility and is a key to escaping poverty. It also helps reduce inequalities and reach gender equality and is crucial to fostering tolerance and more peaceful societies.

Decent work and economic growth
UN Goal: To promote inclusive and sustainable economic growth, employment and decent work for all.
Why it matters: Sustained and inclusive economic growth can drive progress, create decent jobs for all and improve living standards.

Industry, innovation and infrastructure
UN Goal: To build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.
Why it matters: Economic growth, social development and climate action are heavily dependent on investments in infrastructure, sustainable industrial development and technological progress. In the face of a rapidly changing global economic landscape and increasing inequalities, sustained growth must include industrialization that first of all, makes opportunities accessible to all people, and second, is supported by innovation and resilient infrastructure.

Reduced inequalities
UN Goal: To reduce inequalities within and among countries.
Why it matters: Inequality threatens long term social and economic development, harms poverty reduction and destroys people's sense of fulfilment and self-worth. We cannot achieve sustainable development and make the planet better for all if people are excluded from the chance for a better life.

Sustainable cities and communities
UN Goal: To make cities inclusive, safe,
Why it matters: Many cities are also more vulnerable to climate change and natural disasters due to their high concentration of people and location so building urban resilience is crucial to avoid human, social and economic losses.

Responsible consumption and production
UN Goal: To ensure sustainable consumption and production patterns.
Why it matters: Economic and social progress over the last century has been accompanied by environmental degradation that is endangering the very systems on which our future development and very survival depend. A successful transition will mean improvements in resource efficiency, consideration of the entire life cycle of economic activities, and active engagement in multilateral environmental agreements.

Climate action
UN Goal: Taking urgent action to tackle climate change and its impacts.
Why it matters: Climate change is affecting every country in the world. It is disrupting national economies and affecting lives and livelihoods, especially for the most vulnerable. If left unchecked, climate change will cause average global temperatures to increase beyond 3°C, and will adversely affect every ecosystem.

Life on land
UN Goal: To sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss.
Why it matters: Globally, one fifth of the Earth's land area (more than 2 billion hectares) are degraded, an area nearly the size of India and the Russian Federation combined. Land degradation is undermining the well-being of some 3.2 billion people, driving species to extinction and intensifying climate change.

Partnerships for the goals
UN Goal: To revitalize the global partnership
Why it matters: The Sustainable Development Goals remain the framework for building back better. We need everyone to come together—governments, civil society, scientists, academia and the private sector.

1.3.2 European Green Deal

The European Green Deal is a strategy designed by the European Commission to make the EU's economy sustainable, by turning climate and environmental challenges into opportunities, while making the transition just and inclusive for all (European Commission, 2019). The EU aims to be climate neutral in 2050 and in order to reach this target, a set of actions within all sectors of economy must be taken into account: Investing in environmentally-friendly technologies, supporting industry to innovate, rolling out cleaner, cheaper and healthier forms of private and public transport, decarbonizing the energy sector, ensuring buildings are more energy efficient and finally, working with international partners to improve global environmental standards, see figure 8.

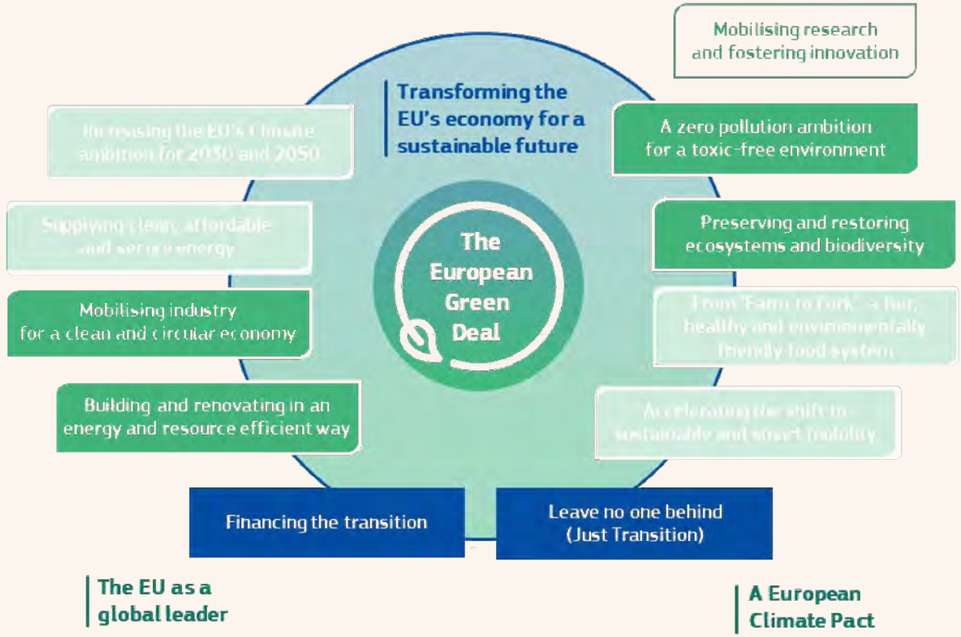


Figure 8, The European Green Deal's actions, (European Commission, 2019).

Just as important as the SDGs, the European Green Deal offers a set of actions and strategies to achieve a circular economy. Again we selected the most relevant ones that will help us guide and result in a sustainable vision and strategy. Their importance and connection to our project is explained as follows:

Mobilising Industry for a clean and circular economy

Why does it matter: Achieving the EU's climate and environmental goals requires a new industrial policy based on the circular economy. More than 90% of biodiversity loss and water stress come from resource extraction and processing. EU's industry accounts for 20% of the EU's emissions. Only 12% of the materials used by EU industry come from recycling (European Commission, 2019).

EU strategies: Stimulate the development of new markets for climate neutral and circular products. Decarbonisation and modernisation of energy-intensive industries such as steel and cement. A 'sustainable products' policy, which will prioritise reducing and reusing materials before recycling them. All packaging in the EU is reusable or recyclable by 2030. Digital platform for monitoring and optimising how energy and natural resources are consumed. (European Commission, 2019).

Building and renovating in an energy and resource efficient way

Why does it matter: The construction, use and renovation of buildings require significant amounts of energy and resources, such as sand, gravel and cement. Buildings account for 40% of energy consumed then the current rates of renovation of public and private buildings should at least double. (European Commission, 2019).

EU strategies: Start a renovation 'wave'. Prices of different energy sources should incentivise energy-efficient buildings, design of buildings should be in line with the circular economy, increased digitalisation, more climate-proofing of buildings, strict enforcement of rules on energy performance of buildings (European Commission, 2019).

A zero pollution ambition for a toxic-free environment

Why does it matter: To protect Europe's citizens and ecosystems, the Commission will adopt the zero-pollution action plan to prevent pollution of air, water and soil (European Commission, 2019).

EU strategies: Reduce pollution from excess nutrients thanks to the Farm to Fork strategy. Reduce particularly harmful pollution from micro-plastics and pharmaceuticals. Reduce pollution from large industrial installations. Review air quality standards in line with the World Health Organization guidelines, among others (European Commission, 2019).

Preserving and restoring ecosystems and biodiversity

Why does it matter: Biodiversity is essential for life. Our planet and the economy depend on it. Half of global GDP, €40 trillion, depends on nature. Biodiversity and ecosystems provide us with food, health and medicines, materials, recreation, and wellbeing. Biodiversity loss and the climate crisis are interdependent and they exacerbate each other (European Commission, 2019).

EU strategies: Establish protected areas for at least 30% of land and 30% of sea in Europe. Restore degraded ecosystems at land and sea across the whole of Europe by increasing organic farming and biodiversity rich landscape features on agricultural land and restoring at least 25 000 km of EU rivers to a free flowing state, and planting 3 billion trees by 2030 (European Commission, 2019).

Leave no-one behind (just transition)
EU Strategy: Helping address the social and economic effects of the transition, focusing on the regions, industries and workers who will face the greatest challenges, and mobilising at least €100 billion, through financial support, transition plans for beneficiary regions to steer the investments, attractive conditions and risk sharing for public and private investors and technical assistance via a Just Transition Platform to advise and support (European Commision, 2019).

Mobilising research and fostering innovation
EU Strategy: In order for Europe to become a climate-neutral continent by 2050, this will require decarbonisation at a speed at least six times faster than anything achieved globally so far. Research and innovation will play a central role in accelerating the necessary transitions, deploying and demonstrating solutions, and engaging citizens in social innovation. Research and innovation will help drive and navigate the long-term systemic changes required to create a cleaner, greener, fairer society (European Commission, 2019).

1.4 Research Questions

How can a symbiosis of stakeholders and resources contribute to a circular construction sector?

- What is the geography of flows?
- What non-renewable resources can be replaced?
- How can flows (materials, data, knowledge) and physical networks be optimised?
- How can maker industries be tied into the symbiosis?
- What will be implications of this symbiosis on the spatial and social sustainability ?

1.5 Conceptual Framework

In figure 10 on the next page, the conceptual framework for FLUX is shown. The basis is formed by three pillars, (1) Waterscape, (2) Flow of resources and (3) Maker industries. The relation and possibilities for a symbiosis of these three pillars is explored, while taking into account the contribution to the transitioning network. The outcome of symbiosis will have a social and spatial impact and therefore the relation with social and spatial justice will function as the assessment of the transition. By keeping in mind the following core concepts: (1) Transition, (2) circularity and (3) governance a total understanding and carefully chosen strategy can be accomplished.

Core concepts

Transition

FLUX calls for a just transition of the construction and demolition sector into a circular model that goes beyond a transition of material types and manufacturing processes. A just transition will emerge if we find ways of transcending the split between local action and global change. These exist within each other, and the transformative impact of niche innovations must not be underestimated. Fusing these scales could result in a rapid spread of alternatives as niche innovations transform into new social movements, knowledge networks and major new developments (Swilling & Annecke, 2012). Flux will show a future image of the new C&D sector in different cities sparking a bigger and broader transition in the rest of its surroundings. Thus, it is important to structure a proposal based on different scales with different stakeholders that can make sure this transition is realised. To visualise transitions the x-curve diagram could be used, see figure 9 (Loorbach, Frantzeskaki, & Avelino, 2017, p. 607).

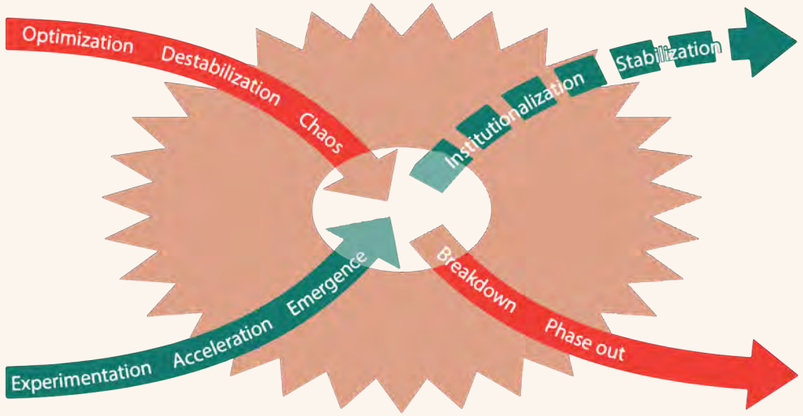


Figure 9, X-curve diagram for the dynamic transitions, (Loorbach, Frantzeskaki & Avelino, 2017, p.607)

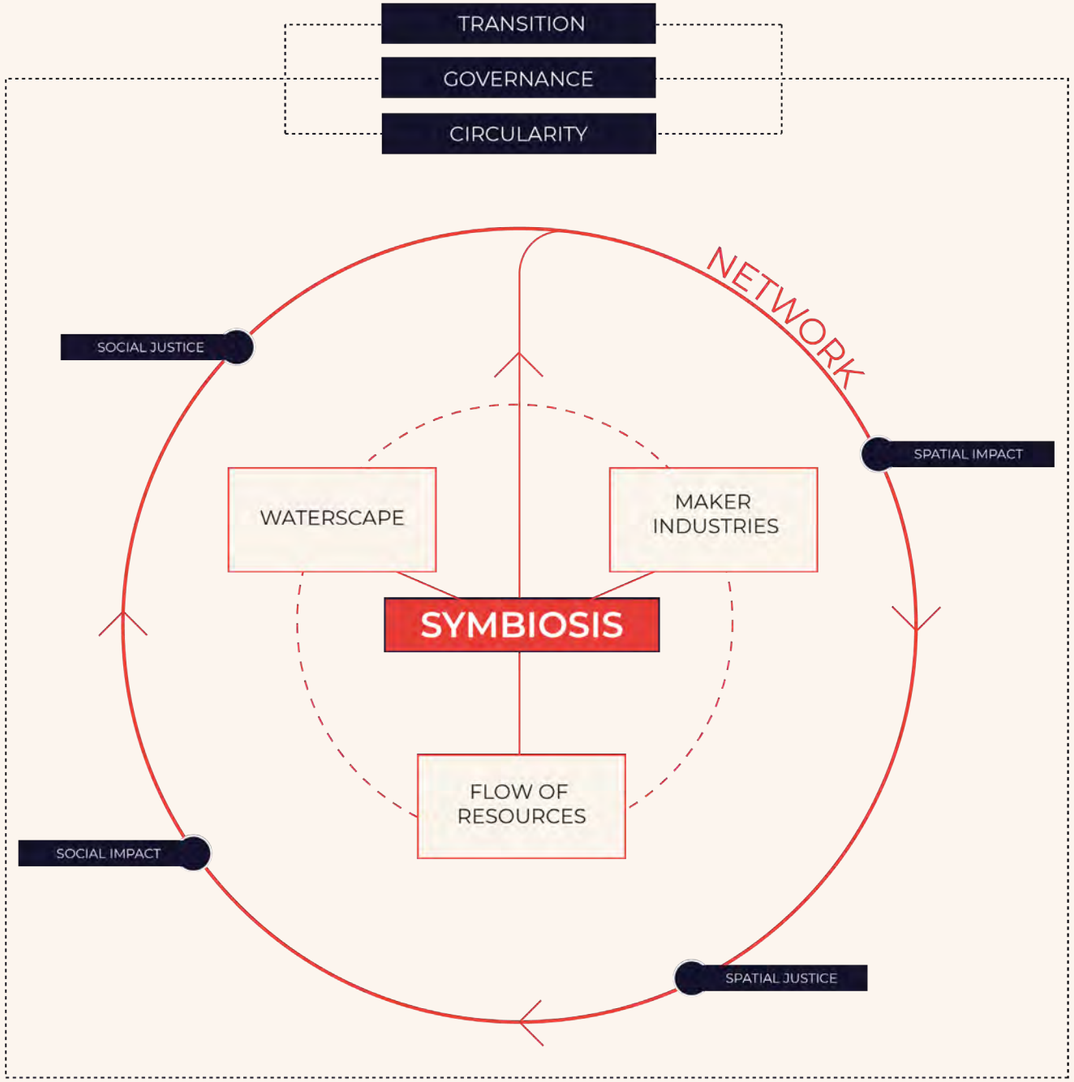


Figure 10, Conceptual framework

Circularity

Circularity is the technology and logistics to close cycles (City of Rotterdam, 2019; p.2). A circular construction and demolition industry (C&D) means aiming for a closed loop system with special attention to the renewability of the materials that are part of this system (de Wit et al., 2018). All this has to be done while understanding how transitions can be managed and integrated through different scales. The circular economy is the underlying economic system for circularity. It is the economic catalyst to make circularity economically attractive to consumers and industry. The basis for a circular economy consists of:

- preventing and reducing the use of primary raw materials;
- extending the life of products;
- reusing products and parts;
- recycling of materials into raw materials (City of Rotterdam, 2019; p. 2).

Governance

According to Mark Bevir (2012, p. 2) governance refers to all processes of governing, whether undertaken by a government, market or network. In FLUX governance is seen through the lens of planning and strategy-making which are mostly about coordination and articulation of a large number of stakeholders with simultaneously diverging and concurrent objectives (Rocco, 2021a). There is no such thing as a 'general public' up till now current methods of engagement struggle to handle the social complexities of an increasingly globalised and urbane but also fragmented and unequal world (Chilvers & Kearnes, 2015)

The initiator of a project must negotiate, coordinate and articulate diverging interests. Communicative rationality and planning has a potential for fair and inclusive policy-making (Rocco, 2021b) Participation in these processes by many different societal groups is needed to get a full understanding of the magnitude of changing the current construction sector into a circular one.

Three pillars

Waterscape

The Netherlands has been depending on water for centuries. A big part of the economy in the past and in the present can be attributed to the success of the harbours of Amsterdam and nowadays especially Rotterdam. The big rivers such as the Rhine and the Waal connect the harbour of Rotterdam with the hinterland. Canals are used for local transportation (Brolsma, 2010). This waterscape is an important factor in the identity of The Netherlands and Zuid-Holland (Ministerie van Verkeer en Waterstaat, 2010). FLUX presents a way to repurpose this waterscape in Zuid-Holland to support a transition to a circular C&D sector.

Flow of resources

The C&D sector requires an enormous amount of resources and it also causes a lot of waste. Currently the sector consumes 50% of all resources and creates 35% of the Dutch CO_2 emissions (Nellissen & Scherpenzeel, 2020). To improve the status quo, these flows need to be analysed: Where and how are these resources sourced? What is needed to turn them into building materials and what happens after the lifespan of the building? At this moment the extracting of resources is unsustainable and many manufacturing processes have a big environmental impact (Arnoldussen et al., 2020). After this analysis weak points, and also opportunities can be determined. Alternative materials, manufacturing processes and new techniques, such as the use of bio-based materials, smart disassembly and urban mining, could be a solution.

Maker industries

The makers movement could play a big role in this transition towards a new circular economy, contributing to closing these material and energy cycles in the cities. By refocusing on local ways of production, introducing innovation and new skills, improving material flows, proposing new land use and working with various stakeholders like entrepreneurs, developers, local communities and the government, the makers industries can contribute to sustain a thriving economy, stimulate innovation, address climate change and foster economic and social inclusion (Cities of making, 2018).

Today's makers are crafters, artists and artisans, technologists, hobbyists, amateur scientists, entrepreneurs, engineers, woodworkers, roboticists, and many others. They are people engaging in hands-on projects that introduce them to science and technology in creative ways (Hirshberg, Dougherty & Kadanoff, 2017). Giving more space for makers industries to create a bridge between the city and industry could catalyse the system (Swilling & Annecke, 2012).

Assessment

Spatial justice

The change to a circular C&D sector will have a spatial impact. Producing more built materials locally will result in more manufacturers and makers within the city. Growing inequality, socio-spatial fragmentation and lack of access to public goods are threats to the sustainability of our cities (Dillard, Dujon, & King, 2009; Larsen, 2012). It is therefore important to keep in mind what the results of these spatial changes are and if they are just.

Social justice

The transition towards a circular economy should be done carefully because of its societal impact. For instance, the effect it will have on jobs. Some jobs will disappear, while others will be created. One example of this is the job loss and economical implications of this transition in the traditional C&D sector. Also the energy transition which will happen simultaneously, will have big consequences on jobs and the harbour of Rotterdam. On the other hand the circular sector is expected to grow, and new jobs will be created (Chahim, Bastein, van Bree, & Rietveld, 2019). It is important however, that people at risk of losing their job are involved by for example the possibility for reeducation, so no one falls behind.

1.6 Methodology

During our process, which can be seen in the figure 11 below, we made use of different research and design methods. The most used methods in our analysis were literature reviews and mapping, in general we looked into flows, resources, stakeholders and goals set by the UN or the EU. While developing our vision, we used gathered knowledge of the current situation and goals to set up new standards for the province of Zuid-Holland and pinpoint strategic locations. These locations form the basis of our strategy. During the strategy phase more literature on strategy-making was done and important stakeholders were identified. The final strategic locations were developed through research by design.

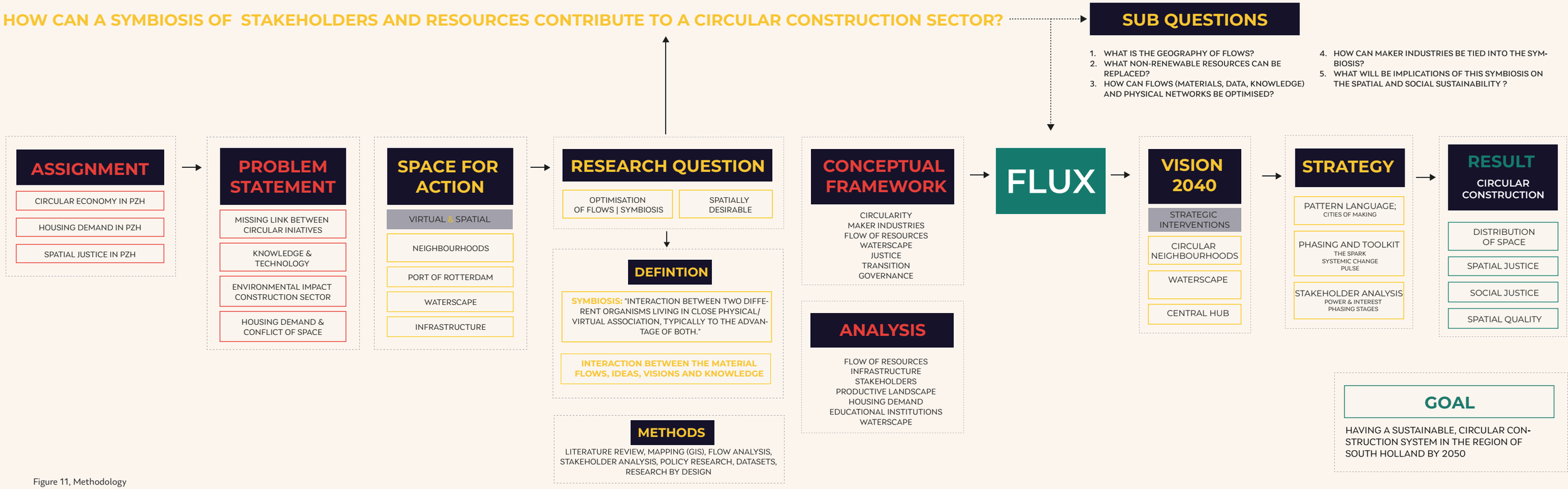


Figure 11, Methodology

ANALYSIS

2

CHAPTERS' CONTENT

To get an idea on how to optimise the construction sector within the province, it is necessary to firstly understand what the current situation is.

What is the current geography of flows and resources? What are the potentials of the province? Which trends are emerging and how can they be relevant in achieving a circular construction sector?

In this chapter, the current situation is being analysed, and challenges and potentials are being brought up.

2.1 Current Geography of Resources and Flows

Starting off with the analysis of the current geography of resources and flows. 40% of all raw material flows are driven by construction. In addition, the construction chain produces the largest waste stream (Drift & Metabolic, 2018). There are many materials being used in the current construction sector, all with different origins and their own road towards the construction site. As can be seen in figure 12, by far the most used material in the Netherlands is concrete, followed by steel, bricks and wood.

In the province of Zuid-Holland yearly 6,8 Mton of construction materials are coming in, while the total outflow is 3,9 Mton. Concrete is also here the biggest flow with 2,1 Mton. Together with the amount of bricks as main construction material for new buildings, the result is that almost half of the released materials after demolishing the buildings is stony debris. These are non renewable materials. Next to this the production of concrete combined with the production of steel are responsible for almost 20% of all CO2 emissions. (Drift, Metabolic, 2018)

To achieve a circulair construction sector the use of these materials have to be replaced by more sustainable renewable materials such as cross laminated timber (CLT) or biobased materials.

As brick and concrete are the most used non renewable materials, and steel adds the most to the CO_2 emissions and has the highest residual value, the optimisation of these flows helps the most to get to a circular construction sector. Therefore this chapter analyses the spatial aspect and geography of flows of these three materials in the province of Zuid-Holland. As sand plays a big role in the production of bricks and concrete, this is also analysed. This is followed by a research about possible renewable replacements like CLT and other bio-based materials.

MASS BALANCE MOST IMPORTANT MATERIAL FLOWS IN THE DUTCH HOUSING AND UTILITY CONSTRUCTION CHAIN. KTON 2014

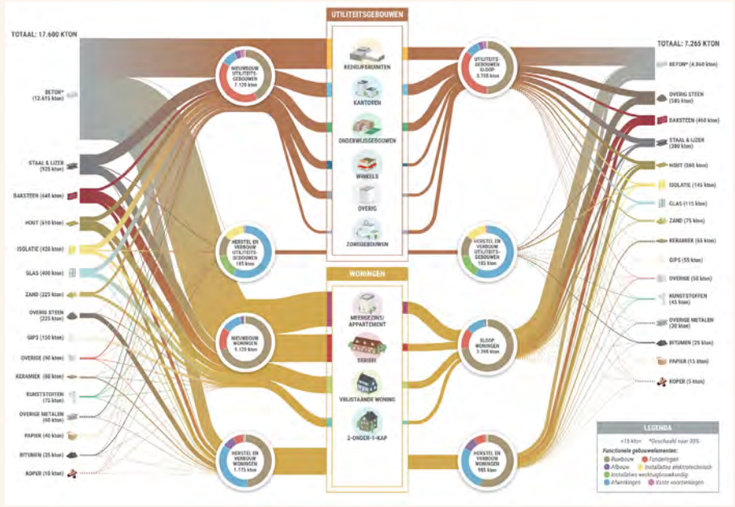


Figure 12, Massabalans belangrijkste materiaalstromen voor de Nederlandse woningbouw- en utiliteitsbouwketen, kton 2014 (Stichting Economisch Instituut voor de Bouw & Metabolic, 2020).

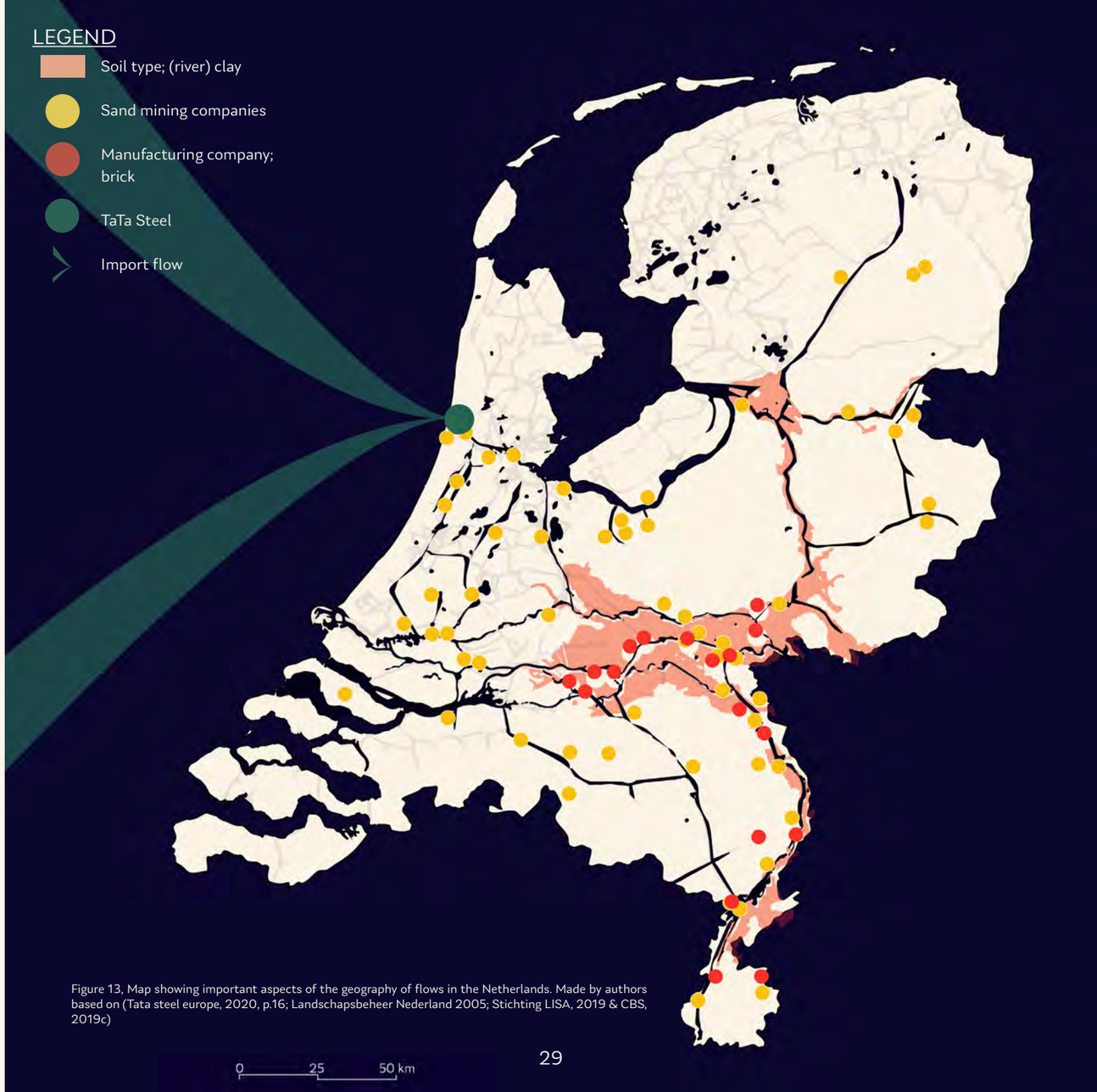


Figure 13, Map showing important aspects of the geography of flows in the Netherlands. Made by authors based on (Tata steel europe, 2020, p.16; Landschapsbeheer Nederland 2005; Stichting LISA, 2019 & CBS, 2019c)

2.1.1 Geography of Resources and Flows

SAND

Two different types of sand are being used for construction; fine and coarse sand. Fine sand is used in substructure and asphalt and in The Netherlands, this can be found on beaches and in sea. Because of its location at the mouth of rivers Eems, Schelde, Rijn and Maas, The Netherlands has acces to more than enough fine sand. Coarse sand can be found more upstream the river and is used for making concrete. Because of the rivers's flow this sand can only be found in a limited number of provinces in the Netherlands. These provinces must issue a permit to the sand-poor provinces to win sand in their region. This is not done wholeheartedly, because the sand is not used for construction (development) of their own region. The Netherlands uses up to 22 mln tons of coarse sand for construction of which up to 10 mln tons is imported from Germany. (Ike, 2000).

The shortage of coarse sand is a worldwide problem. In 2010, 11 billion tons of sand was used for construction worldwide. Because of economic and population growth, the demand for concrete has increased exponentially. Therefore, sand use is also increased. Sand is being extracted at a rate far greater than its renewal. Sand that is mined from the river, will never reach the sea. This is cause for concern, because we need good coastal protection with rising sea levels. It also disrupts the river's ecosystem.

Reducing the sand consumption is one of the solutions to solve the shortage problem. This can be done by recycling glass, urban mining, using alternative materials and expending the lifespan of buildings. Another solution would be to establish international rules on sand mining, an example could be sand taxes (GEAS, 2014).

In figure 14, the sand mining companies located in the Netherlands are visualised.

Figure 14, Map showing sand mining companies within the Netherlands. Made by authors based on (Stichting LISA, 2019 & CBS, 2019c)

CONCRETE

Concrete is a building material consisting of an aggregate (made from sand and gravel) bonded together by cement and water. Portland cement is frequently used in the manufacturing process of concrete building materials, as this type of cement is extra strong. Different from other cement types, Portland cement is being made by burning ground limestone and clay together. By doing this, the cement is a lot stronger than using only crushed limestone. Unfortunately, this also makes the process very energy intensive and atmosphere polluting (Babor, Plian & Judele, 2009).

With 2.1 Mton, concrete is the largest raw material flow within the construction sector of the province Zuid-Holland. Almost this entire flow is used to construct new homes and buildings. When these buildings get demolished, the concrete is mainly downcycled. The concrete is then used as a highway substrate or as a clean fill around buildings (Roemers, van Raak, van Exter, Marseles, 2018).

To minimize environmental impact of the construction sector, the use of concrete should be reduced. The lifespan of current concrete building or building elements should be expanded. For construction, alternative materials should be explored.

In The Netherlands, cement is being imported (Wentink, 1995). As shown in figure 16 on the next page, many of the manufacturing companies of sand and concrete are linked to the river. This is partly because they use the river for transhipment. In figure 15 below, the flow diagram is visualised.

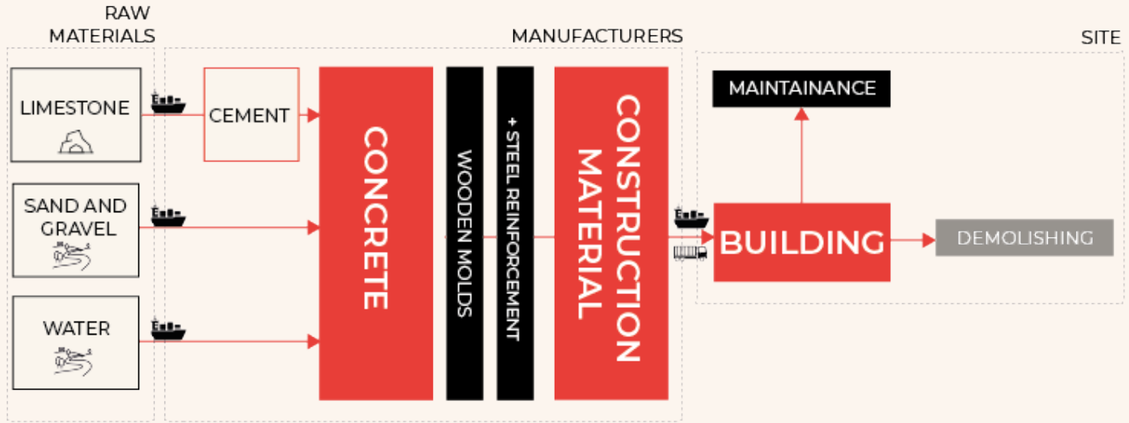


Figure 15, systemic diagram flow concrete

LEGEND

Areas with highest housing demand and capacity

Manufacturing company; concrete

Sand mining company

*No flows have been included in this map, because of the complexity

Figure 16, Map showing the geography of sand. Made by authors based on (Stichting LISA, 2019 & CBS, 2019c)

BRICKS

Brick is after concrete and steel the most commonly used construction material in The Netherlands. It accounted for 645 kilo tons of material being used in the construction sector of The Netherlands in 2014 (Arnoldussen et al., 2020). Though there has been a shift from being a load bearing material for centuries to a material that is mostly used as a surfacing material, it still characterises the Dutch built environment (Stenvert, 2012).

The main raw material used to produce bricks is clay. In The Netherlands the largest factories are located along the bigger rivers, such as the Meuse and the Rhine, as these are the locations where most of the clay is located (Landschapsbeheer Nederland, 2005) and thus extracted from the ground. An overview of the clay grounds and the biggest factories can be seen in figure 18 on the next page. The factories are always located on the side of one of the extraction locations and thus is there no real transport between extracting location and production location. Clay is a renewable source if managed accordingly and the extraction of clay plays an important role in the floodplain evolution along the Rhine and Meuse. Clay is renewable because of the constant accretion of sediment (van der Meulen, Wiersma, van der Perk, Middelkoop, & Hobo, 2009). The process of making the bricks is where it gets less sustainable. One of the other main ingredients is sand, which as explained in previous paragraphs has a big environmental impact. Besides that the baking of bricks has to happen with extremely high temperatures by using gas burners (Engels Baksteen, n.d.) In figure 17 below, the flow diagram is visualised, showing the current production process.

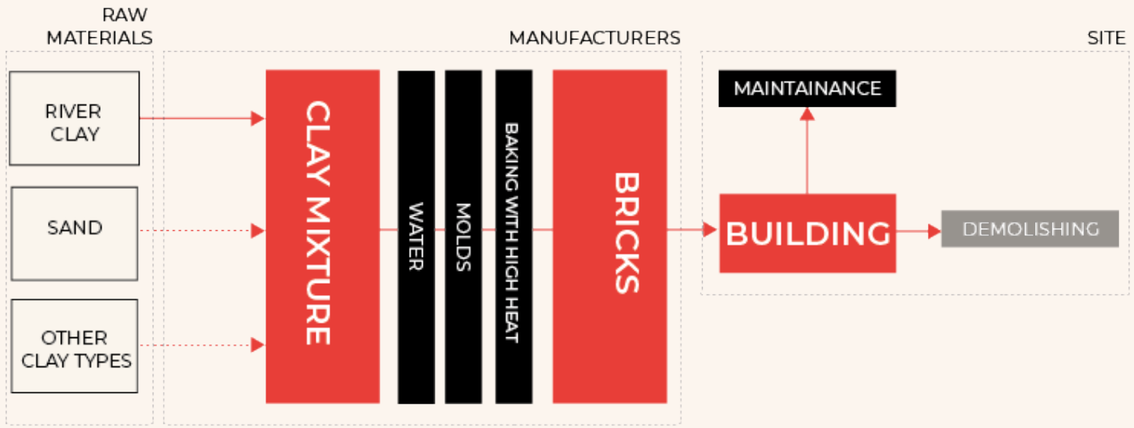


Figure 17, systemic diagram flow bricks

Figure 18, Map showing the geography of flow of bricks. Made by authors based on (Stichting LISA, 2019 & CBS, 2019c)

STEEL

The production of steel has a big environmental impact. The raw materials for making steel are predominantly iron ore, coal, and recycled steel. The raw iron ore is mined all over the world and is the third most produced commodity by volume (World Steel Association, 2018). The mining of iron ore is highly energy intensive and causes a lot of air and water pollution. After iron ores are mined, they are reduced to iron. It is being transported to the steel companies after which the iron is converted to steel in blast furnaces of steel companies. Steel in the Netherlands is made in the blast furnaces of Tata steel in IJmuiden after the iron ore is imported from all over the world, see figure 20 on the next page. The key figures in the sustainability report of Tata steel in 2020 state that Tata Steel in the Netherlands produced 6.62 million tonnes of crude steel in that year (Tata Steel Europe, 2020. p.16). Half of this is used in the construction sector.

The manufacturing of steel from the mined ore is the most energy-consuming and CO_2 emitting industrial activity in the world, using 2.0 GJ of energy, (World Steel Association, 2018) and emitting 1.98 tons of CO_2 per produced tonne of crude steel (Tata Steel Europe, 2020. p.16). Next to this, steel production requires large inputs of cokes which is extremely damaging to the environment (World Steel Association, 2018). In figure 19 below, the flow diagram is visualised, showing the current production process of steel.

However, from all construction materials, steel has the highest residual value (Drift & Metabolic, 2018). With its magnetism, steel is easy and affordable to recover from almost any waste stream. It can easily be recycled and therefore almost all available steel scrap is recycled. In this process the recycled steel maintains the properties of the original steel and these can be modified during the steelmaking process to create the many steel grades available. The quality of the steel product can be improved on recycling and the high value of steel scrap ensures the economic viability. Although all available steel scrap is recycled, there is not enough scrap available to meet demand for new steel products.

Next to this steel's durability enables many products to be reused at the end of their life. As well as extending the product's life cycle, reuse avoids the need to transport and re-melt the steel, and to create new products.

