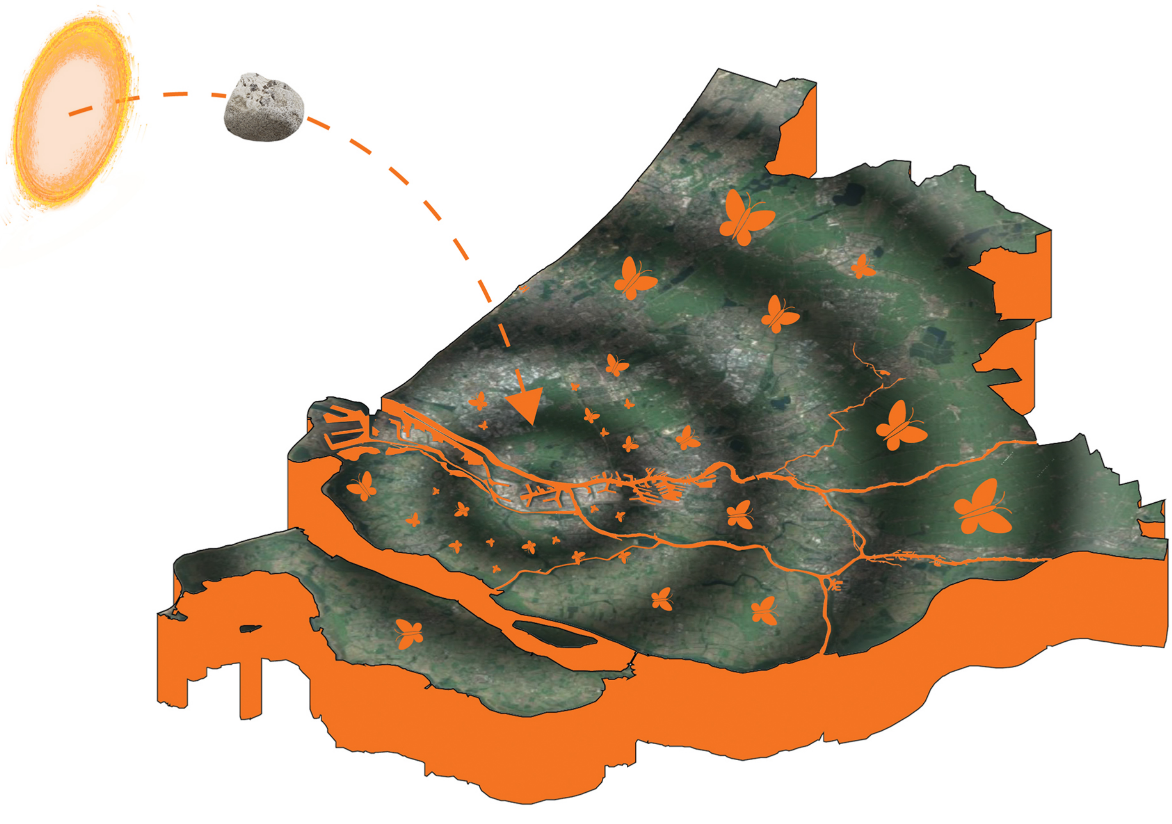
Butterfly Effect

Affordable circular bio-based building for South Holland



Butterfly Effect
Affordable circular bio-based building for South Holland

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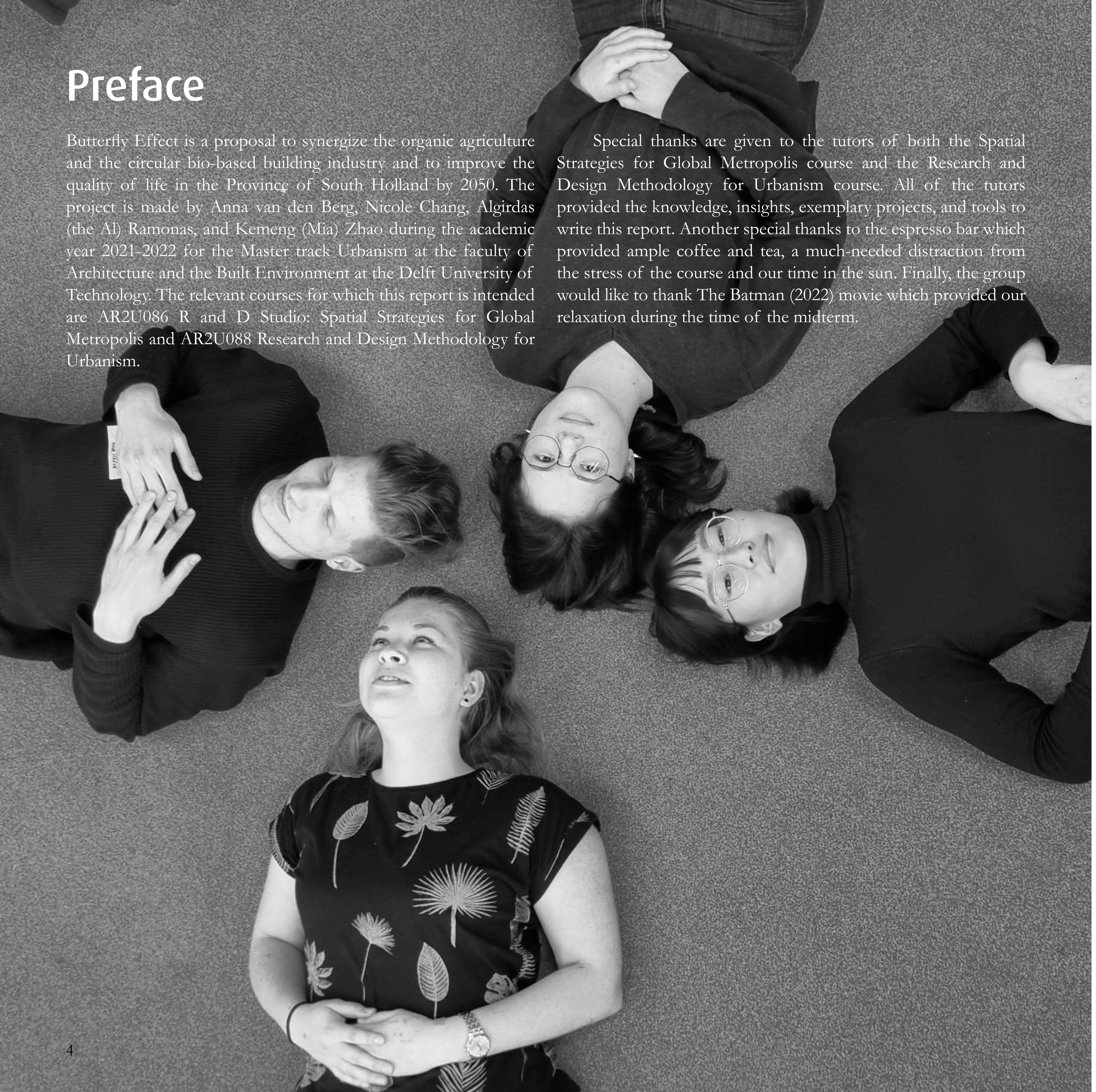


Preface

Butterfly Effect is a proposal to synergize the organic agriculture and the circular bio-based building industry and to improve the quality of life in the Province of South Holland by 2050. The project is made by Anna van den Berg, Nicole Chang, Algirdas (the Al) Ramonas, and Kemeng (Mia) Zhao during the academic year 2021-2022 for the Master track Urbanism at the faculty of Architecture and the Built Environment at the Delft University of Technology. The relevant courses for which this report is intended are AR2U086 R and D Studio: Spatial Strategies for Global Metropolis and AR2U088 Research and Design Methodology for Urbanism.

Special thanks are given to the tutors of both the Spatial Strategies for Global Metropolis course and the Research and Design Methodology for Urbanism course. All of the tutors provided the knowledge, insights, exemplary projects, and tools to write this report. Another special thanks to the espresso bar which provided ample coffee and tea, a much-needed distraction from the stress of the course and our time in the sun. Finally, the group would like to thank The Batman (2022) movie which provided our relaxation during the time of the midterm.

Abstract

The Province of South Holland, not unlike the other provinces in the Netherlands, has quite a big housing demand. To meet it more building materials are needed in a short time frame. The current building sector is not the most environmentally friendly. Hence, a transition to a more sustainable building sector is necessary. Bio-based building materials are the possible solution for this. By transitioning to the bio-based building industry not only the construction sector would be affected, but the agricultural and waste industries would also undergo a positive transition.

With this information the following research question is formulated "How can the PZH synergize the circular bio-based industry and organic agriculture in order to improve the quality of life in a just way?".

To answer this question an analysis was done of the current building sector, the bio-based building industry, the urbanisation strategies, and the landuse in the Province of South Holland. Out of the analysis, the potentials were concluded and a vision for 2050 was created. The implementation of the vision was elaborated by four different illustrative strategies and locations. Each of the them focuses on the implementation of one specific layer of the vision.

By transitioning the building sector into a circular bio-based building sector the Province of South Holland will have more biodiversity zones, an environmentally friendly and faster way of building, increased access to organic food for everyone, an increase in the health of inhabitants, and new job opportunities.

In short, by transitioning to the bio-based building material industry, Butterfly Effect will be created.

Keywords: bio-based building materials, organic agriculture, waste valorisation, Province of South Holland, the Port of Rotterdam

Figure 0.2. The Gleaners. (Millet, 1857; Nahon, 2019).

INTRODUCING BUTTERFLY EFFECT

1

1.1 Introduction

"*Rising temperatures are fuelling environmental degradation, natural disasters, weather extremes, food and water insecurity, economic disruption, conflict, and terrorism. Sea levels are rising, the Arctic is melting, coral reefs are dying, oceans are acidifying, and forests are burning*" (United Nations, 2019).

The world has, on average, heated up with about 1.2 ºC since the preindustrial era. "*We have built a civilization based on a world that doesn't exist anymore,*" as Katharine Hayhoe (Milman et al., 2021), a climate scientist at Texas Tech University and chief scientist at the Nature Conservancy, puts it. Oceans are heating up at an incomprehensible rate and the Earth's temperature has skyrocketed since 1970. "*We are conducting an unprecedented experiment with our planet,*" said Hayhoe (Milman et al., 2021). "*The temperature has only moved a few tenths of a degree for us until now, just small wiggles in the road. But now we are hitting a curve we've never seen before.*" "*We are on a catastrophic path,*" said António Guterres, secretary general of the UN. "*We can either save our world or condemn humanity to a hellish future.*" (Milman et al., 2021).

The environmental problems are getting increasingly worse and governments and companies have to take responsibility to prevent the worst outcome. That is why Butterfly Effect proposes to start with one of the largest sectors in the Netherlands and create a better future for our world.

Figure 1.1. Collage based on (LastWeekTonight, 2019)

***"The realization that it is not just global warming that we are dealing with, but global warming in an unequal and unjust world, has yet to sink in,"* according to Thiagarajan Jayaraman (Jayaraman & Sidhva, 2019).**

1.2 Problem Statement

Creating a circular economy in the building industry and producing more sustainable building materials are high on the priority list for the Dutch building sector. In this problem statement a deep dive into the current state of the building industry and the sectors that hold back the transition toward bio-based building materials will be researched.

1.2.1 Building Materials

Lack of materials

The Netherlands stands before a major housing task. The Province of South Holland has stated that by the year 2030, 230.000 new houses need to be realised. Between 2030 and 2040 another 60.000 houses will be added to the housing demand. By 2050 this amount has been estimated at 270.00 new houses in the Province of South Holland (figure 1.2) (Provincie Zuid-Holland, 2017). To realise this amount of new housing in such a short amount of time the building speed must be sped up (Westendorp, 2021).

Next to new build housing, the Netherlands also aims to have 1.5 million houses off the gas by 2030. For the Province of South Holland this would be an estimated 315.000 houses. As of 2019 39% of the current housing stock with a registered energy label have an energy label B or higher. For the Province this would translate to 311.000 houses (18%) (figure 1.3) (compendium voor de leefomgeving, n.d.). The older housing in the Netherlands currently has limited to no insulation. By insulating the current housing stock, the usage of gas and CO2 emissions will be diminished (milieudefensie, 2018). After 2030 another 1.094.000 houses (64%) in the Province of South Holland will still have to be isolated to reach an energy label B or higher. The renovation of these homes adds to the demand for building materials.

Currently there is a general lack of building materials. In the Netherlands 22% of construction firms (figure 1.4) have a limited production because of material shortage (van Sante, 2022). This shortage is caused by multiple events. Climate disasters, trade disputes, war, the buy-up of building materials, and the costs of energy lead to higher prices and scarcity of building materials in general (van Bokkum et al., 2021). Recently the Coronavirus pandemic increased this problem. Multiple building manufacturers suspended their activities worldwide in anticipation of a dip in the demand for building materials. The dip did not occur on the large scale that was expected and led to an even greater scarcity of building materials (Meijs, 2021).

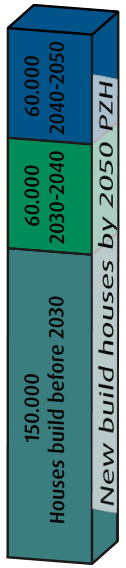


Figure 1.2. Amount of new build housing in the Province of South Holland

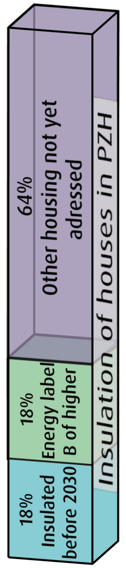


Figure 1.3. The amount of housing in need of insulation by 2030

Besides the lack of building materials, there is also a staff shortage caused by a lack of specialists. After the economic crisis in 2008, a lot of building companies went bankrupt. This also led to a decrease in people that trained to work in the building sector. This results in the fact that contractors cannot handle the demand for work (Meijs, 2021).