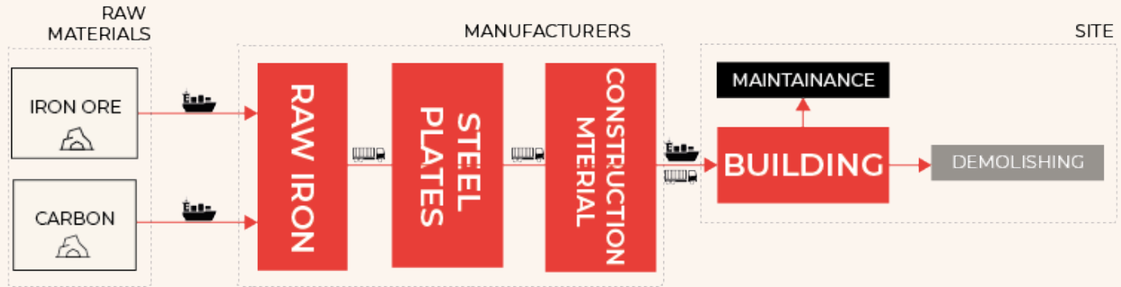
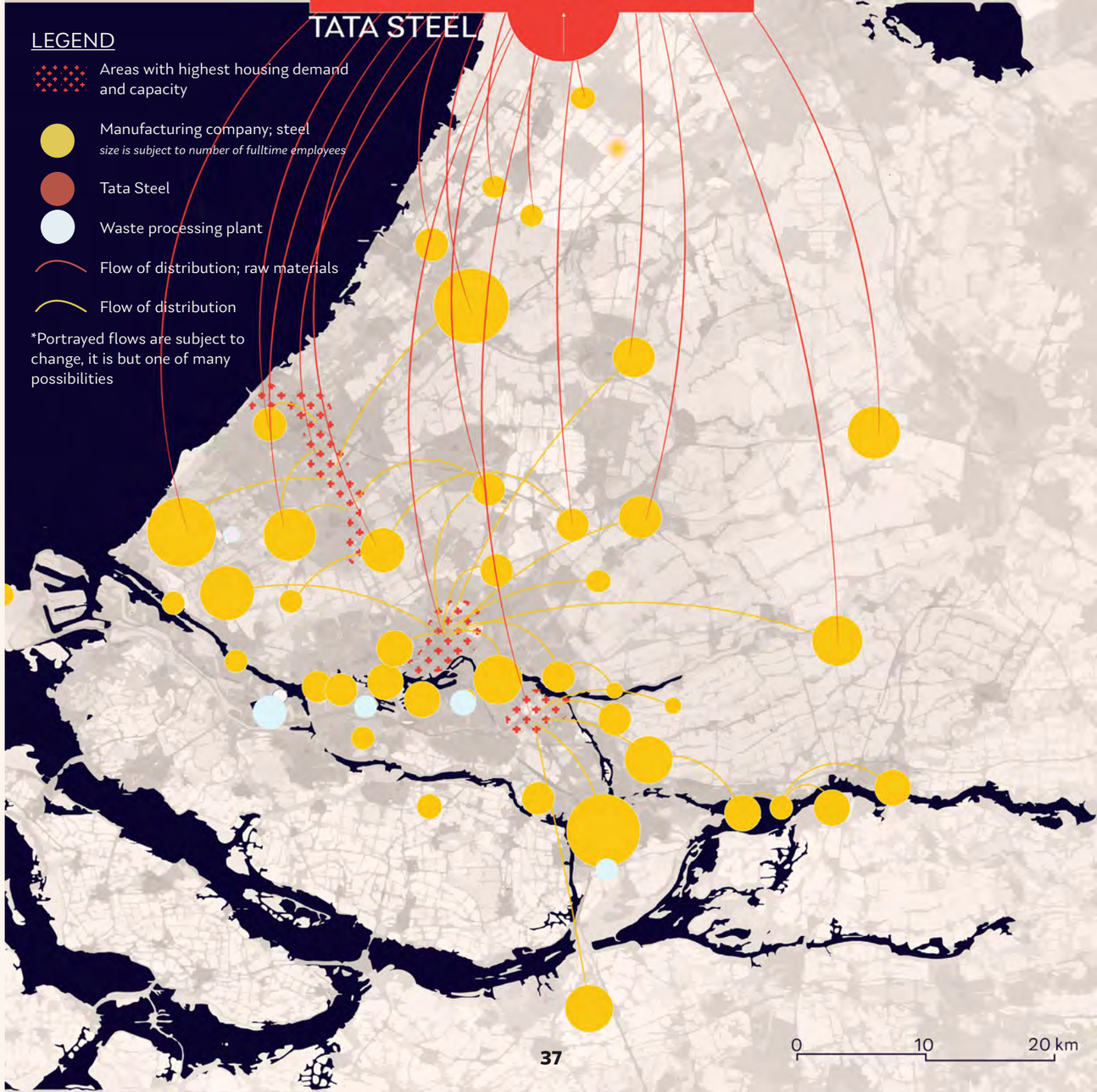


Figure 19, systemic diaram flow steel



> Figure 20, Map showing the geography of steel flow. Made by authors based on (Stichting LISA, 2019 & CBS, 2019c)

CLT

CLT stands for cross laminated timber. This is a wood panel product made from glueing together layers of wood, alternating the directions of grains. This results in a higher structural rigidity in both directions and it is flexible in its application. It can be used for roofs, walls and floors, as a panel or as a beam (NIBE, 2019). In figure 21 below, the flow diagram is visualised, showing the current production process of CLT.

Already, high rise buildings are being constructed with CLT, setting an example for how it could be an alternative for the traditional building materials (Mulder, Muricy, Commu, & van Mil, 2021). Because wood is a renewable source and the production of CLT does not cause much emissions, it is definitely a more sustainable option. At the moment CLT is mainly produced in Germany, Austria and Switzerland. In the Netherlands no CLT factory is located yet, as can been seen in figure 22 on the enxt page (Studio Marco Vermeulen, 2020). This is because there is not that much forest in the Netherlands, but also because there is not a large demand yet. Building with wood is still seen as experimental in the Netherlands (NIBE, 2019). However there are definitely options to expand this sector, forests could be planted, especially in the south and east of the Netherlands (Studio Marco Vermeulen, 2020). However, the province of Zuid-Holland will always remain reliant on the rest of Europe to provide CLT and wood, simply because there is not enough space and forest to grow it here (Studio Marco Vermeulen, 2020).

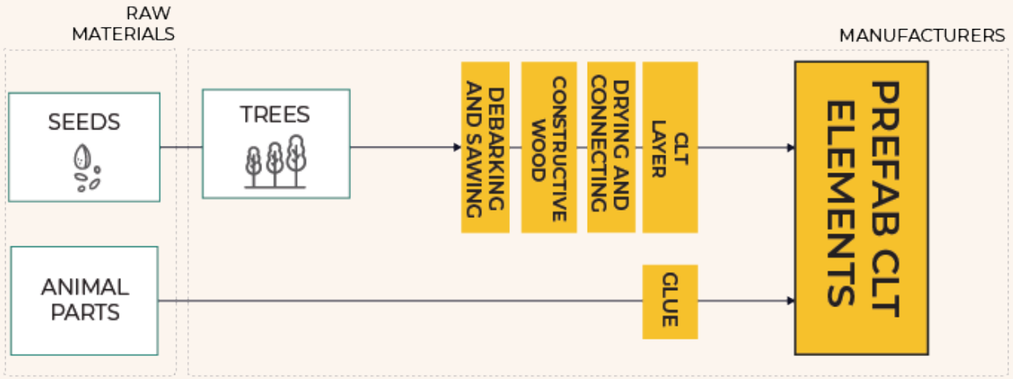
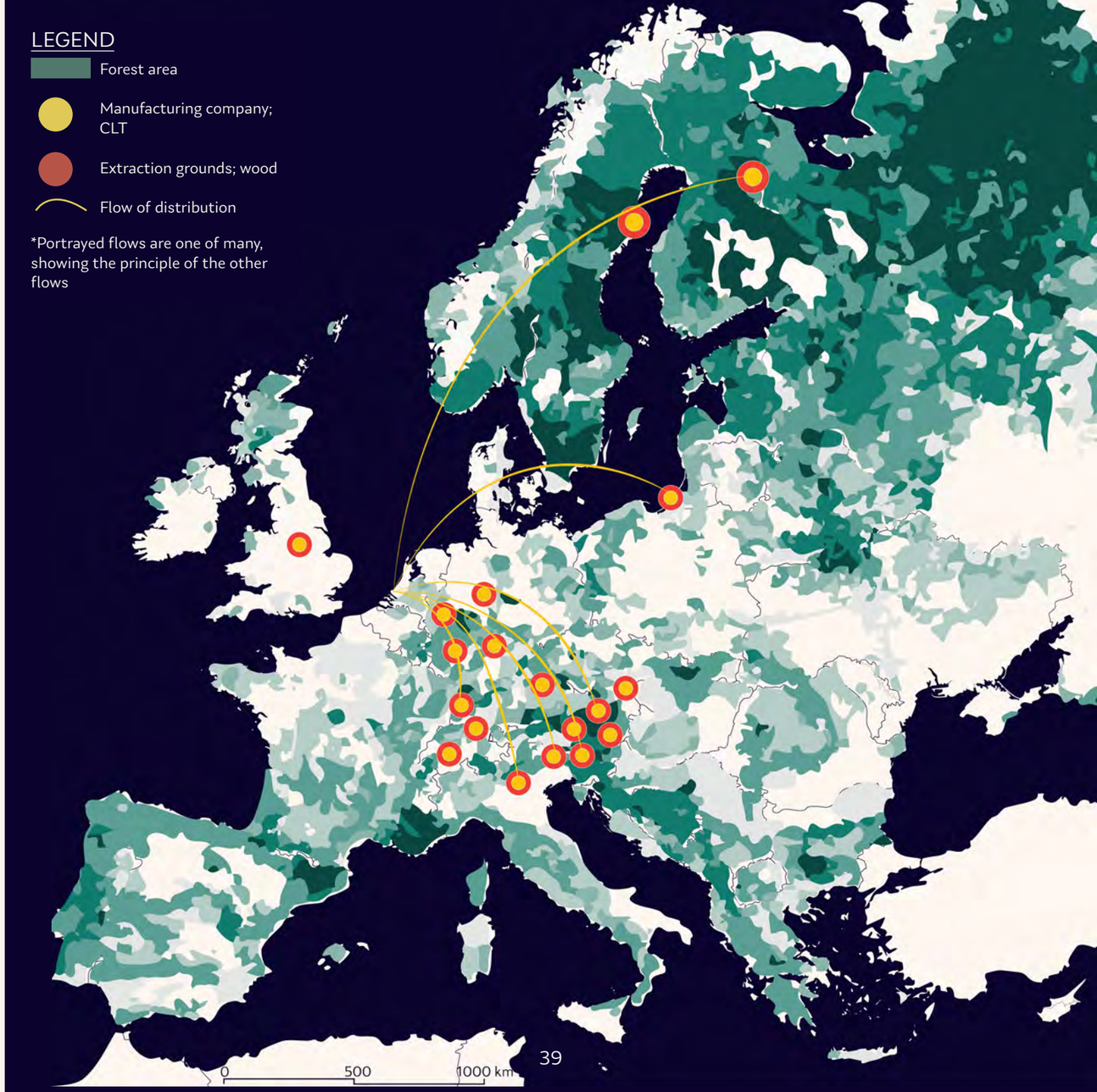


Figure 21, systemic diaram flow CLT



> Figure 22, map showing the geography of CLT flow. Made by authors based on (Studio Marco Vermeulen, 2020)

BIO-BASED MATERIALS

Another alternative worth exploring are bio-based materials. At the moment only 0,1% of building materials used in the Netherlands is bio-based (wood excluded). The most used bio-based material is reed, because the Netherlands has a tradition of thatching roofs with reed (NIBE, 2019). But reed can also be used as a base for a reed-clay construction (Mulder et al., 2021). However there are many other materials, with many applications. For example hemp, known for its recreational use, als has many other applications. The stems from the plant are very strong and could be mixed with limestone and water to create hempcrete. It can be made in bio-bricks, prefab elements or be mixed on site. It does however always need some sort of wooden support. The fibers can be made into insulation blankets. The same goes for the fibers of flax, which can also be used for insulation. The stems can then be compressed and mixed with resin to make boards out of. These can be as a finishing material, to make doors, worktops, kitchens etc (Grow2Build, 2015b).

At this moment, bio-based materials like flax and hemp are barely being produced in the Netherlands, as can been seen in figures 23 and 24 below.

Another interesting material is straw. This is a by-product of the production of grains, which is then dried. It can then be compressed and made into bio-bricks or used to fill in wooden frames on site. It can also be made into prefab panels (Mulder et al, 2021). In figure 25 on the next page, flow diagrams are visualised, showing the current production process of these different bio-based materials.

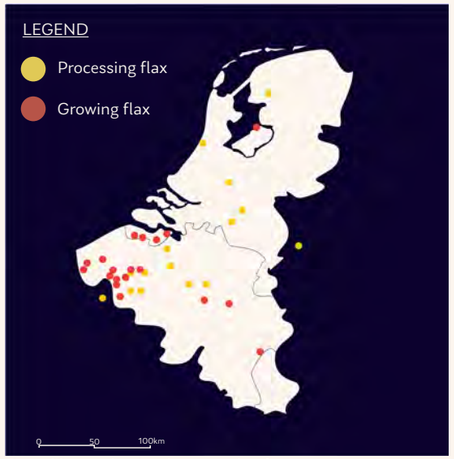


Figure 23, map showing the geography of flax flow. Made by authors based on (Studio Marco Vermeulen, 2020)

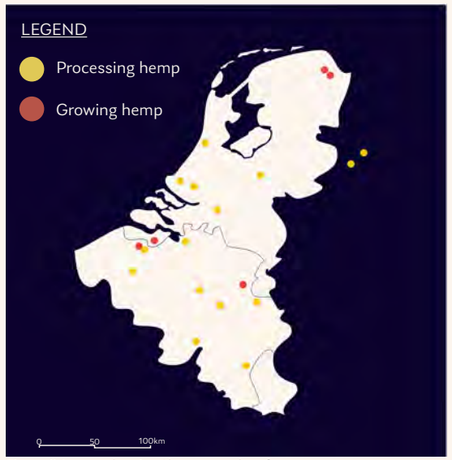


Figure 24, map showing the geography of hemp flow. Made by authors based on (Grow2Build, 2015a)

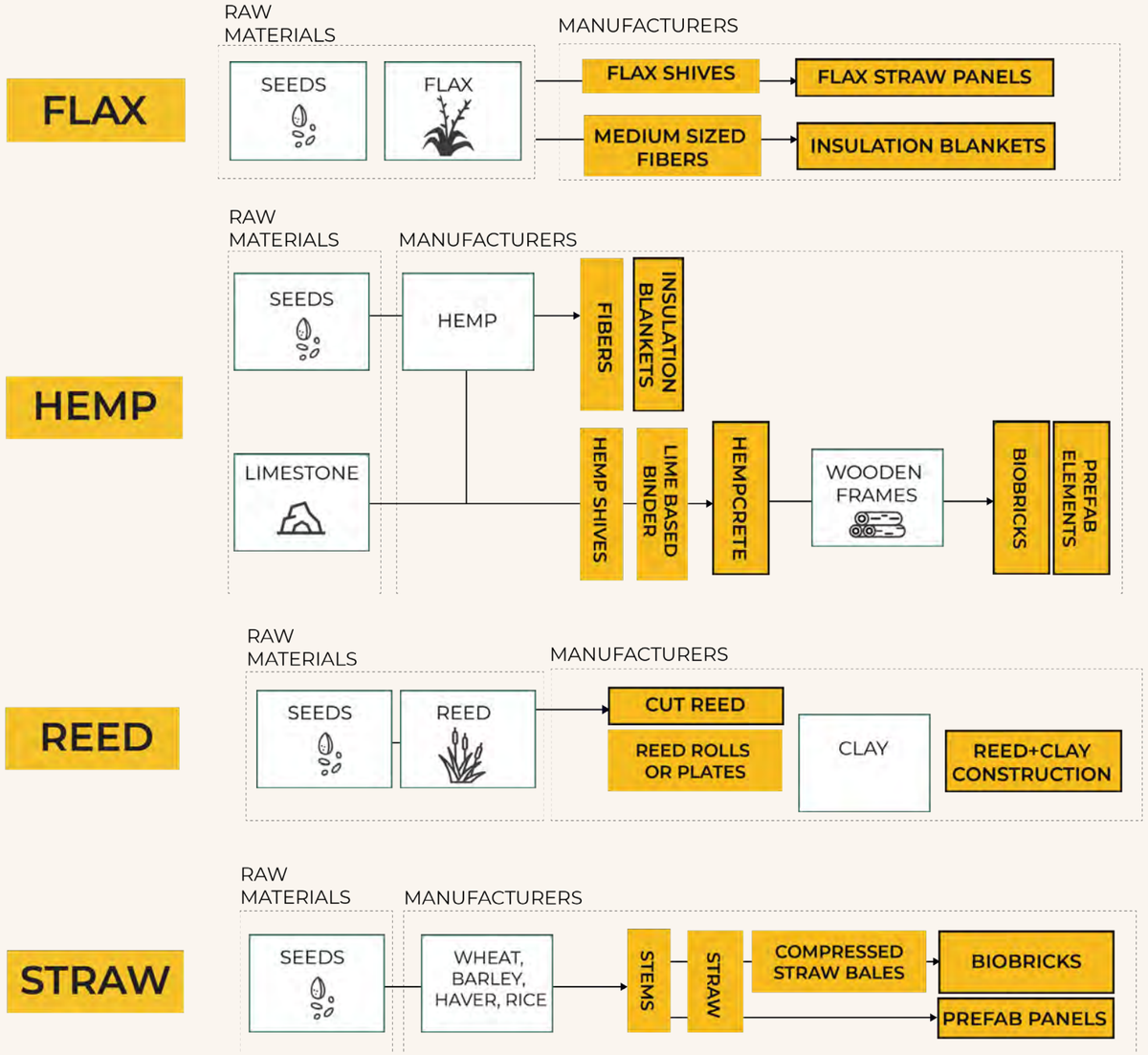


Figure 25, systemic diaram flow of flax, hemp, reed and straw. Made by authors based on (Grow2Build, 2015a)

2.1.2 Deficiency of Current System

The current system is visualised in the systemic section in figure 26 below, and the current flow diagram in figure 27 on the next page.

As explained in the previous paragraph, bio-based materials take up such a small percentage n the current system, that they cannot even be mentioned in both figures.

The figures also show that the raw non-renewable materials used for construction are either imported through the Port of Rotterdam, or mined at the rivers.

Right now, every material has its own flow of distribution, showing a missing link between the different flows.

Globally the construction sector accounts for 6% of global energy use and nearly 11% of energy-related CO2 emissions. In the Netherlands, it is responsible for 50% of all waste produced (Block et al., 2020).

In the current system, when a building's life comes to an end most of its materials are sent to landfill, incinerated or downcycled into products of much lower value. This is a major loss of valuable materials as concentrations of elements in anthropogenic stocks are often comparable or even higher than natural stocks (Koutamanis, van Reijn, & van Bueren, 2018). This is making the current construction process a linear one.

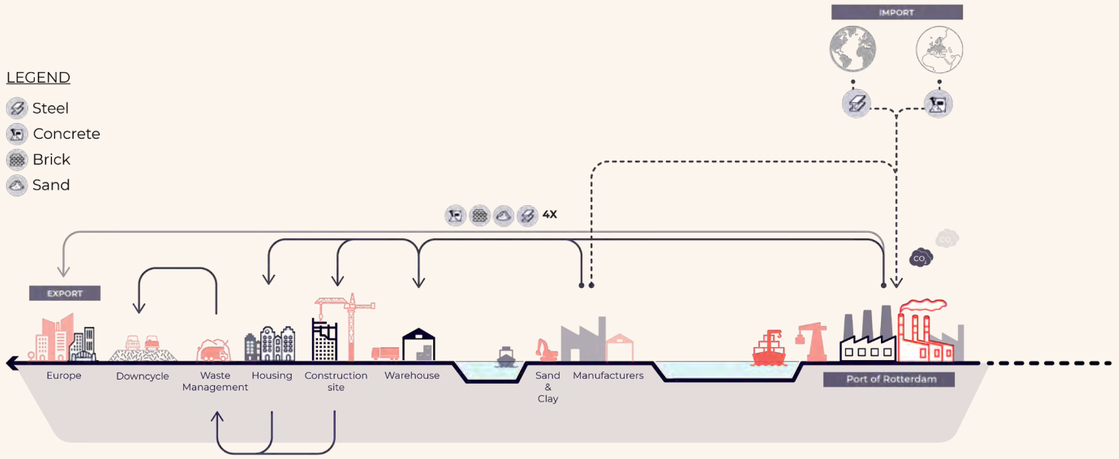


Figure 26, current systemic section

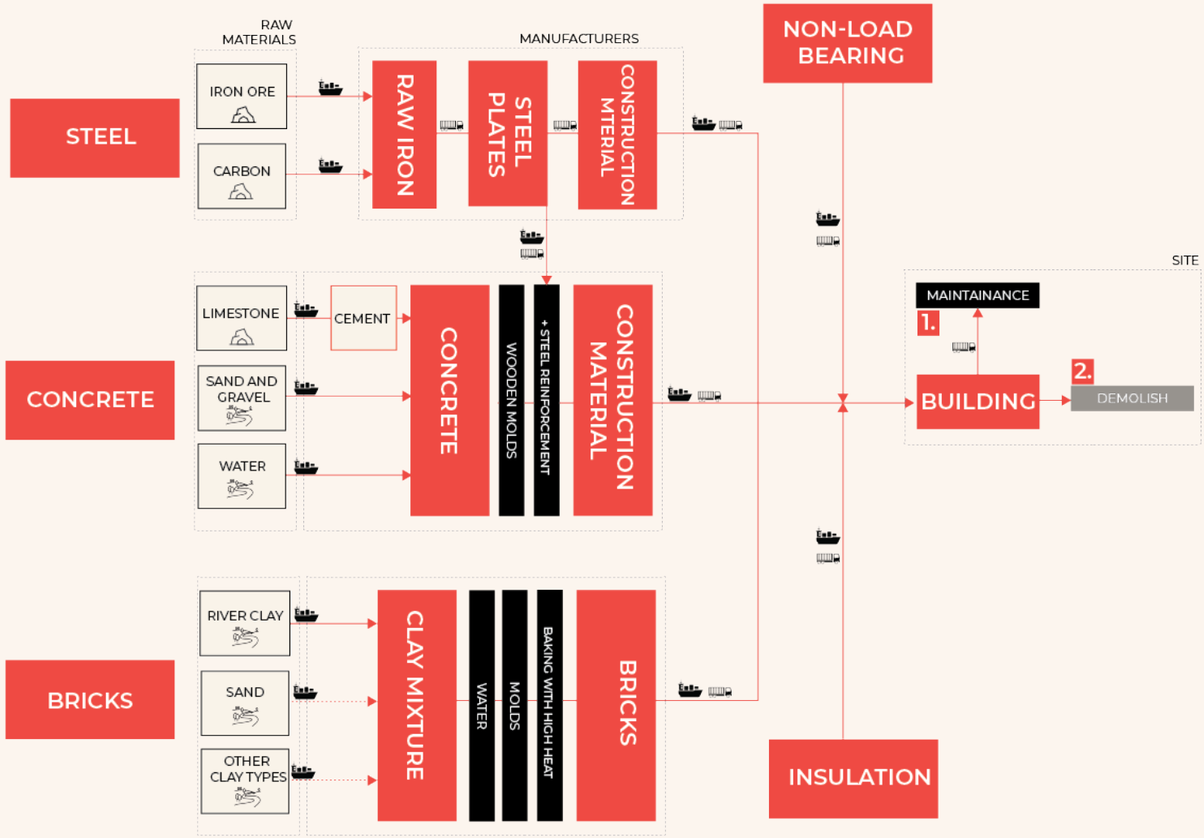


Figure 27, diagram current system

2.1.3 Trends in Resources and Flows

The IRP forecasts that by 2050, the use of materials is accelerated to an amount between 170 and 184 billion tonnes (de Wit et al., 2018. This expactation is shown in figure 28 below.

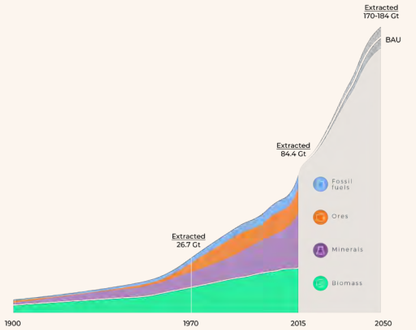


Figure 28, Expacted acceleration of material use by 2050, (de Wit, Hoogzaad, Ramkumar, Friedl & Douma, 2018, p.11).

Although consumption has improve human well-being, the consequences of anthropogenic activities in ecosystems show to be irreversible and fast-growing. Even with increased environmental awareness, resources are being consumed 50% faster than they can be regenerated (Bender & Bilotta, 2019).

This is where new trends like urban mining, material passports and modular building design can play an important role to achieve a circular construction sector.

Urban mining

On the one hand, urban mining is the process of recovering and reusing a city's materials. These materials may come from buildings, infrastructure, or products that have become obsolete. It is essentially about using so-called 'anthropogenic material stocks' to reclaim raw materials (Becker & Schebek, 2017). See figure 29 for the method of recycling for the materials most used in the construction sector. The construction and renovation of buildings in the Netherlands results in an annual demand for 17 million tons of materials, most of which is concrete, followed by steel, bricks and wood. With only 13% of these input materials coming from secondary and renewable sources, it is still largely a linear system (Blok, 2021). Although most of what is demolished is recycled (88% of the 7 million tons of construction and demolition waste), most of this is downcycled, meaning the material loses value and it is primarily used outside the sector meaning only a small amount of construction and demolition waste goes back into buildings (Blok, 2021).

In the Netherlands in 2010, the total waste from construction and demolition amounted to 24Mt (Koutamanis et al., 2018). In a fully circular economy, raw resources and existing products are utilised and, wherever possible, reutilised as efficiently as possible. This may be achieved, for example, by extending the lifespan of products and spare parts, by redesigning products and by recycling (CBS, 2019a). Reusing these millions of tons of materials for new construction projects offers even greater environmental advantage than recycling since there are very few environmental impacts associated with reprocessing. It would shorten supply chains, increase resilience, and maintain as much value as possible from these materials, for as long as possible instead of putting it to inferior uses or depositing it on space-consuming

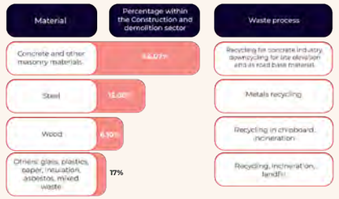


Figure 29, Urban Mining, made by authors based on (Koutamanis, van Reijn, & van Bueren, 2018)

dump site (Koutamanis et al., 2018). However, this calls for far-sighted strategic planning. As building materials are locked into buildings for very long periods of time, the planning challenges are very

different to the ones we face when collecting and recycling household waste (Becker & Schebek, 2017). Therefore, there are many barriers to the more mainstream reuse of construction components and urban mining, which mostly have to do with logistics, the demand for reused materials, and perceived performance. Also, there are a couple of technical barriers such as the lack of standardization of components, a lack of detailed knowledge of the product's properties and history, in addition to a lack of storage space for recovered products and the fact that manual deconstruction has much more risk for the health and safety of the workers than mechanical demolition techniques (Hobbs & Adams, 2017). Yet the most important barrier to tackle is the lack of information on what harvestable materials are present and what their value in reuse could be (Blok, 2021).

Material passports

If the region wishes to upscale urban mining, the first step for cities and regions is to map all the valuable materials that exist in the area. A material database is needed also as part of the open source platform for construction companies, the government and manufacturers to have material stocks information. The amount of construction also presents an opportunity to plan for the urban mine of the future, by designing for disassembly, implementing materials passports, and facilitating the future recycling of urban materials (Block et al., 2020).

A material passport is the identity of a building. Typically in the form of digital data sets, these records of exactly what materials, products, and components go into a structure, where they come from, who supplied them and their environmental impact making it easier at the end of the building's life to recover everything of value, preventing these materials from being dumped or incinerated during demolition or renovation (Dasnois et al, 2020). In the Netherlands there are already several platforms of materials databases and material passports like Madaster and EPEA.

Smart disassembly

On the other hand, as excluding waste in the system is one of the requirements for a circular system, smart disassembly is another option to expand the lifespan of materials. By designing buildings to be disassembled, building elements can be reused. A flexible, resilient, collective, spacious and infrastructural framework offers freedom and flexibility for individual design interventions. Also, new production methods and design strategies can extend the lifespan of a building by at least 150 years, in this way only the program can shift but the structure remains (Openbuilding.co, 2021). As people's housing needs are constantly changing throughout a persons' life, modular housing can play a role in keeping our housing stock up-to-date with current needs, requirements and trends. Figure 30, 31 and 32 show what modular houses could look like.

Figure 30, Smart disassemble housing, (SPACE10, EFFEKT Architects, n.d.)

Figure 31, Smart disassemble housing, (SPACE10, EFFEKT Architects, n.d.)

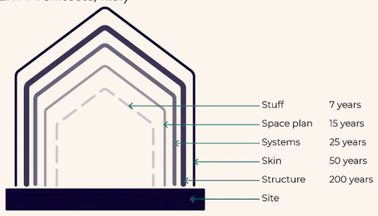


Figure 32, Shearing Layers of Change, (Pereira, Post & Erkelens, 2005, p.2899)

2.2 Social Justice

Up to this point we know that in a circular economy strategies are designed to increase resource efficiency via reducing, recycling or reusing products and materials. Yet, by considering mainly cost-effective opportunities within the competitive economic sector, it does not take into account institutional and social predispositions necessary for societal transitions towards this new economy. The distinction of noncompetitive and not-for-profit activities remains to be addressed, along with other societal questions relating to labor conditions, wealth distribution, and governance systems (Moreau, Sahakian, van Griethuysen, & Vuille, 2017).

While elevating people out of poverty is a desirable goal, even an essential outcome, the associated material use is not (de Wit et al., 2018). Growing inequality, socio-spatial fragmentation and lack of access to public goods are threats to the sustainability of our cities, especially when we consider sustainability in its three fundamental dimensions: social, economic and environmental (Rocco, n.d.). The meeting of environmental sustainability and social justice is often regrettably the meeting of unequals. Prevailing struggles over access to land, the use of natural resources, and the distribution of environmental advantages and dangers continue to emphasize social inequalities. The distributional implications that arise from the worldview shows us that just as goods and services are systematically distributed unequally, so too are environmental privileges and burden (Campbell, 2013). Consequently, the planning field, like other disciplines, runs the risk of privileging one position and marginalizing the other (Campell, 2013).

Cities are spaces where we simultaneously cooperate and compete for resources (Rocco, 2021a). Unfortunately, today's society is divided, for example in health, housing,education, and politics and this division is still growing. This makes it hard to get everyone on board to change society, to make society more equal. We are now competing for resources but we should decide together how these resources are better distributed and shared.

Urban space and the urban fabric can have an impact on the allocation and access of public goods, resources and services. To achieve a fair distribution of burdens and benefits from urban development and how this process is managed we need to take into account spatial justice, the social justice that occurs in the built environment (Rocco, 2021a)

Spatial justice aims to provide equal opportunities and fair allocation and access to public goods and resources to every citizen, no matter their gender, class or status. This process provides everyone with the ability to access educational, economic and environmental opportunities in order to have a better quality of life. Thus, spatial planning and justice is a centrally important government function as it affects the lives of all citizens. It is therefore important that planning decisions are made by authorities that are accountable through democracy.

Furthermore, spatial justice seeks to promote more progressive and participatory forms of democratic and social activism. Bottom-up approaches help to involve more voices and actors in the process. Intrinsic to this process is to involve a wide range of stakeholders that may have different agendas and goals. Planning and design can benefit from conflicts and the negotiations to resolve them. Conflicts can be used as opportunities for dialogue and consensus-building. In these dialogues, new interests or design proposals could arise and on top of that a better look into what the different stakeholders think is important will usually also show up. All this extra information gives designers and planners more insights to base their design, strategy, or vision.

In addition, participatory planning and design are beneficial for everybody and strengthens democracy: Urban planners, civil society, government, public and private sector. When civil society actively expresses their needs, concerns, or demands, the design process is enriched and takes into account this feedback to come up with a project that benefits everybody and not only a few sectors of the population. As David Harvey (2008) states, citizens have the right to belong to and the right to co-produce the urban spaces they inhabit.

2.3 Potentials of the Province of Zuid-Holland

As this report is focussing on the construction sector of the province of Zuid-Holland, this chapter is looking into the potentials of the province.

Within this chapter, the soil types, urbanisation strategy, maker industries, manufacturers and educational institutions within the province of Zuid-Holland are analysed.

PORT OF ROTTERDAM

HOUSING DEMAND

ACCES TO KNOWLEDGE

MAKERS

SOIL TYPES

2.3.1 Soil Types

As already mentioned, biobased materials could be an opportunity towards a circular construction sector. Building with CLT and other biobased materials made from plant fibers, like hemp, flax and straw, offers a lot of opportunities for prefabrication and industrialisation. This results in the fact that the assembling on the construction site does not need specialised employees (Studio Marco Vermeulen, 2020). Then again, that has the effect that the time to construct new buildings goes down, even as the amount of construction mistakes. On top of this, big waste flows are being avoided. In the strategic exploration of Studio Marco Vermeulen, commissioned by the province of Zuid-Holland, the Ministry of Agriculture, Nature and Food Quality and Ministry of the Interior and Kingdom Relations (2020), multiple other benefits and applications of biobased building are being stated.

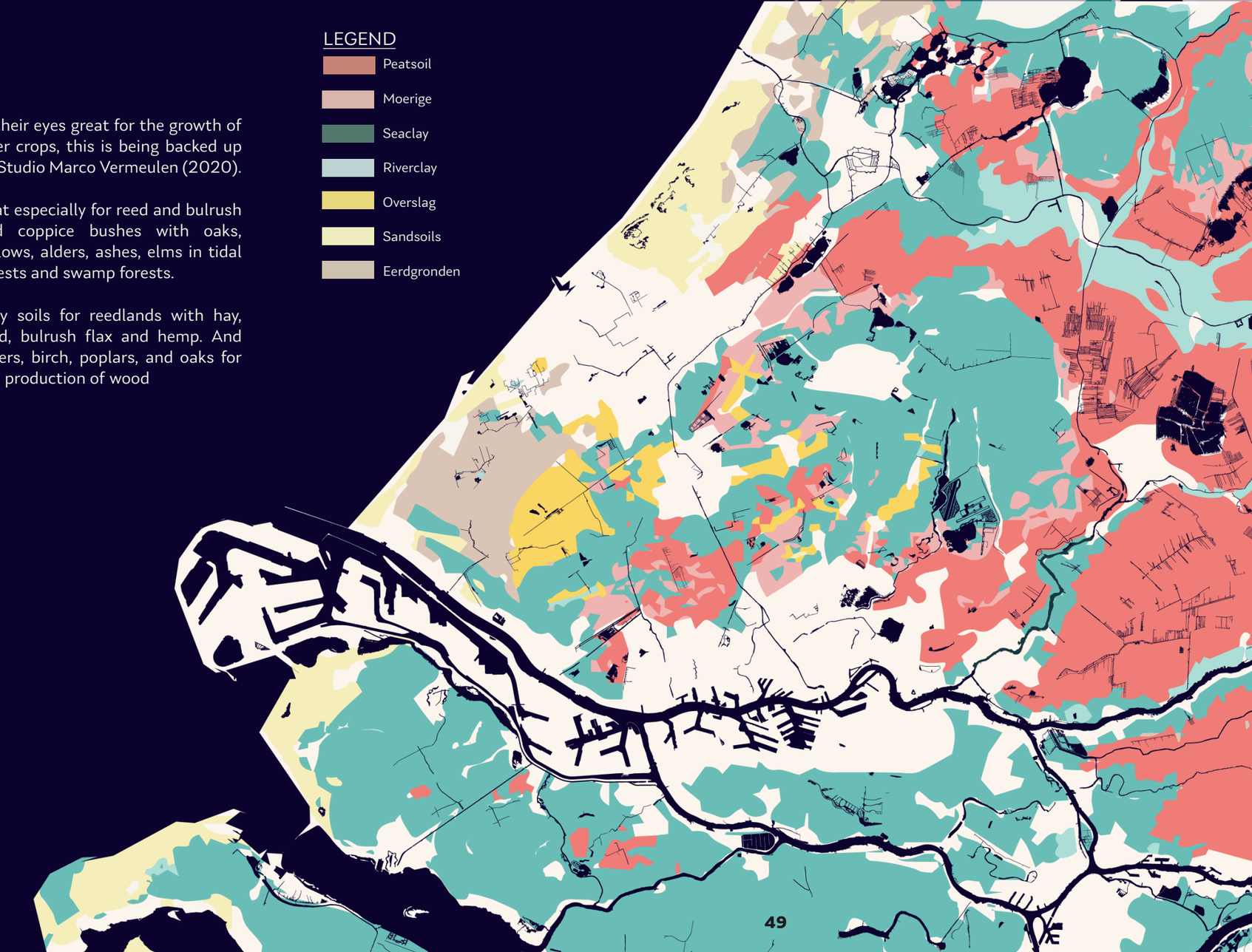
They also mention that right now the growth of the materials is mostly happening outside of the Netherlands. However, growing the biobased materials can give a positive impulse to the dutch landscape. A lot of the agricultural lands in the province are facing problems with the current production methods. They dry up, become arid, silt up, acidify and become rough. They emit CO_2 instead of fixing it (Plambeck & Wijnakker 2019). For these vulnerable areas, transformation into a production landscape for biobased materials is a good alternative.

Peat soil, for example, oxidises as it is dewatered, and is therefore not fitted for forests and agricultural land. However they are good for crops that grow where the soil is permanently wet and occasionally floods, such as bulrush. Wet it can be used as animal feed and dry as insulation and construction materials. (Studio Marco Vermeulen, 2020)

In the report of BOOM Landscape (2020), they have a look into the history of what has grown in the province and by research by design they propose new landscape ideas with returning crops. resulting in Mosaiclandscapes with agricultural land and forests, in which landscape-inclusive agriculture and agroforestry can find a place.
Especially peat and sea clay soil are in their eyes great for the growth of fiber crops, this is being backed up by Studio Marco Vermeulen (2020).

Peat especially for reed and bulrush and coppice bushes with oaks, willows, alders, ashes, elms in tidal forests and swamp forests.

Clay soils for reedlands with hay, reed, bulrush flax and hemp. And alders, birch, poplars, and oaks for the production of wood



> Figure 33, Map showing the soil types of the province of Zuid-Holland. Made by authors based on (Provincie Zuid-Holland, 2014)

2.3.2 Maker Industries

To spark the paradigm shift towards a circular construction sector, creative new actors are needed. Throughout time, three important technological shifts have taken place: First, the industrial revolution driven by the steam power, later in the 19th century, the use of electricity which enabled mass production and thirdly, the computing technology revolution that changed the way we communicate and connect. Sparking all these shifts were the makers, see figure 34 below.

Makers

As long as there have been cities, there have been Makers. The current trend shows more individuals are interested in being producers, not just consumers as the hardware and software tools needed to design and make are becoming more powerful, less expensive, and easier to use. Today, there are new ways to make things which means there are new ways to create value. Making as value creation can take place almost anywhere but increasingly, it is happening as a productive, collaborative activity in cities (Hirshberg et al., 2017)

The Maker movement is reconciling two great forces in our society: it both embraces the latest in technology and simultaneously asks what this means for people and the definition of meaningful work (Hirshberg et al., 2017).

The initiatives of makers nowadays often aim to tackle social and environmental issues that are part of the supply chain of 'making'. They are local stakeholders that work with five strategies: Make, Share, Learn, Connect and Innovate. The makers share knowledge, tools, and materials, and collaborate for and during projects. These makers could spark the next revolution needed to achieve a circular construction sector working with new technologies that bring new possibilities for the manufacturing sector. This next revolution should be about producing locally and engaging makers with their community.

Figure 34, Transition of the maker industries. Made by authors base on (NS; n.d., Mondadori Portfolio, 1925; Sorrel, 2009; RDM Rotterdam NL, n.d.)

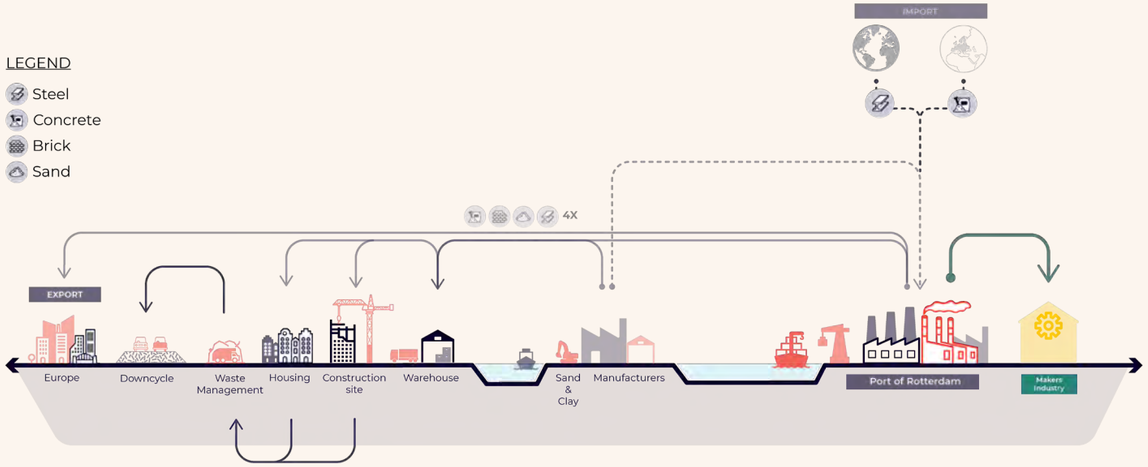


Figure 35, Systemic section involving makers

Furthermore, Makers could play a major role in education and lifelong learning. Sharing technology and production space, which is more common in makerspaces, may offer new opportunities to re-educate workers and teach contemporary skills necessary for the modern jobs. Thus, Making has become a social movement that impacts business, education, and culture. Makers should be the spark of the end of the current systemic section, see figure 35.

Makers City

Manufacturing has a significant role to play in the circular economy and contribute to closing the material and energy cycles in cities (Cities of making, 2018). This may have a positive turn for cities – with urban manufacturing helping to customize goods and technology to suit their markets and needs while managing waste and resources. A Maker City could provide access to the necessary tools required to achieve this goal in a much more democratic manner, so that all of its residents are able to learn new skills, express themselves, and become more entrepreneurial and future oriented (Hirshberg et al., 2017).

Movements have goals, and the organizational capacity to mobilize people and resources to meet those goals. Making offers value in terms of education, workforce development, innovation and entrepreneurship, advanced manufacturing, and economic development. Making can re-open the discussion about what's made in a city and how that becomes part of its present and future identity. It goes beyond the products and services offered locally and speaks also to the shared values of people in the community (Hirshberg et al., 2017).

Cities depend on having many forms of manufacturing nearby, while some manufacturers are dependent on the rich economic base provided by cities for their viability (Cities of making, 2018). In the province of Zuid-Holland, there are already districts popping up especially alongside the Schie. These makers districts are shown in figure 37 on the next page. There also is a potential in other industrial mixed use areas. However, these industries are all working on their own without sharing knowledge, resources and space. Evidence from field work found that for cities to become more circular, a productive base must be maintained and promoted (Cities of making, 2018), see figure 36. Connecting and involving the makers industries to the manufacturing companies can spark the transition. Manufacturing in or close to cities can be an opportunity to reduce the environmental impact from goods travelling long distances. It is important that these places are close to the neighbourhoods with densification potential. That makes the return of local production, together with its jobs and innovation, not only desirable but essential. The shift to re-industrialisation is not just about business. It is about jobs, material flows, local entrepreneurship, new land use and action between various stakeholders including: public services, entrepreneurs, investors, the research/design sector and local communities (Cities of making, 2018).

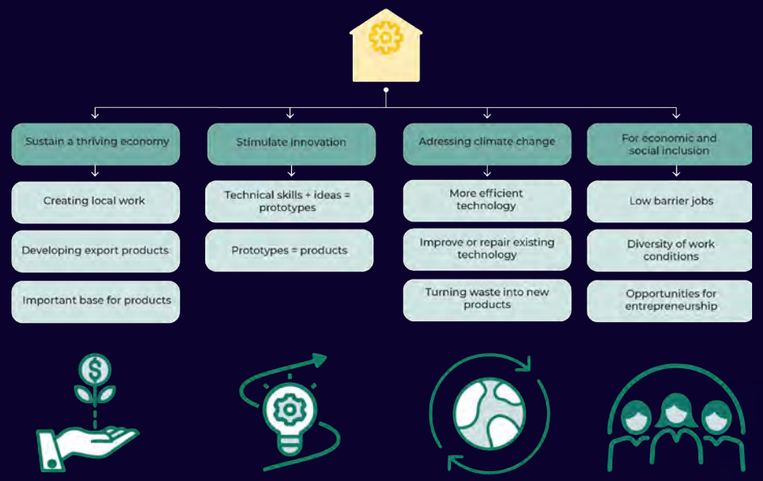
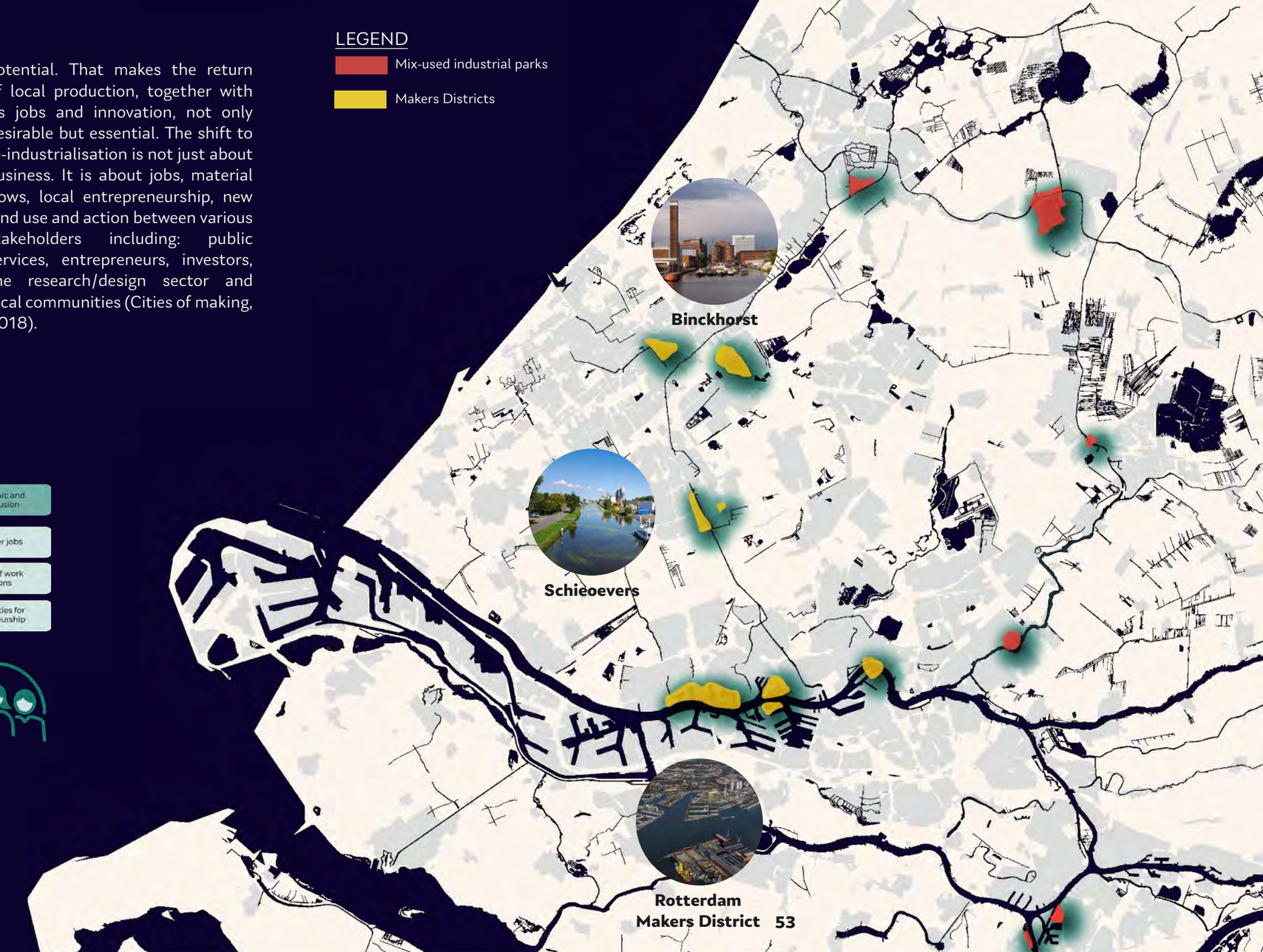


Figure 36, Makers' field of interests and their contribution. Made by authors based on (Cities of Making, 2018)

> Figure 37, Map showing makers in the province of Zuid-Holland. Made by authors based on Rotterdam Makers District, 2020 & Bijl., 2018,)



2.3.3 Urbanisation Strategy

In the past there have been several perspectives on where housing should be built. For example, from the 1960s to the mid-1980s it was believed that urbanization should be managed in a way that would relieve the pressure on large cities and counteract unbridled suburbanization. This was accompanied by major investments in public transport. From 1980 until the year of 2000, the course was almost the opposite. More attention was paid to the economic and spatial strengthening of what was already strong, which led to a revaluation of the big city and the city as a living and working environment. At this time efforts were made to densify the existing and expand neighbourhoods on the outskirts of large cities (Vinex neighbourhoods).

From 2005 there is more attention for the international competitive position of cities and there is a growing awareness that cities are not isolated, but are part of an urban network and regions. In the competitive thinking more attention is paid to the importance of attractive living and working environments and to metropolis formation and transit-oriented development. Attention is also paid to the climate. The course taken since 2005 still determines the current thinking. However, this is increasingly supplemented with attention to social inclusiveness and the major social transitions (Provincie Zuid-Holland, 2017).

In 2020 the Province made a new plan to reach the demand for 230.000 new homes by 2040: the 'verstedelijkingsstrategie 2.0' (Provincie Zuid-Holland, 2020, p.12).

It is focused on extra densification and intensification on existing urban areas. Focussed especially on post-war neighbourhoods and more mixed use areas. The post-war areas were widely designed areas with few dwellings on a big area of land and most of them are reaching the end of their life cycle. Almost all post-war districts are monofunctional residential areas, with limited space for businesses or services. To increase the liveliness, intensify the use of space and improve accessibility, living and working should be ingeniously mixed here. Next to this they identified multiple major urbanisation locations (Provincie Zuid-Holland, 2020).

In figure 38, you can see the already existing plans, the locations of post war neigbhourhoods and opportunities for mixed use neighbourhoods on existing industrial/business sites.

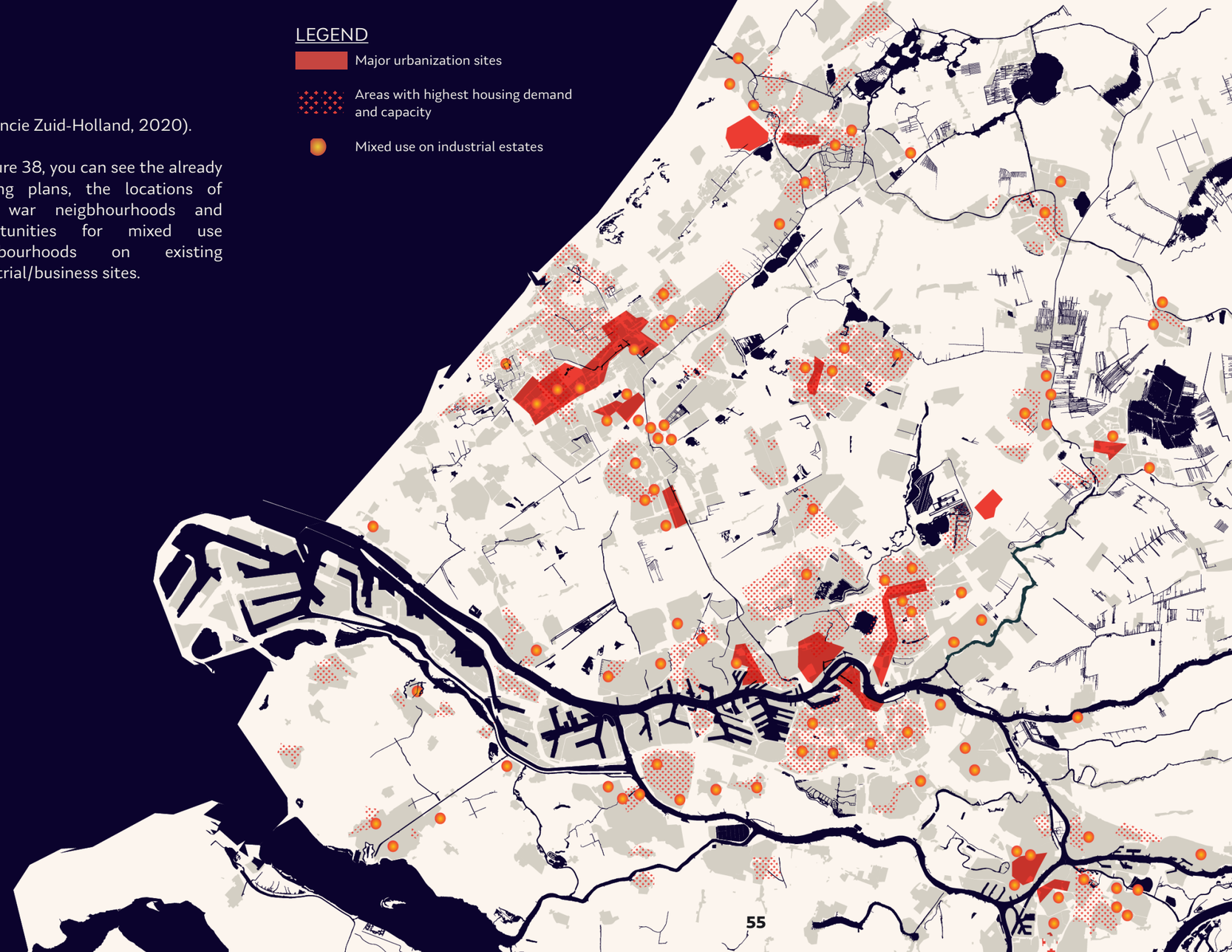


Figure 38, Map showing the urbanisation strategy of the province of Zuid-Holland. Made by authors based on (Provincie Zuid-Holland, 2020, p.12).

2.3.4 Manufacturers

Currently, there are 70,185 manufacturing companies in the Netherlands and 10% of the country's workforce – 825,000 people – works in the manufacturing industry (CBS, 2021). In Rotterdam, jobs in the manufacturing sector account for 32.3%, versus a 67.7% of jobs in the service sector. In contrast, in the larger region of Rotterdam, manufacturing accounts for 53.8% percent. (Cities of making, 2018). The Rotterdam-The Hague region supports a vast range of manufacturers from very large scale chemical refineries, to food producers, machine manufacturers to smaller-scale furniture makers and carpentry workshops and newer manufacturers are emerging through regional knowledge networks (Cities of making, 2018). In figure 39 on the next page, the urbanisation strategy is visualised.

Over the last 50-70 years, manual jobs, technical knowledge and industrial innovation capacity has moved or been pushed out of many industrialized cities. By outsourcing manufacturing out of city centers, environmental issues have been externalized while increasing emissions from long-distance transportation. Moreover, as manufacturing has become a globalised industry over the last half century, production has often been separated from other parts of the value chain, such as research and development (Cities of Making, 2018).

This represents an opportunity to re-introduce manufacturers in the city fabric in order to provide a range of different jobs, to give a push to the economy and finally for cities to be more resilient and sustainable. Equally, manufacturing needs cities for easy access to markets, for large pools of talent, and for the cross-fertilisation of ideas.

Furthermore, manufacturing in cities provides an opportunity to reduce the environmental impact from goods travelling long distances, and are a rich source of valuable secondary materials which could be used in production. These changes in manufacturing offer opportunities for social changes too. Distributed production has the potential for local ownership and involvement, something which large scale centralised production rarely does (Hill, 2020). Thus, manufacturing plays an important role in this transition.

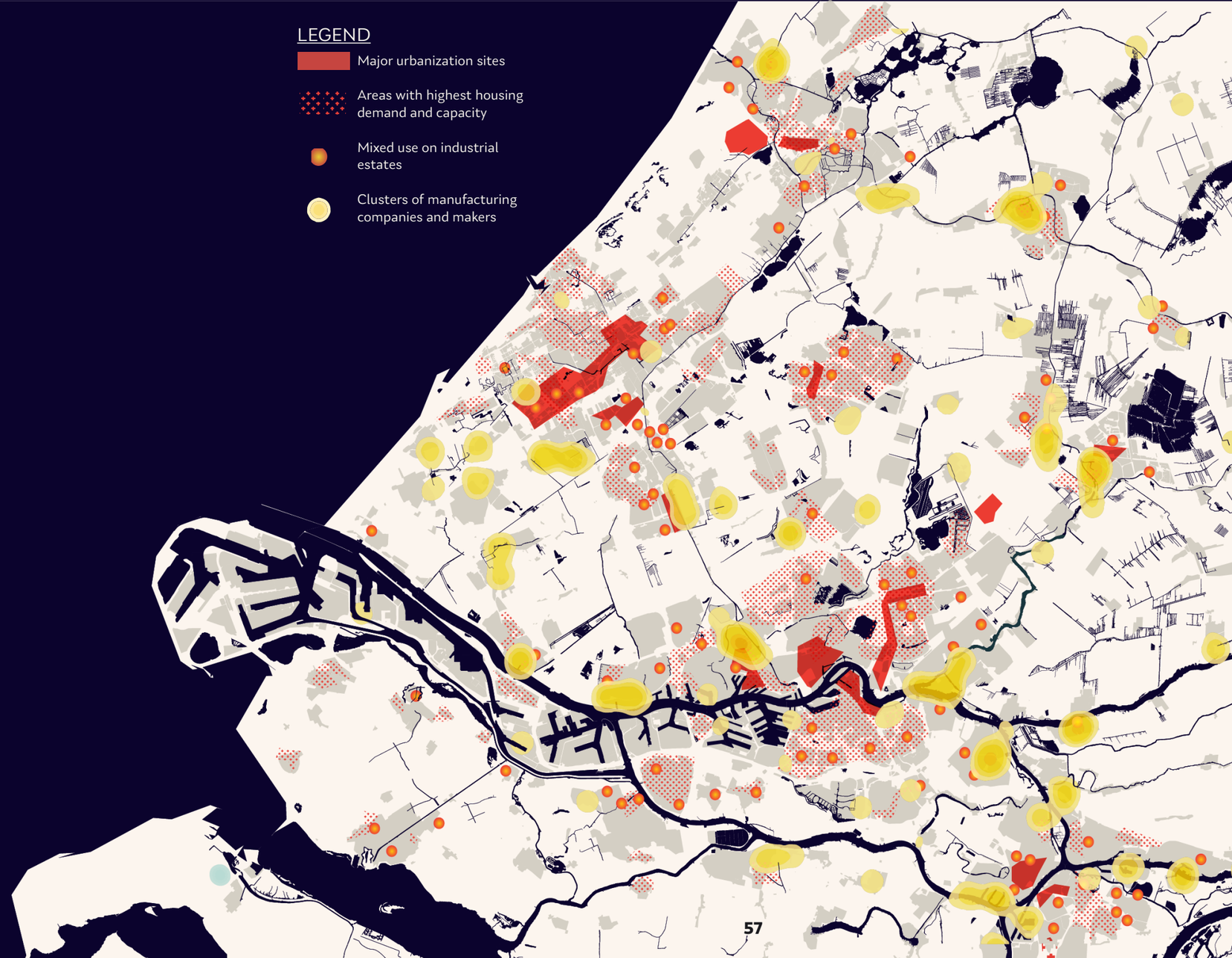


Figure 39, Map showing the urbanisation strategy and manufacturing companies in the province of Zuid-Holland. Made by authors based on (Provincie Zuid-Holland, 2020, p.12; Stichting LISA, 2019 & CBS, 2019c)

2.3.5 Educational Institutions

There is the link between research, design, testing, prototyping and education that are focused around urban areas. Universities and the general research community could support manufacturers both technologically and sustainably. In the Netherlands there is a strong focus on 'linked-up innovation' which connects researchers, knowledge institutes (like TNO and Deltares) and businesses. However, while universities and technical colleges provide training, there is a lack of flexible space and technology to bring these elements together to form an innovation driven manufacturing cluster (Cities of making, 2018).

The Netherlands performs at a high level when it comes to science, among other reasons due to the good cooperation that exists between different parties within the system. At Dutch universities and universities of applied sciences, teaching and research are inextricably linked. Their final aim is to improve understanding of the phenomena studied in the various disciplines they dive into in order to generate new knowledge. Furthermore, under the Dutch National Research Agenda, the government is committed to increase the funding that universities receive to continue doing more advanced research (Government of the Netherlands, 2019).

Therefore, we believe that these different institutions can contribute to the partnership between makers, innovation and manufacturers to the development of new skills. Research at universities of applied sciences frequently involves students and is done not just for, but also with, industry; small and medium-sized enterprises (SMEs); the city and region; partners in society; universities and institutions for applied research (TO2 institutions); and secondary vocational education (Government of the Netherlands, 2019b).

It is important to have a culture in which it is worthwhile for scientists to remain inquisitive and to seek collaboration with other parties. This strengthens the impact of science. Therefore, it is necessary to propose ways or opportunities for knowledge transfer. Alongside education, this can be done through start-ups, existing organizations and sharing knowledge with society as a whole (Government of the Netherlands, 2019).

As shown in figure 40, there are different types of educational institutions located in the region; technical secondary education institutions(MBO),higher vocational education institutions (HBO) and universities. As visible in the map, the institutions are also situated around the areas with densification potential. The clustering of the areas with densification potential, manufacturers and educational institutions shows a link to the water. These clustered areas could be used to bridge the missing link.

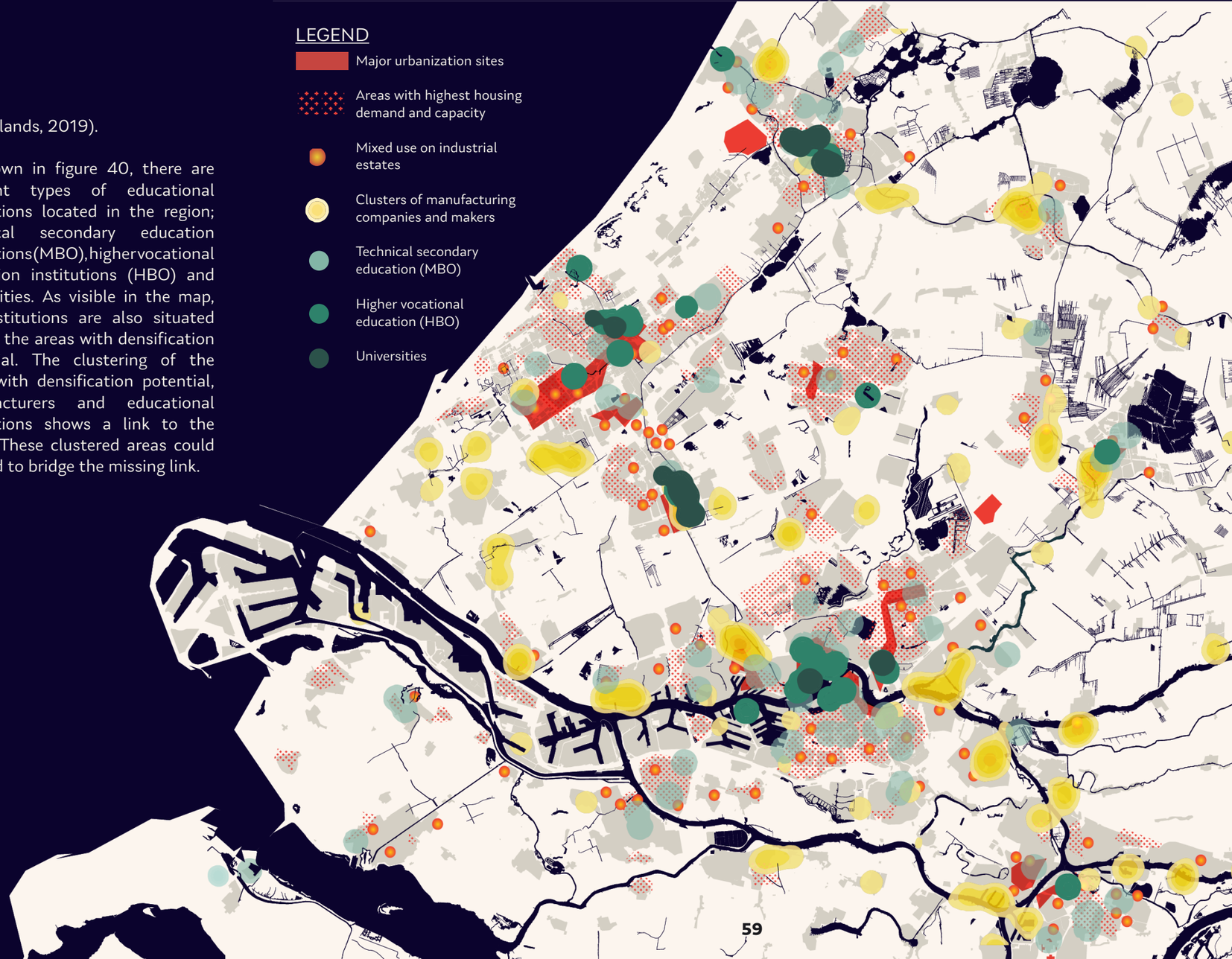


Figure 40, Map showing the urbanisation strategy, manufacturing companies and educational institutions in the province of Zuid-Holland. Made by authors based on (Provincie Zuid-Holland, 2020, p.12; Stichting LISA, 2019 & CBS, 2019c)

2.4 Waterscape

2.4.1 Heritage of the Waterscape

For centuries the Dutch waterscape has been involved in the transportation of people, materials and goods, and therefore in the development of the Netherlands. With sailing ships, barge services, steamboats, motorboats or containerships using the waterscape has always been the most efficient and cheap way for transshipment of materials used for construction. It has been supporting economical and population growth during multiple transitions, such as the Golden Age and Industrial Revolution (Ministerie van Verkeer en Waterstaat, 2010). Since the founding of the port in Rotte-dam in 1250, the port developed to be the world's largest port in 1966, and maintained this position up to 2004. The Port of Rotterdam has set the goal to be completely CO_2 neutral in 2050, following the Paris Climate Agreement (Gemeente Rotterdam, Provincie Zuid-Holland, Port of Rotterdam, Rijksoverheid & Deltalings, 2019). For this to happen, the port has to transition again.

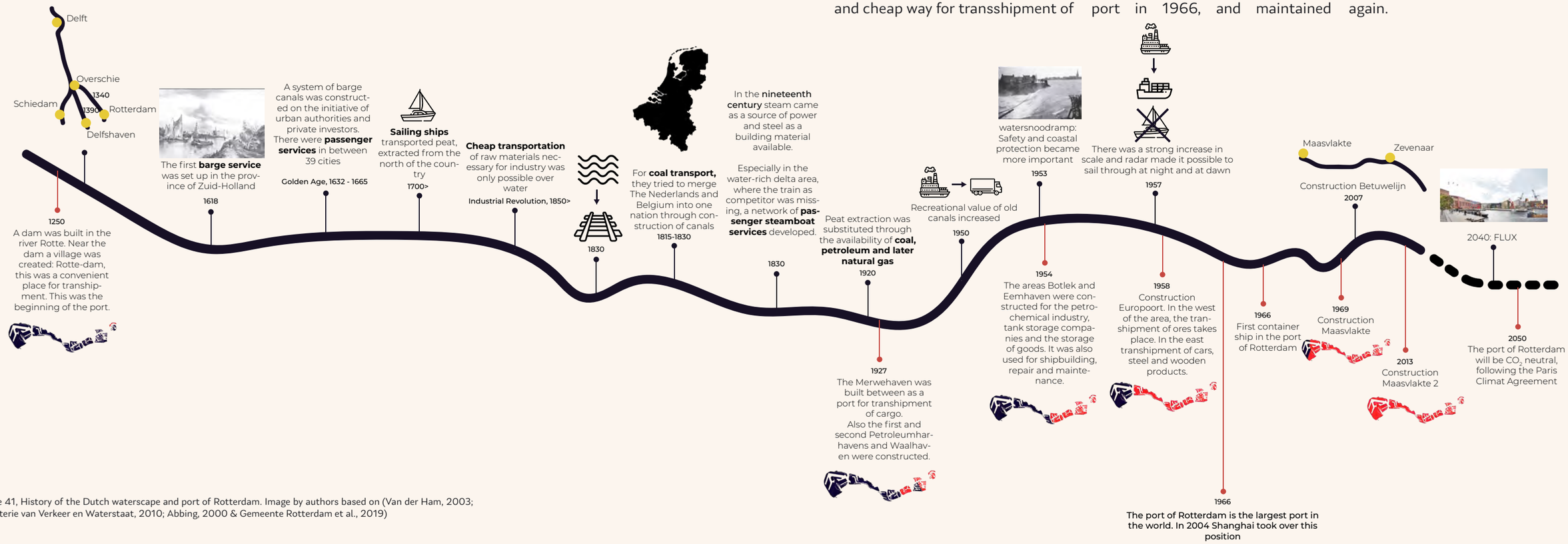


Figure 41, History of the Dutch waterscape and port of Rotterdam. Image by authors based on (Van der Ham, 2003; Ministerie van Verkeer en Waterstaat, 2010; Abbing, 2000 & Gemeente Rotterdam et al., 2019)

2.4.2 Current Waterscape

The waterscape in Zuid-Holland consists of three main categories: agricultural & natural landscape, industrial sites and urban areas. These different categories are visualised in figure 43 on the next page. Now, the different categories are alternating with each other, they are very separated.

The agricultural & natural landscape is always located in between the cities. In these areas farms are frequently linked to the water. As the soil alongside the waterscape is very suitable for agriculture, meadow cultivation and the growing of fruit, the farms are using the waterscape for their manufacturing process (Van Loon-Steensma, 2011 p.50).

Industrial sites are mainly located near the waterscape, as the industries use the water network as their main method of transportation. The waterscape functions as a binding factor for the industry, however these sites are frequently forming a barrier between housing and the waterscape, causing inacessability for living near the water. Now that old industrial sites are losing their original function, this typology can be re-thought (van Dijk & van Gelder, 2012).

For accessibility reasons, early city settlements are frequently characterized by their location linked to a river. Therefore, the waterscape is included in many urban areas (Rutte, 2005 p. 73-90).

In 1996, the water management policy 'Ruimte voor de Rivier' ('Room for the River') aimed to provide the rivers with more space. As the Netherlands is facing a demand for housing, the need of space for water and housing is putting pressure on the available space. Multi-usage of space, with regard to housing and water, can be a solution in this conflict of space (Schuwer, van der Knaap, & Roijackers 2007).

A symbiosis of the categories is therefore needed. This symbiosis will result in a new urban typology, the Circular Neighbourhood, as shown in figure 42 below.

Within the Circular Neighbourhood urban areas and industrial sites are combined and linked to the waterscape. Apart from this, the neighbourhoods will be located near to the agricultural & natural landscape. By rethinking typologies, the symbiosis will add spatial qualities to the neighbourhood. The riverfront will give a new identity to the urban areas.

In order to improve the spatial qualities, activity should be created along the riverfront. To attract users, the riverfront should fulfill the users needs and comfort, and should be approachable for all (Hussain, 2006).

By doing this, an attractive living environment will be created where housing, educational institutions, manufacturing, makers, and farming come together.

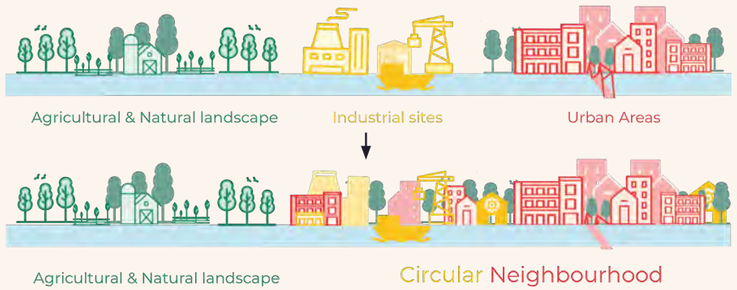


Figure 42, The symbiosis of different categories, forming the Circular Neighbourhood

> Figure 43, Map showing the urbanisation strategy, manufacturing companies and educational institutions in the province of Zuid-Holland.
Made by authors based on (Google, n.d.d; Stichting LISA, 2019 & CBS, 2019b)

0 10 20km

2.5 Bridging the Missing Link

The province of Zuid-Holland has set the goal to have a circular economy by 2050 (Drift & Metabolic, 2018). This now goal seems to be ambitious. Figure 44 below shows the missing link between the expected to be feasible change and the change needed to achieve this ambitious goal (Thöle, 2021).

To bridge this missing link, a transition is needed. For this to happen, regional design is necessary.

The previous chapters have shown that the province has a lot of potential. The waterscape has been used for transportation throughout Dutch history. The canals made the transportation of materials most efficient and thus cheap. The waterscape supported various transitions, and therefore it could support yet another transition.

Apart from the good functioning of the current waterscape, a lot of manufacturing companies, maker industries and educational institutions are clustered within the province. As we need knowledge, innovation and manufacturing for the flux to happen, these companies and institutions are key players in the new transition. The areas including those companies and institutions are all located near the waterscape, and near areas with housing demand.

As stated in the problem statement, the province of Zuid-Holland has a huge housing demand. The load of this demand can be the beginning of a circular construction sector.

Therefore, the waterscape within the province of Zuid-Holland, and the locations surrounding it, are part of the missing link. These lcoations are highlighted in figure 45 on the next page.

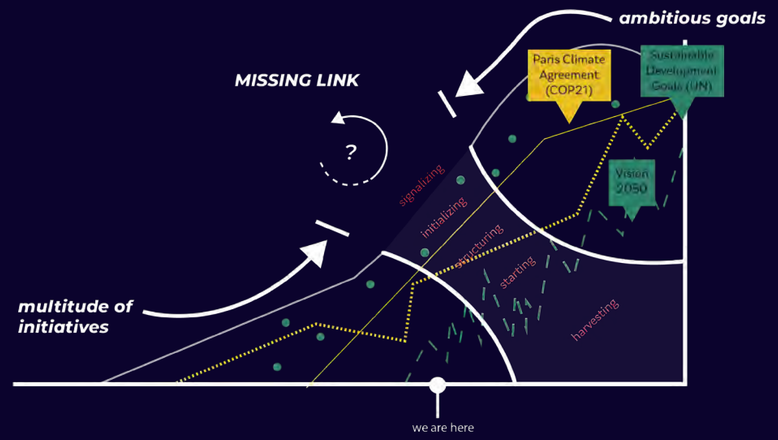


Figure 44, Explaining the missing link, (Thöle, 2021, p.18)

> Figure 45, Map showing the urbanisation strategy, manufacturing companies and educational institutions in the province of Zuid-Holland. Made by authors, based on maps on page 53-63

0 10 20km

LEGEND

- Major urbanization sites
- Areas with highest housing demand and capacity
- Mixed use on industrial estates
- Clusters of manufacturing companies and makers
- Technical secundary ecucation (MBO)
- Higher vocational education (HBO)
- Universities

2.6 Conclusion

In chapter two ‘Analysis’, the current situation was analysed, and challenges and potentials were identified.

The province of Zuid-Holland is in need of 230.000 new homes, focussing in the urban areas. The load and urgency of this demand can be used to spark the transition towards a circular construction sector.

The analysis showed that the current geography of flows and resources is very inefficient, linear and lacking of bio-based materials. To transition into a circular construction sector, bio-based materials should be included in the system and a local supply chain should be set up. Additionally, the lifespan of buildings and materials has to be expanded. To do this, the geography of flows and resources has to be re-thought through regional design.

Based on the analysis, the construction sector seems to be very much linked to the waterscape. This is partly because transportation via water has always been, and still is, the most efficient and cheap way of transportation.

The waterscape has been supporting the economical and population growth during multiple transitions in Dutch history. During this new transition towards a circular construction sector within the province of Zuid-Holland, the waterscape can become of use again.

The conflict in space between industrial sites, urban areas and agriculture & natural landscape has to be resolved. Therefore, new typologies are needed. Circular Neighbourhoods, with multi-usage of space will be part of the solution.

With the change of the original function of industrial sites, consequently jobs will be lost. As the change needs to happen quickly, and job-loss should be avoided, employees should be retrained-on-the-job. Also, students should be educated to contribute to the future, circular construction section.

As knowledge, makers, and manufacturers are needed for this transition to happen, the clustered locations with demand for housing alongside the waterscape are most interesting.

Figure 46, SWOT-analysis

VISION

3

CHAPTERS' CONTENT

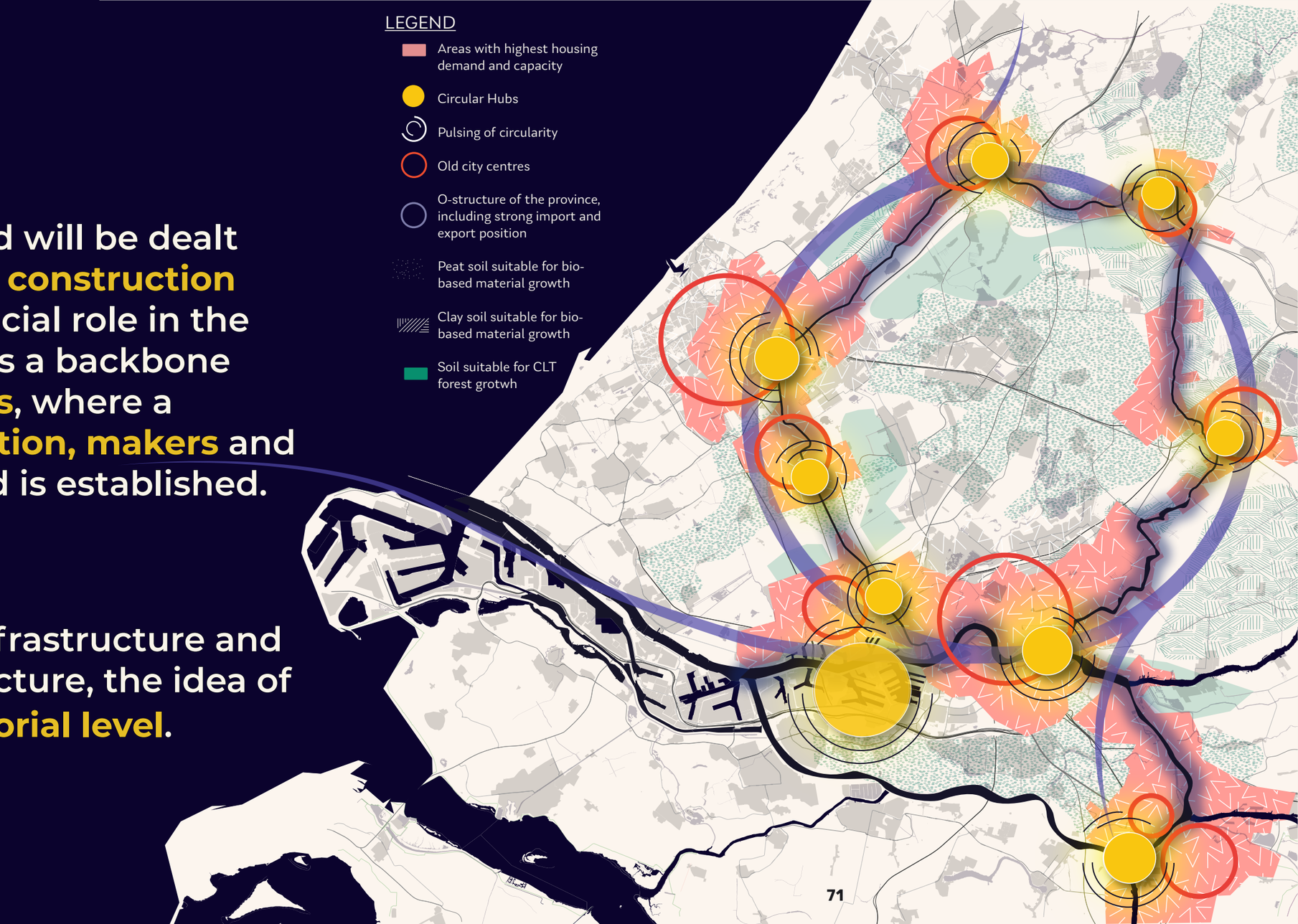
The FLUX vision is split up in a vision for 2040 and 2050. To get to the 2050's vision, a Systemic Change is needed.

Where the 2040 vision will show the future situation of the regions affecting by FLUX, the 2050 vision will show its promising influence of the region.

3.1 Vision Statement

In 2050 the housing demand will be dealt with by a **bio-based circular construction sector**. The canals play a crucial role in the new transport system and as a backbone for **Circular Neighbourhoods**, where a partnership between **education, makers** and the province of Zuid-Holland is established.

By repurposing the canal infrastructure and rethinking the regional structure, the idea of circularity is lifted to a **territorial level**.



> Figure 47, Vision map

3.2 Vision 2040

To achieve the bigger vision of a new regional structure the vision is splitted up in 2 parts. First part of the vision is shown in figure 48 on the next page. In 2040 at first, the canals will have an important role as infrastructure for transport. Surrounding the canal network are the neighborhoods with densification potential.

Secondly, the harbour of Rotterdam will function as the Central Hub for the flow of resources and as an entrance and exit for the rest of Europe.

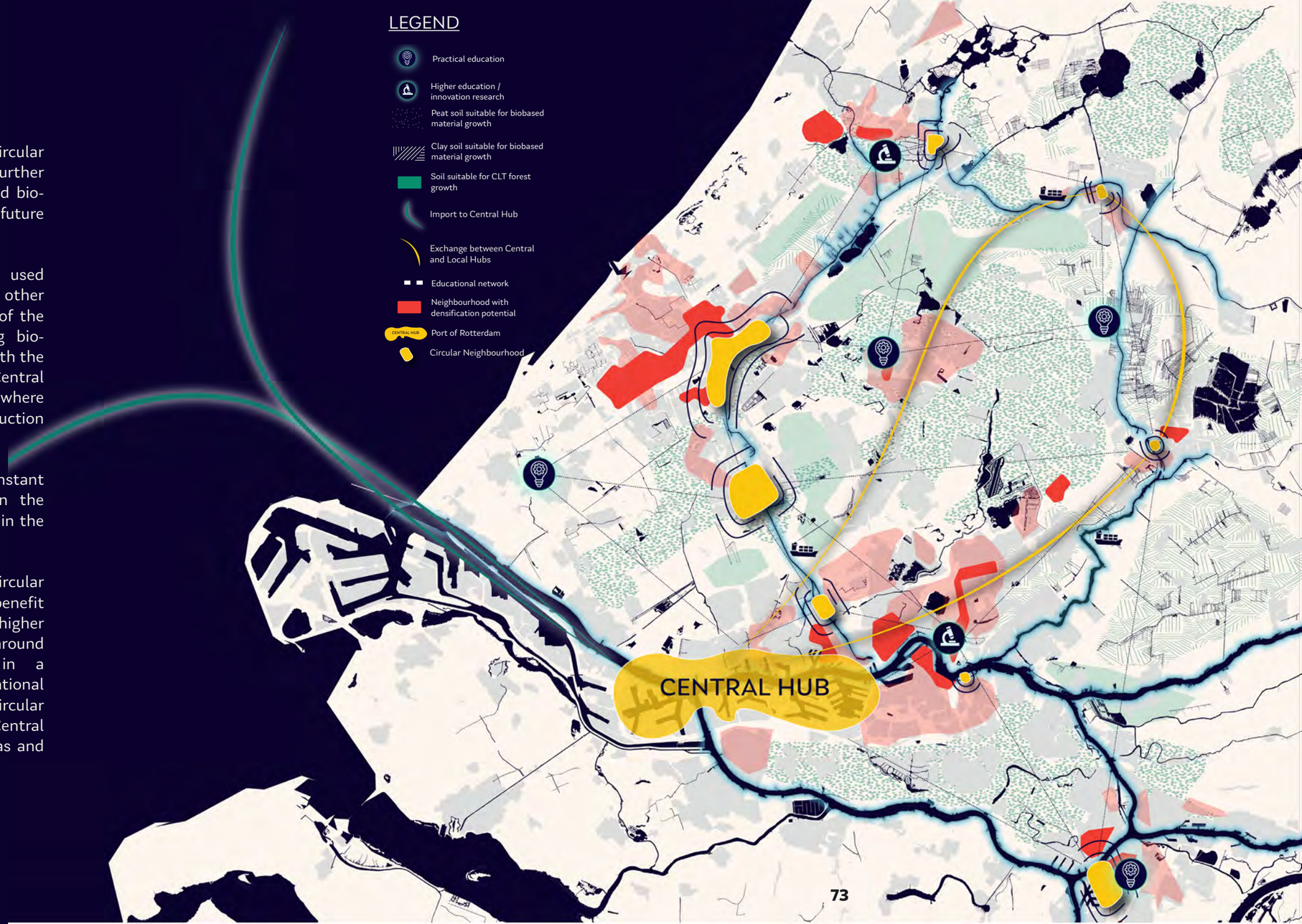
On key locations along the canals, Circular Neighbourhoods will be developed. This is where makers, education, housing and bio-based farms will come together. An important part of the neighbourhoods are the Local Hubs which will function as a distribution centre for the rest of the city.