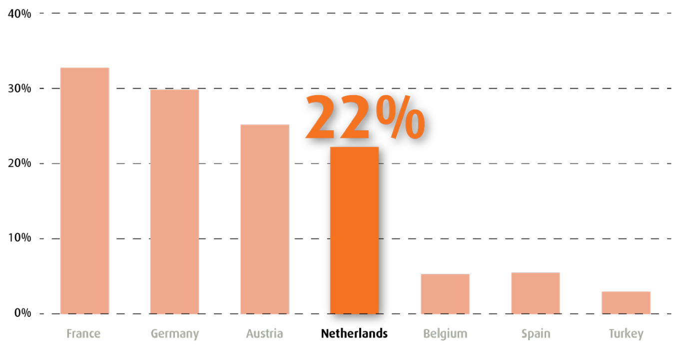


Figure 1.4. Construction firms that have limited production because of material shortage (van Sante, 2022)

The shift in the building sector

The building sector has a big impact on global resources world The building sector has a big impact on global resources worldwide (figure 1.6) as it uses up to 40% of the naturally obtained resources, is responsible for 40% of global waste, and emits 33% of global emissions (van Stijn, Gruis, 2019).

Bio-based building materials are a feasible replacement for current environmentally straining building materials. Currently, measured by weight, only 2% of building materials are made of wood and 0.1% of materials are made of other types of bio-based building materials (figure 1.5). The switch to bio-based building materials is impeded by the Dutch building industry. The industry is not used to working with these types of materials and the usage of regular building materials has been optimized over the years. This makes that the switch to building with bio-based materials has not yet been implemented (van der Velde & van Leeuwen, 2019). Insecurities within market parties lead to limited to no investments in this new way of building. An impulse in knowledge development and innovation is necessary to bring down the cost of bio-based building materials and increase in investments. This can then lead to optimization in the usage of bio-based building materials in the building sector and a large-scale production cycle (Moorlag, n.d.)

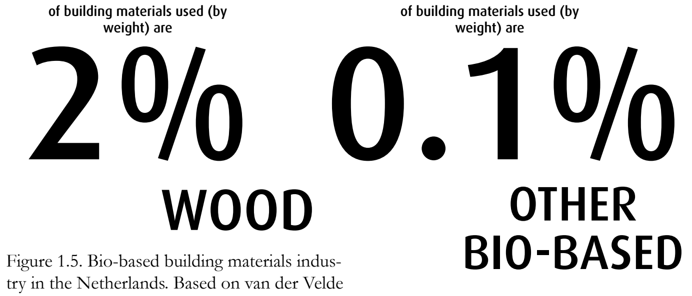


Figure 1.5. Bio-based building materials industry in the Netherlands. Based on van der Velde & van Leeuwen (2019)

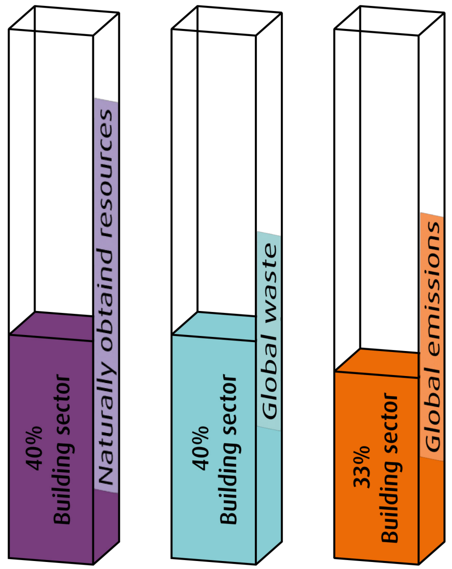


Figure 1.6. Building sector emissions

1.2.2 Agricultural Sector

Emissions

Yearly in the Netherlands a total of 187 Mton emissions are emitted. Of this the agricultural sector emits 14% (26 Mton). The agricultural sector can be divided into three sub-sectors: namely livestock farming which takes up 50% of the emissions in the Netherlands, crop cultivation with 25% of emissions, and greenhouse horticulture which is responsible for the remaining 25% of emissions caused by the agricultural sector (figure 1.7).

For the Province of South Holland the total amount of emissions caused by the agricultural sector is 3.617 kton CO2-eq. Of this 2.306 kton CO2-eq is dedicated to greenhouse horticulture (64%), 1.063 kton CO2-eq from livestock farming (29%), and 247 kton CO2-eq from crop cultivation (7%) (van Well & Rougoor, 2016).

Greenhouse horticulture is quite extensive in the Province of South Holland and consists mostly of cut flowers and flower bulb cultivation. The emissions produced in greenhouse horticulture, which are mostly CO2 emissions, are mainly caused by the usage of natural gas for the heating of the greenhouses and the production of electricity (Rijksdienst voor Ondernemend Nederland, 2016). The flower industry has an extra hand in pollution. By outsourcing a part of the cultivation to Africa, an unknown larger impact on the environment is caused by the flower cultivation industry. The estimated guess is that the energy use is significantly higher than in the Netherlands and that the use of environmentally damaging pesticides is far more accepted than here. This can be environmentally detrimental (de Waart & Palland, 2019).

The emissions produced by livestock farming come mainly from animals and the manure that they produce. They are the second-largest producers of greenhouse gasses in the Province of South Holland (van Well & Rougoor, 2016). Cattle are the main producers of greenhouse gasses in the livestock farming sector. As a by-product cattle produce a lot of methane and the storage of their manure has a big impact on the emissions. For livestock farming 5% of emissions are carbon dioxide and nitrous oxide, 90% of the emissions are methane. The emissions of livestock farming are directly linked to the number of cattle that are in circulation (Rijksdienst voor Ondernemend Nederland, 2016).

The emissions produced in the crop cultivation sector are mainly from fertilizers, where nitrogen is converted into nitrous oxide. Since 1990 the grazing of cows has diminished, resulting in lower amounts of nitrous oxide expelled in this sector. But this led to an increase in methane emissions in the livestock farming industry (Rijksdienst voor Ondernemend Nederland, 2016).

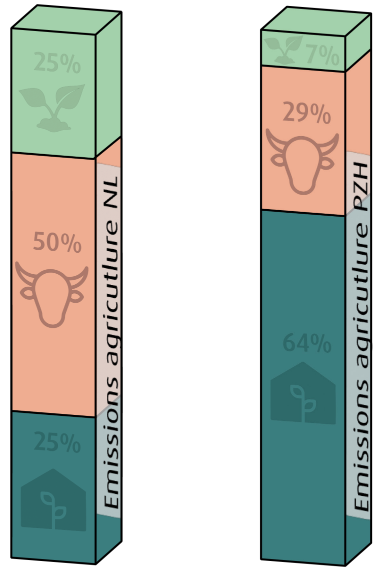


Figure 1.7. Emissions in the agricultural sector by the three sub sectors

Organic agriculture and the EU Green Deal

As a part of the European Green Deal, the European Union set a goal to increase the area of utilized organic agriculture to 25% by 2030. The Netherlands (3%) is currently well below this goal and is not likely to reach 25% at this progression rate (figure 1.8). With the implementation of organic farming, the European Commission wants to achieve a sustainable food system with low environmental impact (European Commission, n.d.). In the last 20 years the area of organic agriculture in the Netherlands has grown from 1% to 3%. In comparison to other European countries the growth in organic agricultural land use has stayed far behind. Part of the problem with the lack of growth is that the consumer has

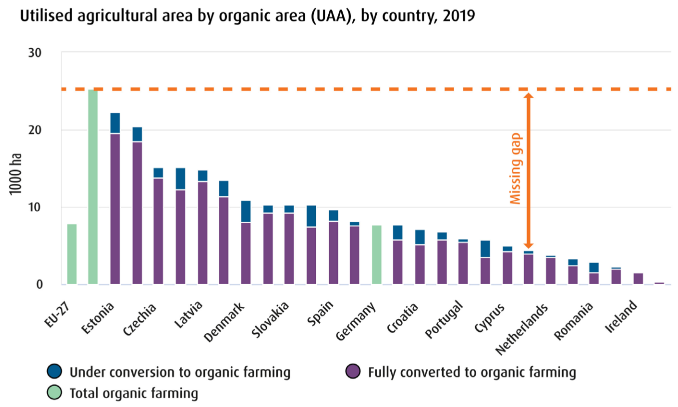


Figure 1.8. The missing gap in organic utilized agriculture (European Commission, n.d.)v

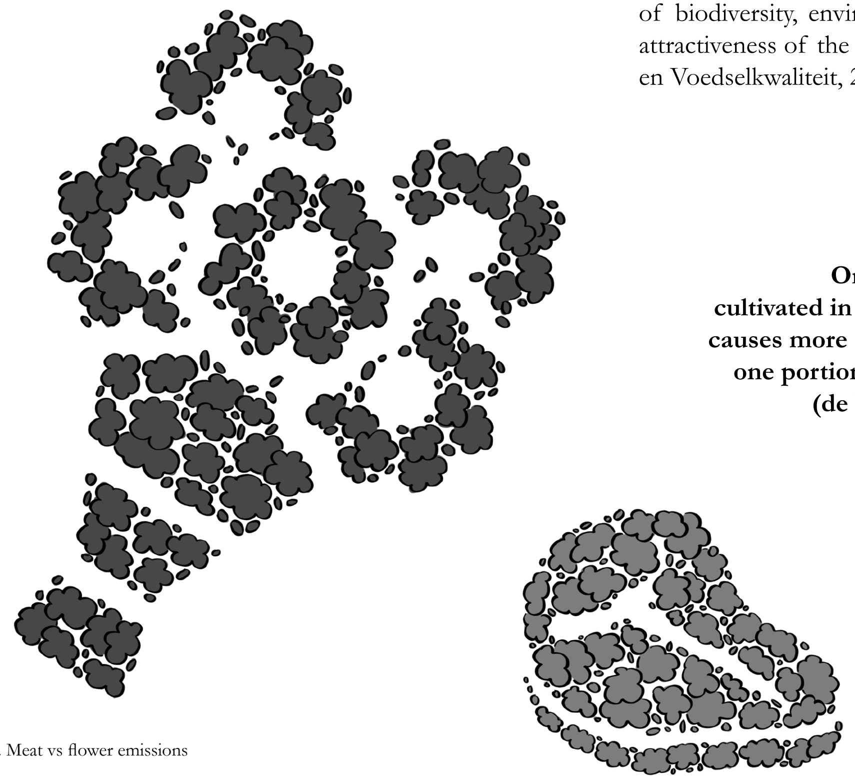


Figure 1.9. Meat vs flower emissions

less bonding with local food production and is on average not prepared to pay more for biological food products. A lack of awareness is missing in the Netherlands (Brandsma, 2021).

Economic impact of agriculture

The Dutch agricultural sector is world-renowned. The Netherlands is the second-largest agricultural exporter. The agricultural production in the Netherlands puts the sector in 22nd place worldwide (Provincie Noord-Holland et al., 2021). By continuously innovating, the sector stays on top of the market and is characterized by cost efficiency and a high production chain. The downside to this is the economic instability that the market experiences. There are large fluctuations in incomes for farms and large income differences between entrepreneurs. There is also increased pressure on the living environment surrounding farms. The cost-efficiency and high production chain are at the expense of biodiversity, environment, quality of drinking water, and the attractiveness of the landscape (Ministerie van Landbouw, Natuur en Voedselkwaliteit, 2018)

One bouquet of flowers cultivated in greenhouses (1,3 – 9 kg CO2eq) causes more damage to the environment than one portion of meat (0,7 – 3,4 kg CO2eq) (de Waart & Palland, 2019).

1.2.3 Waste and the Port of Rotterdam

The port of Rotterdam houses the largest bio-based cluster in the world. Biomass is imported, produced, and exported in the port. The organic waste flows of the port are not optimally valorised. Annually around 74 companies in the port of Rotterdam produce 33 kilotons of pulp, paper, and wood waste, 24 kilotons of organic sludges, and 13 kilotons of other organic wastes (figure 1.11). This is only a small fraction of the actual amount of biomass waste that flows through the port (Port of Rotterdam & circular economy, 2019). Havenbedrijf Rotterdam has stated a vision for the Port of Rotterdam, where it will be the most sustainable port in the world (Port of Rotterdam et al., 2019). Food waste and biomass valorisation are considered priority areas in the European Commission's Circular Economy Package and the Dutch National Circular Economy Program, where the aim is to extract more potential from the current biomass wastes (Port of Rotterdam & circular economy, 2019). When looking at the Biomass worth pyramid, the activities performed in the port of Rotterdam are mostly at the bottom of the pyramid (figure 1.13). The port of Rotterdam has a lot to gain in terms of waste valorisation.

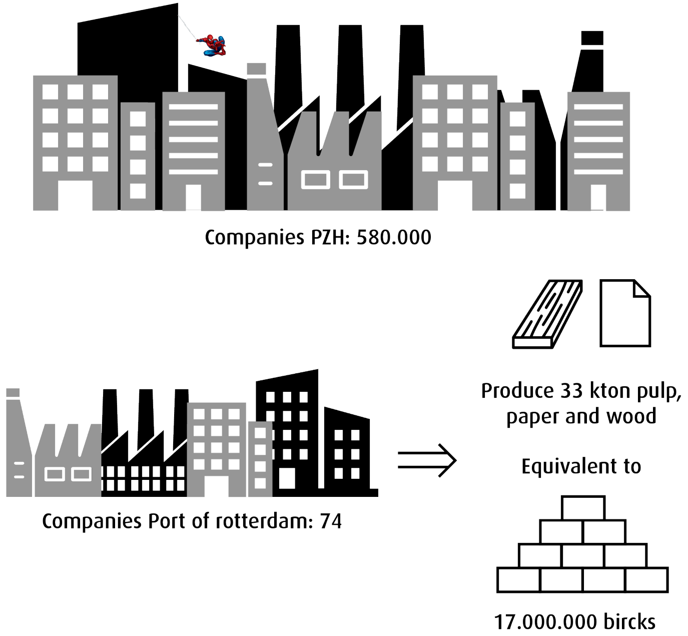


Figure 1.11. The amount of waste produced by the port of Rotterdam, data from (CBS, 2021; Port of Rotterdam & circular economy, 2019)

The port of Rotterdam emits 23.6 Mton co2 yearly. This is 18% of the total co2 emissions in the Netherlands (figure 1.10) (NOS, 2019). By tackling the infrastructure of the port a large portion of co2 reduction can be achieved. The climate accord states the goal for the energy transition is that greenhouse gas emissions should be reduced by 49% by 2030, and 95-100% by 2050 ((figure 1.12). This will only be possible by eliminating the use of fossil fuels (RIVM, n.d.). Energy will have to be gained from renewable energy sources. With this transition, the port of Rotterdam will undergo redevelopment of the whole energy sector.