In addition, the agricultural land in between can be used to grow bio based materials, like hemp, flax and reed. These bio-based materials will also be transported to the Local Hubs in the Circular Neighbourhoods for further processing by the makers and bio-based industry to become future construction materials.

Then, the Central Hub is used for import and export with other countries. But we are aware of the need to continue importing bio-based materials to keep up with the demand. In the future, this Central Hub will also be the place where larger factories for the production of CLT will be located.

At the same time, there is a constant exchange of goods between the Central Hub and Local Hubs in the Circular Neighbourhoods.

Furthermore, the Circular Neighborhoods can also benefit from other institutions of higher and practical education around the province. Resulting in a bigger network of educational institutes connected to the Circular Neighbourhoods and the Central Hub. Sharing knowledge, ideas and breakthroughs.



> Figure 48, Vision 2040

3.2.1 Systemic Change

To be able to use more bio-based materials in the construction sector, and to establish a local supply chain, the province of Zuid-Holland is in need of Systemic Change.

FLUX suggests a two system approach, a local and central system. As the province cannot produce all of the materials within the region, some import will always be needed. All building elements can be manufactured within the province. The imported materials will be distributed to the Central Hub and the locally produced materials will be distributed to the Local Hubs. Between these hubs, there's an ongoing exchange of goods. The aim of this system is to combine as many flows as possible.

Another shift will be the prolonging of lifespan of materials, mainly focussing on good maintenance. If maintenance is not possible, buildings will be smart-disassembled to re-use the construction elements. The current bio-based materials need a sound structure to support it, which is why steel will still be a part of the new system. Urban mining is the least appealing option where materials are distributed back to the manufacturing companies through either one of the hubs. For example steel can be melted back into iron building elements, to close the loop.

The third shift is that the makers industries will be involved throughout the whole construction process, trying to include innovation in there as well. The maker industries will be a part of the manufacturing, distributing, assembling, maintenance and urban mining processes.
In figure 49 on the next page, the Systemic Change is visualised in a diagram.

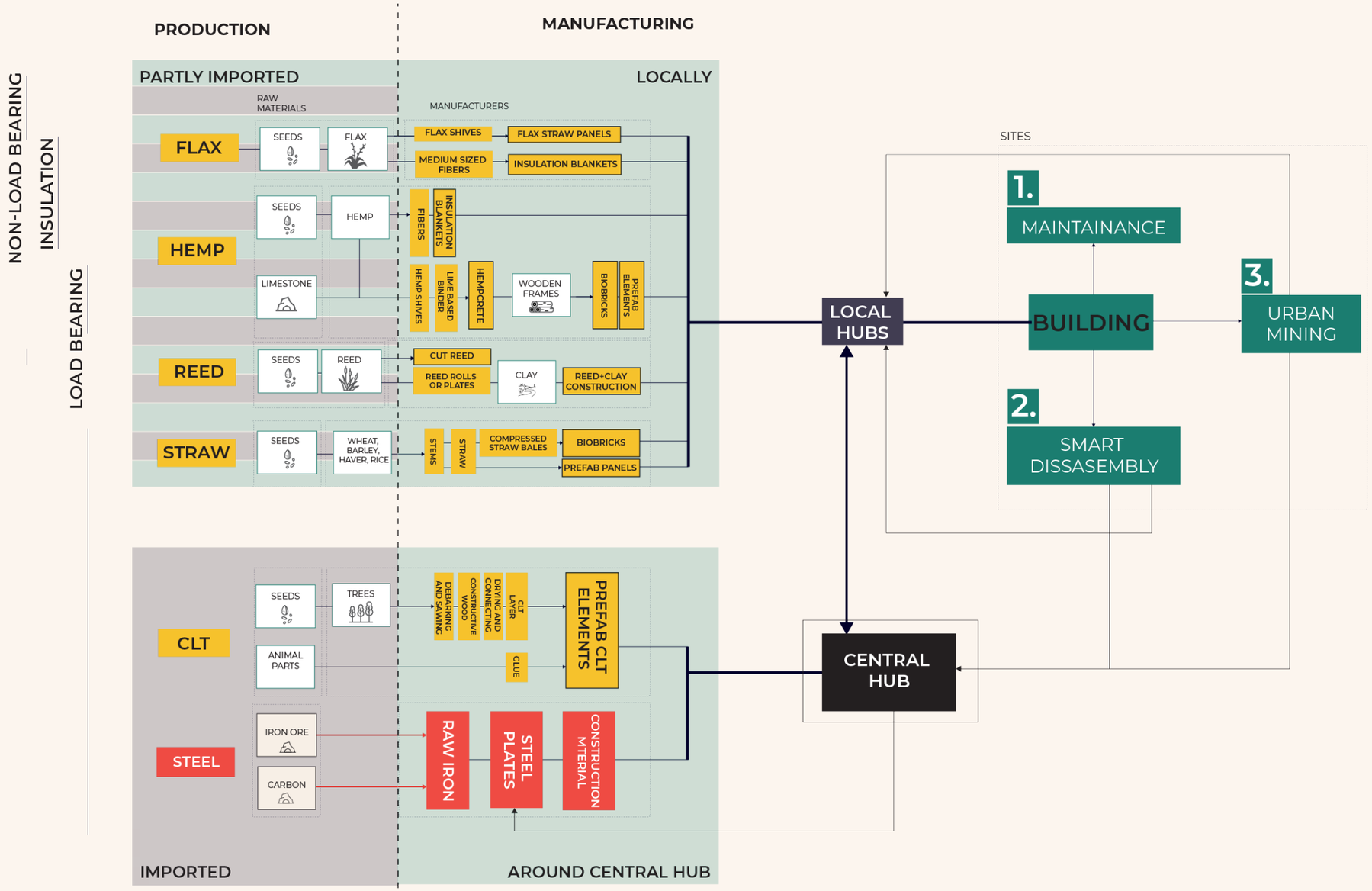


Figure 49, Diagram Systemic Change

3.2.2 Impact of Systemic Change

The Systemic Change not only affects the manufacturing processes within factories, it also has a spatial impact on the region.

The Port of Rotterdam will retain its function as a logistic centre for the Netherlands and as being the entrance of materials and goods to Europe. The Systemic Change will add to this that CLT and bio-based materials will be imported to the Port of Rotterdam. Because of the transition towards the use of bio-based materials, some non-renewable materials like limestone and sand will not be imported in the Port anymore. From the Port, materials will be distributed to the Local Hubs via the water network. By doing this, the Port of Rotterdam will function as a Central Hub.

The Local Hubs are part of the Circular Neighbourhoods. Circular Neighbourhoods also include educational institutions, makers and housing. Urban mining will be included in the new system. Materials that are mined from the Circular Neighbourhoods will be distributed back to the Central Hub. Here, materials are separated and steel materials will be remelted in the steel factory. By doing this, the loops are closed.

The new building elements will support the CLT and bio-based materials with its strong load-bearing capacity. The bio-based farms located near the Circular Neighbourhood support the circular construction within the urban areas. After the Systemic Change, only green energy will be used.

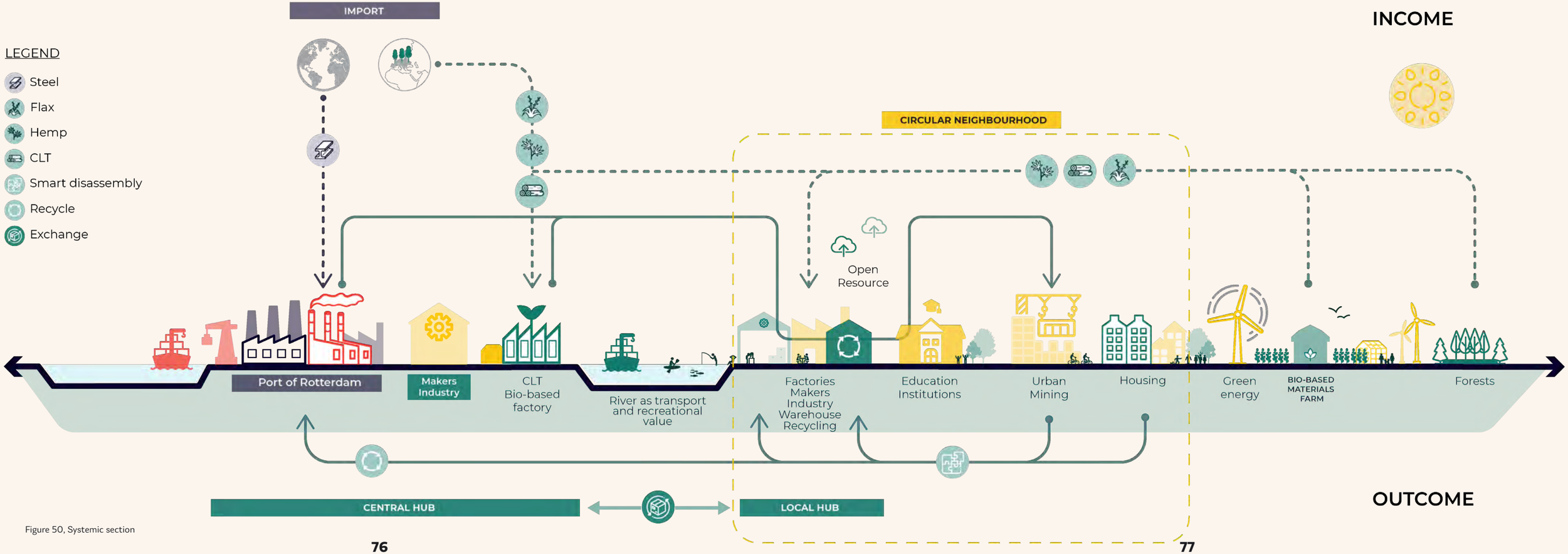


Figure 50, Systemic section

3.3 Vision 2050

After the canal structure with its new Central Hub and Circular Neighborhoods has led to Systemic Change, this will have influence on the rest of the province. As the surrounding of the Dircular Neighbourhoods also are in need of housing, the neighbourhoods have to pulse their circularity to them.

Eventually this will lead to a new structure of the province, where the waterscape is the main structuring element supporting a circular economy. As circularity will be the norm, not only the construction sector has to be circular. Other sectors have to follow the leader. The province of Zuid-Holland will have a new identity and structural element for future improvements toward a circular economy, lifting the idea of circularity to a territorial level.

> Figure 51, Vision 2050

STRATEGY: REALISING FLUX

4

CHAPTERS' CONTENT

In chapter four, the strategy is explained. The chapter starts off with the explanation of the phases and goals of FLUX.

To establish these goals, stakeholders are needed. As FLUX envisions an active collaboration between different stakeholders, the stakeholders are firstly defined and their collisions and synergies are explained.

Then, the Patterns developed by the Cities of Making are explained as they were for great use in the development of FLUX. As we built onto this research and developed new Patterns, the original and FLUX Patterns are presented.

In four strategic projects the use of these Patterns is visualised. The Network is functioning as a supporting factor for the Central Hub and Circular Neighbourhoods, therefore, the Network is shown.

Lastly, the Central Hub and Circular Neighbourhoods Alphen aan den Rijn and Binckhorst are visualised.

4.1 Phases and Goals

4.1.1 Definition of Phases and Goals

Before explaining how the phasing of FLUX will shape the region it is important to share the same understanding of the phases FLUX is made up off. Because of the complexity of the task, establishing a circular construction sector in the province of Zuid-Holland by 2050 many actions are needed. The transition towards this goal has been divided in three phases:

- *2021-2025 The Spark*
- *2025-2040 The Systemic Change*
- *2040-2050 The Pulse*

Each of these phases have a goal that should be met by the end of the phase. This way we can ensure that along the way it is possible to keep track of the progress of the transition that FLUX is supporting.

The Spark (2021-2025)
With 2050 approaching fast there is no time to lose and the first steps towards a circular construction sector should be done sooner rather than later. It is therefore necessary to start right away. The Spark-phase is there to light the transition. It will set examples and will contribute to changing the view of many stakeholders including the government to favour the circular construction sector. First experiments will show surrounding potential location the possibilities and educational institutions and manufactures will be encouraged to start working together to create new bio-based materials. All while starting dialogues with farmers, governmental institutions and non-renewable companies to show what the future will look like. Besides this, the first hand will be laid on getting the new distribution network ready for the transportation of circular materials.

The Systemic Change (2025-2040)
After the experiments have successfully shown the potentials of a circular construction sector they will inspire other potential areas along the waterscape of Zuid-Holland to start with a transition of their own. These locations are always mixed with educational institutions and have space for manufacturers and distribution. The biggest task in this phase is working on a network of Local Hubs supplied by surrounding farmers and manufacturers. Also part of the network and playing a key-role in providing larger bio-based materials that cannot be manufactured within the Circular Neighbourhoods is the Central Hub in the Port of Rotterdam. During the Systemic Change expanding the Central Hub is important. By the end of the Systemic Change all potential locations in Rotterdam, Dordrecht. Gouda, Alphen aan den Rijn, Leiden, The Hague and Delft have been developed into Circular Neighbourhoods besides this the Central Hub is ready to start supplying circular construction materials on a larger scale beyond the Local Hubs.

The Pulse (2040-2050)
The newly added Circular Neighbourhoods will start with their exemplary function to their surroundings. The Local Hubs within the Circular Neighbourhoods will provide easy access to bio-based materials and are supplied by the Central Hub. In this phase circular neighbourhood will act as a beacon in a yet to be transformed city-scape. With the Circular Neighbourhoods supporting the surrounding neighbourhoods and landscape knowledge on how to build or renovate in a circular way is within arm's reach. The positive effects of the mixed-use areas and emphasis on local manufacturing will show other potential densification locations the possibilities. By the end of this phase a circular construction sector is established with at its base the new network of Central and Local Hubs that make use of the waterscape. This new way of looking at the construction sector and spatial structuring of the province will pave the way for other innovation towards a more sustainable and circular society.

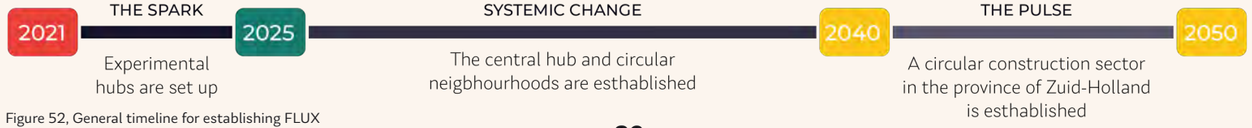


Figure 52, General timeline for establishing FLUX

4.1.2 The Scales of FLUX

With FLUX we aim for a multi-scalar approach as the transition to a circular construction involves different stakeholders with different influences and calls for strategic interventions having impact on multiple scales.

The regional scale is therefore the perfect scale to complete a complex task such as achieving circularity. In the current polycentric urban field of the province of Zuid-Holland all actions will have impact on a regional/city scale but will also impact the local scale where neighbourhoods, Local Hubs, makers and people will see it's effects and vice versa.

FLUX therefore works with the 9 different scales as shown in figure 53, keeping in mind the butterfly-effect certain interventions in one scale will have on the others.

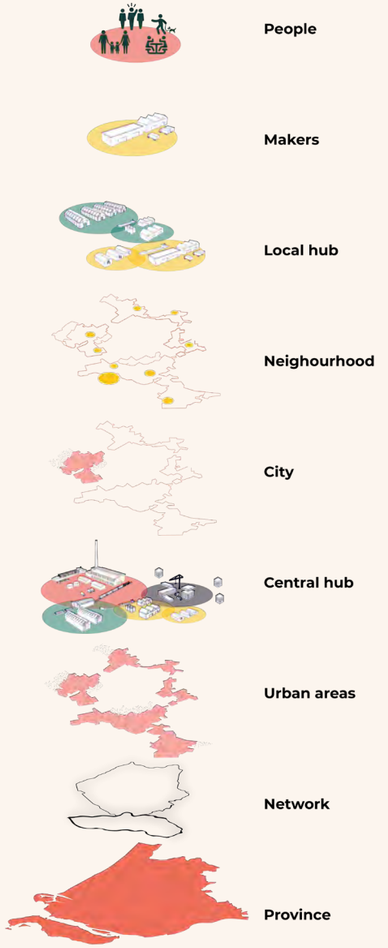


Figure 53, The scales of FLUX

4.1.3 The X-Curve of FLUX

To get to a circular construction sector a societal transition has to take place. Loorbach et al. (2017) explain this process as iterative and dynamic with two main pillars of building up a new regime and breaking down the old regime. In this process multiple states can be recognised, with the most important being chaos and emerge. It is this point in time where the actual transition gets chaotic and disruptive and new of emerging alternatives and transformative regime elements grow into a new regime. These alternatives are usually niche innovations which could thrive in a chaotic environment where the local and global scale fuse (Swilling & Annecke, 2012).

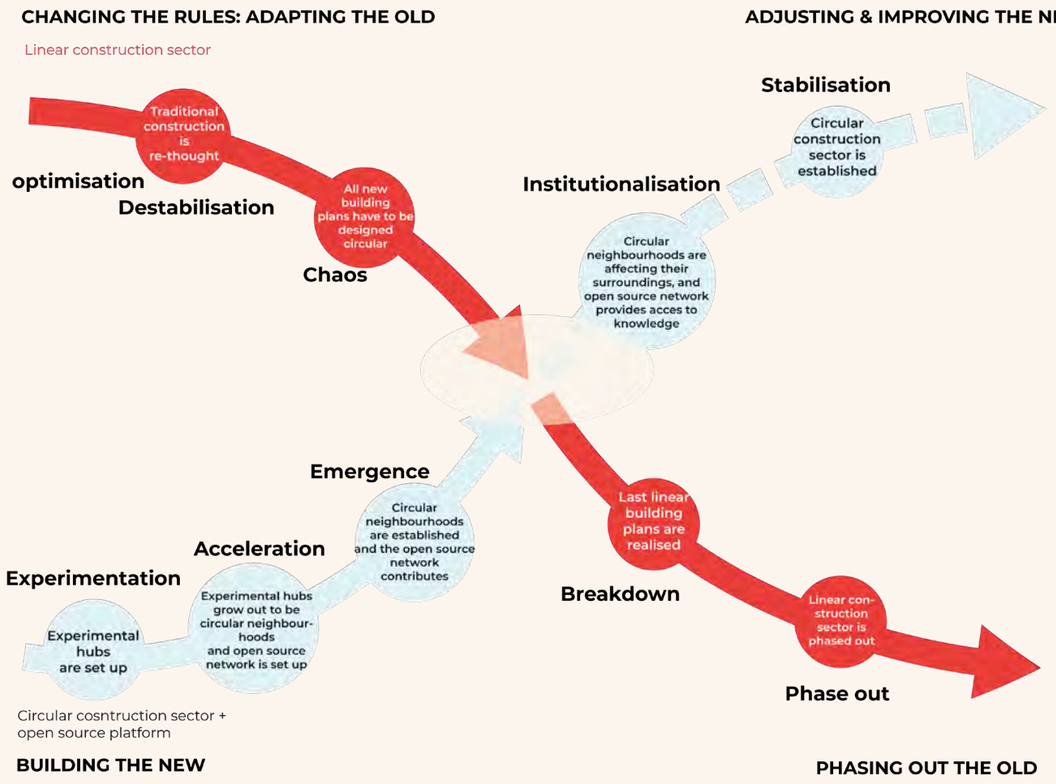


Figure 54, X-Curve showing the transition from a linear construction sector to a circular construction sector. Made by authors, based on (Loorbach et al., 2017)

Figure 54 shows the transition from a linear construction sector to a circular construction sector. Important in the transition is the institutionalisation of emerging alternatives.

Figure 55 gives a detailed look into the transition from simply demolishing buildings to re-using the materials for urban mining or even rethinking the manufacturing processes to prevent demolition of buildings.

The basis of the circular construction sector is the transition of non-renewable industry into a circular one. In the province of Zuid-Holland the fossil-fuel industry has a big impact on its economy and the transition towards a new circular industry should be done carefully. Figure 56 shows the steps that can make this transition possible.

See appendix 7.2 for more zoomed-in versions of the X-curves.

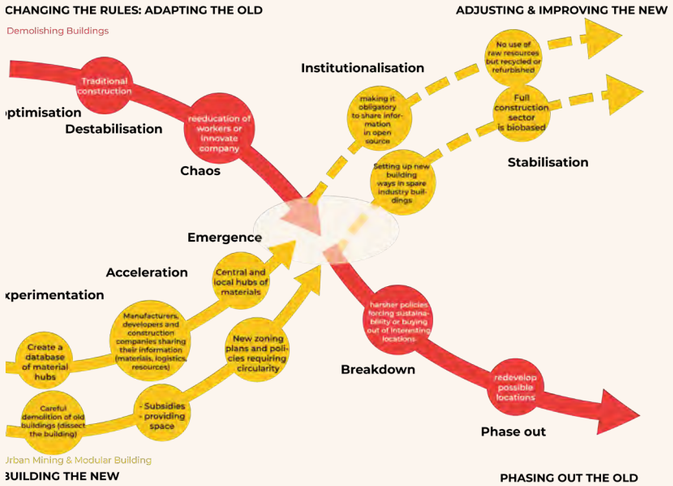


Figure 55, X-Curve showing the transition in lifespan of buildings. Made by authors, based on (Loorbach et al., 2017)

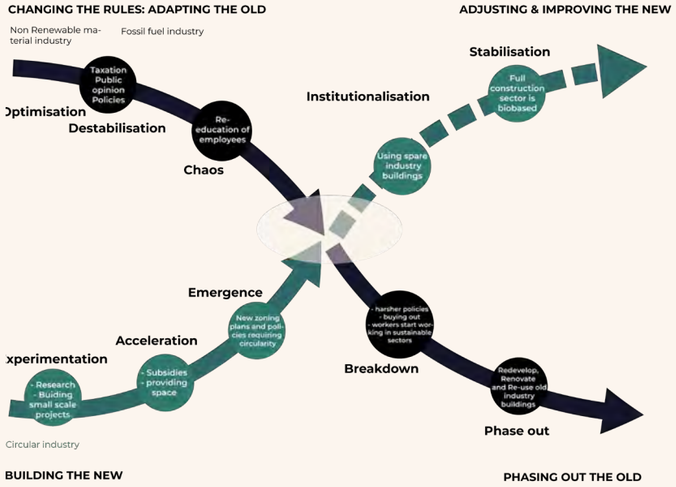


Figure 56, X-Curve showing the transition from a fossil fuel industry to a circular industry. Made by authors, based on (Loorbach et al., 2017)

4.1.4 Phasing of FLUX

In figure 57 on the right shows a detailed timeline of FLUX. The total set of actions have been divided into three groups all working towards a different goal. The three main groups are subdivided into three subgroups that are mostly linked to the three phases. In green we have the development of the network. Yellow shows the experimentation and implementation of new techniques by makers resulting in Circular Neighbourhoods. Red portrays the development of the participatory platform slowly merging with the open source. In the timeline in black different milestones have been included to keep track of the progress. It is important to notice that even though there might be very different actions within one group they are actions that can be carried out within the same timeframe. Furthermore, the table has been divided into 4 domains (1) spatial, (2) technology, (3) social en (4) policy.

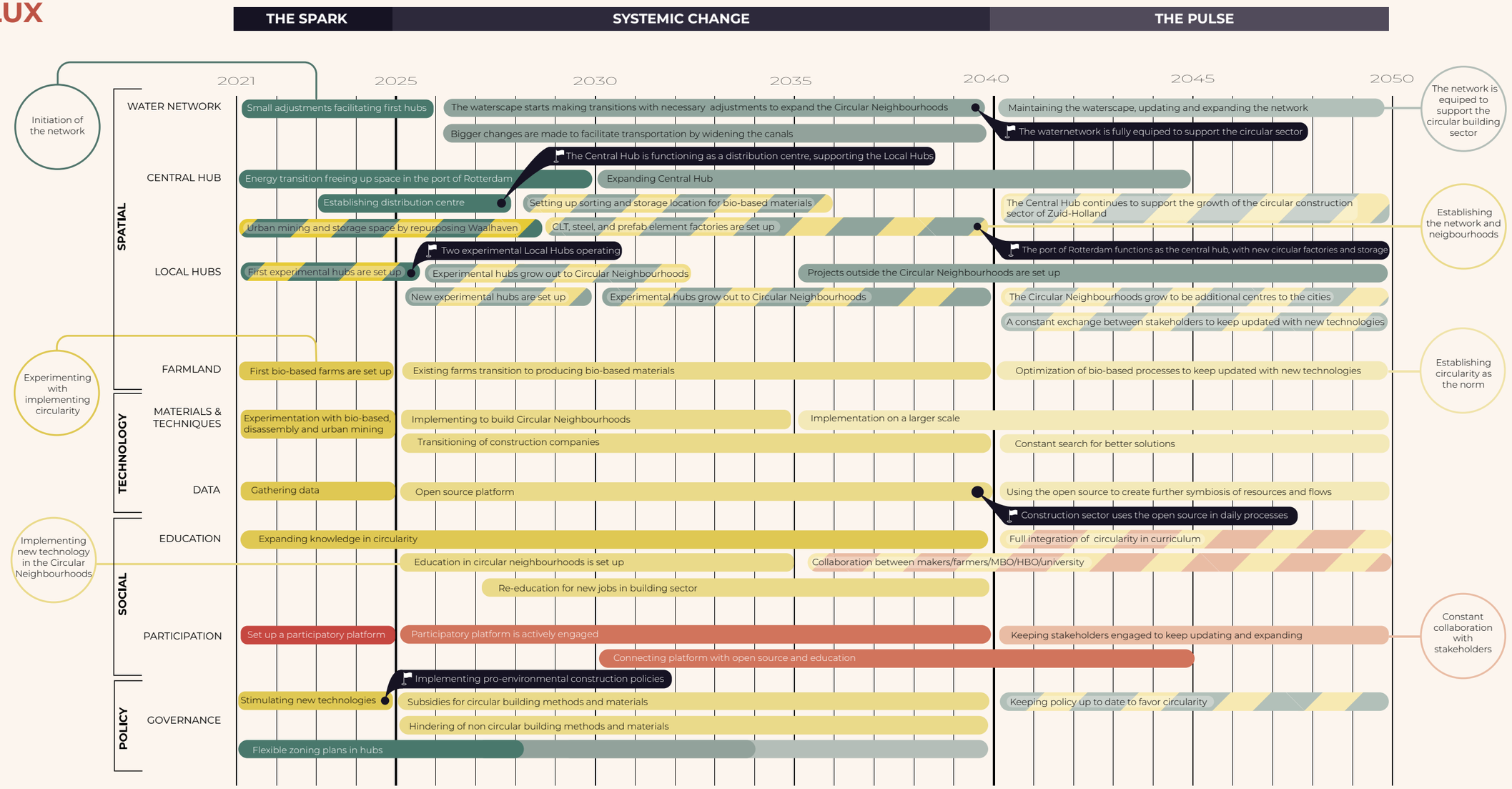


Figure 57, Detailled timeline for establishing FLUX

4.2 Governance

Governance could be defined as the process of governing. It can be done by the government, but also by other institutions, the market or a network, through laws, but also norms, power and language. Governance differs from government in that it focuses less on the state and more on social practices and activities (Bevir, 2012, p. 2-3). It is important to incorporate different voices when 'governing' and making them heard, potentially making processes more just. In planning, therefor, understanding the different stakeholders is crucial. Planning is largely about coordination of stakeholders with simultaneously diverging objectives. One way to understand the stakeholders is by mapping them in a power-interest matrix (Rocco, 2021a).

4.2.1 Stakeholders

The stakeholders can be divided in two four sectors as seen figure 58, the first one being the public sector. This sector consists of governmental organisations, such as the province itself, the national government and the municipalities that are affected. Also included are the waterboards and port of Rotterdam. These stakeholders hold a lot of power and will be the driving force behind the transition. However for this to happen there interest should be increased. This change is also mapped in figure 58.

The second sector is society, these include normal citizens, customers and employees of the relevant companies and they generally have little power. The employees might also not have much interest at the moment, because they could be at risk of losing their job due to the transition. This sector generally needs to adjust to make the transition happen, but it is important to keep them in consideration. Also included are the future generations, it is very important to keep these in mind, because they currently have no voice or power, but a high interest in the transition.

The third sector are the innovation platforms. This is the sector that will spark the transition. This includes the knowledge and educational institutes, on all levels, together with innovative new companies, start-ups and makers industries. This sector has a high interest in the transition, but only the universities and HBO-institutes could, at this moment be considered powerful. It is therefore important that the rest will be supported and encouraged.

The fourth and last sector is the private sector. This includes all traditional companies within the building sector, such as the manufacturers and the construction companies. Another important stakeholder are the developers and investors to get engaged, since this where most of the money has to come from. The farmers also fall into this sector. This sector generally benefits from the status quo and has much power. Some of these companies need to transform (such as the farmers, the construction companies and some of the manufacturers) while others need to be phased out (fossil fuel based companies).

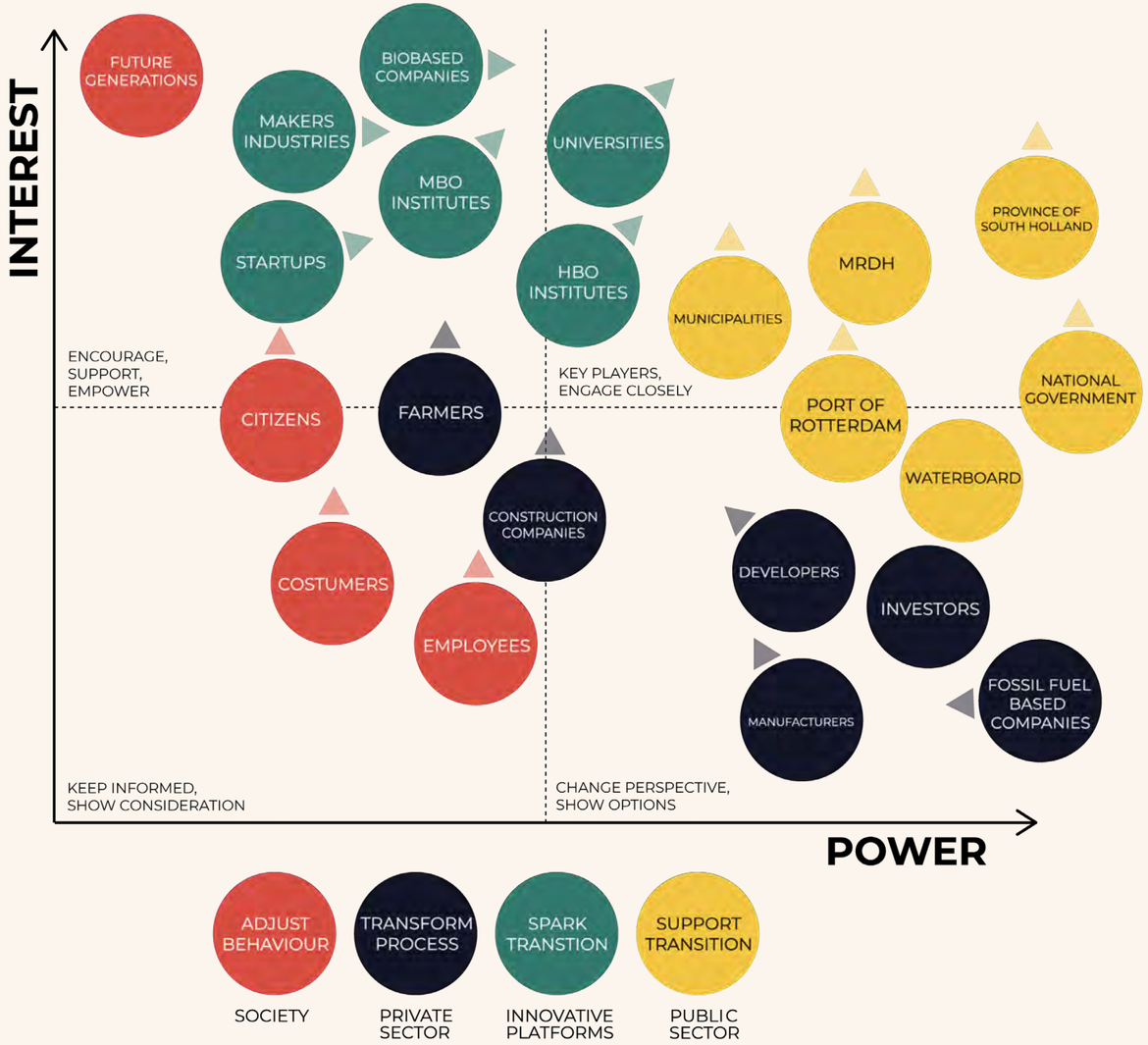


Figure 58, Power/interest diagram of involved stakeholders

Flux envisions a more active collaboration between the different levels of education and the makers industries and the farmers. The education sector also plays a big role in re-educating employees. The maker industries fill the gap of the missing link between the private and innovative sector. Developers should actively collaborate with citizens and makers for new projects, keeping the future generations in mind. Possible conflicts could come up during this transition, mainly between the private sector and the public sector, when the private sector resists reforms.

COLLISON DAGRAM STAKEHOLDERS

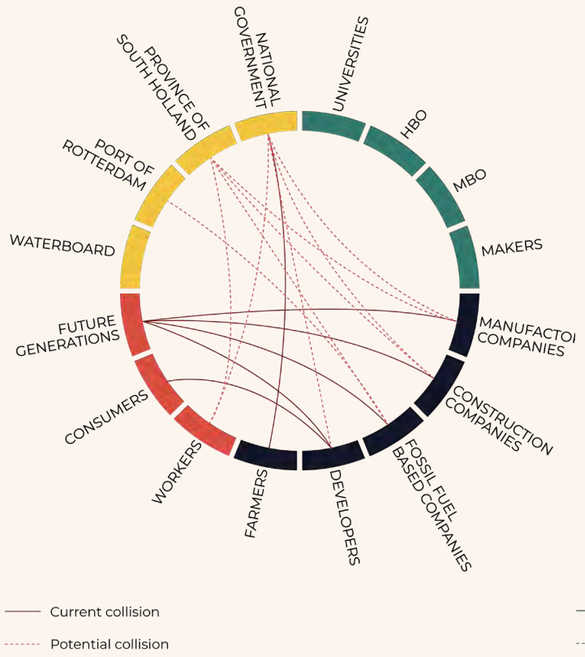


Figure 59, Collision diagram general stakeholders included in FLUX

SYNERGY DAGRAM STAKEHOLDERS

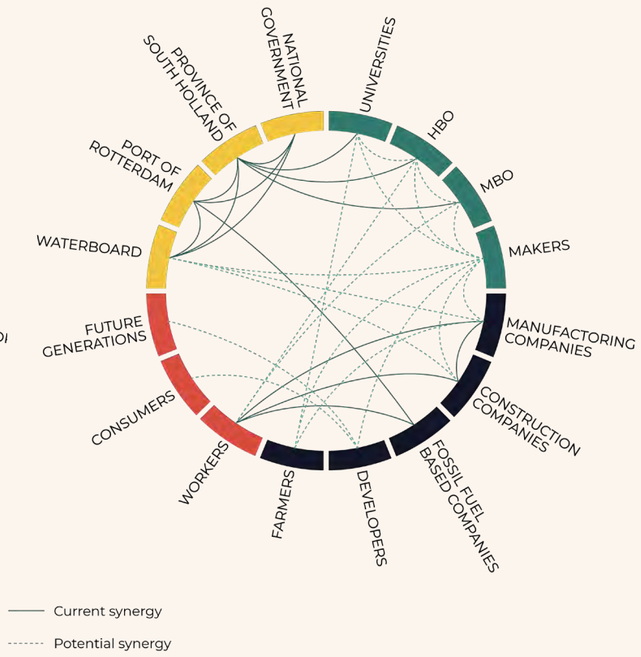


Figure 60, Synergy diagram general stakeholders included in FLUX

4.2.2 Participation Process

A term used in sustainable development is People, Profit, Planet, first coined by John Elkington in 1994. To successfully implement a development the three elements need to be in a balance. This concept demands that the responsibility not only lies with shareholders, but mainly with stakeholders, everyone that is influenced by the actions within the process. However it is important to note that not all stakeholders are equally motivated or affected by these elements. For example the private sector and to a smaller extent the innovative platforms are motivated by profit. They will be encouraged to participate in the transition when it is profitable for them. On the other hand, the public sector should represent its people, with little emphasis on profit.

To encourage and ease circular collaboration between companies, an open source platform will be launched, giving companies insight into uses of materials, resources, waste streams and logistics, encouraging and easing. It could be used to exchange and combine flows, benefitting all companies.

To further encourage participation, an online participation platform is launched, which will be integrated with the open source platform. This platform meant to be an easy and accessible way for everyone to get involved and voice their opinion. In the Circular Neighbourhoods physical projects, like community hubs will be implemented to support synergies, which will be explained later.

PARTICIPATORY PLATFORM AND OPEN SOURCE CONNECTING STAKEHOLDERS

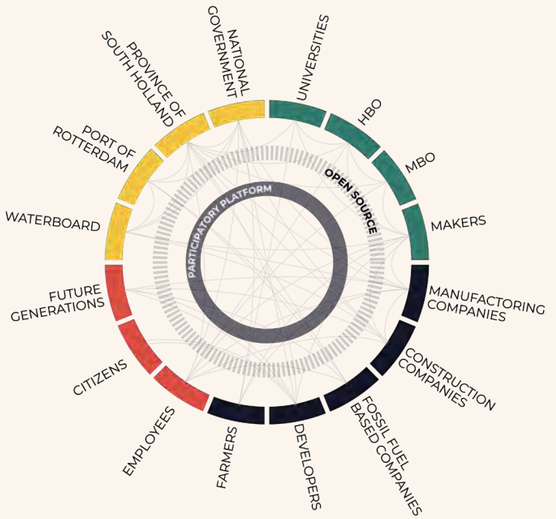


Figure 61, Participatory platform and open source connecting stakeholders

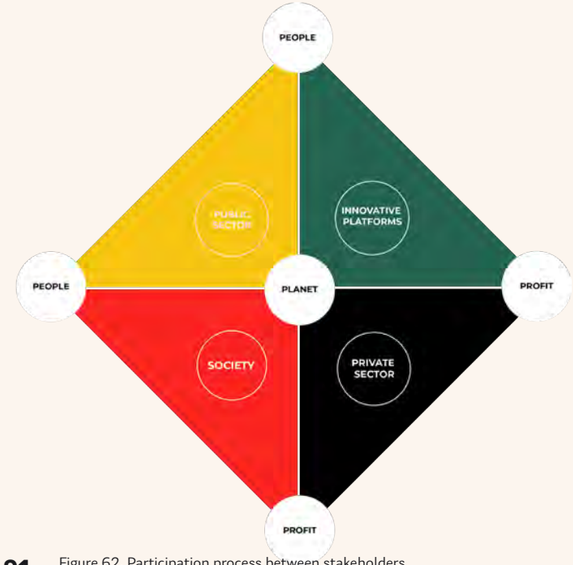


Figure 62, Participation process between stakeholders

4.3 The Patterns

During the research phase of FLUX, the Cities of making (COM) Report 2018, a European research project that looks into manufacturing in three cities: Brussels, London and Rotterdam, has been of great help. This report has contributed greatly to our own project, vision and strategy. In said document, the authors developed a set of patterns: a tool that tries to break down complexity into easily understood blocks of knowledge (Hill, 2020). Inspired by the seminal 1977 book, 'A Pattern Language' (Alexander, Ishikawa, & Silverstein, 1977) the authors translated their findings about how to incorporate manufacturing back again in the city fabric into fifty patterns which help render the diversity of issues concerning manufacturing more tangible. Their goal is to facilitate constructive and solution-oriented discussions between different actors with different skills and knowledge.

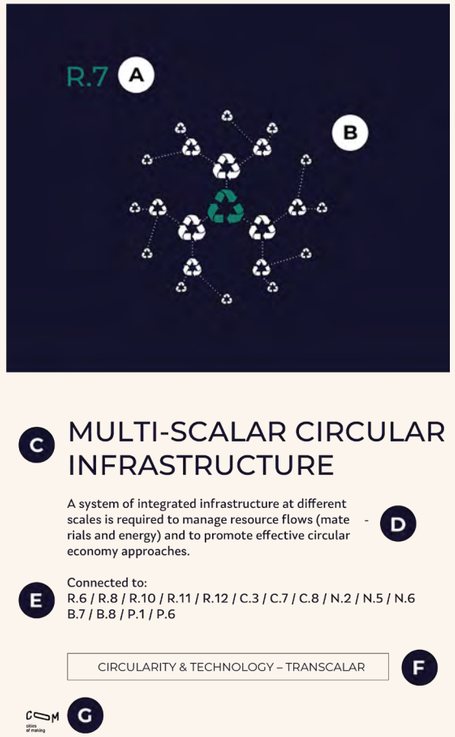
More information on the Cities of Making? Scan me!

4.3.1 The Original Cards

According to the authors, the fifty patterns developed were the result of field work, observations, mapping of similarities of scenarios and most importantly, through discussion with stakeholders and design based research to test the relevance of each pattern. Each pattern description consists of the context it is embedded in, problems that it tackles, forces that might influence it and at the core of the pattern ideas for possible solutions.

The patterns provide generic solutions that can be interpreted and adapted to a specific problem or place and offer a discussion aid for planning and decision making. Finally, patterns never stand on their own, each pattern is linked to another and can consequently form a pattern language. In this way, the patterns and pattern language provide a systemic approach for analysing sites, developing place-based visions, supporting design processes and help monitor the state of urban manufacturing (Hill, 2020).

Furthermore, the patterns are categorized according to scales of action (Transcalar, city/neighbourhood, neighbourhood/block, block/building and programme), the pathways they align to (Urban integration, Circularity and Technology, and People, networks and Policy). From the fifty patterns created, the team chose the ones we thought were applicable to our vision and goals. In the following pages we present the chosen patterns. Figure 63 shows how to read the pattern and the information they provide and for further information about the patterns, you can visit: Cities of Making.



A. Identifying code (in original deck this refers to the five scales of action:
R = Transcalar, C = City/Neighbourhood, N = Neighbourhood/Block, B = Block/Building, P = Programme, F = FLUX-expansion.
The numbers (1, 2, 3...) serve the cross-referencing

B. The pathways can be distinguished by background colour:
white = Urban Integration; dark blue = Circularity and Technology; green = People, Networks and Policy

C. The ***title*** of the pattern

D. The ***hypothesis*** of what this pattern represents

E. ***'Connected to'*** indicates links to related patterns

F. The ***scale*** of action

G. Logo ***identifying*** if the card is original (COM) or added (FLUX)

H. Possible ***phasing*** in which card can be played - FLUX patterns only see page 98

Figure 63, Explaination showing how to read the Patterns. based on (Cities of Making, 2018)

B.1

MAKING AROUND COURTYARDS

Organising manufacturing around courtyards inside blocks allows businesses to make noise, dust, move vehicles safely and provides additional space outside of the workshop area while allowing cohabitation with some forms of mixed-use.

Connected to:
C.10 / B.2 / B.4 / B.6 / B.8 / N.1 / N.2 / N.4 / N.6 / N.10 N.11 / P.8

URBAN INTEGRATION – BLOCK/BUILDING

B.2

YARD FOR LOGISTICS

Yards with sufficient space for turning and parking can facilitate safe loading and unloading, without disruption, in high density areas.

Connected to:
R.3 / R.8 / C.1 / N.5 / N.6 / N.8 / N.9 / N.11 / B.1 / B.4 B.5 / B.6

URBAN INTEGRATION – BLOCK/BUILDING

B.3

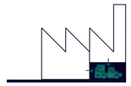
PUBLIC FACE

Activities which have a public interface achieve better neighbourhood integration and acceptance, while improving exposure to clients.

Connected to:
R.1 / B.2 / C.1 / N.3 / N.8 / N.10 / B.9 / P.2 / P.3 / P.6 P.7 / P.8

URBAN INTEGRATION – BLOCK/BUILDING

B.8



SPACE FOR STORAGE

Manufacturing spaces with smart storage solutions allow for efficient use of space and production processes.

Connected to:
R.6 / R.7 / R.8 / R.12 / C.8 / N.5 / N.6 / P.2

URBAN INTEGRATION – BLOCK/BUILDING

C.3

BALANCE BETWEEN PUBLIC & PRIVATE LAND

Public ownership of manufacturing space enables public interests to have an active stake in neighbourhood issues while ensuring space is available for unconventional or foundational forms of manufacturing.

Connected to:
R.1 / R.3 / R.9 / R.10 / C.1 / C.4 / P.7 / P.8

PEOPLE NETWORKS & POLICY – CITY/NEIGHBOURHOOD

C.4

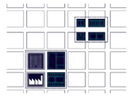
DIVERSE TENURE MODELS

A range of land and property tenure models allows for manufacturing space to be accessible to businesses according to their financial means and ownership needs.

Connected to:
R.3 / R.9 / C.3 / C.5 / P.4

PEOPLE NETWORKS & POLICY – CITY/NEIGHBOURHOOD

C.5



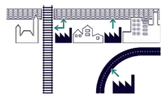
VARYING UNIT SIZES

Variations of unit sizes help to promote a variety of business types and facilitates manufacturers growing or shrinking without needing to leave an established neighbourhood.

Connected to:
R.9 / C.1 / C.3 / C.4 / N.3 / N.10 / B.1 / B.5 / P.2 / P.3 / P.4 / P.5

URBAN INTEGRATION – BLOCK/BUILDING

C.7



LINKS TO TRANSPORT INFRASTRUCTURE

Manufacturing benefits from being near relevant infrastructure, multimodal logistics hubs and good access to distribution networks.

Connected to:
R.7 / R.8 / R.9 / C.3 / C.4 / C.6 / C.8 / C.9 / N.1 / N.2 / N.5 N.6 / N.10 / P.2

URBAN INTEGRATION – CITY/NEIGHBOURHOOD

C.8

ACCESSIBLE MATERIAL RECOVERY FACILITIES

Waste processing and recycling facilities must be locally accessible through efficient logistics networks.

Connected to:
R.4 / R.6 / R.7 / R.8 / R.12 / C.7 / N.2 / N.5 / N.6 / P.6

CIRCULARITY & TECHNOLOGY – CITY/NEIGHBOURHOOD

C.9

CONCENTRATING MESSY MAKING ALONG INFRASTRUCTURE

Concentrating manufacturing activities that produce noise, dust, and problematic odours along infrastructure, minimises nuisances.

Connected to:
R.9 / C.1 / C.2 / C.7 / C.10 / N.1

URBAN INTEGRATION – CITY/NEIGHBOURHOOD

C.10

TRANSITION ZONES

Zones adjoining industrial areas can provide ideal space for small to medium size manufacturing businesses and supporting services that help transition into mixed-use and residential areas.

Connected to:
R.3 / R.4 / C.1 / C.5 / N.3 / N.9

URBAN INTEGRATION – CITY/NEIGHBOURHOOD

N.2

RE-USE OF MATERIAL & ENERGY FLOWS

Local production of waste water, materials and heat could be turned into innovative new uses, to reduce the dependency on primary raw materials and reduce environmental pressures.

Connected to:
R.3 / R.6 / R.7 / R.10 / R.11 / R.12 / C.2 / C.7 / C.8 / C.10 / N. 3 / N.4 / N.5 / N.6 / B.1 / B.7 / P.6

CIRCULARITY & TECHNOLOGY – NEIGHBOURHOOD/BLOCK

N.3

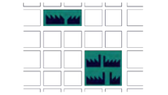
MIXING COMPLEMENTARY MAKING & RELATED SERVICES

Mixing complementary manufacturing with related activities creates conditions for efficient work flows and provides opportunities for resource and knowledge synergies through cross-sectoral innovation.

Connected to:
R.2 / R.3 / R.6 / R.12 / N.4 / N.6 / B.1 / P.2 / P.7 / P.8

CIRCULARITY & TECHNOLOGY – NEIGHBOURHOOD/BLOCK

N.4



CLUSTERING SIMILAR MAKING

Clustering similar types of manufacturing promotes conditions for innovation, competition and collaboration while increasing access to staff and concentrating associated environmental issues.

Connected to:
R.3 / R.6 / R.8 / C.1 / C.2 / C.5 / C.6 / C.7 / C.8 / C.9 / C.10 N.1 / N.2 / N.3 / N.5 / N.6 / N.7 N.8 / N.9 / B.3 / P.7 / P.8

URBAN INTEGRATION – NEIGHBOURHOOD / BLOCK

N.5

LOCAL COLLECTION POINTS OF SEGREGATED WASTE

To ensure full recovery of waste streams, non-domestic waste collection points must be both easily accessible and well distributed across the city, into segregated waste streams to guarantee homogeneity, purity and maximise value and recovery potential.

Connected to:
R.3 / R.6 / R.7 / R.8 / R.10 / R.11 / C.2 / C.7 / C.8 / N.2 N.10 / P.6

CIRCULARITY & TECHNOLOGY – NEIGHBOURHOOD/BLOCK

N.6

CENTRALISED LOGISTICS ZONE

Central collective logistics space in accessible locations facilitates efficient delivery and discharge of goods while providing opportunities to store material or manufactured goods.

Connected to:
R.7 / R.8 / C.1 / C.7 / N.5 / B.2 / B.8

CIRCULARITY & TECHNOLOGY – NEIGHBOURHOOD/BLOCK

N.7

LOCAL DESIGN & PROTOTYPING

Locating R&D testing facilities for manufacturing within knowledge hubs such as technology parks, innovation districts, and research centres promotes synergies in the use of technology and transfer of knowledge.

Connected to:
R.3 / R.10 / R.11 / C.3 / C.5 / N.3 / N.4 / P.4 / P.8

CIRCULARITY & TECHNOLOGY – NEIGHBOURHOOD/BLOCK

N.8

QUALITY URBAN ENVIRONMENT IN MAKING AREAS

A high quality public realm is attractive for both employees and clients, increasing a sense of safety, encouraging mixed use, improving staff retention and encouraging visitors.

Connected to:
R.1 / R.2 / R.3 / R.5 / R.8 / R.10 / C.1 / C.2 / C.3 / C.4 / C.5 C.6 / N.1 / N.5 / N.6 / N.9 / N.10 N.11 / B.1 / B.2 / B.3 B.6 / P.8

URBAN INTEGRATION – NEIGHBOURHOOD / BLOCK

P.1

PRODUCTIVE ROOFTOPS

Roofs complement the performance of a building or intensifying land use, allowing for climate adaptation, food and energy production.

Connected to:
R.7 / R.10 / R.11 / N.3 / N.8 / B.3 / B.5 / B.7 / P.7

URBAN INTEGRATION – BLOCK/BUILDING

P.2

SHARED MAKING SPACES &TECHNOLOGY

Smart use of space and technology through sharing can increase accessibility to expensive equipment, make more effective use of technology, while encouraging knowledge transfer between manufacturers.

Connected to:
R.4 / R.6 / R.9 / R.11 / R.12 / C.4 / C.8 / N.2 / N.7 / B.2 / B.7 P.3 / P.6

URBAN INTEGRATION – NEIGHBOURHOOD/BLOCK

P.3

FLEXIBLE SPACES FOR MAKING

Multi-functional spaces accommodate different user needs over time, allowing for easy reconfiguration, growth, or shrinkage of manufacturing processes.

Connected to:
R.6 / R.9 / R.11 / C.3 / C.4 / C.5 / B.3 / B.4 / B.5 / B.7 / B.8 B.9 / P.2

URBAN INTEGRATION – PROGRAMME

R.1

MAKING MAKING VISIBLE

Manufacturers need visibility to connect their products and services with the local market, while ensuring that the general public values what manufacturing does for the city.

Connected to:
R.2 / R.3 / R.10 / R.11 / B.3 / N.7 / N.10 / P.7 / P.8

PEOPLE NETWORKS & POLICY – TRANSCALAR

R.2

TRANSPARENT MAKING

Providing transparency in environmental, economic, and social processes helps building trust and acceptance of urban manufacturing, while also founding a basis for interaction and collaboration between businesses.

Connected to:
R.1 / R.3 / R.5 / R.11 / R.12 / B.3 / P.8

PEOPLE NETWORKS & POLICY – TRANSCALAR

R.4

AVAILABILITY OF DIVERSE JOBS

A diversity in job opportunities that are fairly distributed across the city allows for workplaces to fit the skills, capacities and interests of the local workforce, provides businesses with options for staffing while ensures cities are resilient and accessible.

Connected to:
R.1 / R.3 / R.5 / R.10 / C.6 / N.10 / P.2 / P.3 / P.5 / P.6 / P.7

PEOPLE NETWORKS & POLICY – TRANSCALAR

R.6

SUSTAINABLE PRODUCT CYCLES

Manufacturing contributes to city-scale circularity, helping reduce distances from resource to processing site, distribution and retail, and then to re-use, remanufacturing, material recovery and back to the production cycle.

Connected to:
R.2 / R.7 / R.8 / R.12 / C.8 / N.2 / N.5 / N.7 / B.8 / P.2 / P.5 / P.6

CIRCULARITY & TECHNOLOGY – TRANSCALAR

R.7

MULTI-SCALAR CIRCULAR INFRASTRUCTURE

A system of integrated infrastructure at different scales is required to manage resource flows (materials and energy) and to promote effective circular economy approaches.

Connected to:
R.6 / R.8 / R.10 / R.11 / R.12 / C.3 / C.7 / C.8 / N.2 / N.5 / N.6 B.7 / B.8 / P.1 / P.6

CIRCULARITY & TECHNOLOGY – TRANSCALAR

R.8

MOVING THINGS EFFICIENTLY

Time-distance efficiency in logistics contributes to sustainable and competitive manufacturing.

Connected to:
R.10 / C.1 / C.3 / C.7 / N.6 / N.10 / N.11 / B.3 / R.10

CIRCULARITY & TECHNOLOGY – TRANSCALAR

R.10

PLACE-BASED FINANCIAL LEVERS

Financial instruments are important mechanisms to improve neighbourhood scale infrastructure and technology, while rendering businesses more compatible with their context.

Connected to:
R.1 / R.3 / R.4 /R.6 / R.8 / R.11 / C.1 /N.2 / P.1 / P.4 / P.6 / P.7

PEOPLE NETWORKS & POLICY – TRANSCALAR

R.11

INCENTIVES FOR RESEARCH & DEVELOPMENT

Cities can stimulate research and development through incentives such as providing finance and space, offering technical support, business development and support with tenders.

Connected to:
R.1 / R.3 / R.8 / R.9 / R.10 / C.4 / N.3 / N.7 / P.2 / P.3 / P.4 P.7 / P.8

PEOPLE NETWORKS & POLICY – TRANSCALAR

R.12

MATERIAL DATABASE

A centralised spatially connected database, containing data on flows of material (and waste), helps to facilitate and optimise local distribution of resources and maximise opportunities for material recovery.

Connected to:
R.1 / R.2 / R.3 / R.6 / R.7 / R.10 / R.11 / C.1 / C.8 / C.10 / N.2 N.3 / N.4 / N.5 / N.7 / P.3 / P.6

CIRCULARITY & TECHNOLOGY – TRANSCALAR

4.3.2 The Toolbox

The patterns are a great tool to use during the design of Circular Neighbourhoods, the Central Hub and the network. With the toolbox FLUX provides an overview of which patterns can be used in which phase for each of the main strategic interventions. To make the pattern language complete for FLUX new patterns have been added. This way future developers have a complete toolbox they can use. In figure 64 the original patterns are visible in dark green all newly added FLUX-patterns are white. The background of the number shows the pathway it is a part of.

The fourteen new patterns have been specially developed for FLUX, based on research strategic goals and ambitions for this vision, but the FLUX-expansion pack can also be used for other projects as they are made as general as possible. Besides adding cards a new scale of action has been added, the regional scale. Expanding the scales that are used from 5 to 6 scales.

A more detailed look into the newly developed patterns will be provided on the next page.

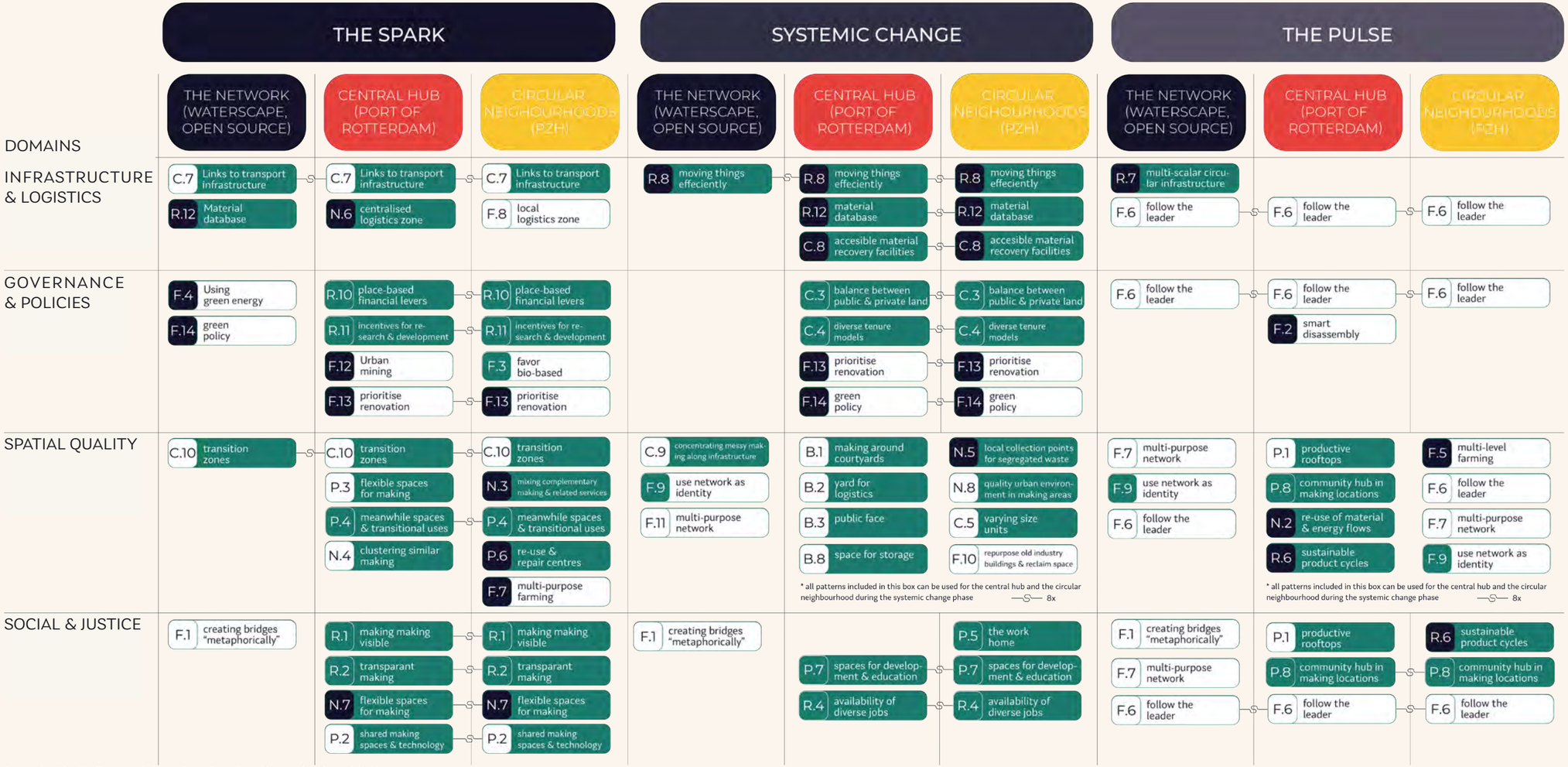
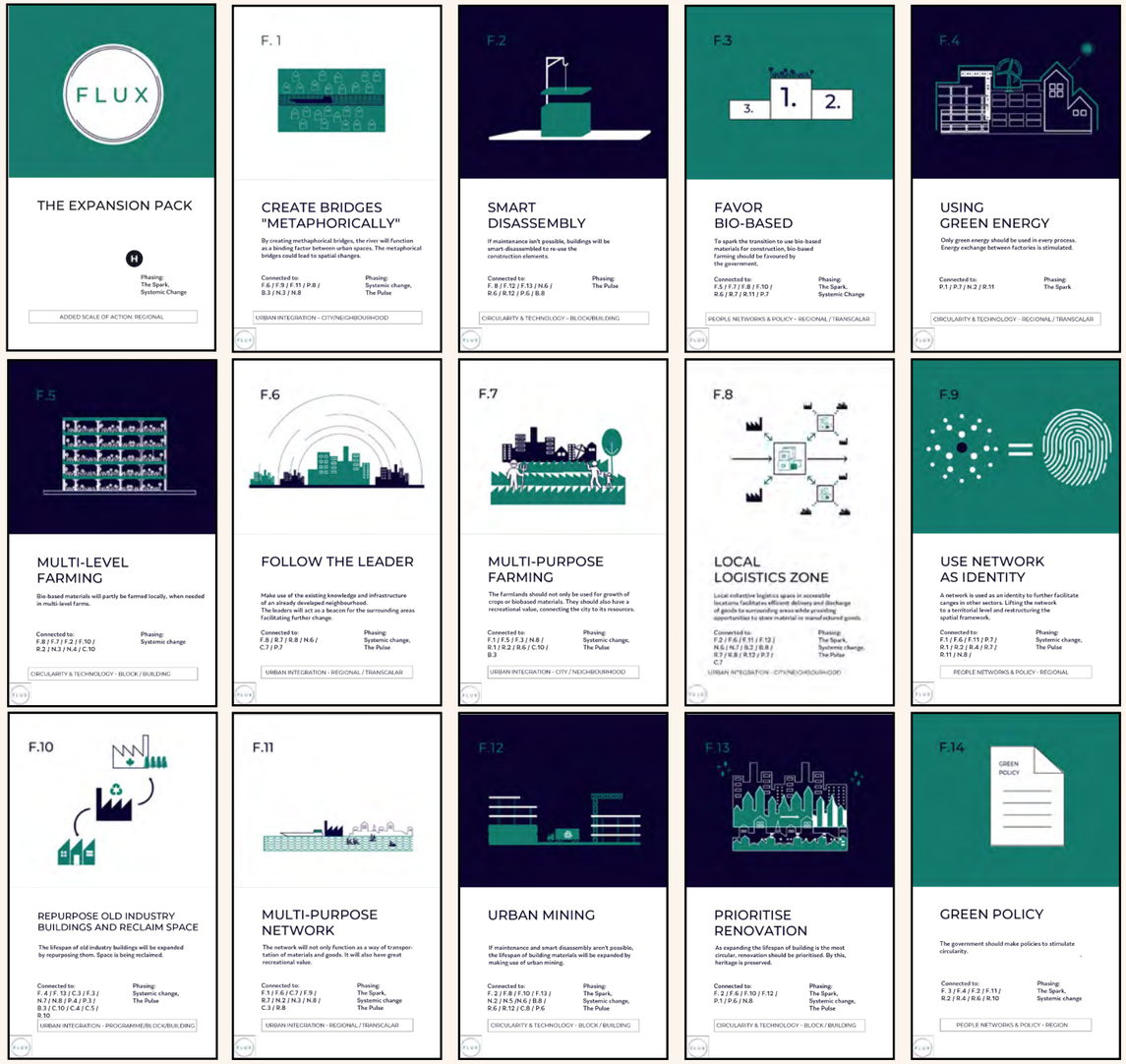


Figure 64, The Toolbox. Made by authors, based on (Cities of Making, 2018)

4.3.3 The FLUX Expansion Pack



4.3.4 Let's Play the Game

After careful analysis of the chosen patterns, in addition to the ones we considered necessary to add, we play the pattern language.

In figure 66, the patterns were played as cards according to their role in the timeline and phasing of the vision and on the other hand, according to their relation with other patterns, thus creating our own pattern language for this project.

The patterns can be connected to others based on complementary needs and/or goals, in order to solve different problems that overlap, to solve the same issue in equally valid ways and finally if they share similar structure.

Additionally, the arrows show if one pattern is a Prerequisite card, a follow up card, and advisory follow up card, and lastly if one set of patterns can be played simultaneously. It is important to notice that once a pattern is played it will become part of an active deck, still being influential as other patterns will be stacked on top of it adding to the pattern language, see figure 65.

Figure 65, Illustrating stacked Patterns in a deck of cards. Made by authors, based on (Cities of Making, 2018)

More information on the original pattens? Scan me!

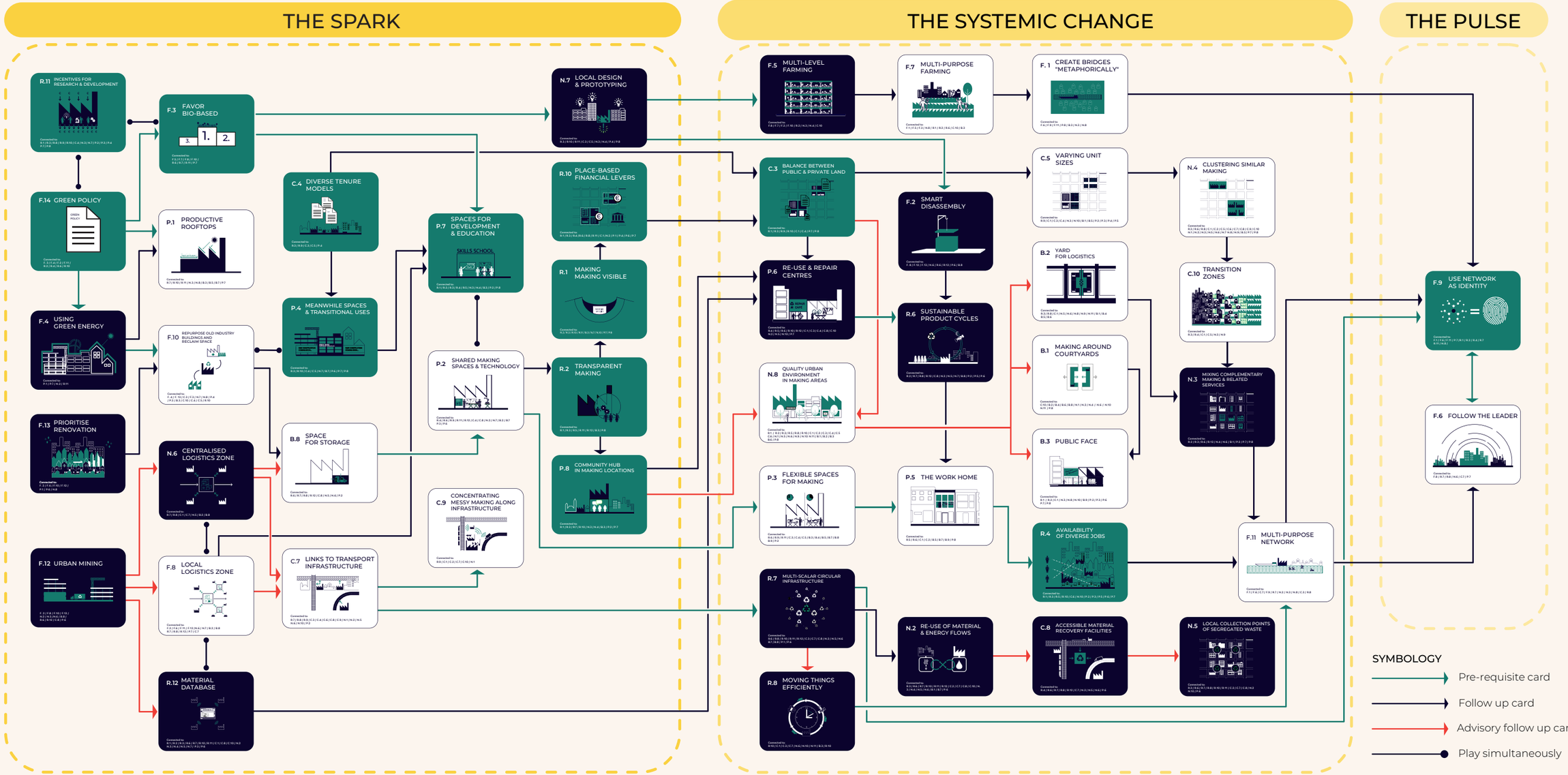


Figure 66, Pattern languages, playing the game for FLUX.
Made by authors, based on (Cities of Making, 2018)

4.4 Strategic projects

A strategy has been developed to reach the 2050 vision of FLUX. By establishing the network for a circular construction sector in the province of Zuid-Holland, circularity is lifted to a territorial level. This network is both physical and non-physical, as data and knowledge are part of this network. Within this strategy, the governance is analysed and a pattern-expansion pack is developed to lift circularity to the regional scale. In this subchapter, the game will be played to show how the new system will work via three exemplary strategic projects, supported by the new network. These strategic projects are: the Central Hub in the port of Rotterdam and the Circular Neighbourhoods in Alphen aan den Rijn and The Hague.

Figure 67, Map showing the composition of strategic projects

4.4.1 The Network - The Backbone of Region

To support the Central Hub and Circular Neighbourhoods, a solid base network is needed. Making it a vital part of FLUX. Developing along the waterscape will always go hand in hand with developing the network that is the waterscape, which will the binding factor for the several hubs. Therefore it should be passable by larger ships. On figure 68 on the right, a map of the province of Zuid-Holland is presented. New developments should keep in mind what adjustments should be made to the waterscape to accomodate for the change in flows and resources. As new material flows will make use of the waterscape as its main method of transportation. These changes to the waterscape can be done at the same time the Circular Neighbourhood are developed, combining forces.

Besides it's transportational function the network will function as a bridge between different neighbourhoods, could provide recreational space and will restructure the province of Zuid-Holland. The restructuring is one of the most importants aspects of realising the network as it will create a multi-purpose network with a fair distribution of opportunities.

> Figure 68, Map showing crossing of the water network in the province of Zuid-Holland. Image made by author based on (Google, n.d.d)

4.4.2 Current Status Strategic Locations

THE PORT OF ROTTERDAM

The Port of Rotterdam is one of the largest ports in the world housing the following functions: Container/ Breakbulk, Liquid Bulk, Dry Bulk, Distribution, Chemical Industries/ Refineries/Energy (Zandvliet, 2015).

The Port of Rotterdam wants to create a future-proof port. In the future, business will still be blooming and providing income and jobs. The Port of Rotterdam has set the goal to be fully CO2 neutral by 2050, and minimise the environmental impact of the port (Port of Rotterdam, n.d.). Therefore, the Port of Rotterdam fits in the FLUX vision.
As the Port of Rotterdam will function as the Central Hub, the port is one of the strategic locations.

ALPHEN AAN DEN RIJN

In the province of Zuid-Holland, there is a strong urban L-structure. including the big cities Leiden, The Hague and Rotterdam.

With Alphen aan den Rijn as one of the experimental Circular Neighbourhoods, the L-structure will transform into an O-structure.

The O-structure will include Leiden, The Hague, Delft, Rotterdam, Gouda, Alphen aan den Rijn.

In Alphen aan den Rijn, there already is a good harbour structure and mixed-used industrial park. Furthermore, Alphen is surrounded by farmland, which makes it a promising location to experiment with bio-based materials.

This makes Alphen aan den Rijn suitable as a location for a Circular Neighbourhood.

BINCKHORST

The Hague has a huge demand for new homes. As a change is needed in the construction of those new homes, Binckhorst is the second experimental Local Hub.

Binckhorst is an area located in the West of The Hague. At this moment, a plan is already been made to transform this area into a mix-used area including education, housing, living, working and making (PosadMaxwan & Gemeente Den Haag, 2019).

The plan does not completely fit in the FLUX vision, as it for instance is still including a concrete factory in this area.

The zoning of the plan does fit the FLUX vision. Therefore, the strategy for this strategic location is built up on this plan.

Figure 69, map showing part of Rotterdam, (Google, n.d.)

Figure 70, map showing part of Alphen aan den Rijn, (Google, n.d.a)

Figure 71, map showing part of The Hague, (Google, n.d.b)

4.4.3 The Central Hub

The Central Hub will be located within the port of Rotterdam. As the Port of Rotterdam has set the goal to be completely CO_2 neutral in 2050, space belonging to the fossil fuel industry will open up in the port.

The Central Hub will be located in Waalhaven. This area is now used for containers/breakbulk. Rotterdam's port has a high concentration of raw materials and residual flows from numerous industrial and logistics activities. Combined with its good accessibility, this creates an excellent foundation for the broad introduction of circular production and consumption processes (Port of Rotterdam, 2019). Therefore, the current infrastructure of this area can be repurposed for the Central Hub.

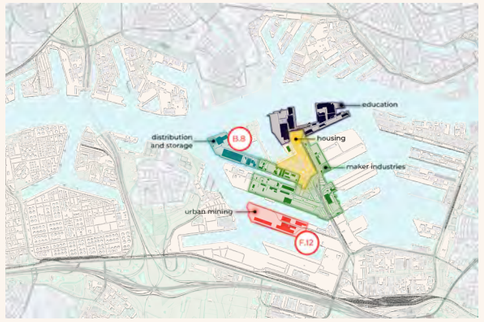
In The Spark phase, a distribution centre and urban mining area will be set up in the port, supporting the first experimental Local Hubs Alpen aan den Rijn and Binckhorst. The current housing will remain in this area, possible renovation and densification will happen circular. The current RDM Campus will expand and space for education increases.

During the Systemic Change, the Central Hub will further expand. As the province cannot produce all of the materials within the region, some import will always be needed. A CLT, steel and assembling factory will now be located in the hub. The steel factory will be located in an area opened up by the energy transition of the port. Directly next to the steel factory, a large space for urban mining is established to make this process as efficient as possible.

By 2025, the Merwe Vierhavens (M4H) will be transformed to be a housing area. During the Systemic Change, this area will turn into a mixed-used area where housing, makers, education and living is combined (Gemeente Rotterdam & Havenbedrijf Rotterdam N.V., n.d.).

The metaphorical bridge between the educational institutions within the Central Hub and M4H will become physical. By a ferry, a direct location between both mixed-used areas will be established. Furthermore, space for distribution, storage, makers and assembling will increase. The 'messy making' within the urban mining and steel, CLT and assembling factories will take place on the south side of the Central Hub, to limit nuisances. The makers will function as a transition zone between those areas and housing.
In The Pulse phase, the Central Hub will continue to expand to be able to keep on supporting the circular construction sector within the province of Zuid-Holland or maybe even further regions. Therefore, areas to support this expansion potential are needed.
All these different phases, together with the 'played patterns' are visualised within figure 72 below. See appendix 7.3 for a more zoomed-in version of the maps.

CENTRAL HUB: THE SPARK



CENTRAL HUB: THE SYSTEMIC CHANGE

CENTRAL HUB: THE PULSE

Figure 72, Phasing of the Central Hub

STAKEHOLDERS

At the moment there is collaboration in the RDM campus between Hogeschool of Rotterdam and the Techniek College. This can be extended by involving the Erasmus university and the new makers industries. This will also be the location where employees can be re-educated. New factories in the circular sector will be located here and new collaborations with the already existing logistic and waste management companies should be established. Conflicts could arise between the citizens of the location and the new coming factories and makers. As well as between governmental organisations and existing companies.
Collaboration between the makers and other companies is supported by shared facilities, such as shared buildings, machinery, resources and means of transport. Synergy between all stakeholders is supported by community hubs. This is a place where several events and activities are organised aimed at engaging people in the transition.

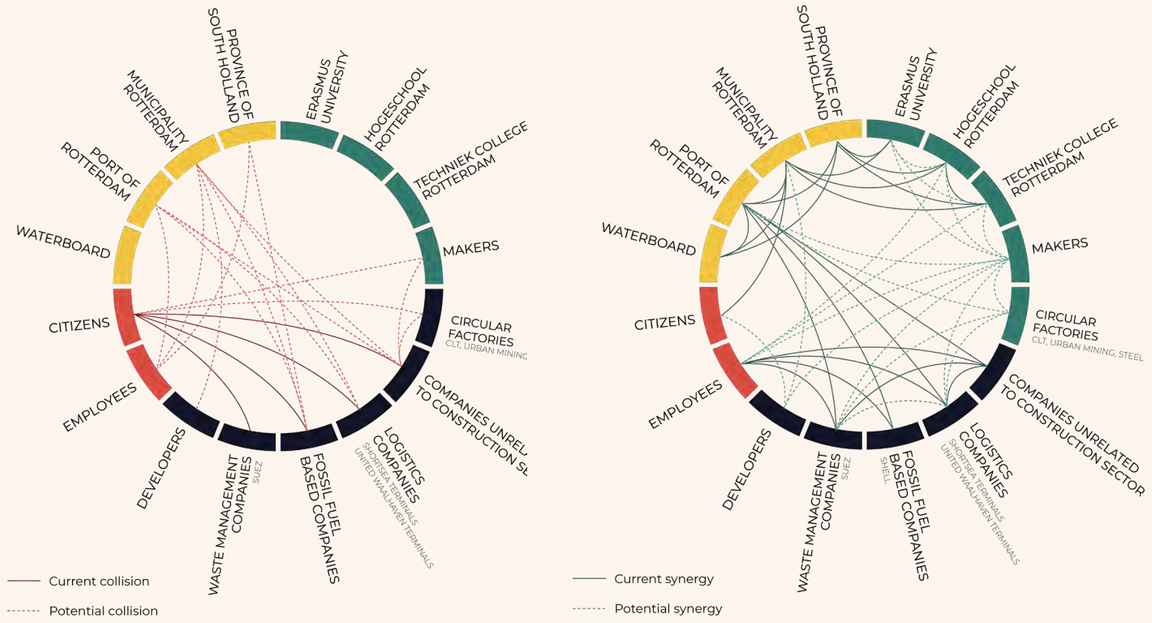


Figure 73, Diagrams showing collisions and synergies between involved stakeholders

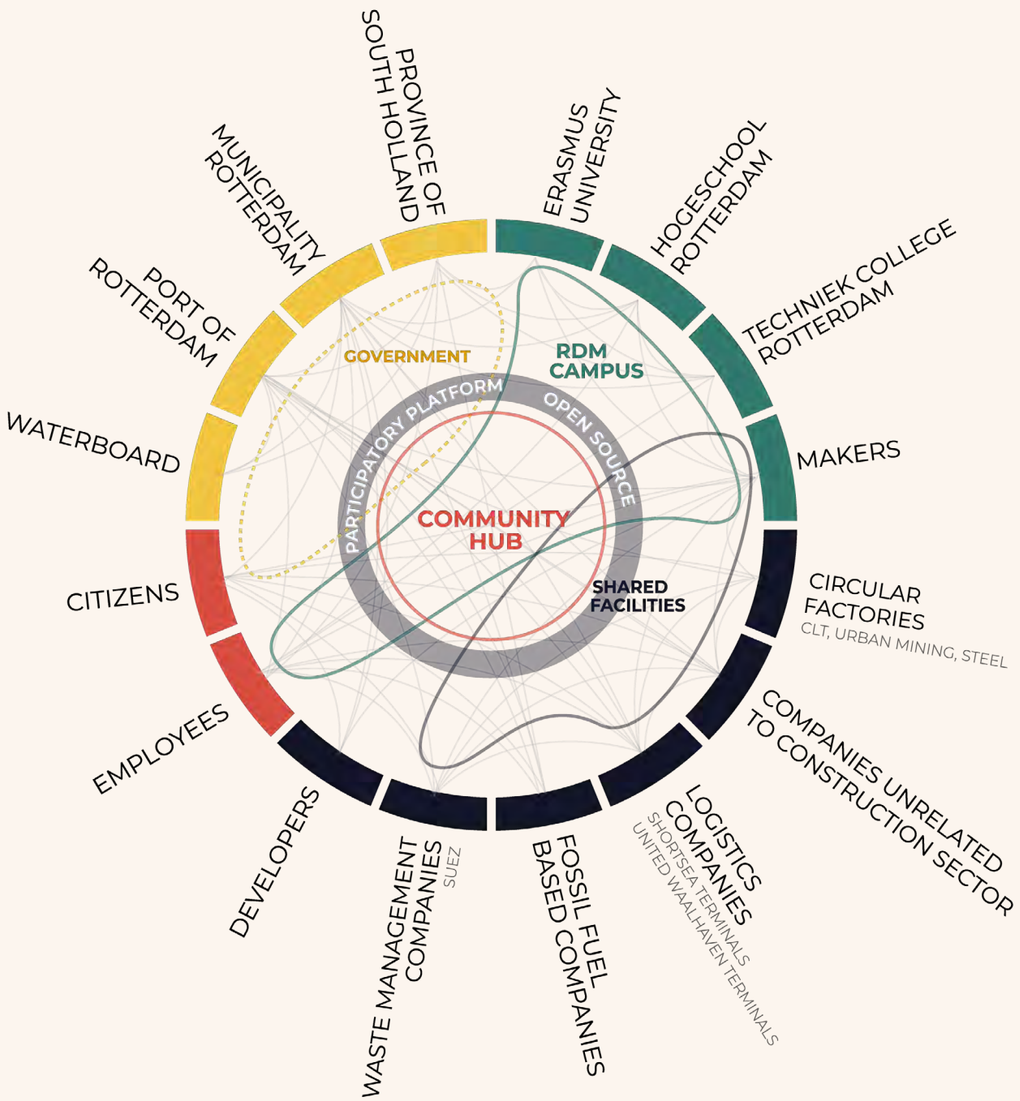


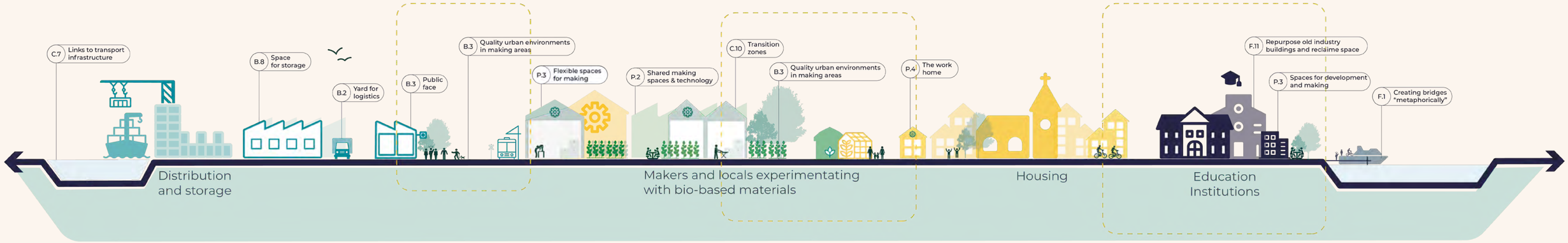
Figure 74, Diagram showing involved stakeholders in spatial interventions

SPATIAL QUALITIES

The section below shows how the patterns of the game are played in the transition of the Waalhaven to a Central Hub and what the spatial influence is of these patterns. The shared distribution and storage area helps manufacturers in its surrounding in solving the issue of shortage of space. It functions as a centralised logistics zone (N.6) that facilitates moving things efficiently (R.8) at the scale of the Central Hub. In combination with the material database (R.12) and the link to infrastructure (C.7) This results in the most efficiënt and least disturbing way to move and stock materials. The residential area is not disturbed by traffic because of the connection to the water and yards for logistics for manufacturers. These yards allow trucks to load and unload without conflicting other traffic. This is important in mixed use areas. The yard is located within the block and vehicles can pass between buildings. In this way, yards are not located at the front of buildings, which makes the frontages have 'urban' quality and a public face.