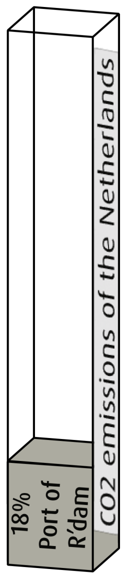


Figure 1.10. The total amount of emissions caused by the port of Rotterdam, compared to the Netherlands

Figure 1.12. The climate goal to reduce greenhouse emissions. Data from (RIVM, n.d.)

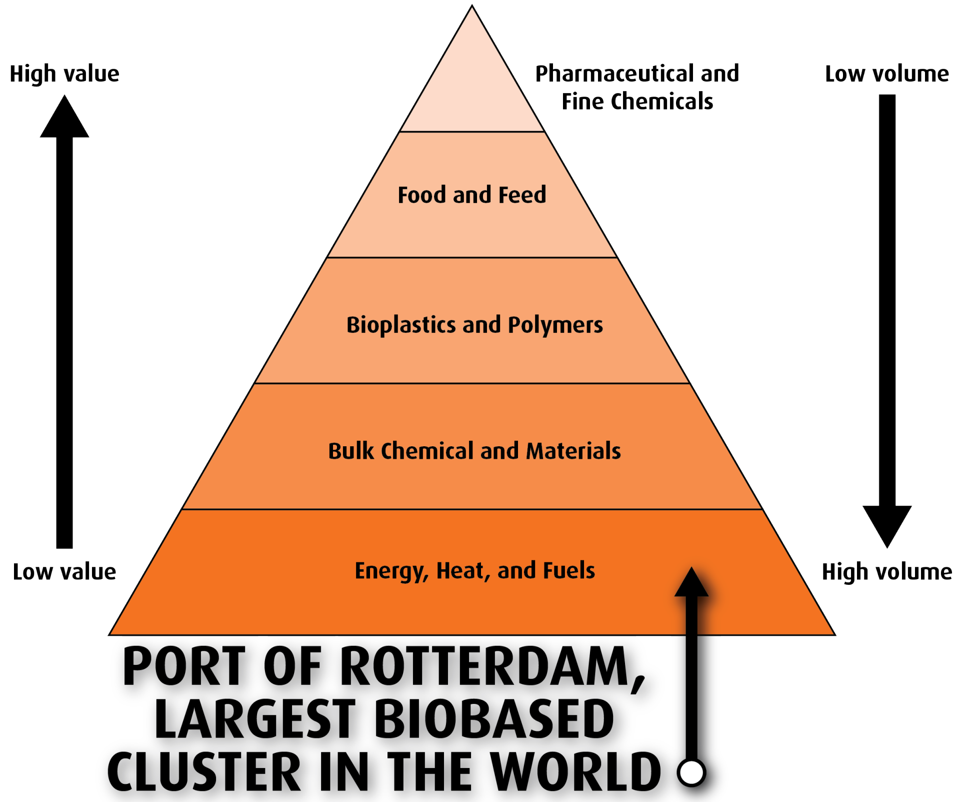


Figure 1.13. Biomass worth pyramid

1.2.4 Biodiversity

The abundance of species has plummeted in the last century. This is a worldwide problem, but the situation is especially grave in the Netherlands (Compendium voor de Leefomgeving, 2013). In the Netherlands the decline in biodiversity is very visible in the agricultural landscape. In the last century field plants have diminished by 35%, grassland butterflies by 80%, and birds characteristic of agricultural farmland by 85% (CBS, 2020). While the decline in biodiversity has, on average, come to a stop in nature reserves, to reverse the decline in the agricultural landscape a structural change to the landscape will be necessary (figure 1.15) (Bouma et al., 2020).

The agricultural landscape can be divided into three different characteristic landscapes: the common landscape, circular agriculture, and organic agriculture (figure 1.14). In the diagram, the environmental pressure and biodiversity are represented. The common landscape has high environmental pressure and low biodiversity, while organic agriculture has low environmental pressure and high biodiversity. A reason why the shift towards organic agriculture has not happened yet is the fact that common agriculture provides affordable and safe food. For the shift to happen these criteria have to be met in the organic agricultural landscape as well (Bouma et al., 2020). With the intense common agricultural landscape, a loss of biodiversity occurs. The loss of biodiversity is connected to the intense use of pesticides and fertilisers. Nutrient pollution (commonly from pesticides and fertilisers) is one of the main, and growing, pressures on biodiversity. With this comes a downwards spiral since biodiversity is an important factor in the succession of crop cultivation and the high turnover of this sector (Sud, 2020).

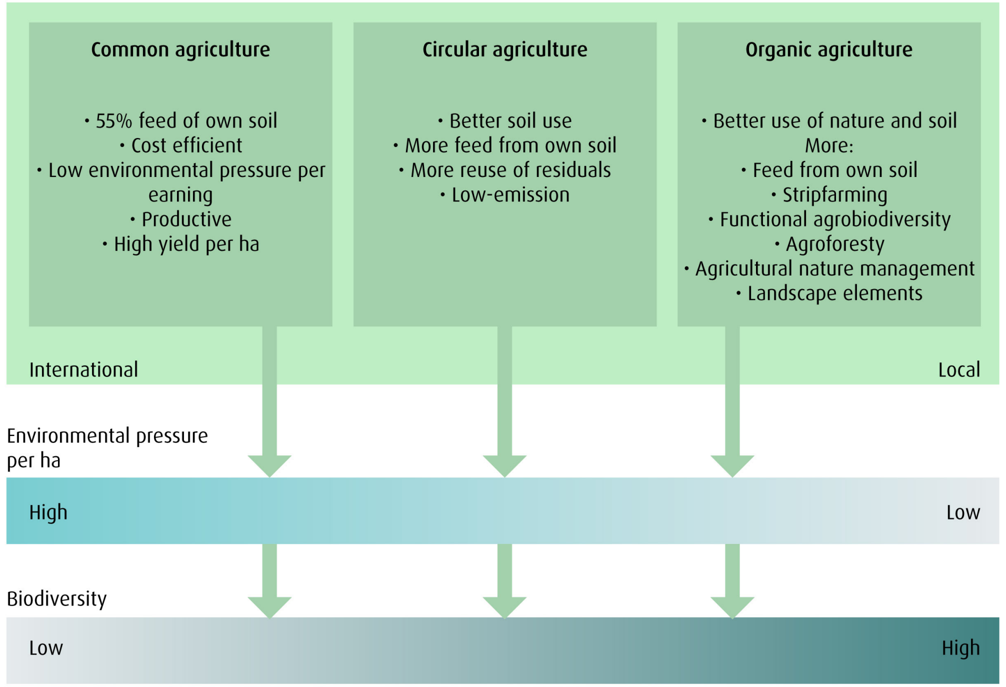


Figure 1.14. Agricultural- and food system, based on (Bouma et al., 2020)

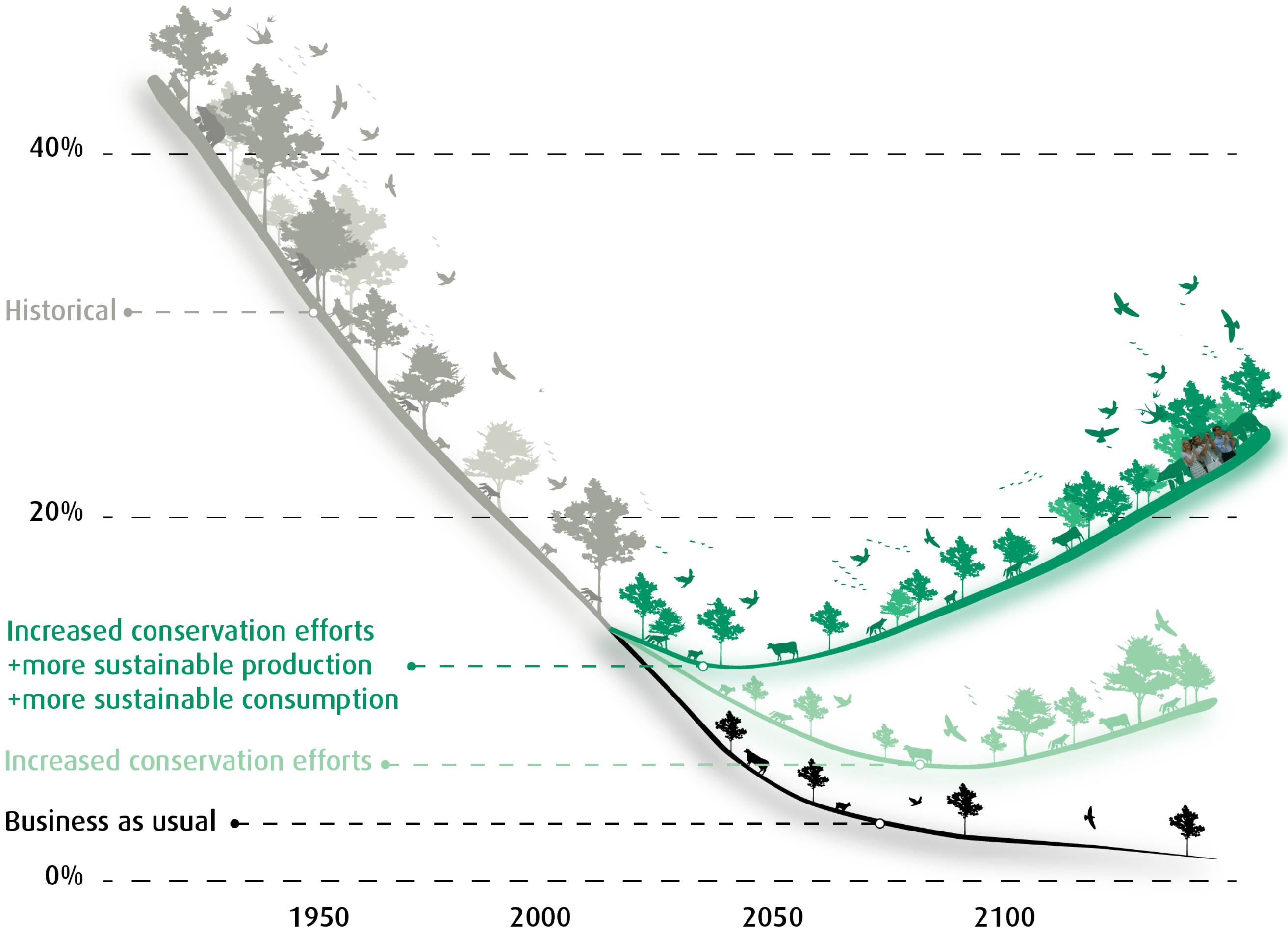


Figure 1.15. Decline of biodiversity in the Netherlands. Based on Netherlands Compendium voor de Leefomgeving, (2013), Alkemade, (2020).

1.2.5 Social Justice

Jobs

In the agricultural sector a trend is visible. Even though the area of farmland within the Netherlands has been secure over the last decades, the number of agricultural and horticultural farms has almost decreased by half between 2000 and 2019. This shift suggests a large-scale change within the agricultural sector (figure 1.17). The diagram shows that the total area of agriculture area has diminished by 8%, while the numbers of farms and workers decreased by 45% and 26% respectively, this suggests the monopolization of farms and automatisation of the workforce (van der Meulen & Berkhout, 2020).

Within the Netherlands, a large sum of the European agricultural budget is directed toward large farms. Large farms represent 24% of the total amount of farms in the Netherlands, and receive 84% of the amount of funding (figure 1.16). Smaller farms in the Netherlands are less likely to receive these funds. These smaller farms will much less likely to make a switch to organic agriculture, simply because they do not have the funds (Utrecht University of Applied Sciences, NL, 2019).

The transition in the economy of the port of Rotterdam will bring a large shift in the type of workforce that will be necessary to sustain the port. With the technological improvements that come along with the energy- and feedstock transition, automatisation of standardised work will occur. The new jobs that come along with the sector will ask for a higher degree in education from the employees (Port of Rotterdam et al., 2019). A shift in the availability of certain types of jobs will be inescapable.

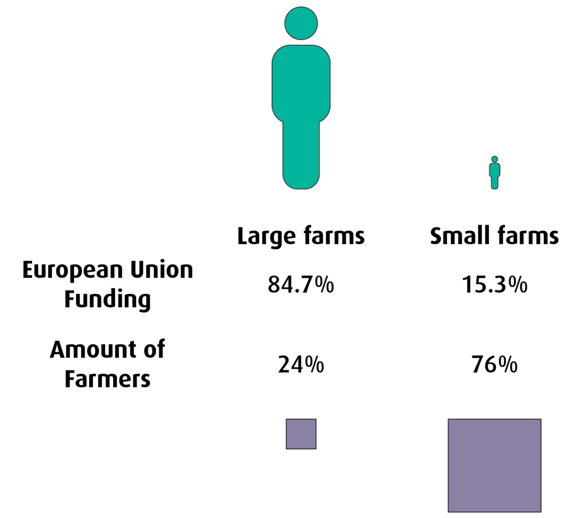


Figure 1.16. EU funding inequality

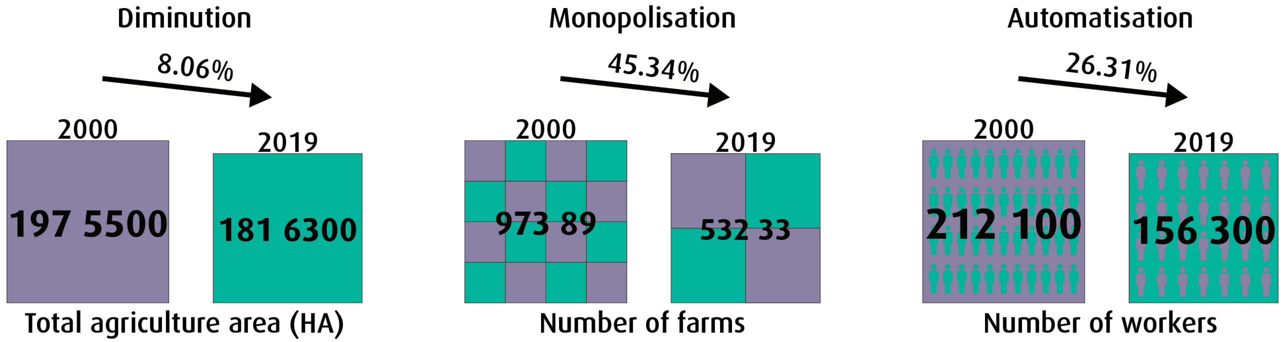


Figure 1.17. Trends in agriculture sector. Based on Meulen & Berkhout (2021). This diagram shows that in past 20 years total agriculture area diminutiated by 8%, while number of farms and workers shrinked by 45% and 26% respectively.