The zones adjoining the storage, distribution and urban mining provide ideal space for small to medium sized manufacturing businesses to transition into mixed use and residential areas. This transition zone has a diversity of activities as designers, engineers, restaurants, material suppliers, small artisan workshops, mechanics, re-use & repair centres (P.6) and so on. This zone can offer the availability of diverse jobs (R.4) supporting manufacturing. With varying unit sizes (C.5) there is a transition from small spaces in mixed use buildings and integrated workplaces within dwellings (P.5) to larger scale plots and buildings along infrastructure and the industrial zones. It ranges from a mixed use neighbourhood towards clusters of similar types of manufacturing (N.3).

Within this transitional area, smart use of space and technology is important for experimenting with biobased materials. Shared making spaces and technologies (P.2) increase accessibility to expensive equipment and effective use of technology and encourage knowledge transfer between manufacturers. Start-ups and small businesses benefit from this shared technology and space, together as they can re-use materials and energy flows from each other (N.2). employing diverse tenure models (C.4) take place to create flexible spaces for making (P.3). Combined with a Material Database (R.12) and linked material recovery facilities (C.8) this will improve the circularity of materials.



QUALITIES OF SPACE:
- Meeting space with restaurants and stores
- ability to interact with makers and manufacturers

QUALITIES OF SPACE:
- Meeting space with restaurants and stores
- ability to interact with makers and manufacturers

QUALITIES OF SPACE:
- Meeting space with restaurants and stores
- ability to interact with makers and manufacturers

Figure 75, Section showing spatial qualities of linked areas. Made by authors, Reference images left to right (Allorge, 2016; Franzen, 2015 & Swire Properties, 2014)

RDM-CAMPUS
P. 7

WATERBUS
F. 1

MODULAR HOUSING, MADE FROM BIOBASED MATERIALS OR URBAN MNING
F. 2
F. 3
F. 12

MAKERSHUB
P. 2

PUBLIC FACE FOR INDUSTRIAL BUILDING
B. 3

REPURPOSING INDUSTRIAL BUILDINGS
F. 10

DISTRIBUTION CENTRE
N. 6

CENTRAL HUB

Figure 76 Visualisation showing spatial qualities of the Central Hub. Made by authors, based on (Techniek College Rotterdam, n.d; Mark Koehler Architects, 2016; Frantzen et al, 2020 & Franklin Azzi Architecture, 2017)

4.4.4 Circular Neighbourhood Alphen aan den Rijn

As explained earlier, one of the first experimental Local Hubs will be Alphen aan de Rijn.

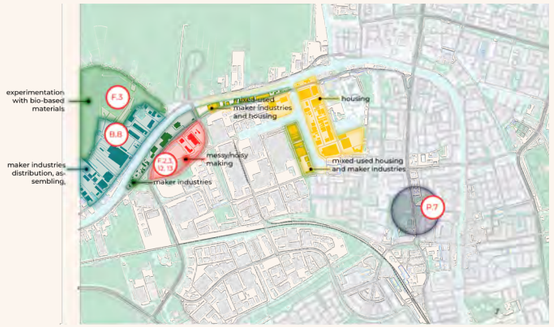
In The Spark phase, the first area where experiments with bio-based materials for construction farming takes place. Next to this, the current concrete factory will transform into an area where makers, distribution and assembling comes together. In this area, experiments with bio-based materials used for construction takes place. Also, the educational institutions located more towards the city centre of Alphen aan de Rijn will expand our knowledge about bio-based materials to support the makers. The current housing area will expand towards the east and the river. Here, makers and housing are combined. Within the area between to different motorways, noisy and messy making will be located, as this area is not suitable for housing nor living.

During the Systemic Change, the Local Hub will turn into a Circular Neighbourhood. As space for distribution and storage is increased, makers will again function as a transition zone between housing and distribution/storage. In the Systemic Change, two different axes will be established to increase the quality of the public space. The first axis will be the green axis that will open up the waterfront. This will add a green structure to the housing /living area. The second axis is a knowledge axis, linking the current educational institutions with the new educational institutions within the makers district.

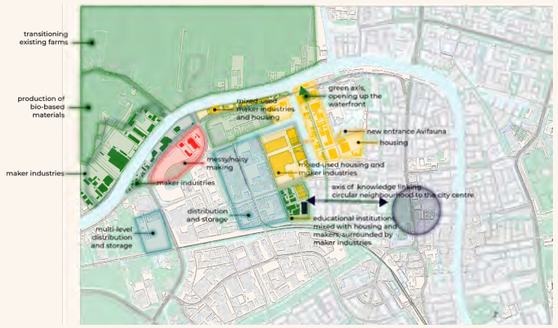
In The Pulse phase, the Circular Neighbourhood will pulse its circularity to its surroundings. Therefore, more area to support this pulse is needed, mainly focussing on bio-based farming, distribution, storage and making.

All these different phases, together with the 'played patterns' are visualised within figure 77 below. See appendix 7.3 for a more zoomed-in version of the maps.

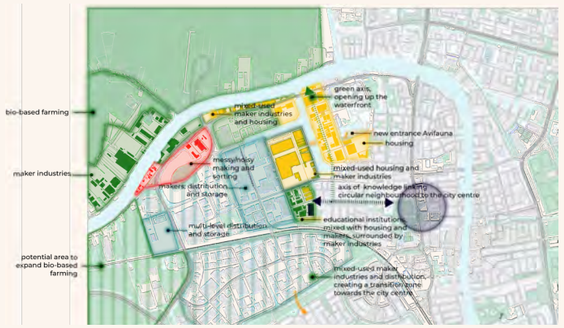
ALPHEN AAN DEN RIJN: THE SPARK



ALPHEN AAN DEN RIJN: THE SYSTEMIC CHANGE



ALPHEN AAN DEN RIJN: THE PULSE



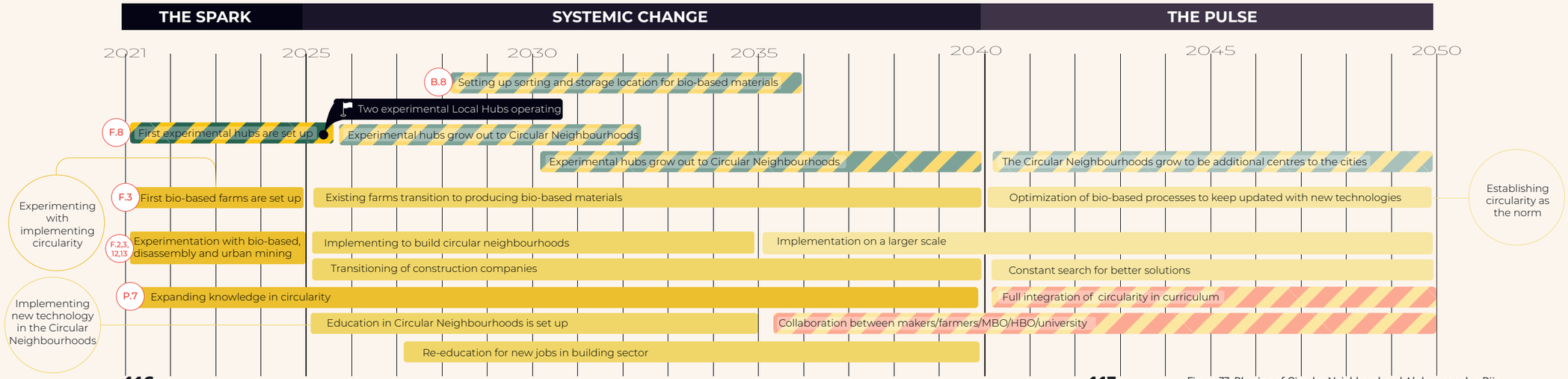


Figure 77, Phasing of Circular Neighbourhood Alphen aan den Rijn

STAKEHOLDERS

Also in Alphen a collaboration between the different levels of education is desired, attracting Leiden university to also participate. A new educational/research institute will be established, in collaboration with farmers and makers. Mainly focused on the farming part of the circular transition, because Alphen aan den Rijn is in the middle of the Green Hart. Furthermore a waterfront park is envisioned with room to experiment with the growing of biobased materials. This is also in collaboration with the recreational harbour and Avifauna, strengthening the recreational value of the area. Also in this hub a community centre and shared facilities are set up, to support collaboration and participation.

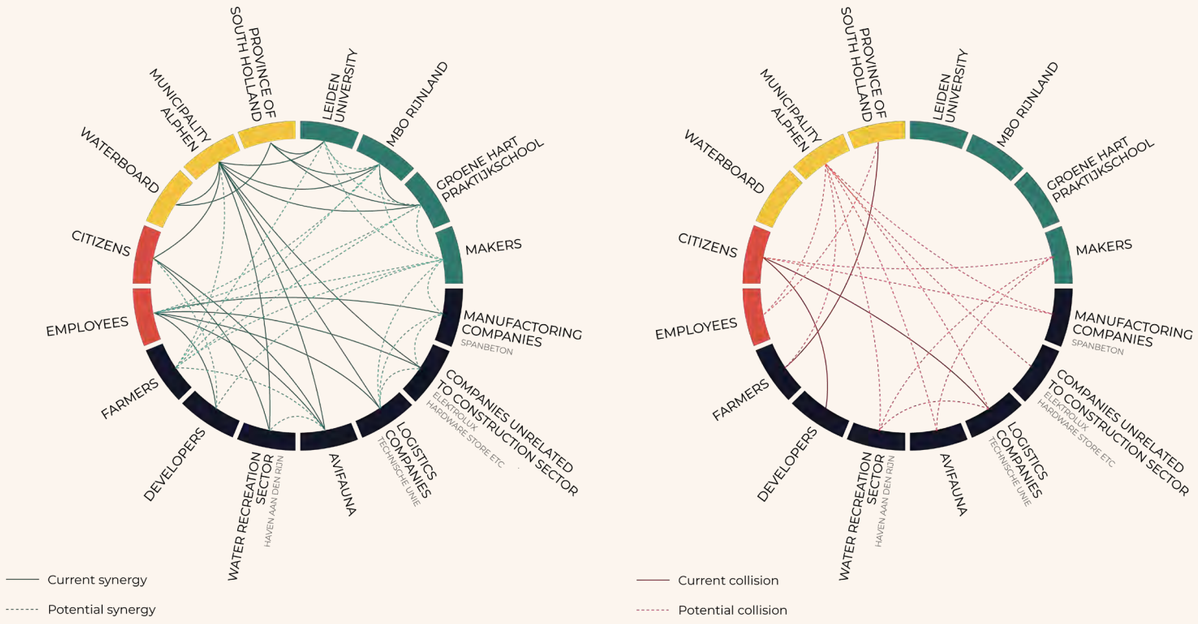


Figure 78, Diagrams showing collisions and synergies between involved stakeholders

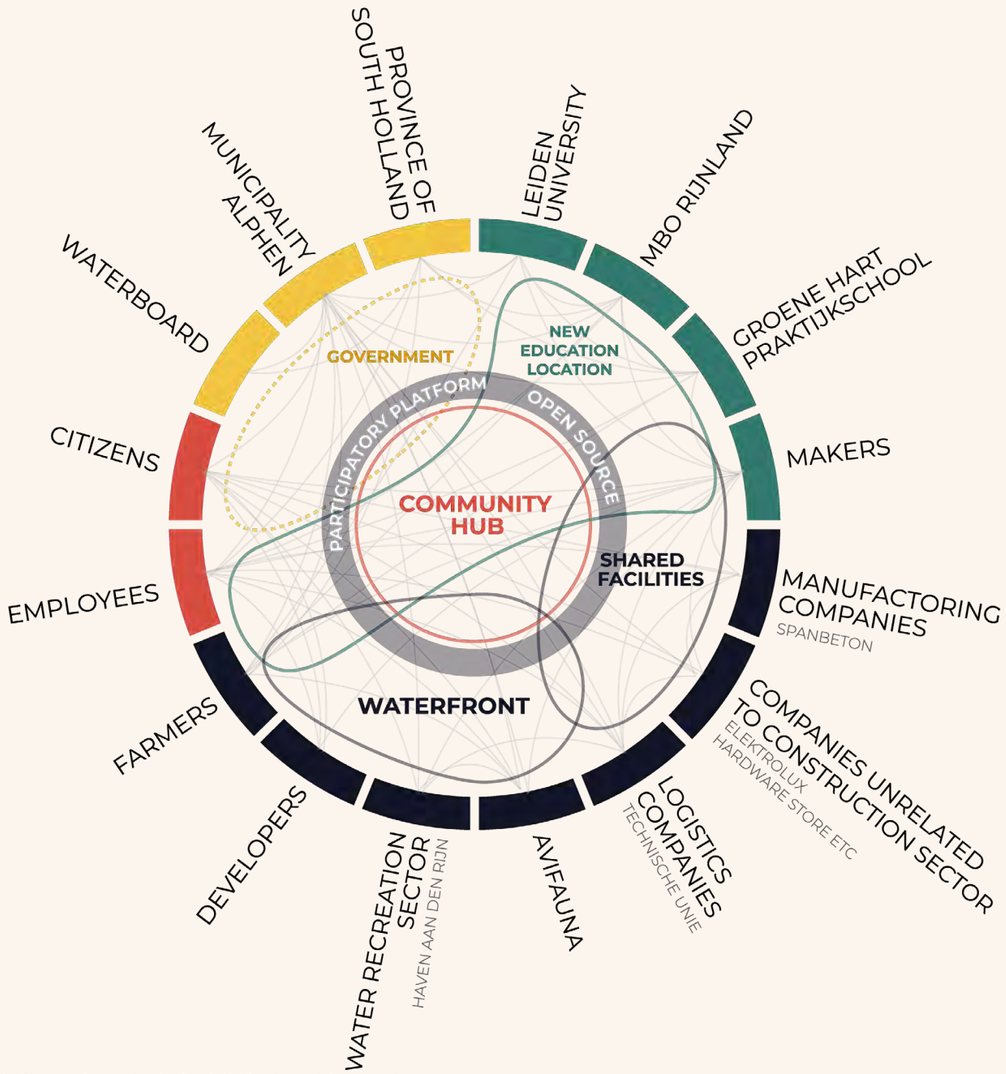


Figure 79, Diagram showing involved stakeholders in spatial interventions

SPATIAL QUALITIES

Figure 80, 81 and 82 give a more in detailed view on how the patterns of the game are played within the Circular Neighbourhood of Alphen, how they contribute to spatial qualities and what the characters of certain areas are. The section from left to right starts at the new space for the growth of crops for biobased materials, which is located at the back of the storage and distribution center, then goes over the water, towards the messy industry. As can be seen in both the section as the isometric view, the messy making is located near infrastructure. On this site housing is not possible, because the highway is already causing a lot of noise pollution. Therefore it is perfect to house more messy making. Adjacent to this, the logistics center functions as a local logistics zone. With its yard for logistics it regulates the incoming goods from the Central Hub on eastern dock. At the end of the Systemic Change more makers are situated here to create more of a transition towards the recreational public zone at the west side of the southern dock. This area has a recreational public character, with flexible spaces for makers where making is transparent towards visitors. It has a link to the park Avifauna through the new bridge. The opposite side of the water is a mixed use neighbourhood with high rise dwelling. The waterscape in this part is recreational, and the green waterfront connects to the new green connection toward the educational zone.

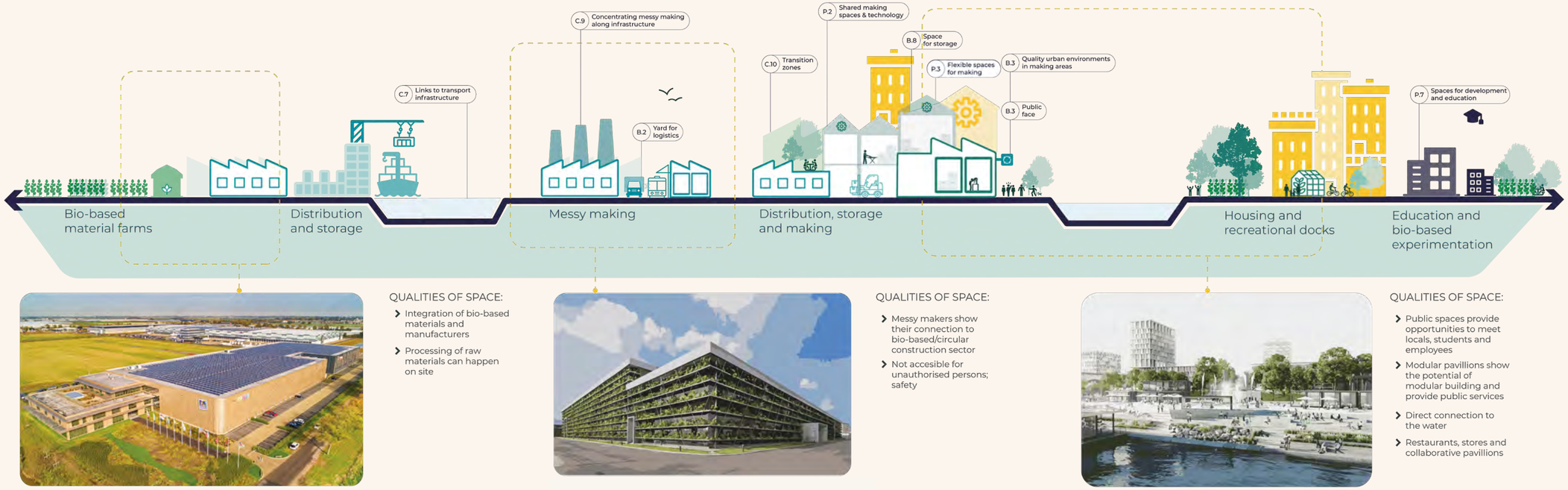


Figure 80, Section showing spatial qualities of linked areas. Made by authors, reference images left to right (RAU Architecten, 2018; Oki, 2020 & WXCA, 2017)

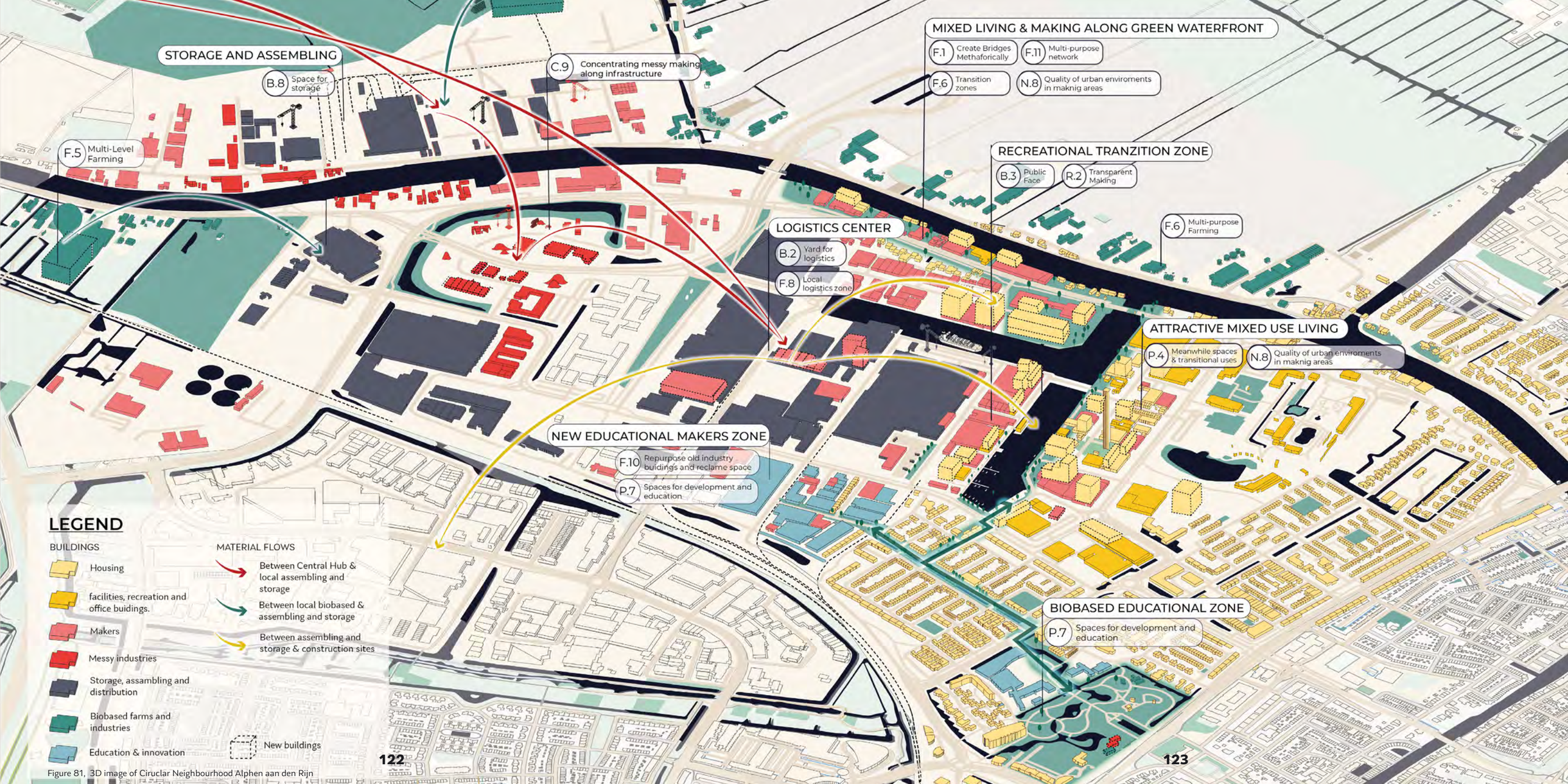


Figure 81. 3D image of Ciruclar Neighbourhood Alphen aan den Rijn

COMBINED HOUSING AND MAKERSHUB

P. 2

P. 8

PUBLIC FACE FOR INDUSTRIAL BUILDING

B. 3

NETWORK ALSO USED FOR RECREATION

F. 11

DISTRIBUTION CENTRE

N. 6

MODULAR HOUSING, MADE FROM BIOBASED MATERIALS OR URBAN MNING

F. 2

F. 3

F. 12

GROWING OF BIOBASED MATERIALS

F. 3

F. 7

CIRCULAR NEIGHBOURHOOD ALPHEN AAN DEN RIJN

Figure 82, Visualisation showing spatial qualities of the Circular Neighbourhood Alpen aan den Rijn. Made by authors, based on (Mark Koehler Architects, 2016; Frantzen et al, 2020 & Vink Bouw, 2020)

4.4.5 Circular Neighbourhood Binckhorst

The second location that will function as an experimental location to grow into a Circular Neighbourhood is Binckhorst, a city located in The Hague.

Next to Binckhorst, Laakkwartier is located. This area includes a lot of houses built in the 1930's. As these houses are in need of renovation, and the area is in need of densification, the Local Hub will support this in a circular way. This will happen in The Spark phase. Apart from this, a bio-based farming area will be established in Binckhorst. This will be a multi-purpose area which is adding quality to the public space and will also function as a transition zone between urban mining and housing. East of The Hague, in Wilsveen, bio-based farming will be established on a larger scale.

During the Systemic Change, the Local Hub will turn into a Circular Neighbourhood. Between the maker areas, a mixed-use housing area will be established. Here, making, housing, living and events are combined. An area for distribution will be located along the river, next to the makers. Some of the old housing in Laakkwartier will be repurposed; instead of housing humans, they will be housing plants. Multi-level farming will make the making visible for citizens. The bio-based farming in Wilsveen will further expand.

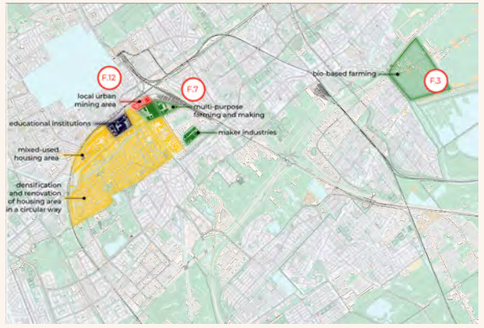
In The Pulse phase, circularity has been set to be the norm. The Circular Neighbourhood will pulse its circularity to its surroundings.

To do this, more space to support this bio-based construction sector is needed. This space is mainly focussing on bio-based farming in and around Wilsveen. In The Pulse, bio-based processes are being optimalised to keep up with new tehnologies and to use the land as efficient as posible, while adding spatial qualities to the public space.

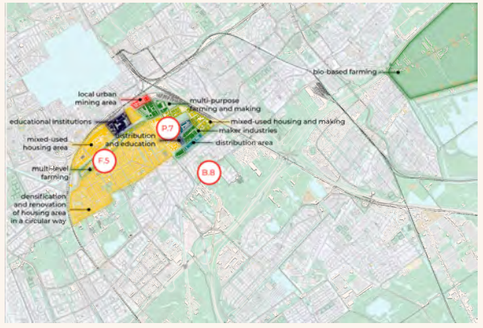
All these different phases, together with the 'played patterns' are visualised within figure 83 below.

See appendix 7.3 for a more zoomed-in version of the maps.

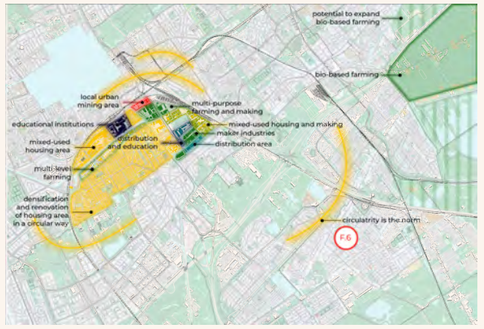
BINCKHORST: THE SPARK



BINCKHORST: THE SYSTEMIC CHANGE



BINCKHORST: THE PULSE



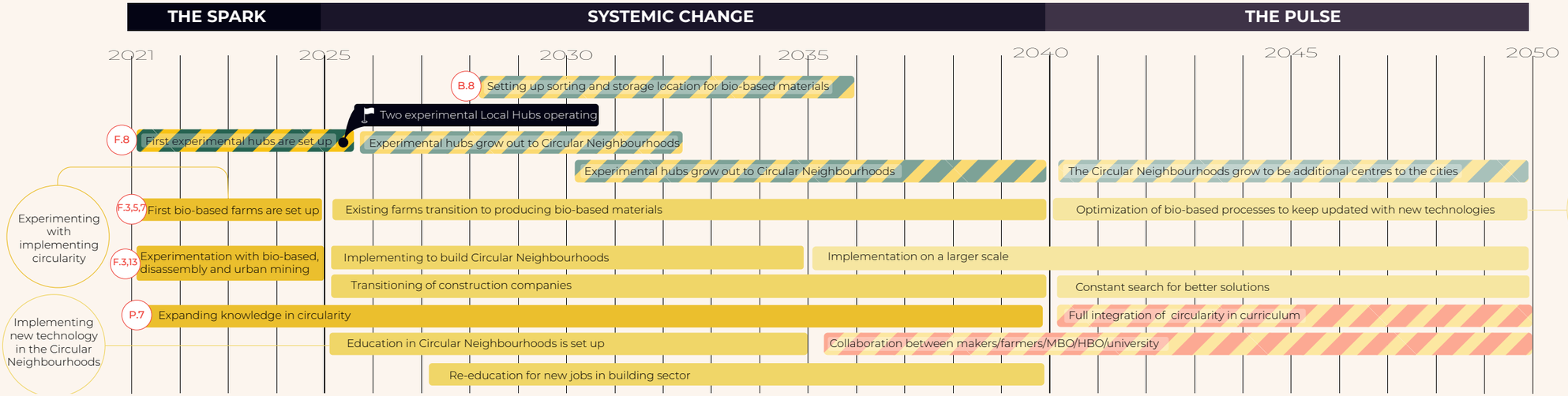


Figure 83, Phasing of Circular Neighbourhood Binckhorst

STAKEHOLDERS

Stakeholder diagram of The Hague follows similar patterns of that of Alphen. Again a new educational location will house part of the Haagse Hogeschool, TU Delft, Leiden university and ROC Mondriaan, working together, focussing on circularity. Also the waterfront will be used for a collaboration between the recreational sector and farmers, this time using vertical farms. Again the existing manufacturers: HAC, focussed asphalt and Dyckerhoff, focussed on concrete, need to be reformed, which may cause friction.

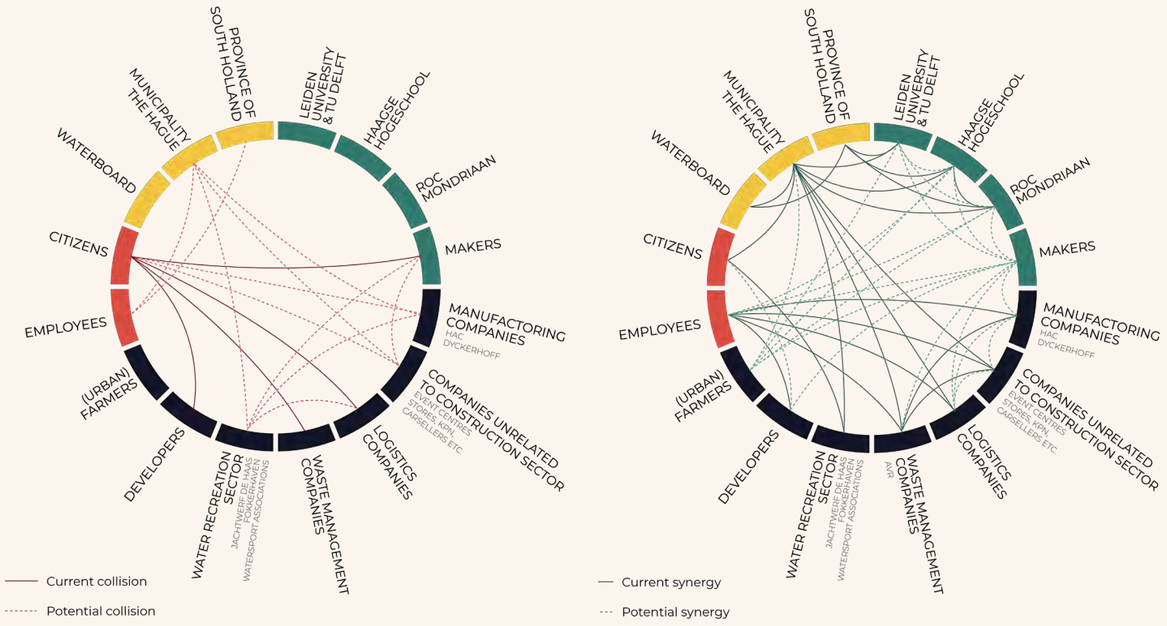


Figure 84, Diagrams showing collisions and synergies between involved stakeholders

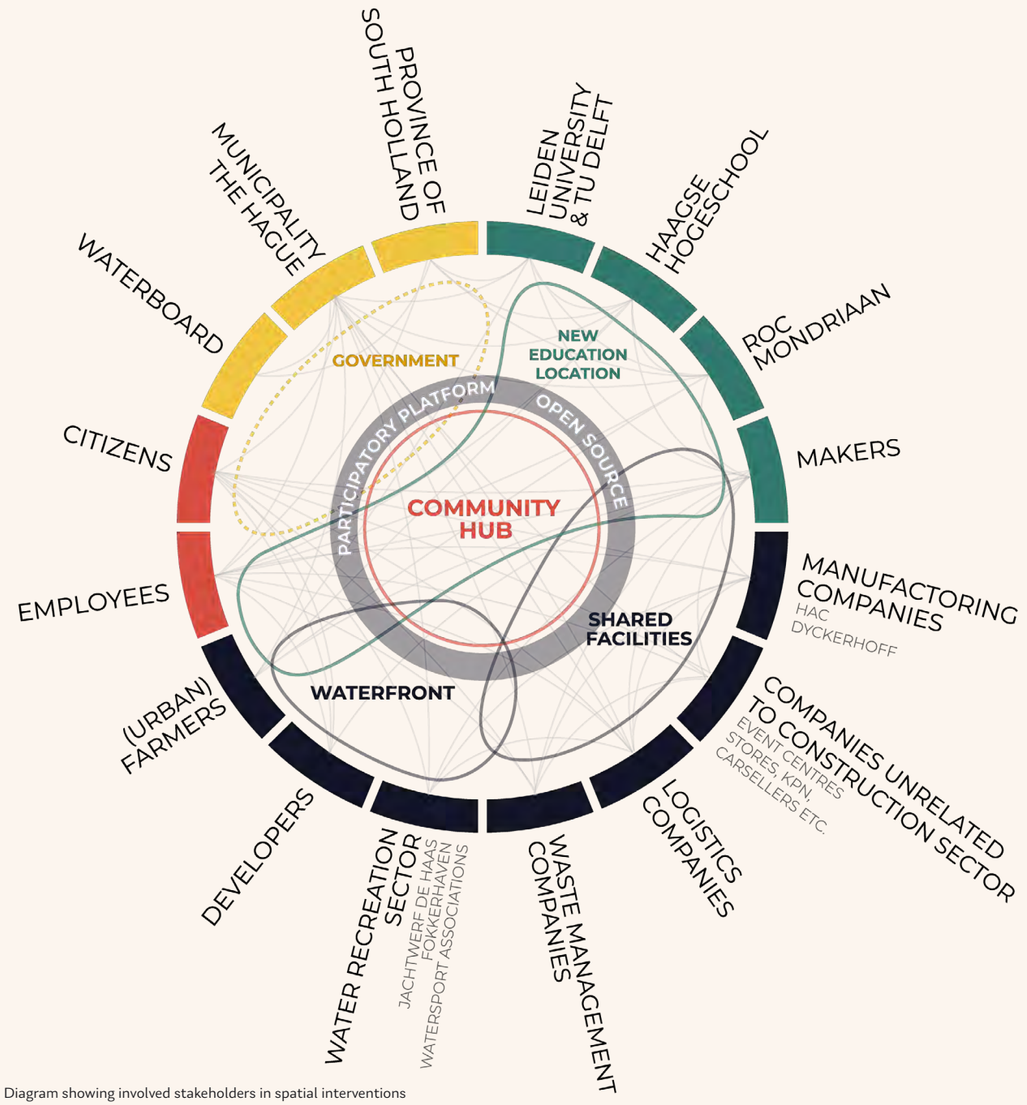


Figure 85, Diagram showing involved stakeholders in spatial interventions

SPATIAL QUALITIES

The following figures show how the different realised parts in binckhorst are transitioning into each other, what patterns are played and what the character of the different areas is. The section (figure 86) from left to right is taken from the renovated residential and multi level farming neighbourhood laakhaven, crossing the water in the direction of the Haagse Hogeschool. This part of the waterscape has a more recreational character, with a green waterfront, giving quality to the laakhaven waterfront. From there the section shows the transition into the existing residential neighbourhood on the east and then again crosses the waterscape. Here the water has a different function, namely the transportation of goods from and towards the small scale urban mining area. However as can be seen in the axonometric view, this is also a green waterfront which can be used to reside and connect the two sides of the water: the existing residential areas on the one side and the new high rise makers, farming and housing districts on the other side. This makers and farming district makes making and farming transparent for the residents and visitor and should be an area where the residents are being brought in contact and will be participating with them. The section continues to the south, through the high rise residential area. The impression on pages 134-135 shows the character of this area, with high rise clt buildings and its recreational waterfront. this also shows how the old industry buildings are being reused. This is especially done in the new makers district and storage and distribution centre on the other side of the water from the high rise area. Here the old factory buildings and halls will transform into a distribution and storage center in combination with spaces where makers can work together.