Access to green and recreational space

Access to green and recreational spaces is important for the health of human beings. The average distance to a sufficient hiking or bike route should on average not exceed 5 km. When looking at the Province of South Holland these needs are not met (figure 1.18). On average there is a big shortage in accessibility to these green patches and networks (CBS et al., 2008)

Food poverty

In the Netherlands food security can be qualified as robust when looking at the perspective of the resilience of the production system. However, when access to food and its contribution to a healthy lifestyle are taken into account inequality among the Dutch population is noticeable. Overweight is currently a major problem for half of the Dutch population, because unhealthy foods are easily accessible and in abundant supply (Silvis et al., 2021). While healthy foods are harder to get by and on average more expensive.

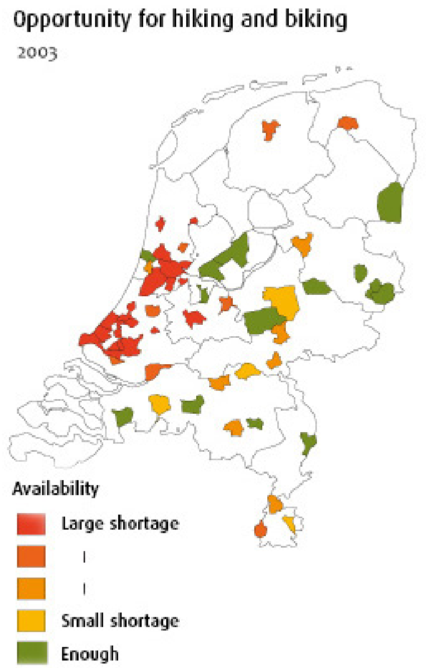


Figure 1.18. Opportunities for hiking and biking in the Netherlands, based on (CBS et al., 2008)

Energy labels

The DNB estimates that it will cost about 24.000 euros per house to isolate and add a heat pump to get energy label B. This is a difficult and unrealistic task as 21% of homeowners cannot afford this. Almost 90% of the group who cannot afford this renovation have houses of energy labeled C and lower (figure 1.19) (Waterval, 2022). The government of the Netherlands wants to implement more subsidies for the transition but the energy tax will still increase (van Hest & Duintjer Tebbens, 2021).

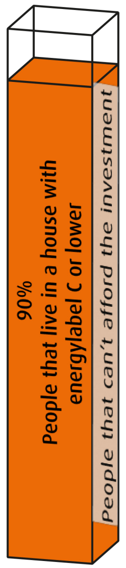


Figure 1.19. People that cannot afford investment into their home

1.3 Summary Problem Statement

Bio-based building materials
The Netherlands stands before a major housing task (Provincie Zuid-Holland, 2017) and simultaneously will need to insulate a large number of older exiting buildings (Compendium voor de leefomgeving, n.d.). With these tasks a lot of building materials will be needed. But currently there is a general lack of building materials. Climate disasters, trade disputes, war, the buy-up of building materials, and the costs of energy lead to higher prices and scarcity of building materials in general (van Bokkum et al., 2021). Together with the lack of specialists in this field, contractors cannot handle the current demand for work (Meijs, 2021).

Bio-based building materials are a feasible replacement for the current environmentally straining building materials. Unfortunately, the switch to bio-based building materials is impeded by the Dutch building industry. The lack of knowledge about working with these types of materials, and the fact that the usage of regular building materials has been optimized, effects hinder the transition toward the usage of bio-based building materials (van der Velde & van Leeuwen, 2019). An impulse in knowledge development and innovation is necessary and can lead to the optimization of the usage of bio-based building materials in the building sector and a large-scale production cycle (Moorlag, n.d.). With the shift toward bio-based building materials, the group of homeowners that cannot afford the investment in their homes (van Hest & Duintjer Tebbens, 2021) can be helped as well.

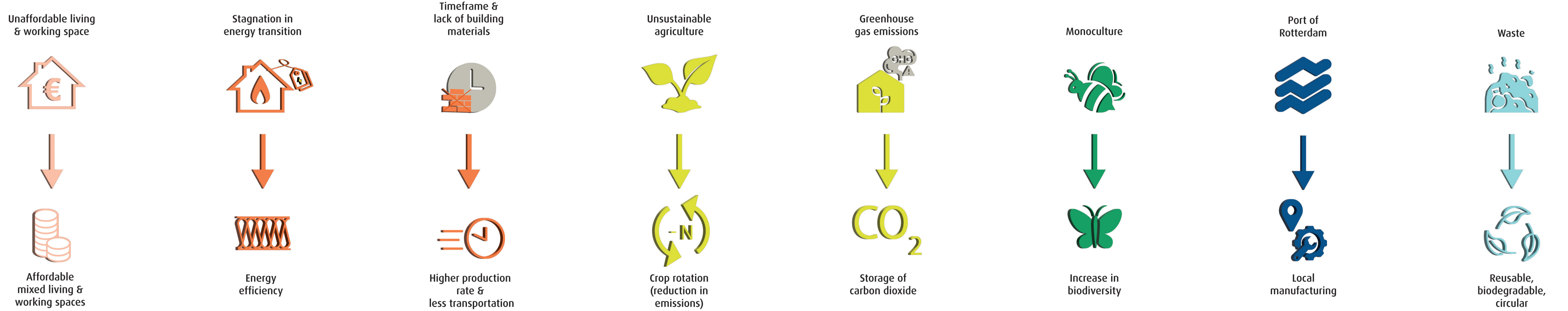
Organic agriculture
In the Province of South Holland, greenhouse horticulture is responsible for a substantial amount of the yearly CO2 emissions (Rijksdienst voor Ondernemend Nederland, 2016). The flower industry has an extra hand in the emissions by outsourcing part of the cultivation to Africa. The estimation is that the impact there is substantially larger than the production in the Netherlands (de Waart & Palland, 2019).

The European Union wants to increase the amount of organic agriculture in Europe. With the implementation of organic farming, the European Commission wants to achieve a sustainable food system with low environmental impact (European Commission, n.d.). The Netherlands has a very low amount of organic agriculture compared to the goals set. Part of the problem is the fact that the consumer has less bonding with local food production and is on average not prepared to pay more for biological food products. A lack of awareness is missing in the Netherlands (Brandsma, 2021). With a shift towards more organic foods and better accessibility, food poverty in the Netherlands (Silvis et al., 2021) can be eradicated.

Waste valorisation
The port of Rotterdam houses the largest bio-based cluster in the world (Port of Rotterdam & circular economy, 2019) and has the vision to become the most sustainable port in the world (Port of Rotterdam et al., 2019). Food waste and biomass valorisation are considered a priority area in the European Commission's Circular Economy Package and the Dutch National Circular Economy Program, where the aim is to extract more potential from the current biomass wastes (Port of Rotterdam & circular economy, 2019). In this strategy, the port of Rotterdam still has a lot to gain in the area of waste valorisation.

Biodiversity
The abundance of species has plummeted in the last century and the situation is especially grave in the Netherlands (Compendium voor de leefomgeving, 2013). While the decline in biodiversity has, on average, come to a stop in nature reserves. The agricultural landscape will need extensive structural change to stop the decline in biodiversity there. By shifting toward organic agriculture biodiversity can be increased, while the environmental pressure on the land be diminished (Bouma et al., 2020). Nutrient pollution can also be stopped by switching to organic agriculture (Sud, 2020). With access to green and recreational spaces being below standard in the province (CBS et al., 2008), the quality of life declines. The lack of biodiversity in the Province of South Holland asks for a radical change in the landscape if we want to avoid the inevitable.

Social justice
In the agricultural sector a trend of the monopolisation and automatisation of farmland is seemingly ongoing (van der Meulen & Berkhout, 2020). The transition in the economy of the port of Rotterdam will bring a large shift in the type of workforce that will be necessary to sustain the port. New jobs that come along with the new sectors will ask for a higher degree in education from the employees (Port of Rotterdam et al., 2019). A shift in the availability of certain types of jobs for the agricultural industry and the port of Rotterdam will be inescapable.



METHOD
BUTTERFLY EFFECT

2

2.1 Sustainable Development Goals

SUSTAINABLE DEVELOPMENT GOALS

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs) (figure 2.1), which are an urgent call for action by all countries - developed and developing - in a global partnership. They recognize that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – all while tackling climate change and working to preserve our oceans and forests (United Nations, 2015).

Figure 2.1. 17 goals to transform our world (United Nations, 2022)

No Poverty

UN Goal: End poverty in all its forms everywhere

Nowadays, many people are still fighting hunger. Poverty is extremely detrimental to almost every aspect of humanity, such as personal health, living environment, social cohesion, economic development and sustainability. Eradicating poverty is so essential that, if one can't even solve the minimum problem of food, all other goals will be rhetoric.

Good Health and Well-Being

UN Goal: Ensure healthy lives and promote well-being for all at all ages

Coronavirus pandemic has halted progress in health sector. However, even before pandemic, access to health protection, as well as healthy foods and environments were largely unequal across the globe. Therefore ensuring healthy lives for everyone is crucial.

Quality Education

UN Goal: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Education is something that is important not only to one person but also for the whole globe. On the one-person level, education can help people live a better life. On a bigger scale, education enables us, humans, to overcome shortsightedness and get along with each other and the planet in the long term.

Decent work and economic growth

UN Goal: Promote inclusive and sustainable economic growth, employment, and decent work for all

Decent work is a key part of one's life, which leads to a better and more meaningful life. It is also significant to social stability and economic growth. With economic growth, poverty is able to be eliminated and more actions could be taken to achieve sustainability.

Industry, innovation and infrastructure

UN Goal: Build resilient infrastructure, promote sustainable industrialization and foster innovation

The world is changing increasingly rapidly, so a strong capacity for innovation is needed to face it. Innovation and industry are strongly connected because the industry will maximise the benefits of innovation. They both rely much on infrastructure, so industry, innovation and infrastructure form a strong network requiring attention and investment.

Reduced inequalities

UN Goal: Reduce inequality within and among countries

In the whole world, resources, access, benefits, opportunities, risks are not evenly distributed due to the gaps in many aspects among people. The inequalities are aggravated under the global crisis like pandemic and climate change, they are issues for all mankind, but some people suffer more than others.

Sustainable cities and communities

UN Goal: Make cities inclusive, safe, resilient, and sustainable

Cities and communities are units of people living and working, so they are connected closely with people's well-being. Sustainable cities and communities are the stepping stones to achieve the sustainability goal for the whole globe.

Responsible consumption and production

UN Goal: Ensure sustainable consumption and production patterns

Consumption and production are the main agents of the global economy. In the pursuit of economic development, people should be very cautious to make the consumption and production processes responsible.

Climate action

UN Goal: Take urgent action to combat climate change and its impacts

The Climate crisis is the most pressing challenge people face together. To make it worse, the consequences of the climate crisis are unbearable to humankind. Almost all countries are suffering from it to varying degrees, so it is imperative to take concerted actions.

Life on land

UN Goal: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss

The planet is the habitat for not only humankind but also other lives, humankind is only a tiny part of the ecosystem and relies much on it. However, the living conditions for many lives are worrisome, the forest is facing desertification, animals are losing their habitats, and the biodiversity is dropping at an unprecedented rate. Therefore, the ecosystem is becoming ever more vulnerable.

Partnerships for the goals

UN Goal: Revitalize the global partnership for sustainable development

All the issues and goals mentioned above are pressing challenges faced by all mankind, no country or organisation can shirk its responsibility to this race. A strong partnership is needed to achieve these goals.

2.2 European Green Deal

The atmosphere is warming and the climate is changing with each passing year. One million of the eight million species on the planet are at risk of being lost. Forests and oceans are being polluted and destroyed.

The European Green Deal is a response to these challenges. It is a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use (figure 2.2).

It also aims to protect, conserve and enhance the EU's natural capital, and protect the health and well-being of citizens from environment-related risks and impacts. At the same time, this transition must be just and inclusive. It must put people first, and pay attention to the regions, industries and workers who will face the greatest challenges (European Commission, 2019).

Figure 2.2. The European Green Deal (European Commission, 2019).

Mobilising industry for a clean and circular economy

Achieving a climate neutral and circular economy requires the full mobilisation of industry. It takes 25 years – a generation – to transform an industrial sector and all the value chains. To be ready in 2050, decisions and actions need to be taken in the next five years (European Commission, 2019).

Building and renovating in energy and resource-efficient way

The construction, use and renovation of buildings require significant amounts of energy and mineral resources (e.g. sand, gravel, cement). Buildings also account for 40% of energy consumed. Today the annual renovation rate of the building stock varies from 0.4 to 1.2% in the Member States. This rate will need at least to double to reach the EU's energy efficiency and climate objectives (European Commission, 2019).

Mobilising research and fostering innovation

New technologies, sustainable solutions and disruptive innovation are critical to achieve the objectives of the European Green Deal. To keep its competitive advantage in clean technologies, the EU needs to significantly increase the large-scale deployment and demonstration of new technologies across sectors and across the single market, building new innovative value chains (European Commission, 2019).

A zero pollution ambition for a toxic-free environment

The natural functions of ground and surface water must be restored. This is essential to preserve and restore biodiversity in lakes, rivers, wetlands and estuaries, and to prevent and limit damage from floods (European Commission, 2019).

Preserving and restoring ecosystems and biodiversity

Ecosystems provide essential services such as food, fresh water and clean air, and shelter. They mitigate natural disasters, pests and diseases and help regulate the climate. However, the EU is not meeting some of its most important environmental objectives for 2020, such as the Aichi targets under the Convention on Biological Diversity. The EU and its global partners need to halt biodiversity loss (European Commission, 2019).

From 'Farm to Frok': a fair, healthy and environmentally friendly food system

Although the transition to more sustainable systems has started, feeding a fast-growing world population remains a challenge with current production patterns. Food production still results in air, water and soil pollution, contributes to the loss of biodiversity and climate change, and consumes excessive amounts of natural resources, while an important part of food is wasted (European Commission, 2019).

2.3 Research Question

How can the PZH synergize the circular bio-based building industry and organic agriculture in order to improve the quality of life in a just way?

PZH: How can the Province of South Holland (PZH) form a network to improve the flows of materials, agriculture, and biodiversity?

Circular bio-based building industry: How can bio-based building materials be produced, manufactured, and distributed?

Organic agriculture: Does the Province of South Holland (PZH) have enough space to cultivate enough raw material to meet the demand?

Improve the quality of life: What will the spatial and social implications of the transition to the circular bio-based building industry mean?

In a just way: How can the transition be equal and fair to everyone?

Sustainable Housing & Living Environment

Bio-based building materials

Circular Economy

Education

Organic agriculture

2.4 Conceptual Framework

Figure 2.3 depicts Butterfly Effect's conceptual framework. The main concept is supported by four pillars, agriculture, the Port of Rotterdam, no more waste, and social justice. The four pillars are connected to one another, forming circles in various aspects. Bio-based building materials and affordable, circular buildings are at the center of these concentric circles, acting as a spark for the entire network. As the ripple spreads, it touches all of the circles and accomplishes the final goals for each pillar.

Agriculture
Currently, the Province of South Holland is well-known for its greenhouse agriculture, with cutting flowers as the primary product. Horticulture, on the other hand, is unsustainable and therefore must be transformed. Agriculture can become the main source of raw materials for the innovative bio-based building materials industry. Therefore, we propose to use remediating organic farming as a tool to replace current deteriorating agriculture and progress towards the ultimate goal of sustainable transformed agriscapes.

No more waste
Waste can be a valuable resource, but its potential is underappreciated, and waste utilisation is currently low-intensity. We want to achieve a regenerated circular economy with waste valorisation in the waste sector with our concept. Waste valorisation will be spatialized through biorefineries. Furthermore, the waste sector is intertwined with the Port of Rotterdam and agriculture, both of which are important sources of waste. Aside from that, the Port of Rotterdam will serve as the waste valorisation network's central hub.

Port of Rotterdam
The polluting petroleum industry has taken over the Port of Rotterdam. According to our concept, the Port of Rotterdam will be transformed into an environmentally sustainable port by combining the scapes. The petroleum industry will be phased out and replaced by bio-based industries, with the port serving as a central hub for waste valorisation and bio-based building material production.

Social Justice
From the beginning of the project, social justice has been a crucial task. Social justice, unlike other self-contained pillars, is more overarching. It's something we'd like to incorporate into the project's overall process. To make it more operational, we set the end goal as a higher quality of living and working environment, which will be achieved through creative mixing of the two.

In conclusion, the bio-based building materials industry is something that connects all of the pillars and provides an opportunity to have a significant impact on the spatial and social aspects, similar to how a stone can cause a ripple effect.
Butterfly Effect (2022)

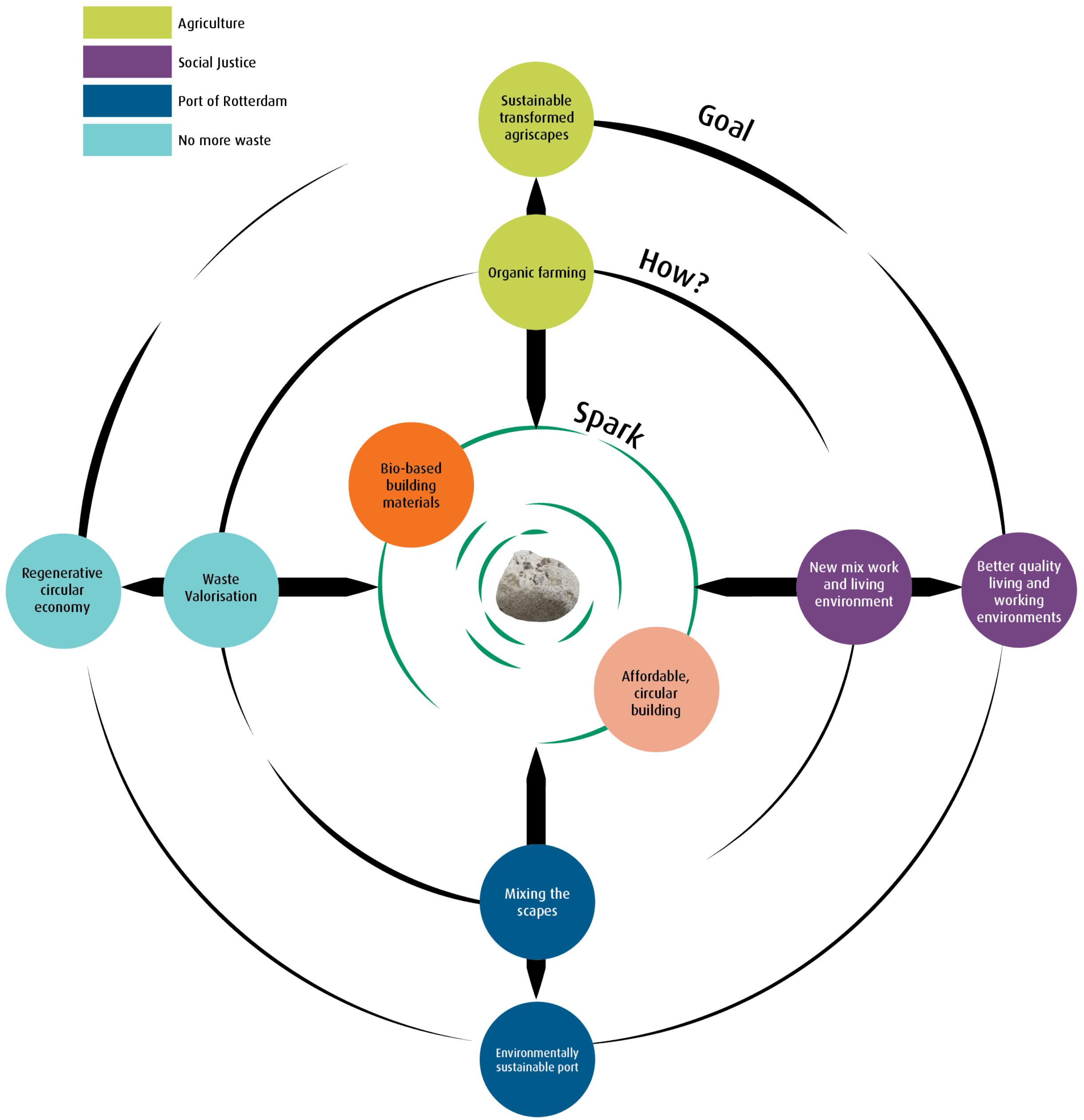


Figure 2.3. Conceptual Framework.

2.5 Methodology

Defining the research question, researching the potential, vision, strategy, and conclusion are the five stages of the project. Several research and design methods were used during the process: Course Lectures, GIS Analysis, Case Study, Quantitative Calculation, and Field Trip.
The most common method for almost all processes is to conduct a literature review, such as looking up information and problems in PZH, potential bio-based building raw materials, yield per unit of land supporting quantitative calculation, possible solutions to problems, and so on. The course lectures are also a major source of information for our progress, with methodology and SDS lectures providing us with a wealth of information about the project. We also conducted GIS analysis with mapping in order to understand the activities and flows in PZH, which is an important part of our output. Quantitative calculations are critical in determining when and to what extent we can transition to a bio-based building industry. Field Trips, both real and virtual, provide us with intuitive cognition.

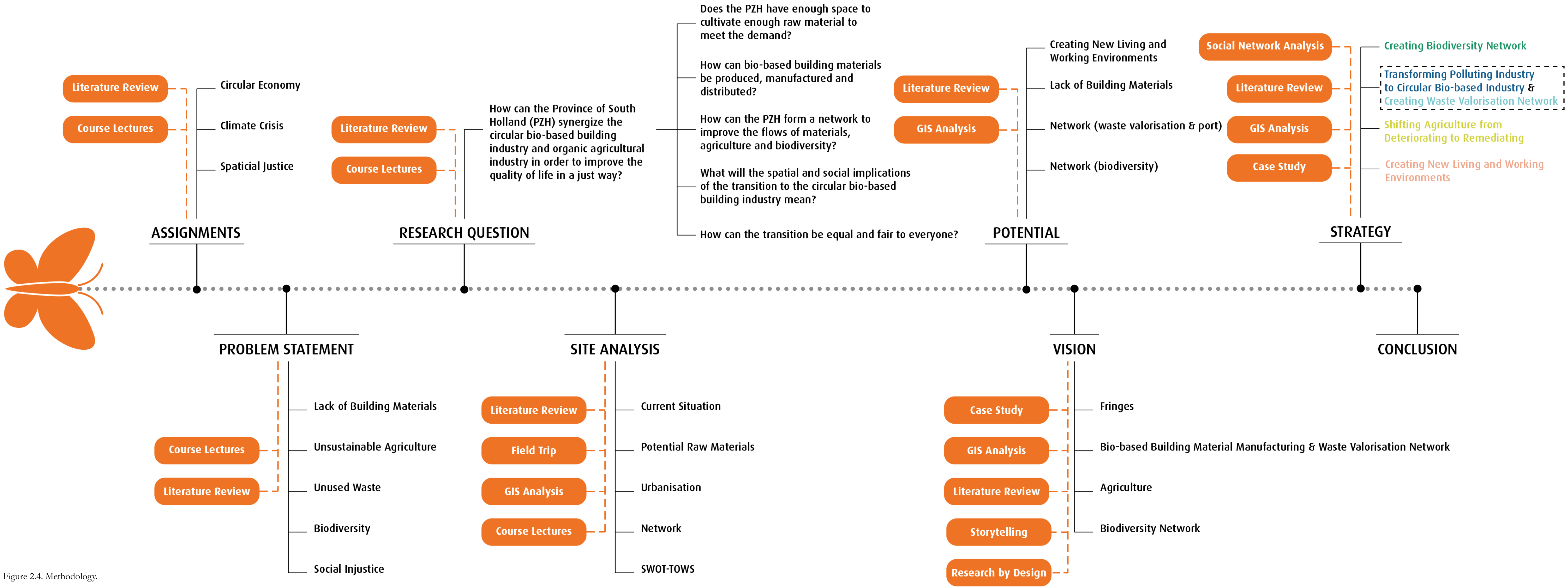


Figure 2.4. Methodology.

ANALYSIS

3

3.1 Current Situation in PZH

3.1.1 Soil Types

This map shows the soil condition in the Province of South Holland, including contaminated soil, salinated soil, and peatlands that cannot be used for agriculture for the time being. Measures must be taken to convert these areas into plant-growing areas.

Salinated Soil

Figure 3.1. Salinated Soil (Salt Farm Foundation, 2018)

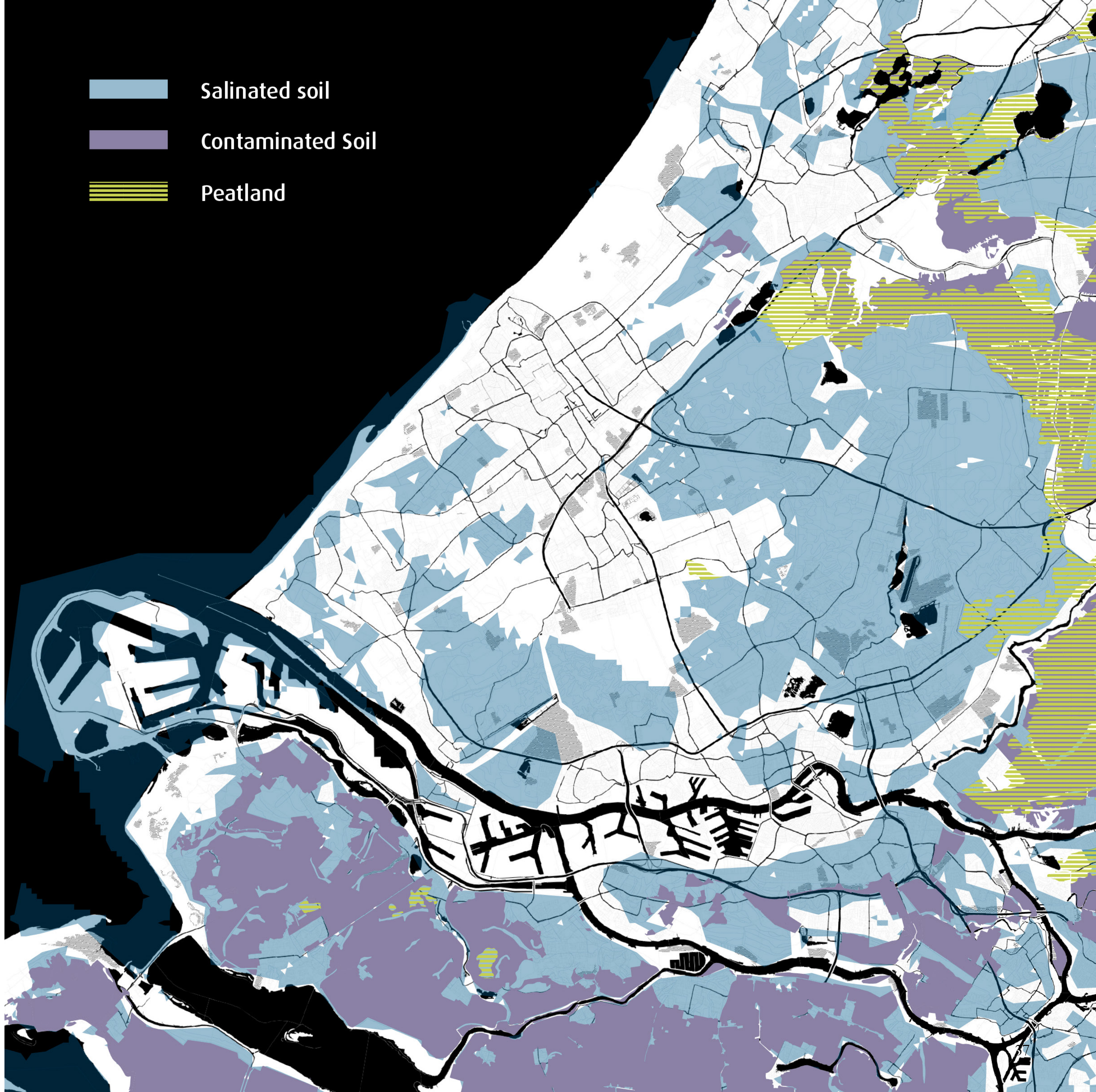
Contaminated Soil

Figure 3.2. Excavation showing soil contamination at a disused gasworks in England. (Dumelow, 2007)

Peatland

Figure 3.3. Northern carbon sink (Guêné-Nanchen, 2019)

>Figures 3.4. Mape depicting soil types in the Province of South Holland.