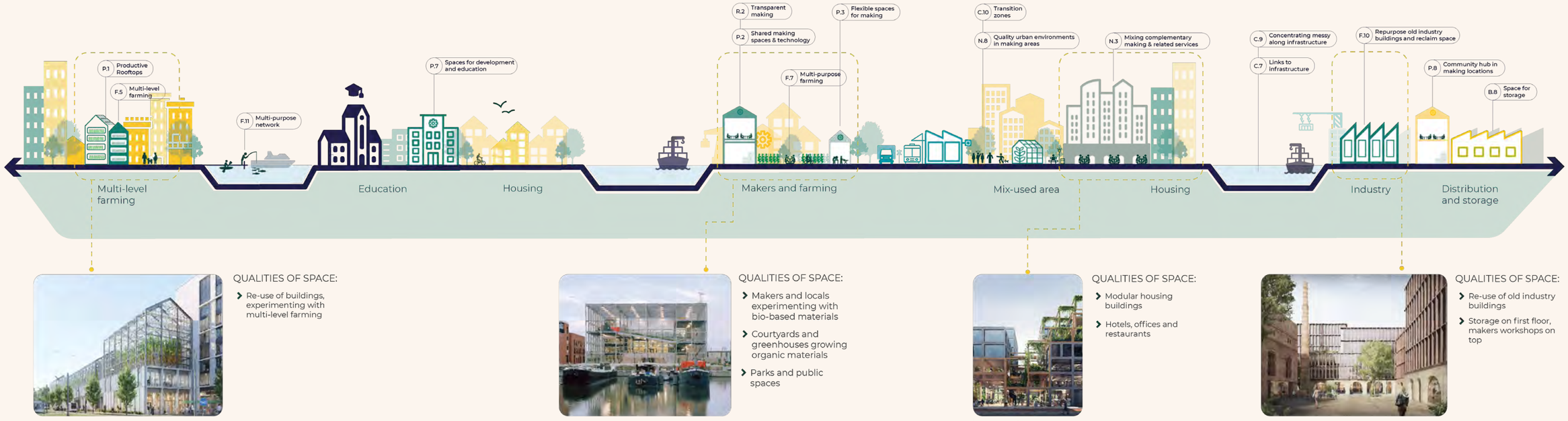


Figure 86, Section showing spatial qualities of linked areas. Made by authors, reference images left to right (Ilimelgo Architects, 2018; Delvaux, 2020; Studioninepoint Architects & Schmidt Hammer Lassen Architects, 2018)

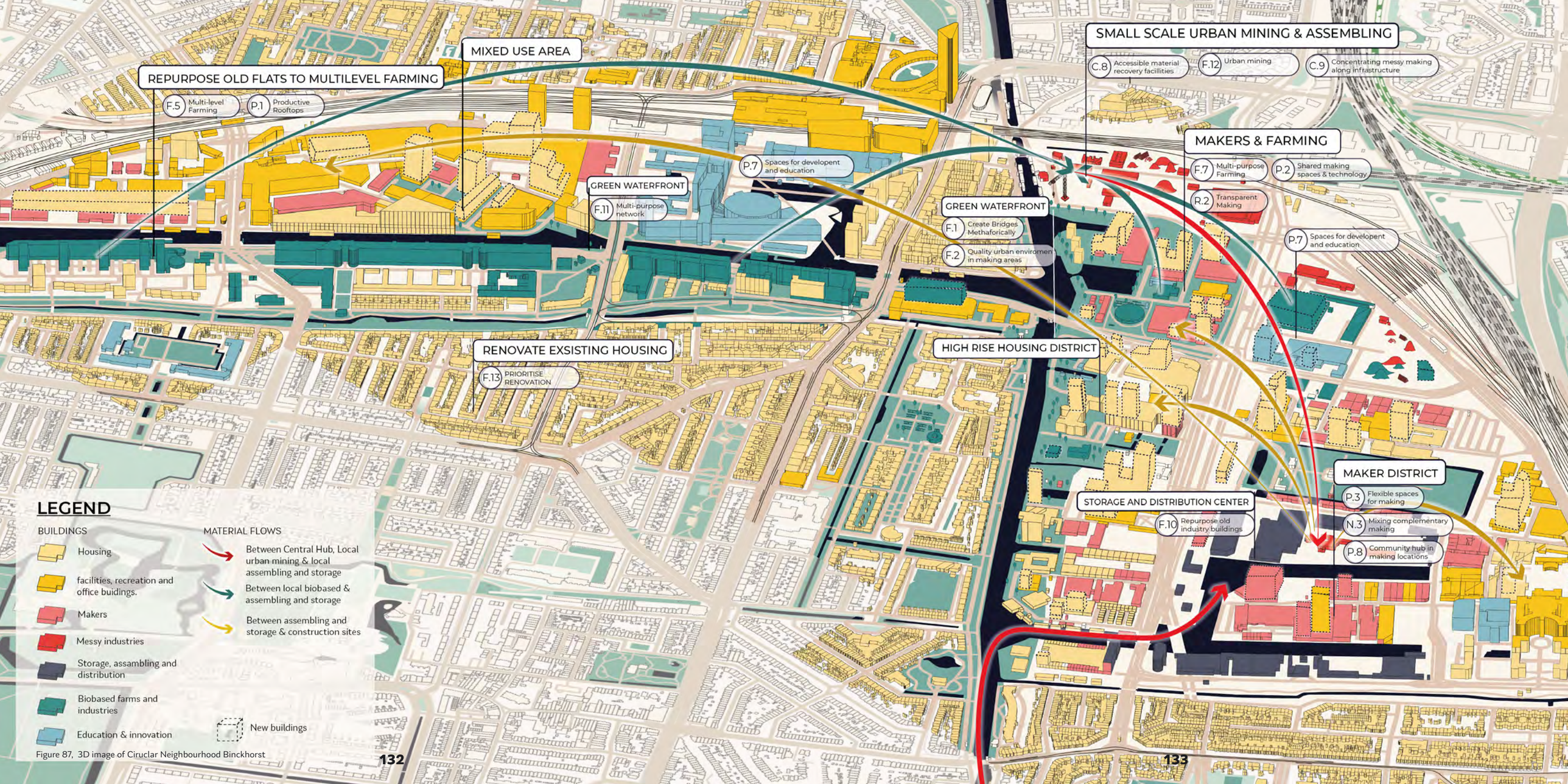


Figure 87, 3D image of Ciruclar Neighbourhood Binckhorst

Figure 88, Visualisation showing spatial qualities of the Circular Neighbourhood Binckhorst. Made by autors based on (Franklin Azzi Architecture, 2017; ATELIER ARS°, 2014; Bijl, 2019; O&O Baukunst, 2018; Illimego architects, 2018; Studio Precht, 2017 & Team V., 2021)

CIRCULAR NEIGHBOURHOOD BINCKHORST

CONSLUSION & DISCUSSION

5

CHAPTERS' CONTENT

5.1 Discussion

Existing plans

With circularity and urbanisation being two themes that are widely discussed right now it is near impossible to think of new interventions that have not been thought out to some extent. Both in The Hague and Alphen aan den Rijn some plans are in place to redevelop industrial areas making it more a mixed use area. FLUX does not take away from these plans but rather adds an extra dimension, in the form of circular construction standards and connecting multiple interventions in different cities by rethinking flows. Because the interventions of FLUX will have a big impact on existing building plans, it is realistic to say that these interventions might be too late to be part of the new plans that might be already submitted to the local governments. On the other hand there is already a consensus to change this area, which might ease the transition. It is not the built form or zoning, but mainly the building methods and connection to surrounding areas that sets the FLUX interventions apart from these plans.

Dependencies

The realisation of the strategic projects and the effect they have on their surroundings is highly dependent on the success of The Spark phase. It is in this phase that examples should be set for other areas with potential. If during this phase not enough stakeholders are convinced of the change and transition that we have to go through, the other phases of FLUX cannot start. On top of that FLUX is not taking into account the speed of the energy transition. The transition is needed to free up space for the Central Hub, if this takes more time than expected, it will slow down the transition FLUX is envisioning.

Besides this dependency stakeholders and the energy transition, there is also a big dependency on the circularity of other sectors. FLUX is a strategy to establish a circular construction sector. Within this strategy the focus is mostly on construction and not on other sectors. This while there is a big interdependency with both the chemical and agricultural sector. These could and should be well integrated with each other to achieve a circular economy.

Farmers in particular should be mentioned. It is this group of stakeholders that are vital to the manufacturing process. Without enough production of bio-based materials less bio-based built materials can be manufactured in the Circular Neighbourhoods. Add to this that the demand for new buildings in the Province of Zuid-Holland is extremely high, resulting in a high demand for bio-based materials. The strategy FLUX proposes does not elaborate on the quantities and space that is needed to accommodate this demand.

Ethical issues

With the FLUX strategy we propose to redevelop the areas near the construction sites to more attractive living spaces. Right now the houses near these industrial sites are less expensive. There lies a danger in our plan that when we develop these areas, the prices of the buildings will go up and this will drive away low class incomes. Therefore it is important to include multiple types of dwellings in these areas, also for the low class incomes.

And what will these newly developed areas mean for the existing urban fabric and structure? FLUX proposes a new structure, where the Circular Neighbourhoods close to the local material hubs will function as new central points within the city. What will this mean for the current city centers, for example, will they still function the same, or will they lose value?

Also there lies a question about the price of the biobased materials and exclusivity of the new housing developments. Will the development of sustainable and energy efficient bio-based material housing create a problem of gentrification?

Transitions bring chaos and uncertainty. With FLUX some social groups like employees in the fossil fuel industry, will be impacted by the transition to a circular construction sector. They will lose their current jobs or will have to move. Those impacted negatively by this transition to a circular construction sector or even a circular economy should be well guided to find their place in the new economy. This is something that cannot only be done on a regional scale, but should be addressed on the national scale. Also policies that favour a circular economy, the green policies as has been suggested in FLUX, will have to be enacted by the national government as the provincial

government does not have the authority to do so. The best the province can do is provide funds and inform municipalities to favour the transition, but for this again the national government backing this would be highly desirable.

Relevance

With our project, we aim to achieve desirable results not only for the province of Zuid-Holland but also for other regional structures related to the waterscape in the country and Europe. By establishing a circular construction sector in the province of Zuid-Holland, this will be an example for other regions and countries to do the same. Furthermore the waterscape of the province is connected well to the rest of the country and a big part of Europe. The implementation of biobased materials in the province will drive up demand in Europe, because a part of the materials will be imported. This will hopefully result in the growing of this sector in other countries and finally in also supplying themselves with these materials.

Recommendations

Further research therefore should be done on quantities and space that is needed to grow the bio-based materials for the new circular buildings, the impacts this will have on the surroundings, and how this can be done sustainable. Research into other new materials and techniques should always be ongoing, improving what is already there. Innovation is a never ending ongoing process.

Furthermore, as said earlier in this discussion, there is a need to look into the integration of a circular construction sector with other sectors within the Circular Economy. There must be other sectors that have valuable resources that can contribute to achieving circularity. It is also valuable to look further than the boundaries of the province and of the Netherlands and connect this vision to that. The ideal result would be the symbiosis of multiple sectors on a large scale

Lastly, FLUX calls for the use of an open-source platform where stakeholders, resources and flows can meet. In order to make this work more insights on this platform are needed, this is now a gap in our research. How can we implement this in a way that everyone is able and willing to use this?

5.2 Assessment

In the first chapter multiple goals have been set based on the Sustainable Development Goals from the United Nation and the European Green Deal. In this chapter there will be assessed how FLUX contributes to these goals.

1. NO POVERTY

FLUX proposes a wide range of jobs in the new economy by re-introducing the manufacturers and green industry in the region to promote economic stability, resilience and to sustain diversity.

4. QUALITY OF EDUCATION

FLUX tries to ensure that people who are working in the fossil industries and non-renewable manufacturing companies are being re-educated, so that they do not lose their jobs in this transition. In the future, lifelong learning should be the rule to promote innovation. Furthermore it encourages the integration of circularity in education, keeping education up to date with new developments. This is also linked the Green Deal goal: **Mobilising Research and fostering innovation** FLUX aims to promote partnerships between education institutes in the province, entrepreneurs, makers and the government to come up with innovative sustainable practices.

8. DECENT WORK AND ECONOMIC GROWTH

FLUX incorporates the transition of the “makers industries” as the main actor within the chain of production for the reuse of construction materials. The mix of working and living in the new area’s will aim to boost the economy in those neighbourhoods and provide diverse job opportunities for all.

9. INDUSTRY, INNOVATION AND INFRASTRUCTURE

FLUX repurposes and renovates the current waterscape in the region and creates partnerships between higher education institutes and manufacturers to promote a constant exchange of knowledge and breakthroughs. This also adds to the Green Deal goal: **Mobilising Industry for a clean and circular economy.** The main focus of FLUX is on circularity, specifically in the building sector. It scales up urban mining, promotes smart disassembly of buildings and contributes to less extraction of natural resources. The shift for the industry is to go from oil-based to bio-based.

10. REDUCED INEQUALITIES

FLUX strives for a fair redistribution of land with equal opportunities and new jobs, healthier communities, self-governance and in close relationship with the government. Participation, continuous dialogues and citizens input is vital in order to incorporate everyone’s needs into the project. This also contributes to the goal of the european Green Deal to **Leave no-one behind** (just transition).

11. SUSTAINABLE CITIES AND COMMUNITIES

FLUX proposes new types of neighbourhoods that follow circularity principles. These neighbourhoods are sustainable, with flexibility of housing typologies, are mix-used and take into account the spatial quality and resilience needed to achieve a sustainable healthy community.

12. RESPONSIBLE CONSUMPTION AND PRODUCTION

FLUX promotes renovation of old buildings, the use of bio-based materials for construction and incorporates urban mining in the life cycle of a building, in order to limit the extraction of raw materials from the environment and achieve a circular construction sector. This is also linked the Green Deal goal: **Building and renovating in an energy and resource efficient way.**

13. CLIMATE ACTION

FLUX aims to reuse existing construction materials, encourages use of biobased materials and aims to make current manufacturing processes more sustainable in order to reduce CO2 emissions that come from the production of the whole process. This is also linked to the European Green Deal: **A zero pollution ambition for a toxic-free environment.**

15. LIFE ON LAND

FLUX promotes the growth of biobased materials and food by repurposing farmlands, thus creating productive landscapes. This also further advances the Green Deal goal: **Preserving and restoring ecosystems and biodiversity**. FLUX stops urbanization on the horizontal way that results in more loss of biodiversity, instead it proposes vertical growth, and growth within city centers and on industrial sites to keep up with the housing demand.

17. PARTNERSHIP FOR THE GOALS

FLUX promotes a continuous collaboration with other stakeholders within the building sector. It aims to create partnerships between educational institutes, civil society, the private sector and the government to achieve a circular construction sector for the region of Zuid-Holland by the year 2050.

5.3 Conclusion

Due to rapid urbanisation 230.000 dwellings are needed in the province of Zuid-Holland. It is estimated that around 40% of all raw material flows within the province of Zuid-Holland are generated by the C&D sector and that it is the largest waste stream in this area. The current flow of materials is linear and unsustainable. A biobased and circular sector should be established within the province.

In the beginning of this report a main question was coined: How can a symbiosis of stakeholders and resources contribute to a circular construction sector? This question was further divided into sub questions.

The first question being: What is the geography of flows? The research done concluded that the main materials used in the buildings sector were brick, concrete and steel. Resources for these materials are extracted in unsustainable ways and the production causes a lot of emissions. The current geography of flows and resources is very inefficient, linear , as these materials are either downcycled or sent to waste facilities and lacks bio-based materials. Based on the analysis, the construction sector seems to be very much linked to the waterscape. This is partly because transportation via water has always been, and still is, the most efficient and cheap way of transportation in The Netherlands.

The next step is to analyse opportunities, what non-renewable resources can be replaced?
Biobased materials could be an option to replace these traditional building materials. CLT can be used for loadbaring structures. Hemp, flax, straw and reed can be used for isolation, walls, floors, panels etc. Because of its strength, steel still has a place in a circular construction sector, but the process should be reformed, using urban mining to make the process circular instead of linear. Bio-based materials should be included in the system and a local supply chain should be set up. Additionally, the lifespan of buildings and materials has to be expanded. To do this, the geography of flows and resources has to be re-thought through regional design.

Which brings us to the next question: How can flows (materials, data, knowledge) and physical networks be optimised? The waterscape will have an important role as infrastructure for transport. The harbour of Rotterdam will function as the Central Hub for the flow of resources and as an entrance and exit for the rest of Europe. On key locations along the canals, Circular Neighbourhoods will be developed. This is where makers, education, housing and bio-based farms will come together. The collaboration between these stakeholders is actively encouraged, by shared facilities and buildings. Another important part of the neighbourhoods are the Local Hubs which will function as a distribution centre for the rest of the city and connect the agricultural land around the cities, used for the growing of biobased materials. In addition to physical changes also an open source platform will be launched, giving companies not only insight into uses of materials, resources, waste streams and logistics but providing easy access to collaborate with other stakeholders. It could be used to exchange and combine flows and keep innovating.

To give more insight into how these Circular Neighbourhoods work, it is important to look at the makers: How can maker industries be tied into the symbiosis? Within these Circular Neighbourhoods the makers industries will be the missing link between the knowledge institutes and the manufacturers. Exchanging knowledge and keeping up to date with new developments. The maker industries will be involved throughout the whole construction process, trying to include innovation in there as well. The maker industries will be a part of the manufacturing, distributing, assembling, maintenance and urban mining processes. They will produce locally and engage with their community.

The transition will take place in three phases: The Spark, the Systemic Change and The Pulse. First in The Spark phase, experimental hubs will be established. This phase is about experimenting and gathering knowledge that can be implemented in the next phase: the Systemic Change. In this phase all the hubs will be set up and the network is functioning. In The Pulse phase the Circular Neighbourhoods will be exemples and will affect the surrounding beyond these neighbourhoods.

These neighbourhoods will of course have consequences for the surroundings. What will be the implications of this symbiosis on spatial and social sustainability? The Circular Neighbourhoods will be located on former industrial sites and could be a solution to the conflict of space between industrial sites, urban areas and agriculture & natural landscape. Circular Neighbourhoods will be mixed use, and function as an additional centre to the cities. Nuisance is minimized and urban quality is protected by implementing the different patterns, like giving the industrial buildings a public face. With the change of the original function of industrial sites and the reforming of companies in the building sector, consequently jobs will be lost. As the change needs to happen quickly, and job-loss should be avoided, employees should be retrained-on-the-job, the new educational location with collaboration between different levels will play a big role in this. Also, students should be educated to contribute to the future, circular construction section.

Another problem is the conflict of space between industrial and residential areas. Applying a network of mixed use Circular Neighbourhoods would allow for a positive interaction between both land uses. These neighbourhoods are connected to the waterscape, which will be repurposed to support the circular building sector. the agricultural land in between can be used to grow bio based materials. These bio-based materials will be transported to the Local Hubs in the Circular Neighbourhoods for further processing by the makers and bio-based industry into prefabricated elements. This connects the buildings directly with its surrounding. The built environment becomes part of the landscape again and reinforces its identity by deriving from the surrounding landscape.

With this knowledge the main question: 'How can a symbiosis of stakeholders and resources contribute to a circular construction sector?' can be answered. Collaboration between stakeholders and resources is crucial to make this transition work and will be facilitated in the Circular Neighbourhoods and the Central Hub. Education and knowledge about circularity, in FLUX also seen as stakeholders and resources, will be a driving force behind the transition, due to an intensive collaboration between makers and universities. This will be further supported by an open source and participatory platform.

The term Flux refers to different layers of the vision: the repurposing of the waternetwork and the constant flows of resources, affecting the areas around it. In short, FLUX.

Figure 89, Map showing the composition of strategic projects after FLUX

REFERENCES

6

6.1 Literature

Abbing, M. R. (2000). Beleidsramp Betuwelijn: Groepsdenken houdt alternatieven voor megaproject tegen. AGORA Magazine, 16(2), 16-19.

Alexander, C., Ishikawa, S., & Silverstein, M. (1977). *A pattern language: towns, buildings, construction*. Oxford university press.

Allorge, L. (2016) *Halle Pajol in Paris, France* [Photo]. Wikimedia commons. https://commons.wikimedia.org/wiki/File:Halle_Pajol_à_Paris_le_13_août_2016_-_10.jpg

Arnoldussen, J., Errami, S., Semenov, R., Roemers, R., Blok, M., Kamps, M., & Faes, K. (2020). *Materiaalstromen, milieu-impact en energieverbruik in de woning- en utiliteitsbouw.*

ATELIER ARS°. (2014). *Levering Trade* [Photo]. Archdaily.
https://www.archdaily.com/771468/levering-trade-atelier-ars-degrees?ad_medium=gallery

Babor, D., Plian, D., & Judele, L. (2009). Environmental impact of concrete. Buletinul Institutului Politehnic din Iasi. Sectia Constructii, Arhitectura, 55(4), 27.

Becker, U., & Schebek, L. (2017, February 2). *Urban Mining – recovering materials in metropolitan regions*. Urbanet.
https://www.urbanet.info/urban-mining-materials-metropolitan-regions/

Bender, A. P., & Bilotta, P. (2019). *Circular Economy and Urban Mining: Resource Efficiency in the Construction Sector for Sustainable Cities.*
https://doi.org/10.1007/978-3-319-71061-7_40-1

Bevir, M. (2012). *Governance: A very short introduction*. OUP Oxford.

Bijl, J. (2019). *Omgevingsplan Binckhorst* [Photo]. Haacs.
https://www.haacs.nl/omgevingsplan-binckhorst-een-experiment/

Block, M., Schouten, N., & Dasnois, M. (2020, August 12). *On the journey to a circular economy, don't forget your materials passport.*
https://www.metabolic.nl/news/circular-economy-materials-passports/

Blok, M. (2021, February 2). *Urban mining and circular construction – what, why and how it works*. METABOLIC.
https://www.metabolic.nl/news/urban-mining-and-circular-construction/

BOOM Landscape. (2020). Biobased (ver)bouwen Zuid Holland. https://www.collegevanrijksadviseurs.nl/adviezen-publicaties/rapport/2020/03/10/yi-2019-boom-landscape-biobased-verbouwen

Brolsma, J. U. (2010). Beknopte geschiedenis van binnenvaart en vaarwegen. Geraadpleegd van https://puc.overheid.nl/rijkswaterstaat/doc/PUC_136872_31/

Campbell, S. D. (2013). Sustainable Development and Social Justice: Conflicting Urgencies and the Search for Common Ground in Urban and Regional Planning. *Michigan Journal of Sustainability, 1*(20181221).
https://doi.org/10.3998/mjs.12333712.0001.007

Centraal Bureau voor de Statistiek [CBS]. (2019a, November 8). *Construction sector leading in waste and recycling.*
https://www.cbs.nl/en-gb/news/2019/45/construction-sector-leading-in-waste-and-recycling

Centraal Bureau voor de Statistiek [CBS]. (2019b), ***Regionale bevolkings- en huishoudensprognose 2019–2050:*** Den Haag. https://www.pbl.nl/sites/default/files/downloads/pbl2019-pbl-cbs-regionale-bev-en-hhprognose-2019-2050-belangrijkste-uitkomsten-3812.pdf

Centraal Bureau voor Statistiek [CBS]. (2019c). *Standaard Bedrijfs Indeling 2008* (Versie 2018 Update 2019). [Data set].

CBS. (2021). How many enterprises in the Netherlands? - The Netherlands in Numbers 2020 | CBS. https://longreads.cbs.nl/the-netherlands-in-numbers-2020/how-many-enterprises-in-the-netherlands/

Chahim, M., Bastein, A., van Bree, M. W., & Rietveld, E. (2019). *De gevolgen van de transitie naar een Circulaire Economie op de werkgelegenheid in de provincie Zuid-Holland.*

Chilvers, J., & Kearnes, M. (2015). Public participation in science and technology: why the failure to launch? *December 17.*
https://www.theguardian.com/science/political-science/2015/dec/17/public-participation-science-technology-failure-to-launch

Cities of Making. (2018). *Cities of Making, Cities Report.*
https://citiesofmaking.com/cities-report/

City of Rotterdam. (2019). *From Trash to Treasure.* http://rotterdamcirculair.nl/Programma_Rotterdam_Circulair_2019-2023/UK/index.html

Delvaux, Maxime. (2020). *Melopee School* [Photo]. XDGA.
http://xdga.be/#195_melopee

Drift, & Metabolic. (2018). *Zuid-Holland; Verkenning van grondstofstromen en handelingsopties voor de Provincie.*
https://www.zuid-holland.nl/publish/pages/21255/hoofdrapportzuid-hollandcirculair.pdf

van Dijk, M., & van Gelder, F (2012). Transformatie van industriële gebieden. Retrieved from https://edepot.wur.nl/311416

Economisch Instituut voor de Bouw [EIB], & Metabolic. (2020). Materiaalstromen, milieu-impact en energieverbruik in de woning- en utiliteitsbouw. Retrieved from https://circulairebouweconomie.nl/wp-content/uploads/2020/02/Rapport-Materiaalstromen-in-de-woning-en-utiliteitsbouw-klein.pdf

Elkington, J. (1994). *Cannibals with Forks*. New Jersey, USA: Wiley.

Engels Baksteen. (n.d.) ***Productieproces.***
https://www.baksteen.nl/engels-baksteen/test-4/

European Commission. (2019). *A European Green Deal.*
https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en#relatedlinks

Franklin Azzi Architecture. (2017). *Nantes Métropole Higher School of Fine Arts* [Photo]. Archdaily. https://www.archdaily.com/915442/alstom-warehouses-nantes-metropole-higher-school-of-fine-arts-franklin-azzi-architecture?ad_medium=gallery

Franzen, N. (2015) Copenhagen_Denmark_0239 [Photo]. Flickr. https://www.flickr.com/photos/nicolefranzen/19863490511/sizes/l/

Frantzen et al. (2020). *Top-up* [Rendered image]. OpenBuilding.
https://www.openbuilding.co/topup-frantzen-et-al

Geels, F. W. (2005). *Technological transitions and system innovations: a co-evolutionary and socio-technical analysis.* Edward Elgar Publishing.

Gemeente Rotterdam & Havenbedrijf Rotterdam N.V. (n.d.). Ruimtelijk Raamwerk Merwe-Vierhavens Rotterdam.
https://m4hrotterdam.nl/wp-content/uploads/2019/07/DLA-M4H-17028-Boekwerk-190627-LQ.pdf

Gemeente Rotterdam, Provincie Zuid-Holland, Port of Rotterdam, Rijksoverheid & Deltalings. (2019). Havenvisie Rotterdam

Gladek, E., Van Exter, P., Roemers, G., Schlueter, L., De Winter, J., Galle, N. & Dufourmont, J. (2019). Circular Rotterdam, Opportunities for new jobs in a zero waste economy. *Metabolic & Circle Economy.*

Google. (n.d.a). *Alphen aan den Rijn.* [Satellite image]. Google. https://www.google.com/maps/@52.13258,4.6430313,2550m/data=!3m1!1e3

Google. (n.d.b). *The Hague.* [Satellite image]. Google. https://www.google.com/maps/@52.0594029,4.3407638,3404m/data=!3m1!1e3

Google. (n.d.c). *Port of Rotterdam.* [Satellite image]. Google. https://www.google.com/maps/@51.8921745,4.3538327,10200m/data=!3m1!1e3

Google. (n.d.d). *Provincie Zuid-Holland.* [Satellite image & Photo]. Google. https://www.google.nl/maps/@52.004179,4.505229,77178m/data=!3m1!1e3

Government of the Netherlands, & Ministry of Education, C. and S. (2019a). *Infographic summarizing the new science policy.* [Policy Note]. https://www.government.nl/topics/science/documents/publications/2019/01/28/infographic-summarizing-the-new-science-policy

Government of the Netherlands, & Ministry of Education, C. and S. (2019b). *Curious and committed - the value of science* . [Policy Note]. https://www.government.nl/topics/science/documents/policy-notes/2019/01/28/curious-and-committed---the-value-of-science

Grow2Build. (2015a). *Flax & hemp G2B* [Dataset]. https://inagro.maps.arcgis.com/apps/Viewer/index.html?appid=66e2b906e9a8408fb4f66b4e9b642ab6

Grow2Build. (2015b). *Grow2Build.*
http://www.grow2build.eu/

van der Ham, W. (2003) Watersnoodramp van 1953 was te voorkomen. *Tijdschrift van Waterstaatsgeschiedenis, 1*(21-31).

Harvey, D. (2008). The Right to the City. New Left Review, (53), 23–40. https://doi.org/10.1080/13604819608713449

Hill, A. V. (2020). *Foundries of the Future: a Guide to 21st Century Cities of Making* (B. Croxford, T. Domenech, B. Hausleitner, A. V Hill, H. Meyer, A. Orban, V. Muñoz, F. Vanin, & J. Warden (eds.)). TU Delft Open.

Hirshberg, P., Dougherty, D., & Kadanoff, M. (2017). *Maker city - A practical guide for reinventing our cities.*
https://makercitybook.com/

Hobbs, G., & Adams, K. (2017). *Reuse of building products and materials–barriers and opportunities.* International HISER Conference on Advances in Recycling and Management of Construction and Demolition Waste, June, 109–113.

Hoosain, M. S., Paul, B. S., Raza, S. M., & Ramakrishna, S. (2021). Material Passports and Circular Economy. In *An Introduction to Circular Economy* (pp. 131–158). Springer Singapore. https://doi.org/10.1007/978-981-15-8510-4_8

Hussein, H. (2006). *Urban recreational riverfronts: Successful revitalisation elements. Journal of Design and Built Environment*, 2(1). https://ejournal.um.edu.my/index.php/jdbe/article/view/4940.

Illimelgo architects. (2018). *Magellan's urban farm* [Rendered image]. Ilimelgo. http://ilimelgo.com/en/projects/nouvelle-traduction-20-ferme.html

Ike, P. (2000). De planning van zandwinning in Nederland. *Rooilijn*, *33*(9), 444-449

Koutamanis, A., van Reijn, B., & van Bueren, E. (2018). Urban mining and buildings: A review of possibilities and limitations. *Resources, Conservation and Recycling, 138*. https://doi.org/10.1016/j.resconrec.2018.06.024

Kruit, C., & Beltman, J. (2020). Open Building. Geraadpleegd van https://www.openbuilding.co/

Landschapsbeheer Nederland. (2005). *Kleiput.*
https://www.leestekensvanhetlandschap.nl/kleiput

Larsen, G. L. (2012). *An Inquiry into the Theoretical Basis of Sustainability*. In: Dillard, J., Dujon, V. & King, M. C. (eds.) Understanding the Social Dimension of Sustainability. London: Routledge.

van Loon-Steensma, J. M. (2011). Robuuste multifunctionele rivierdijken: welke kansen en knelpunten zien stakeholders voor robuuste multifunctionele dijken langs de rivieren in het landelijk gebied?, 2228 (50). Alterra.

Loorbach, Derk & Frantzeskaki, Niki & Avelino, Flor. (2017). *Sustainability Transitions Research: Transforming Science and Practice for Societal Change.* Annual Review of Environment and Resources. 42. doi: 10.1146/annurev-environ-102014-021340.

Mark Koehler Architects. (2016). *Superlofts* [Photo]. OpenBuilding. https://www.openbuilding.co/superlofts-mka

McDonough, W., & Braungart, M. (2002). *Cradle to cradle: remaking the way we make things.* North Point Press.
https://newtechpackaging-5a64.kxcdn.com/wp-content/uploads/2017/07/Cradle-to-Cradle.-McDonough-and-Braungart.pdf

van der Meulen, M. J., Wiersma, A. P., van der Perk, M., Middelkoop, H., & Hobo, N. (2009). Sediment management and the renewability of floodplain clay for structural ceramics. *Journal of Soils and Sediments*, 9(6).
https://doi.org/10.1007/s11368-009-0115-8

Ministerie van Verkeer en Waterstaat (2010). Beknopte geschiedenis van binnenvaart en vaarwegen. De ontwikkeling van de natte infrastructuur in Nederland. http://www.vliz.be/imisdocs/publications/ocrd/222420.pdf

Miu, I. (2020). *Fundamental characteristics and concept of material passports.*

Moreau, V., Sahakian, M., van Griethuysen, P., & Vuille, F. (2017). Coming Full Circle: Why Social and Institutional Dimensions Matter for the Circular Economy. *Journal of Industrial Ecology, 21*(3).
https://doi.org/10.1111/jiec.12598

Mulder, S., Muricy, B. C., Commu, L. A., & van Mil, J. (2021). *Let's stop talking and start building* (Master Thesis).

Nelissen, E. Scherpenzeel, H. (2020) De circulaire bouweconomie: van Transitieagenda naar uitvoering. *Stadsblad, Perspectief op circulair en inclusief bouwen*. https://www.cirkelstad.nl/wp2/wp-content/uploads/2019/09/Krant_DNWC19_v1.2_web.pdf

NIBE. (2019). *Potentie van biobased materialen in de bouw. Een onderzoek naar de mogelijkheden en impact.*

https://circulairebouweconomie.nl/wp-content/uploads/2019/07/CBE-Eindrapportage-potentie-biobased-materialen-NIBE-juli-2019.pdf

Oki, H. (2020). Jakob Factory / G8A Architecture & Urban Planning + rollimarchini architekten [Photo]. Archdaily. https://www.archdaily.com/947300/jakob-factory-g8a-architecture-and-urban-planning-plus-rollimarchini-architekten/5f573e22b35765e32a000285-jakob-factory-g8a-architecture-and-urban-planning-plus-rollimarchini-architekten-photo

O&O Baukunst. (2018). *Ernst Busch University of Performing Arts* [Building]. https://www.archdaily.com/912095/ernst-busch-university-of-performing-arts-o-and-o-baukunst?ad_medium=gallery

Pereira, A.R., Post, J., Erkelens, P. (2005) Innovating Built Heritage: Adapt the Past to the Future. Presented at The 2005 World Sustainable Building Conference,Tokyo, 27-29 September 2005, 2899 https://www.researchgate.net/publication/228865622_INNOVATING_BUILT_HERITAGE_ADAPT_THE_PAST_TO_THE_FUTURE

Plambeck, P. & Wijnakker, R. (2019) *Ontwerpend onderzoek Groene Hart*. Den Haag: Buro Sant & Co Landschapsarchitectuur+Fabrications https://www.bestuurlijkplatformgroenehart.nl/sites/stuurgroepgroenehart/files/2020-06/juli_2019_-_sant_en_co_fabrications_-_groene_hart_-_ontwerpend_onderzoek_-_rapport_def.pdf

Port of Rotterdam, (2019). International position as Waste-to-Value Port: Rotterdam circular hub for raw materials transition. [Position paper]. https://www.portofrotterdam.com/sites/default/files/circular-economy-position-paper.pdf

PosadMaxwan, Gemeente Den Haag.(2019) Uitwerking van de Gebiedsaanpak Binckhorst, *Beeldkwaliteitsplan Binckhorst*.

Provincie Zuid-Holland. (2014). *Bodematlas Zuid-Holland* [Dataset]. https://atlas.zuid-holland.nl/GeoWeb54/index.html?viewer=Bodematlas

Provincie Zuid-Holland. (2017). *Discussienota: Verstedelijking Provincie Zuid-Holland: Koers en Inzet*. https://www.zuid-holland.nl/publish/pages/19103/discussienotaverstedelijking.pdf

Provincie Zuid-Holland. (2019). *Verstedelijkingsalliantie*. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwi81POswtruAhXD-aQKHa9rDl0QFjAAegQIAhAC&url=https%3A%2F%2Fwww.zuid-holland.nl%2Fpublish%2Fpages%2F19519%2Fbijlage1pamfletverstedelijkingsalliantie-versie6nov.pdf&usg=AOvVaw3qhbjDKtai

Provincie Zuid-Holland. (2020). *Bouw mee, Zuid Hollandse woningbouwagenda. December.* https://www.zuid-holland.nl/publish/pages/26641/de-zuid-hollandse-woningbouw-agenda-december2020.pdf

RAU architecten. (2018). *Eosta* [Photo]. Systabo. https://www.systabo.nl/referenties/eosta-waddinxveen/

Rocco, R. (n.d.) Spatial Justice, Understanding the spatial dimensions of justice. Spatial Justice Blog. https://spatialjustice.blog/

Rocco, R. (2021a). *Attention Please* (No. 3; Methodology for Urbanism). https://indd.adobe.com/view/970581e3-b3de-4110-84c2-432a5b881a8d

Rocco, R. (2021b). *I have a dream* (No. 4; Methodology for Urbanism). https://indd.adobe.com/view/abc083c0-eaab-4b65-83a5-9609c14bc5c0

Roemers, G., van Raak, R., van Exter, P., Marseles, I., Rach, S., Hoeks, J., & Kotvis, X. (2018). Zuid-Holland Circulair. https://www.researchgate.net/publication/34297719_Zuid-Holland_Circulair_-_Verkenning_van_Grondstofstromen_en_Handelingsopties_voor_de_Provincie/link/5f1013da45851512999e61b0/download

Roser. M, Ritchie. H and Ortiz. E (2013) ***World Population Growth***. https://ourworldindata.org/world-population-growth'

Rutte, R. (2005). Landschap vol steden. Over het ontstaan van de Nederlandse steden en hun plattegronden van de elfde tot de vijftiende eeuw. *OverHolland, 2*(73-90). https://doi.org/10.7480/overholland.2005.2.1579

Schmidt Hammer Lassen Architects. (2018). Kimmel Quarter [Rendered image]. SHL. https://www.shl.dk/kimmel-quarter/

Schuwer, D., van der Knaap, I. W., & Roijackers, R. (2007). Wonen op het water: succes-en faalfactoren. Living on the water: success—and failure—factors]. Wageningen University.

SPACE10, EFFEKT Architects, (n.d.) *The Urban Village Project*. https://www.urbanvillageproject.com

Studio Marco Vermeulen. (2019). *Bouwen met bomen*. https://marcovermeulen.eu/nl/projecten/bouwen+met+bomen/

Studio Marco Vermeulen. (2020). *Ruimte voor biobased bouwen - een strategische verkenning*. https://www.rijksoverheid.nl/documenten/rapporten/2020/11/02/rapport-ruimte-voor-biobased-bouwen-strategische-verkenning

Studioninepoints Architects. (n.d.). *Rebel building* [Rendered image]. Studioninepoints. https://studioninedots.nl/project/rebel/

Studio Precht. (2017). *High-rises of vertical farms and modular homes [*Rendered image]. Designboom. https://www.designboom.com/architecture/chris-precht-the-farmhouse-modular-farming-02-25-2019/

Soja, E. W. (2010a). *Seeking Spatial Justice*. Minneapolis: University of Minnesota Press.

Stenvert, R. (2012). *Biografie van de baksteen 1850-2000*. WBooks/Rijksdienst voor het Cultureel Erfgoed.

Stichting LISA. (2019). *LISA Data* (update 2019) [Data set].

Swilling, M., & Annecke, E. (2012). *Just transitions: Explorations of sustainability in an unfair world.* UCT Press.

Swire Properties (2014) *The Swire Daci Temple Project.* [Rendered Image] Jingdaily. https://jingdaily.com/swires-juggernaut-project-poised-to-shake-up-chengdus-retail-scene/

Team V Architectuur. (2021). *Haut* [Rendered Image]. Teamv https://teamv.nl/en/projects/haut/

Tata Steel Europe. (2020). *Tata Steel in Europe Shaping a sustainable society for generations to come.*

Techniek College Rotterdam. (z.d.). *Rdm campus* [Photo]. https://www.techniekcollegerotterdam.nl/locatie/rdm-kade-59

Thöle, H. (2021). Course Documents [Lectures of PZH on Monday afternoon 8 feb]. Lecture of Helmut Thöle. https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2071983/View

TU Delft. (2021). Course Documents [Q3 Quarter Guide 2020_2021]. Spatial Strategies for the Global Metropolis. 21. https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2065666/View

UNEP Global Environmental Alert Service [GEAS]. (2014). *Sand, rarer than one thinks*. https://na.unep.net/geas/archive/pdfs/GEAS_Mar2014_Sand_Mining.pdf

United Nations. (2021). *17 Goals to Transform Our World.* Sustainable Development Goals. https://www.un.org/sustainabledevelopment/

Vink Bouw. (2020). *DOK2404* [Photo]. Vinkbouw. https://www.vinkbouw.nl/projecten/wonen/dok2404

Wentink, H. (1995). Kalk & Cement. Stichting Projectbureau Industrieel Erfgoed. https://www.industrieel-erfgoed.nl/sites/default/files/bijlagen/bestanden/pie_rapport_16_kalk_en_cement.pdf

de Wit, M., Hoogzaad, J., Ramkumar, S., Friedl, H., & Douma, A. (2018). The Circularity Gap Report: An analysis of the circular state of the global economy. https://pacecircular.org/sites/default/files/2020-01/Circularity%20Gap%20Report%202018_0.pdf

World Steel Association. (2018). Sustainable Steel: Indicators 2018 and industry initiatives. *Sustainable Steel: Indicators 2018 and Industry Initiatives.* https://www.worldsteel.org/en/dam/jcr:ee94a0b6-48d7-4110-b16e-e78db2769d8c/Sust_Steel_2018_v8.pdf

WXCA (2017). *The Vistula River Boulevards* [Rendered Image]. Archdaily. https://www.archdaily.com/882063/warsaw-selects-wxca-as-winner-for-riverfront-masterplan/59ea17a0b22e38dd0500011a-warsaw-selects-wxca-as-winner-for-riverfront-masterplan-image

Zandvliet, K. (2015). *Arbeidsmarktonderzoek Haven-en Industriecomplex Rotterdam 2014-2015.* https://www.deltalinqs.nl/stream/eindrapport-am-hic-2014-2015.pdf

APPENDIX

7

7.1 Individual reflections

Individual reflection I Monserratt Cortés Macías

The increasingly rapid way cities have been changing, growing and evolving should finally teach us to embrace temporality. We should be more conscious that our actions must leave a minimal mark in this planet as we continue to see the effects the anthropogenic era has had in the natural environment after years of taking, making and wasting. Sadly, we are the generation that not only has to think about climate change, social crisis and injustices, pandemics and our destructive ways of consumption driven by capitalism. However, we are also the generation that can take on these challenges and spark the transition and paradigm shift for a better future in favor of the upcoming generations. We have the energy, tools, ambition and knowledge to do it.

During this quarter, my team and I developed a regional design vision and strategy for the Province of Zuid-Holland that sought to answer big "what if" questions on the basis of a circular construction sector that at the same time, would take into account spatial justice and have a positive effect within the urban fabric and its civil society. Since the early stages of our process, we started collecting information, gaining understanding of the current situation and material flows as well as the social implications if our vision is to be implemented.

As we jumped through the different regional scales, we continued to construct and deconstruct the territory into its various layers, introducing a new network of flows, processes and actors. In this way, I learned that regional design forces you to re-interpret the territory but not only in its physical landscape but also through the lens of societal challenges and its ever changing context, depending on which scale you are focusing on. Moreover, by going through these transformation processes, starting with strategic local projects connected through the waterscape network, I realized the important role that infrastructure and open data have to serve as a solid foundation for our project. Even when looking at the big picture, these strategic local initiatives have huge impact and their pulse can be felt through the different layers, reaching finally the regional one. As integration and regional identity is important, the stronger the integration within these local initiatives the better their performance in the bigger scale (Cardoso, 2021). Finally, after a continuous process of analysis, debate, imagination, predictions, assessments along the way and re-evaluations... we present to you: FLUX.

Undoubtedly, our first attempt at regional design was indeed a complex task. I learned that the translation of social and economic factors into the spatial plan must come from a design for social inclusion perspective and that in order to take on these challenging tasks, our process needs to be adaptive spatial frameworks instead of a fixed masterplan. We must then recognize the spatial capital and negotiate how to use it and fairly redistribute it. As seen with the makers, sustainable urban development acknowledges the city not only as the consumer but also as the producer. Therefore, an organic development based on patterns and design principles is a more desirable one to be able to come up with different solutions towards resilient urban landscapes.

Finally, we cannot do this alone. Regional design needs a transdisciplinary approach. Planning must take into account the proposals of different participants like institutions, specialists, public administration, and politics. Coordination is thus a challenge but, with communicative planning we should seek to make the process of planning cities as fair and inclusive as possible. This way of planning helps us designers, planners, and managers of the built environment to focus the attention of the stakeholders with the help of spatial visions, new laws and regulation, policies, guides and different scenarios. These planning instruments help guide, shape, regulate and stimulate transitions to be able to finally live in the era of sustainability.