3.1.2 Waterscapes

The waterscape resources are very rich in the Province of South Holland. The map shows three types of waterscape in the Province of South Holland, differing by the surroundings. They are industrial, urban, and green waterscapes respectively.

We distinguished these three types of waterscapes which would could support water based transportation.

Green Waterscape

Figure 3.5. Steet view (Google, 2010)

Urban Waterscape

Figure 3.6. Street view (Google, 2020)

Industrial Waterscape

Figure 3.7. Street view (Google, 2009)

>Figures 3.8. Map depicting three types of waterscapes in the Province of South Holland.

0 5 10 km

3.1.3 Port of Rotterdam

The diagram below depicts the history of Rotterdam's port, from the dam's construction in 1250 to the construction of Maasvlakte 2 in 2013. We can conclude that the Port of Rotterdam experienced significant growth during the 1970's.

Current industries are represented on the map on the following page (figure 3.10). Petroleum, power, and chemistry industries, as well as supporting logistics industries are the most common.

On a smaller scale, the history maps below depict the formation of the petroleum industry in Botlek. The functionality of the oil refineries and their interdependency is visible in this historical analysis (figure 3.11).

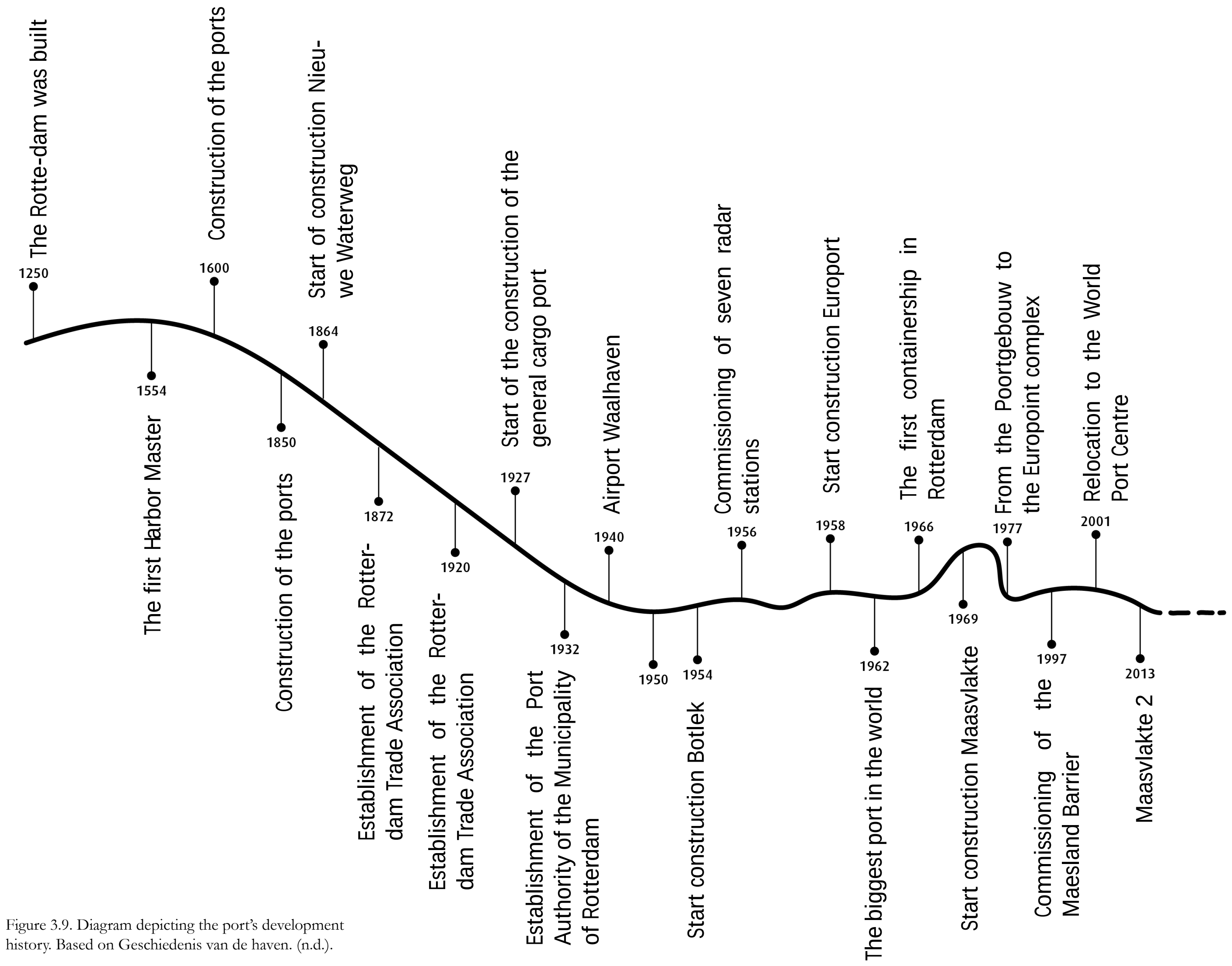


Figure 3.9. Diagram depicting the port's development history. Based on Geschiedenis van de haven. (n.d.).

Current Programs on the Port

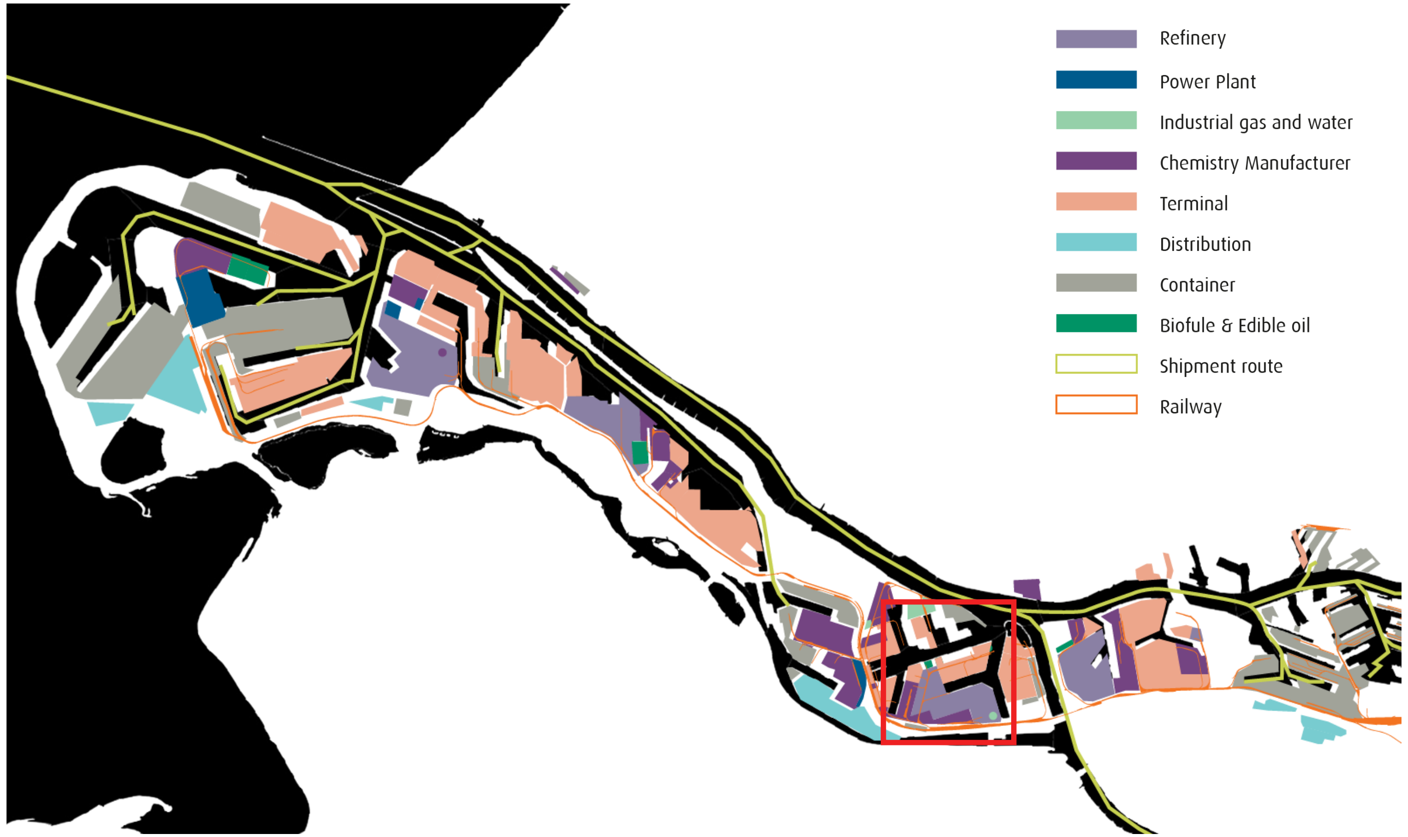


Figure 3.10. Map of current programs of the Port of Rotterdam.

Historical Development in Botlek

Figure 3.11. Maps depicting historical development of the Botlek area.

3.2 Can it Grow?

3.2.1 Building Material Industry Today

We continued by investigating the current building material manufacturing in the Netherlands and Province of South Holland. What we found out is that the majority of the materials used in building construction, for example wood, limestone, and gypsum are imported (Probos, 2019) (CBS, 2021) (figure 3.12). The amount of transportation involved increases the prices of materials and is not circular. Also dependency on global flows is non-resilient, as worldwide material shortages can impact skyrocketing of prices, as demonstrated by the aftermath of the Covid-19 pandemic (van Sante, 2022).

Moreover, companies in this sector in the Province of South Holland are mostly small-scale (figure 3.13), around 10 employees on average. Furthermore, companies in wood and concrete sector are concentrated in non structural, interior details, furnitures, and veneers. Larger companies working with concrete are usually building contractors who use material as cast-in-place element.

This situation raises two questions. Firstly, the dependency on the import, is it possible to supply the needs of building and renovation with locally grown raw materials? Secondly, the weakness of current manufacturing, can new production hubs be created and where?

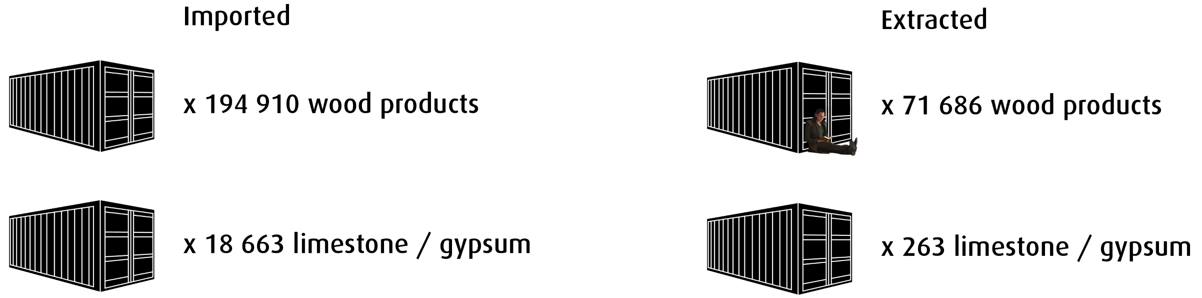
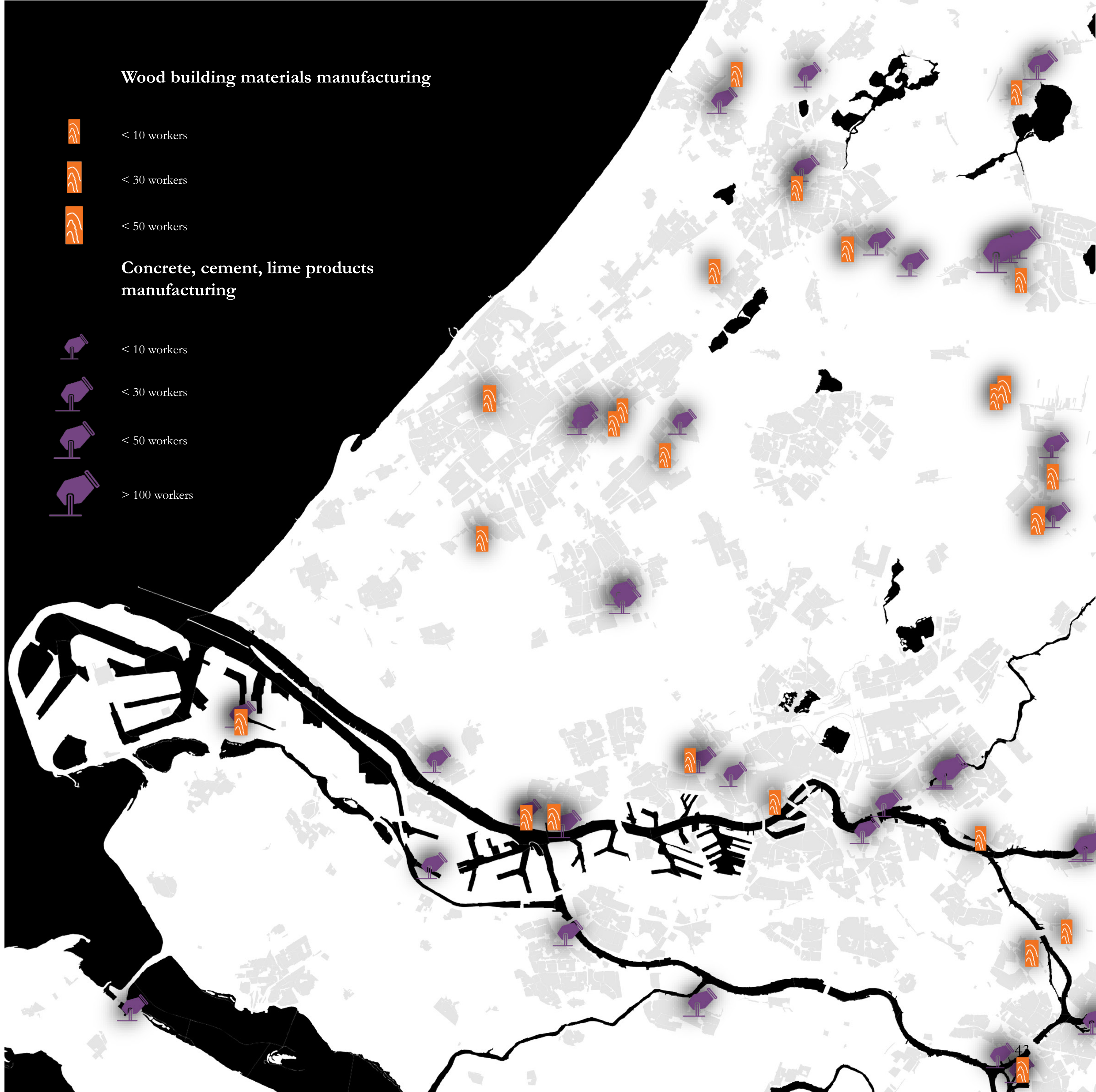


Figure 3.12. Diagram showing imported and extracted wood, limestone, and gypsum materials in the Netherlands quantifyed by the volume of shipping container. Based on Probos (2019), CBS (2021). Shipping container volume - 33.2m3 (Pacific Marine, n.d.). These numbers emphasizes that while there are some products extracted locally in the Netherlands, much more raw materials used in building material industry are imported.

Is it possible to supply the needs of building and renovation with locally grown raw materials?

>Figure 3.13. Map showing the current situation of concrete and wood building material manufacturing in Province of South Holland, graduated by the amount of workers. It is visible that most companies are small scale. What is more, they are mostly producing non-structural, interior veneers.

0 5 10 km



3.2.2 What to Grow?


Wheat (Cereal). By Askew (2015)


Hemp. By Proctor (2018)


Mycelium. By Pradejoniensis (2014)


Flax. By Nemophila (2020)


Soybean (Legume). By Egli (2021)


Cellulose fiber. By Fiber Region (n.d.)

Figure 3.14. Photographs of potential products to be valorised from different plants, organic and paper waste.

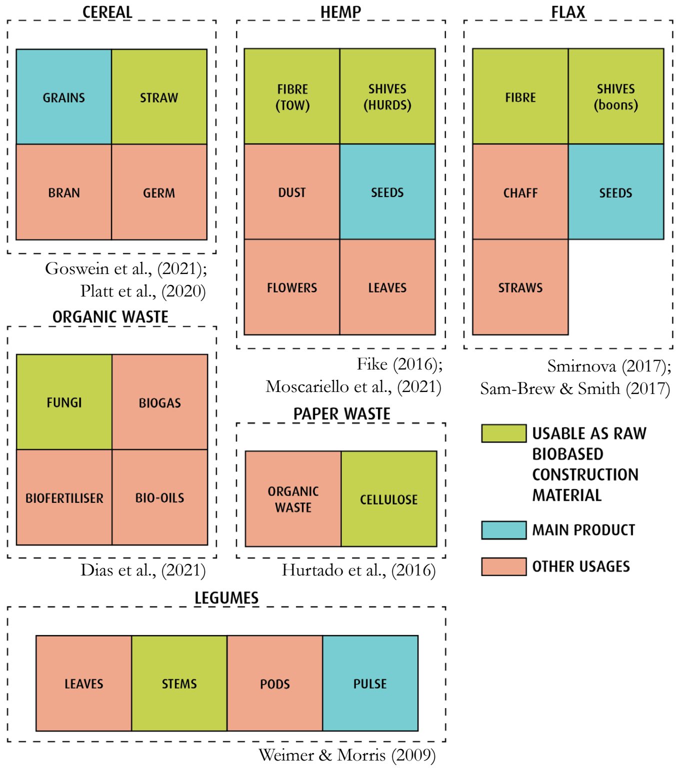


Figure3.15. Potential products to be valorised from differet plants, organic and paper waste. This diagram shows not only potential by-products of plants and waste that could be used in bio-based building material production, but also that there are multiple other parts that could be used as food or valorised.

To answer the question posed in previous page, we looked into elements that could be used in bio-based building material manufacturing. Currently the most commonly used are cereal, hemp, flax, and legume cultivation by-products, such as shives and fibre (figures 3.14 and 3.15). Term by-product in this case means that they are not used as main target of cultivation. For example the main and most financially rewarding part of hemp cultivation today are seeds, which are used in pharmaceutical and chemistry sectors.

Fungi grown on organic waste and cellulose from paper waste can be used in bio-based building material manufacturing as well. These elements are in early stage of innovation and has great potential.

The products presented here do not cover every possibility. Yet these materials are the most researched today.

3.2.3 What to Make?

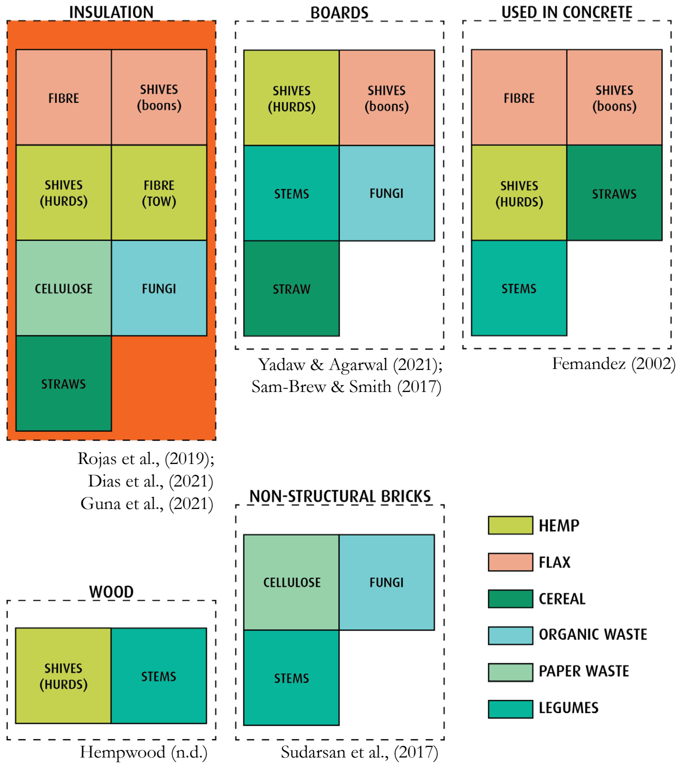


Figure 3.16. Bio-based building material products and plants from which it could be made. We chose to investigate further insulation production as illustrative example because it is the most conventional, advanced in terms of technology, and needed in quantity.


Fungi insulation. By Biohm (n.d.)


Hempcrete. By Isohemp (n.d.)


Flaxboard. By Linex (n.d.)


Fibre cement. By TTS (n.d.)


Hempwood flooring. By Hempwood (n.d.)


Paper brick. By Woojai (2016)

Figure 3.17. Bio-based building material products.

From the aforementioned raw materials, there are multiple products that could be manufactured (figure 3.16). Most of them currently are non-structural, such as insulation, boards, bricks, and flooring materials. However, advancements are being made in structural bio-based element technology. For example hempcrete and fibre cement blocks can be used partly or fully as bearing wall elements (figure 3.17).

In both cases bio-based building materials offer potential to reduce the construction sector's dependency on wood and concrete recources. This is important because both materials are scarce. Moreover, concrete production is very unsustainable. Wooden materials manufacturing, while much more sustainable, pose the danger of rapid deforestation (Goswein et al., 2021).

To investigate further the land availability in the Province of South Holland we chose to focus on bio-based insulation manufacturing. It is the most conventional research product, with varied ways of making it. Moreover, in terms of quantity it is one of the most needed, because it could be used both in new construction and renovation. As a result, insulation production serves as a good illustration on land availability for raw material cultivation.

3.2.4 How to Grow?

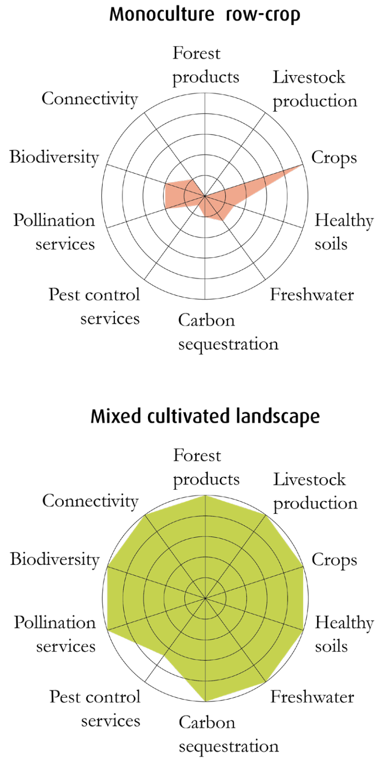


Figure 3.18. Benefits of mixed cultivated agriculture. Based on Kremen & Merelender (2018). The upper diagram shows the current problems of agricultural practices in the Netherlands. Bottom diagram shows the potentials of the agricultural transition.

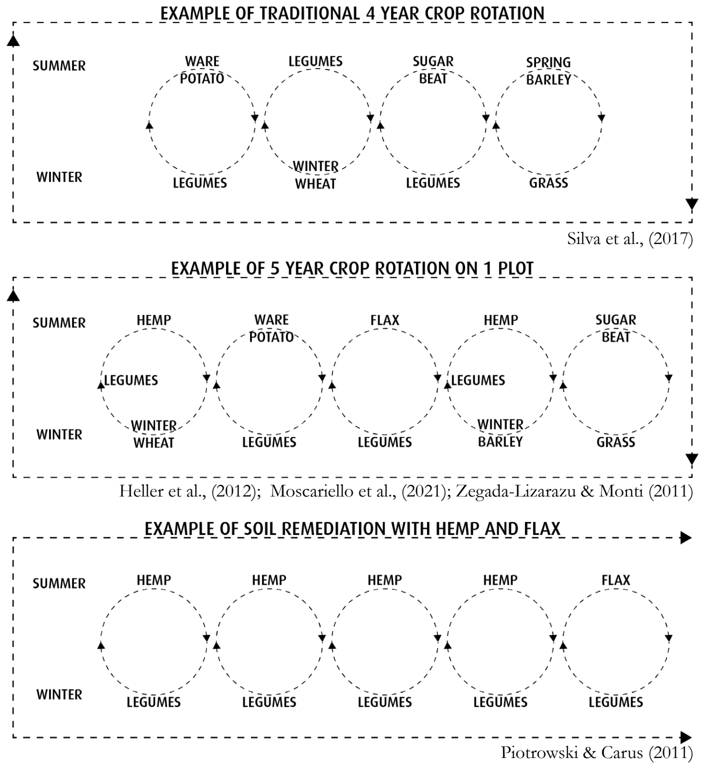


Figure 3.19. Current and potential crop rotations in the Province of South Holland. The potential crop rotations shows how new plants, like hemp and flax, could be introduced into existing crop rotation without removing other plants from cultivation. Bottom part shows how crop rotation would work in very polluted landscapes, like sites of oilrefineries.

Based on our choice to investigate further into insulation production, we looked into specific plants that needs to be cultivated. In this case it would be cereals, legumes, hemp, and flax (cellulose and fungi are be grown or produced in non-agricultural processes). Various cereals (winter wheat, spring barley), and legumes are mainstream crops in the Netherlands (figure 3.19). Hemp and flax are partly cultivated, but that would need to be upscaled.

Butterfly Effect proposes to extend typical Dutch 4-year crop rotation cycle into 5-year and introduce hemp twice and flax cultivation once. Since hemp can be harvested (depending on the species) in 4 months, there is time to introduce winter plants. As a result, all of the mainstream crops could remain in the cycle.

Furthermore, this diversified crop rotation could create multiple benefits not only for crop yields, but also for biodiversity, soil health, pollination (figure 3.18). These benefits could be strengthened even more if spatial diversification of crops would be introduced.

Hemp, flax and specific types of legumes have the potential for soil remediation and could be used in polluted soils, for instance sites of oil refineries.