In conclusion, I remember the first studio session where our tutors started to talk about something called "circular economy". Honestly, that was the first time in my life hearing the concept. Therefore, I think I have come a long way in this quarter after hours of research. Group Work with my team was an enriching experience. Even though we would not always think the same way, we learned to compromise in favor of the greater good. As we come from different backgrounds, hearing different perspectives, ideas and solutions showed me the importance of transdisciplinary processes and approaches towards the task. Each team member shared their skills and knowledge and all of us showed the same commitment and energy during the entire quarter. We enjoyed the process and are happy with the results.

Sources:

Campbell, S. D. (2013). Sustainable Development and Social Justice: Conflicting Urgencies and the Search for Common Ground in Urban and Regional Planning. Michigan Journal of Sustainability, 1(20181221). https://doi.org/10.3998/mjs.12333712.0001.007

van Schaick, J. (2021) Shaping (Zuid) Holland - Lessons from 25 years of regional design in the Southern Randstad . [SDS and Capita Selecta lectures] retrieved from https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2071961/View

Cardoso, R. (2021) Cities reconfigured at the regional scale - Polycentric urban regions and the process of metropolisation. [SDS and Capita Selecta lectures] retrieved from https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2083951/View

Rooij, R. (2021) Methods of regional planning and design. [SDS and Capita Selecta lectures] retrieved from https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2083953/View

Individual reflection I Thomas van Daalhuizen

The last few decades the world has seen a rapid change in scales. The connectivity of different cities and countries has become increasingly better, making it harder to look at cities on a small scale. Where in 1950 the cities that would later form the Randstad were still viewed as separated, in 2021 we see them as a polycentric urban region. The new way that these cities work together and are also depending on one another calls for a new approach when looking at complex tasks. The regional scale is what we need to see how these cities interact and can all contribute to a similar goal. With circularity being one of the main goals of the province of Zuid-Holland (Drift & Metabolic, 2018) it is time to really start using regional design to bridge some missing links (Thöle, 2021, p.18). Many different cities are working on individual strategies and visions while we should be working together to complete such a hard-to-reach goal.

As Helmut Thöle (2021, p.19) suggested in his lecture: "politically the regional scale is not always a very powerful scale, but it is the scale where challenges, decisions and actions have a lot of impact.

The role of regional design is to bring stakeholders together that are needed to make complicated transitions happen. By looking outside of the city limits and using the knowledge and network of the region a much greater number of interested parties can be activated. It is regional design that can bring different interests and views together to create a uniform structural plan.

Being a connecting force is something that keeps surfacing when discussing regional design. These discussions were not only held during lectures but also tutoring sessions or even while discussing the project with friends this is something that comes up. It is the complex tasks that are taken up through regional design that call for a collaborative approach. As an urbanist I have always liked this part of designing, bringing together different stakeholders and working with multiple instances through different scales. The teamwork of this quarter has really shown me how important communication is in these complex processes.

The team that I have been a part of has been communicating really well all throughout the course, making sure that each one of us knew what the other team members were doing. Besides communication, creating a comfortable environment is equally as important. Telling peers or interested parties what you are struggling with helps enormously. It can give new insights and keeps up the pace, which is usually necessary for the challenges that are presented on the regional scale.

To me it has become clear that current and future challenges such as circularity are in need of a regional approach where collaboration is the most important aspect. I would be glad to become part of a team that could help bridging the missing links to tackle such important but complex tasks.

Sources:

Thöle, H. (2021). Course Documents [Lectures of PZH on Monday afternoon 8 feb]. *Lecture of Helmut Thole* retrieved from: https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2071983/View

Drift & Metabolic. (2018). *Zuid-Holland Circulair*. https://www.zuid-holland.nl/publish/pages/21255/hoofdrapportzuid-hollandcirculair.pdf

Individual reflection I Paula Nooteboom

Urbanisation, population growth, the need for renewable energy and a circular economy, more space for green and water and social justice. All these challenges are being stacked up and the fight for space is bigger than ever. There are dozens of visions and ideas, in different sectors and scales, and all these visions have their own idea of how space is divided, planned and designed.
The role of strategic regional planning is crucial within this division of space, as it is much more than just spatial land use planning and design, it also touches the society, stakeholders, culture, transport, policies, the environment, social justice and so on. (Balz, 2021) Everything is interfering with each other and nothing can be certain. Therefore the role of a regional planner, in my opinion, is to look at all these different waves of ideas and visions, use them and connect them with each other to complement each other. Within FLUX we tried to get a grab on multiple different ideas and visions and tried to create a symbiosis between spatial visions for more housing, biobased landscapes and preserving the waterscape with more societal visions for a circular economy, renewable energy and the creation of new jobs and trends of makers industries, new building initiatives and an open source network.
Within the project we made a rather detailed plan for first strategic projects. However it is not certain how these interventions will in the end contribute to the structure for the province we have in mind. This is typical for Regional Planning; the results are loose ended as the projects are long term and depend on multiple factors. From the SDS and methodology lectures, I learnt that as an urban designer, it is important to facilitate actions and stakeholders towards guided decisions. Regional design is not designing a region and convincing clients that your design is the best, it is using existing ideas, bringing them together and steering into the right direction. As Fred Hobma said in the lecture on planning tools (March 2021) "Realisation of governmental designs heavily relates on implementation by market parties, governments do not act as client for housing, offices, shopping centres ... The key issue is how planning tools affect the 'decision-environment' of market actors. " Regional design is making strategies, patterns, including uncertainties, making a pathway and going into conversation with relevant stakeholders. This is something I had never done before, as until this course I always made more detailed zoning plans and designs. In Flux, we approached the strategy with a pattern language. This maintains the option of flexibility but guides the stakeholders and government towards our vision.
Just as Regional design has involved many stakeholders with their opinions and visions, FLUX has also been created by multiple members. Working together with four teammates and three different tutors has given multiple visions within the FLUX project. Sometimes it is hard, as the visions and ideas are contradictory to each other and a way to come to an agreement or settlement has to be found. Nevertheless, we managed to find those settlements and got to combine multiple narratives, as everyone has had their main interest point within the project.
Gaining so much knowledge and knowing that there is so much more to be explored within the circular economy, triggered my interest. There is much more to connect and as an urban designer I want to contribute to finding this symbiosis.

Sources:

Hobma, F. (2021) Lecture on planning tools [SDS lectures on Monday morning 15 march]. retrieved from: https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2098477/View

Balz, V. (2021) From vision to strategy. [SDS lectures on Monday morning 15 march] retrieved from https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2099006/View

Individual reflection I Siene Swinkels

Coming from the architecture track I chose this course, because I was doubting between the two master tracks. I felt that in architecture my personal artistic vision was always at odds with sustainability. Sustainability did not seem as important to me on this small scale, because I felt that the impact of one building would always be minimal. I think this is somehow symbolic of how a lot of stakeholders within regional design act: All have different objectives and are focussed on different scales, a lot of bigger challenges, such as circularity are not the first thing they will tackle, simply because more context is needed to understand the importance of this.

This might also be the biggest challenge of regional design: how to get everyone on board? Urbanism is not about designing a beautiful vision, but really about guiding and supporting the different stakeholders to do the right thing and also showing the benefits for these stakeholders in the transition. As Fred Hobma talked in his lecture about the importance of markets aware planning. 'The state does not control 'place production'. It must find ways to influence the behavior of development actors.' (2021). Sometimes this also means compromising, finding the right balance between objectives and not having the outcome that was first envisioned.

The larger the scale, the more stakeholders and the more complex the projects become. In Thöle's lecture it became clear that in the last few decades a big jump in scale has been made in the Randstad, from smaller independent cities to a big network of centres, all connected and dependent on one another. This has become so complex that conflicts of space arose and also the province now has to be selective of what it focuses on (Thöle, 2021). This also means that there is less control, the end result will always be different from the first vision that was made.

The same goes for working in a team: I might have an idea of how the project should go, but I will always have to work together with your teammates, compromising your own vision. It complicates the process, but the end result normally is a lot better and nuanced than what I originally envisioned.
Which is also what happened collaborating this quarter. We all worked hard and communicated well. The team was a comfortable environment. We were able to be honest with one another, telling someone when something is or is not working out, but also willing to help each other when someone was struggling. I think this type of open communication is crucial within team work, and helps to bring everyone's best qualities out. During discussions with my team and tutors I have learned a lot about different points of views on the project and how to bring this together.

Learning about the regional scale this quarter has really opened my eyes. In terms of challenges like circularity, energy transition, urbanisation etc. the solutions should be found on a regional scale. Policy on an EU level or national level is being made, and also on a smaller scale initiatives are popping up, but somehow there is still a missing link between these two scales: now the regional planning should come in (Thöle, 2021). Whether or not I will continue with architecture, I think my attitude towards designing has changed. Buildings do not stand on their own and even if their impact is small, it is part of a bigger story.

Sources:
Thöle, H. (2021). Course Documents [Lectures of PZH on Monday afternoon 8 feb]. *Lecture of Helmut Thole* retrieved from: https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2071983/View

Hobma, F. (2021) Lecture on planning tools [SDS lectures on Monday morning 15 march]. retrieved from: https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2098477/View

Individual reflection I Rosa de Wolf

As I only started the Urbanism Master track at the Faculty of Architecture and the Built Environment this February, I at first was a bit insecure about my qualities and knowledge about regional design. Throughout the course, all different Methodology, Capita Selecta and Spatial Development Strategies (SDS) lectures and workshops, gave me essential insights on the theories and methods of the regional design. It ensured me to have sufficient knowledge to fully participate and made me feel secure about my capabilities.

The lectures also worried me a bit as they showed how much had to happen in such a short period of time, as the province of Zuid-Holland has set the goal to be fully circular by 2050 (Drift & Metabolic, 2018). The lectures described the missing link, which was defined as the difference between the feasible change and the change needed to achieve this wanted goal (Thöle, 2021, p18). The big question seems to be: how can we bridge this missing link? It became clear that to make the transition towards a circular economy, regional design was most important.

During the first studio meeting, we were asked to express our preference regarding one of the sectors; construction and demolition, agri-food or chemical. As I'm a student, living in the province of Zuid-Holland and facing the problem of the demand of affordable housing within the region, I chose the construction- and demolition sector. Nevertheless, during the AR2U086 and AR2U088 courses we got insights on all different sectors. The courses didn't only make me think about a circular construction sector, it also set my mind to start thinking about circularity as a whole. I questioned myself whether I was sincere when doing research and designing for a circular construction sector, which includes making people change their behavior, when I myself don't even contribute my bit by doing something as easy as to stop eating meat. The SDS lectures changed my mindset; everyone can contribute to sustainability no matter what amount of power a person or institution has.

During design discussions, my student team and I talked a lot about all different stakeholders involved in the transition. While creating the regional design, we considered all different actors, tying to represent them all. This process made me realize that with regional design, there are so many different stakeholders involved.

I think this huge number of stakeholders is part of the answer to the question 'how can we bridge this missing link?'. To start the transition, to bridge the missing link, we have to get everyone on board. I find our vision and strategy to be part of the missing link, trying to connect all different research, initiatives and opportunities. In the end, I think for transition to actually happen we need a serious change in policies, in many cases; sustainability should come first.

During these courses, we've been introduced to the regional scale and design. For me, this scale turned out to be a very interesting one because of its complexity. With all the knowledge, skills and tools I've gained this quarter, I feel able to contribute to the transition towards a circular economy in future projects.

Sources:
Thöle, H. (2021). Course Documents [Lectures of PZH on Monday afternoon 8 feb]. *Lecture of Helmut Thole* retrieved from: https://brightspace.tudelft.nl/d2l/le/content/278701/viewContent/2071983/View *P-18*

Drift & Metabolic. (2018). *Zuid-Holland Circulair*. https://www.zuid-holland.nl/publish/pages/21255/hoofdrapportzuid-hollandcirculair.pdf

7.2 Zoomed-in X-Curves

X-CURVE SHOWING THE TRANSITION FROM A LINEAR CONSTRUCTION SECTION TO A CIRCULAR CONSTRUCTION SECTOR

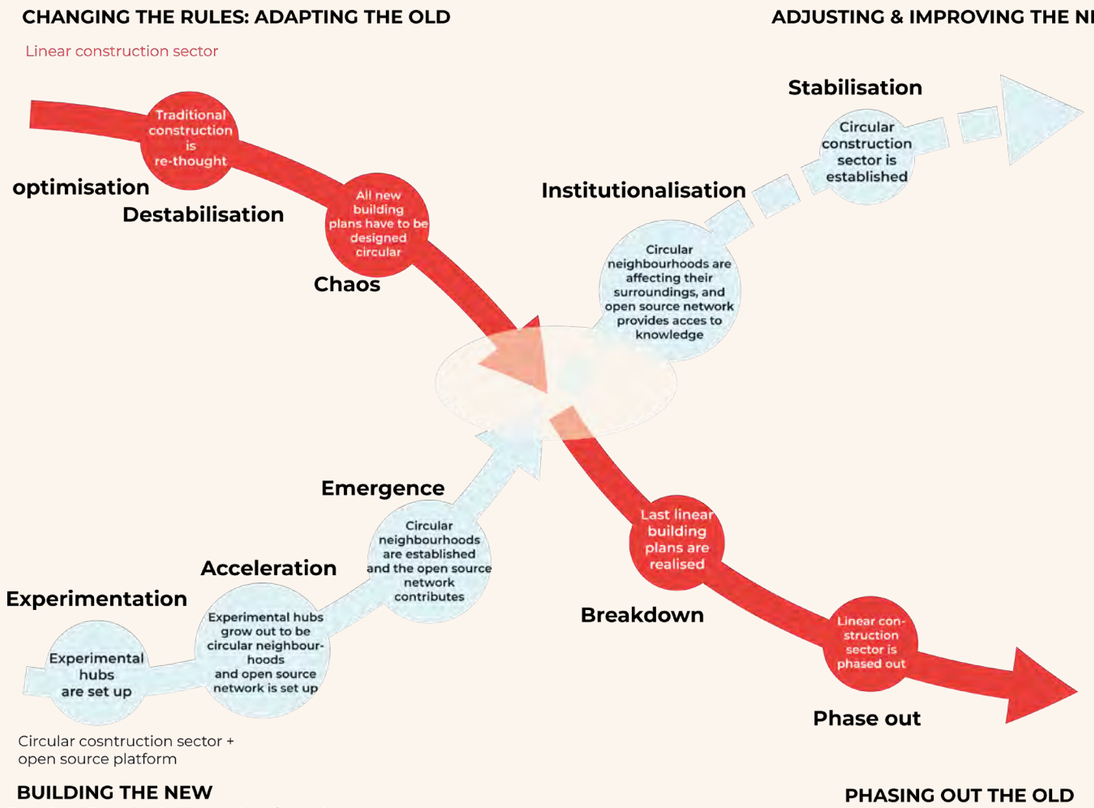


Figure 54, X-Curve showing the transition from a linear construction sector to a circular construction sector. Made by authors, based on (Loorbach et al., 2017)

X-CURVE SHOWING THE TRANSITION IN LIFESPAN OF BUILDINGS

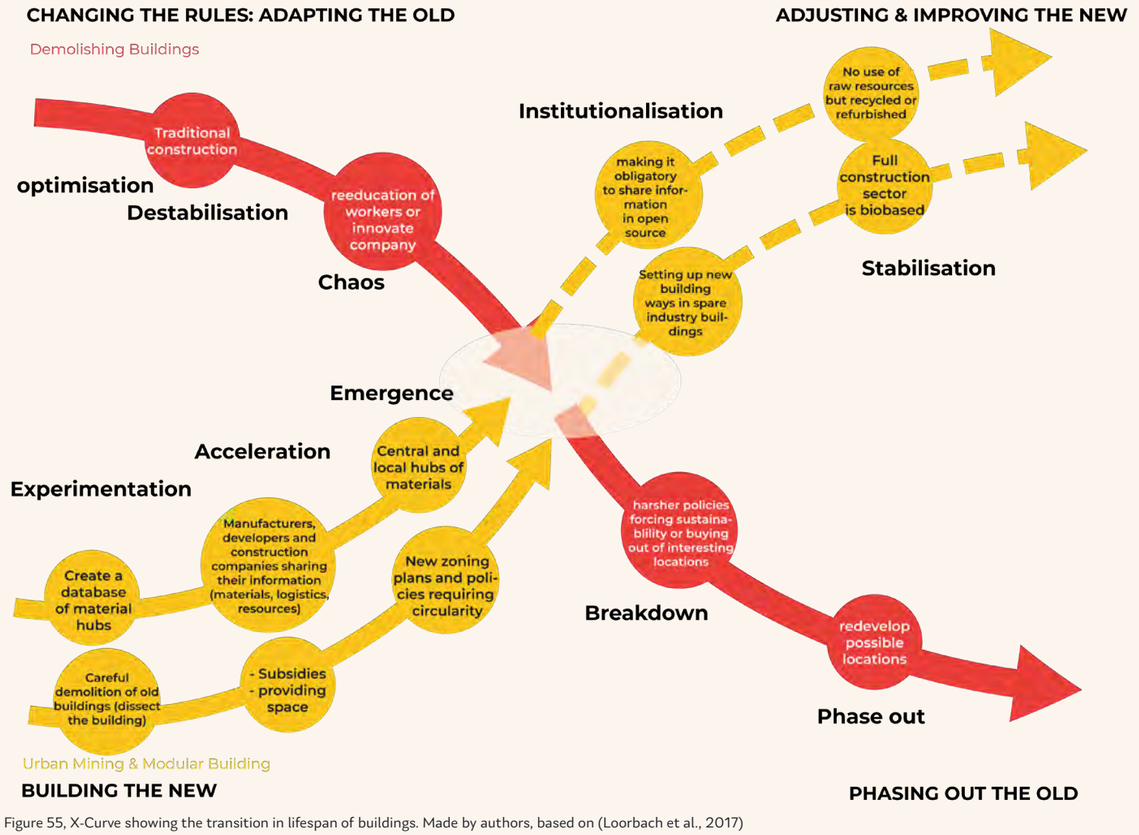


Figure 55, X-Curve showing the transition in lifespan of buildings. Made by authors, based on (Loorbach et al., 2017)

X-CURVE SHOWING THE TRANSITION FROM A FOSSIL FUEL INFUSTRY TO A CIRCULAR INDUSTRY

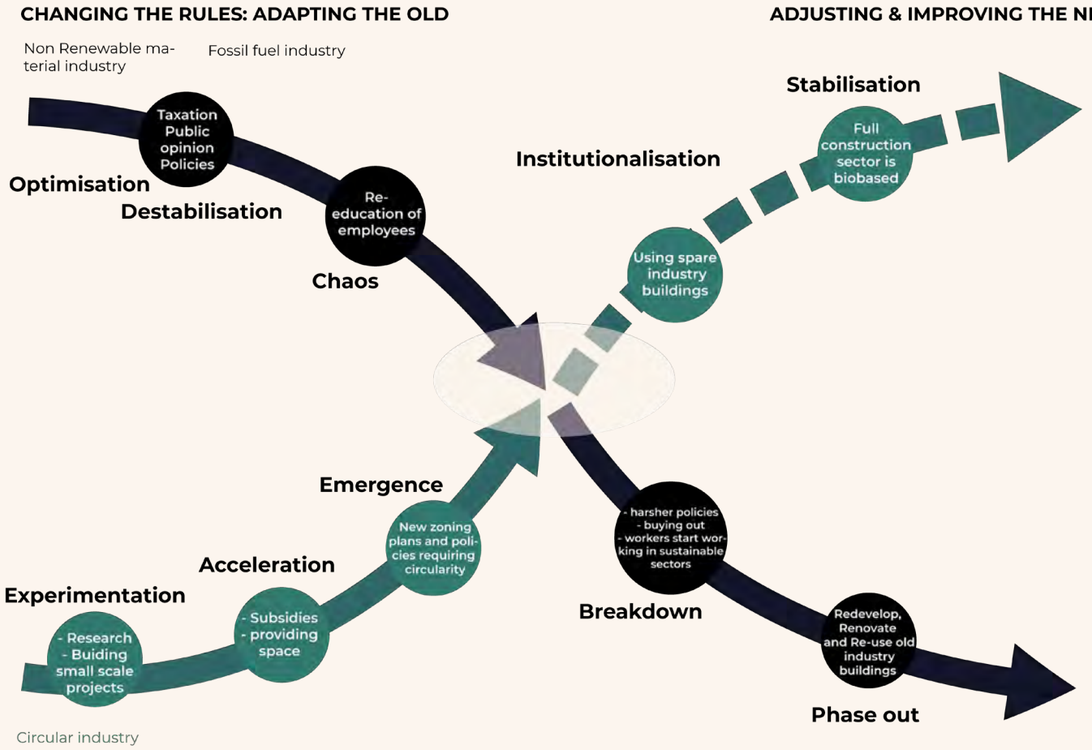
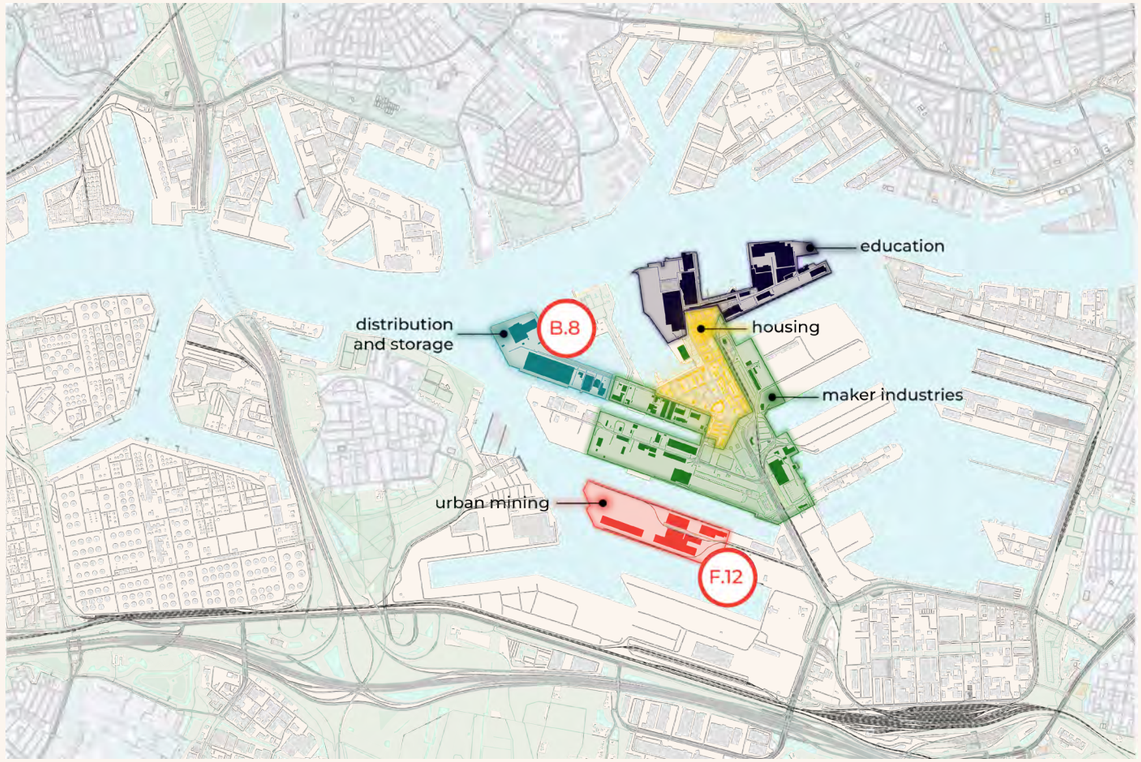


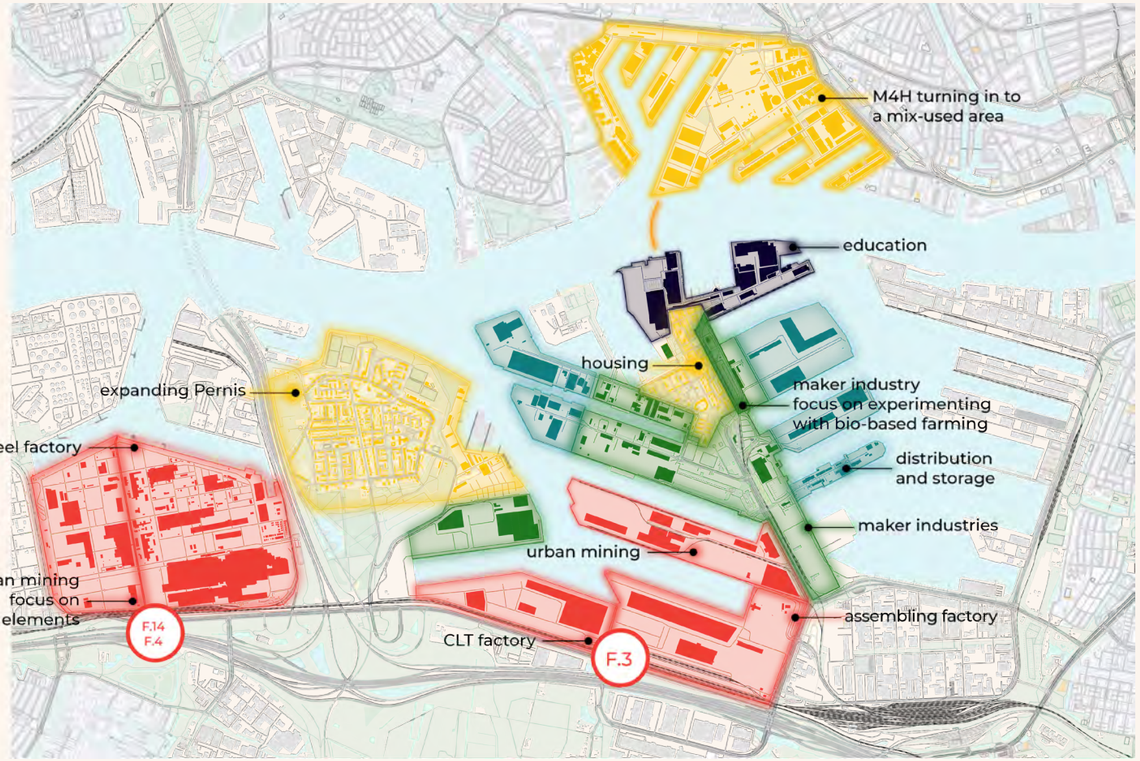
Figure 56, X-Curve showing the transition from a fossil fuel industry to a circular industry. Made by authors, based on (Loorbach et al., 2017)

7.3 Zoomed-in Maps

CENTRAL HUB: THE SPARK

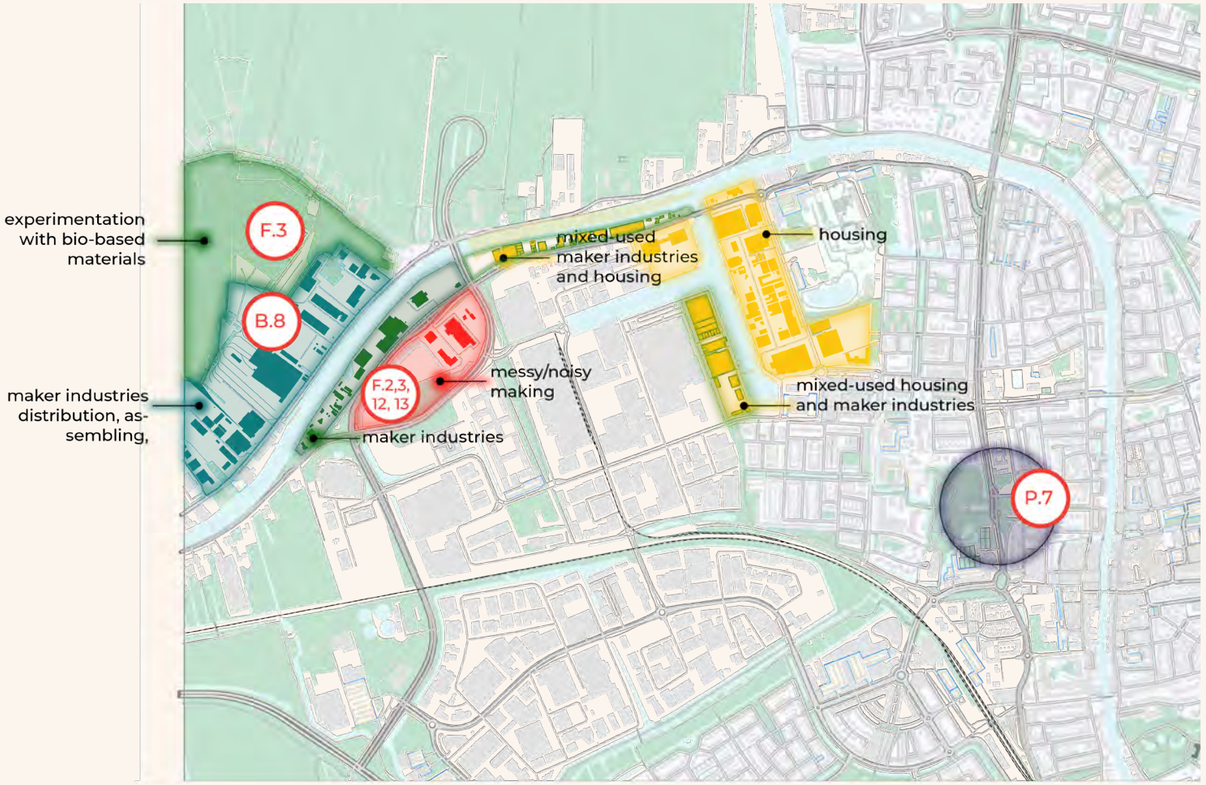


CENTRAL HUB: THE SYSTEMIC CHANGE

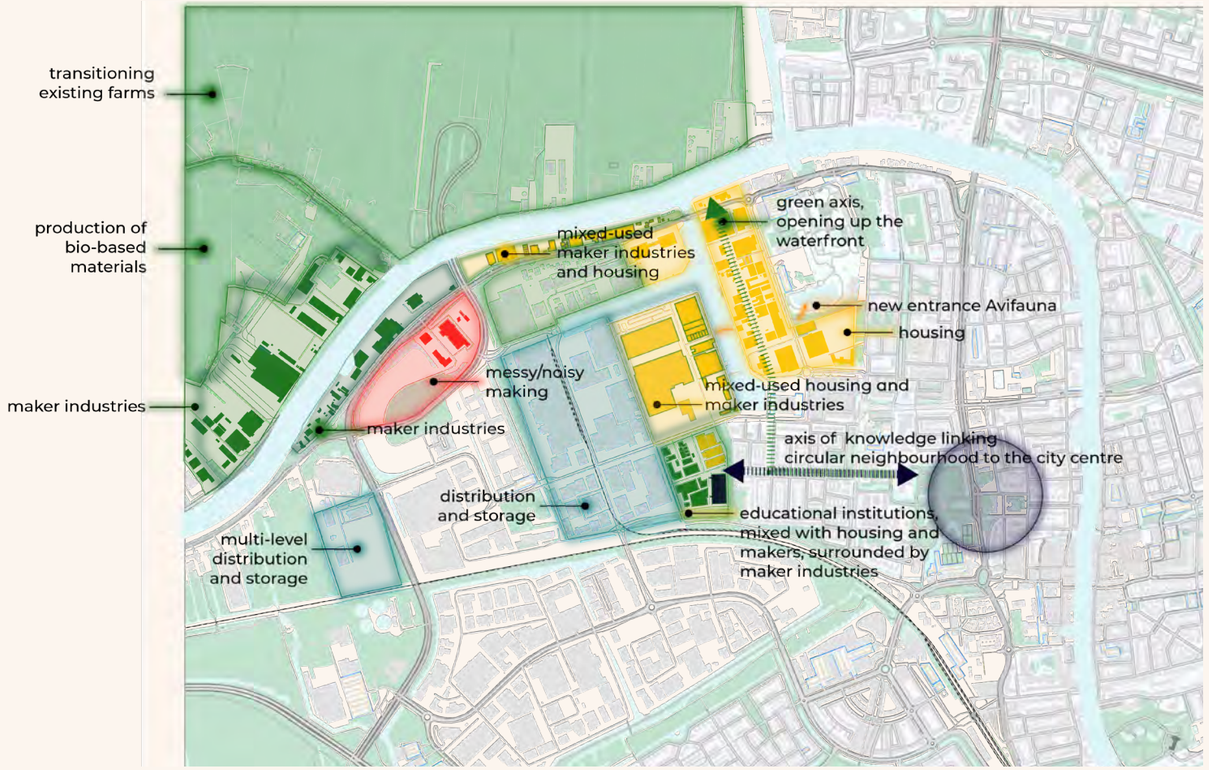


CENTRAL HUB: THE PULSE

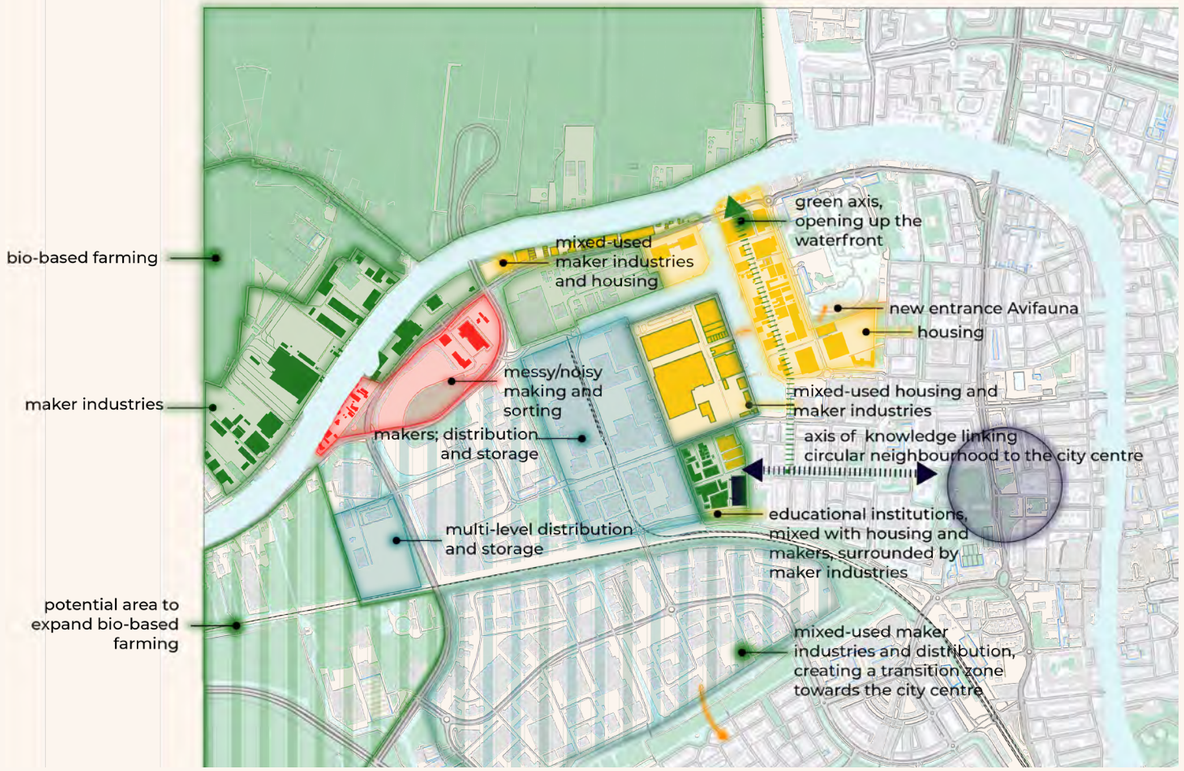
ALPHEN AAN DEN RIJN: THE SPARK



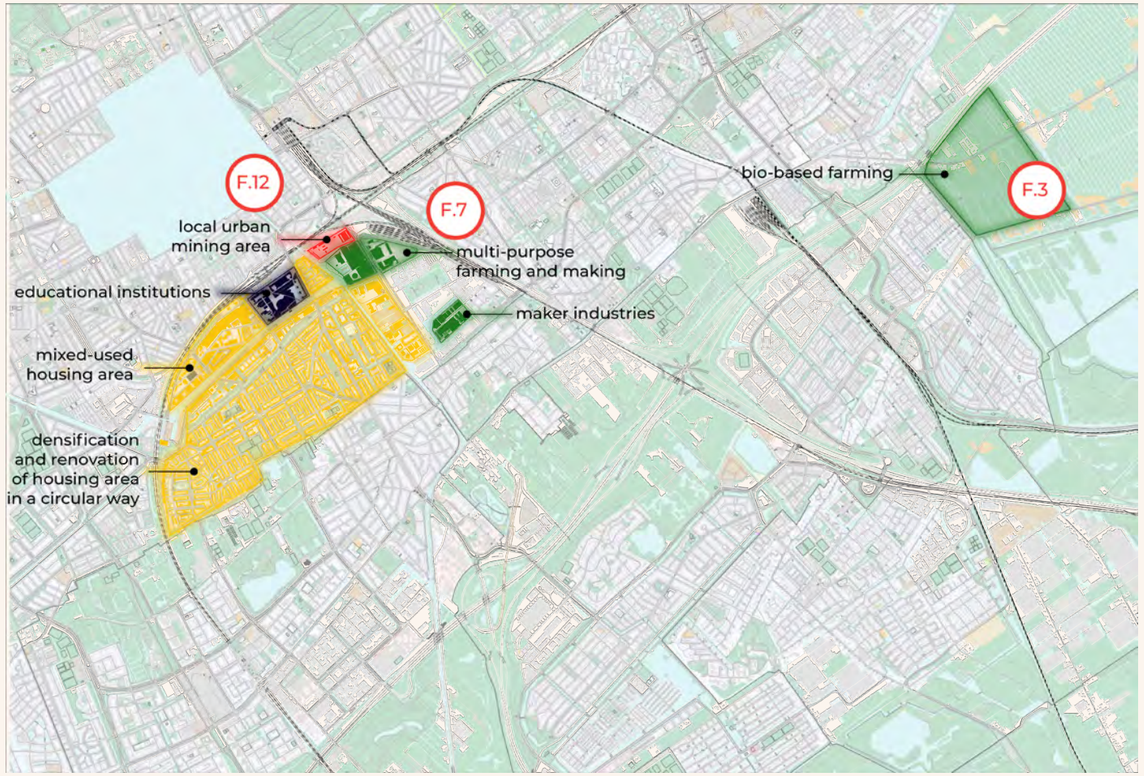
ALPHEN AAN DEN RIJN: THE SYSTEMIC CHANGE



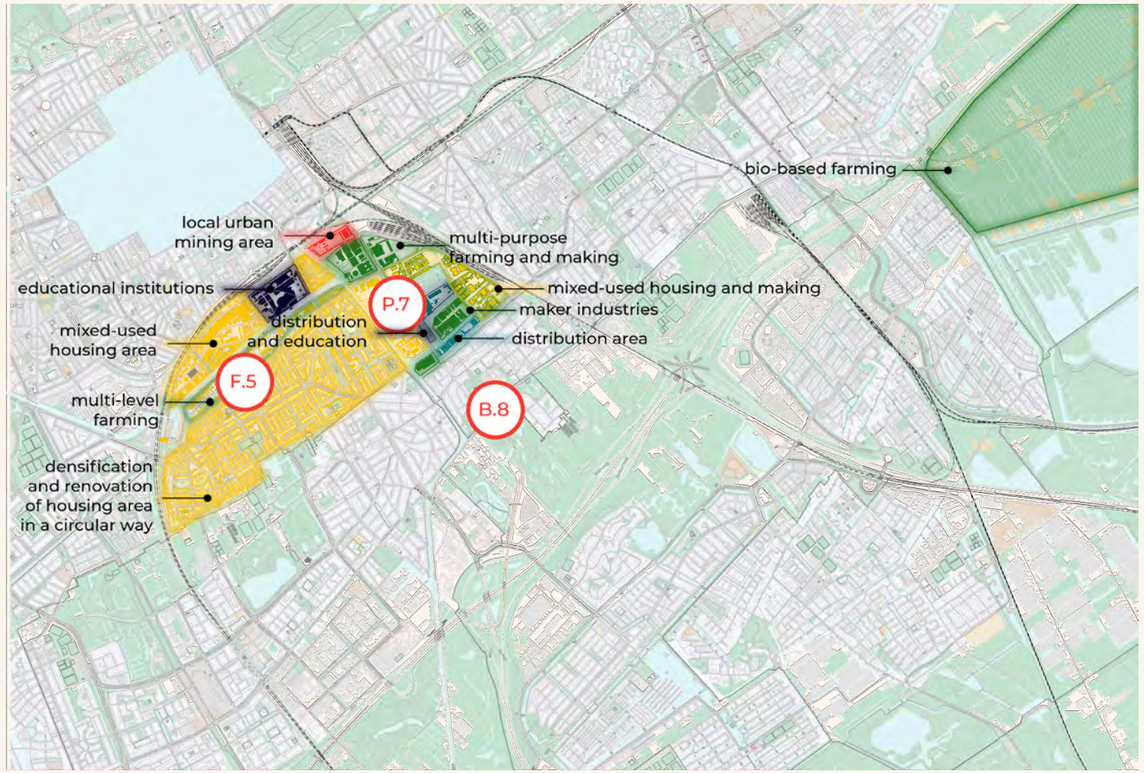
ALPHEN AAN DEN RIJN: THE PULSE



BINCKHORST: THE SPARK



BINCKHORST: THE SYSTEMIC CHANGE



BINCKHORST: THE PULSE