3.2.5 How Much Area is Needed?

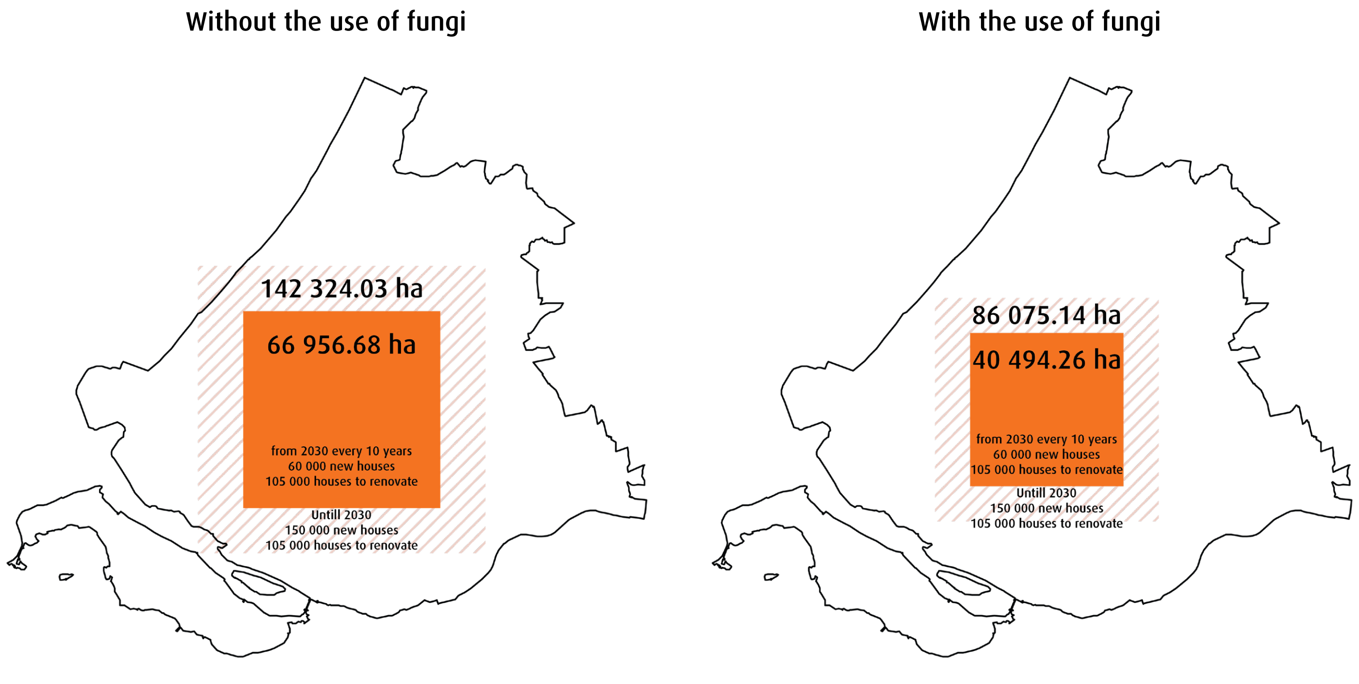


Figure 3.20. Area needed to supply the insulation demand both for new construction and renovation. Detailed tables are presented in the appendix (Tables 1 - 8). The process of calculation is briefly described here. Firstly we used strategic plans of Provincie Zuid-Holland (2017) for the amount of houses needed to be built and renovated and converted it into overall m^2 needed by using avarage household size and floor space per person in Province of South Holland (CBS, n.d.b.). By using calculations from Villoria Sáez et al., (2012), we were able to assess the total amount of walls and roofs to be built in m^2 and amount of insulation needed in m^3. By using information of average crop yealds in the Netherlands (CBS, n.d.a), and knowing average densities of products, we were able to calculate yearly m^3 of insulation from hectare for different elements. Lisa (2019) dataset allowed us to know sizes of different areas in the province and calculate the outcomes. To see, how using fungi differentiates the outcomes we calculated using different densities, as fungi products are much lower density.Based on Villoria Sáez et al., (2012); Demir & Dogan (2020); Hurtado et al., (2016); Goswein et al., (2021); Dias et al., (2021); Platt et al., (2020); Kazachenko er al., (2021); Bouaesker et al., (2014); Sam-Brew & Smith (2017); Zhang et al., (2012); Liu et al., (2019); McCullough (2019); Guna et al., (2021); Cerbu (2015); Jayas & Cenkowski (2006); Lam et al., (2008); Gelaw et al., (2014); Provincie Zuid-Holland (2017); CBS (n.d.a); CBS (n.d.b); CBS (2018); Lisa (2019);

Using exemplary crop rotation cycle, we were able to calculate the overall space needed to cultivate supply insulation demands both for new construction and renovation in different periods and methods (figure 3.20).

Two diagrams separates needed space with and without use of fungi. The separation is made because fungi growing processes have yet to be developed to be efficient and feasible. However, it would greatly reduce the amount of raw materials needed. Hence the left diagram is the safe, conventional option and the right one is the potential future scenario. Division is made as well for different periods. Diagonal hatch shows area needed until 2030. Solid hatched space shows land needs for every decade after. Because of the potentially lengthy transition, we chose the periods after 2030. Moreover, latter decades possibly will have more stable demand.

3.2.6 How Much Can We Supply Without Fungi?

Figure 3.22. represents how much of the needed insulation can be supplied by raw materials from the different areas in percentages. In this scenario rooftops, arable land, and an area of current greenhouses could be used for the cultivation of cereals, hemp, and flax. Oil scapes, areas currently highly polluted and potentially not used for fuel production in the future, could be re mediated by hemp and flax cultivation. Grasslands would become a mixture of animal grazing and agriculture. The paper waste potential is calculated based on the current output in the Port.

In total, we can grow 1.3 times more raw materials than we need, while only using around ¼ of products (figure 3.21). This means that there still would be food and other high value products.

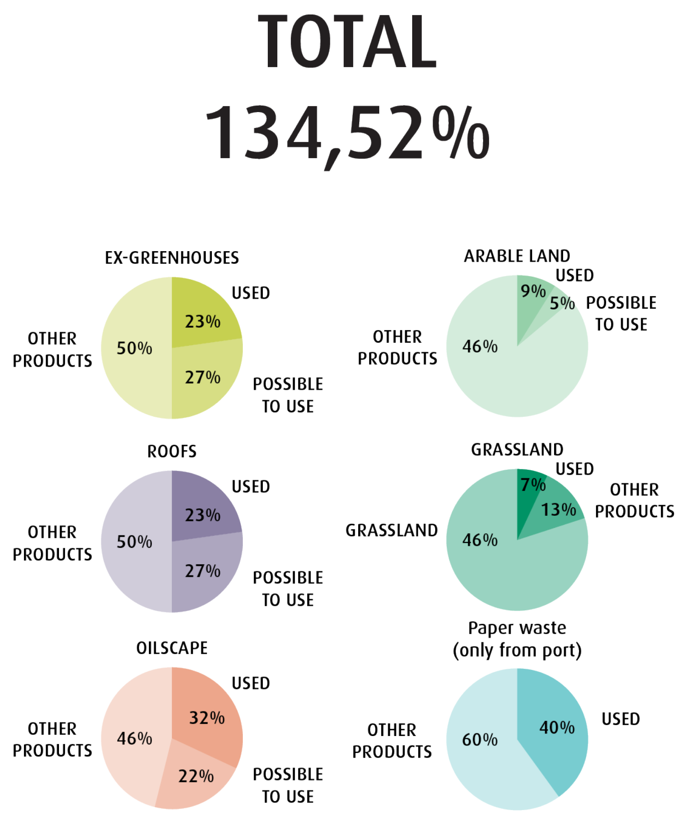
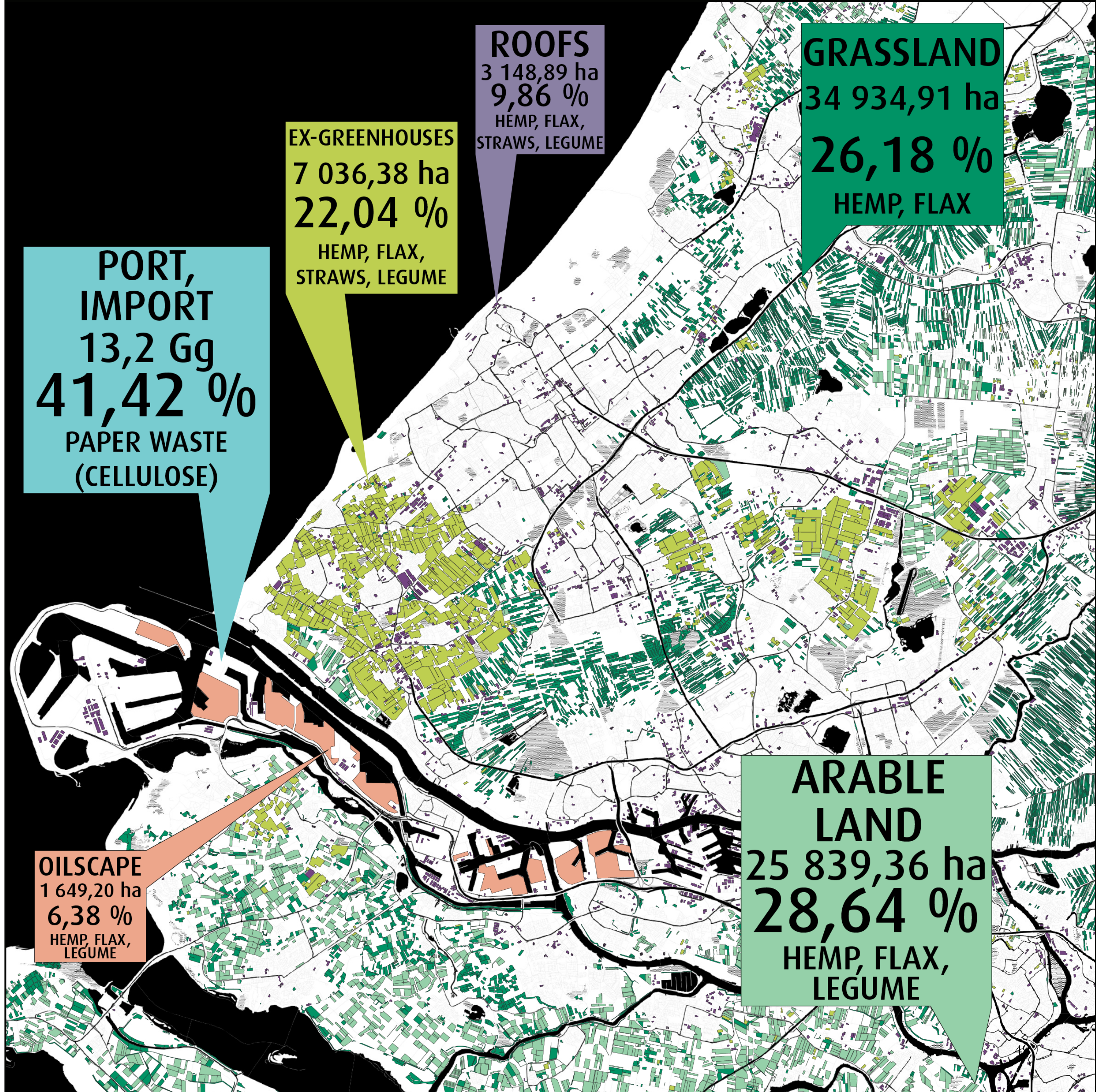


Figure 3.21. Diagram showing how much of total bio-based insulation demand could be supplied without use of fungi. Moreover, it represents that this could be achieved by using on average less than 1/4 of all potential products.

>Figure 3.22. Map showing the potential raw material supply for bio-based insulation manufacturing from different areas and sources. Calculated for the needs of every decade after 2030, without use of fungi. Percentage shows supply of the total need from different locations.

0 5 10 km



3.2.7 How Much Can We Supply With Fungi?

Figures 3.23 and 3.24 show that with the mass use of fungi the total bio-based insulation supply can reach up to 2.4 times the amount of the demand. As a result we argue that with funding for fungi manufacturing facilities and research in the near future this technology could be fully industrialised. Especially with large quantities of raw material inputs, because mycelium can grow on the same elements that bio-based insulation is produced.

Therefore in our opinion it is possible in the future to manufacture other products than insulation and export it nationally or globally. Moreover, potentially current amount of agricultural land could be reduced prioritising other necessary functions.

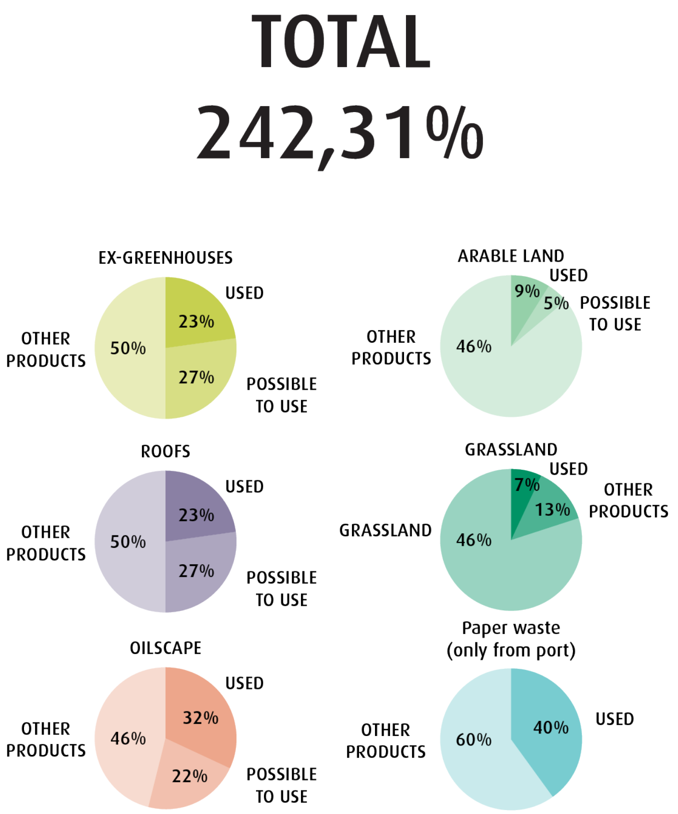
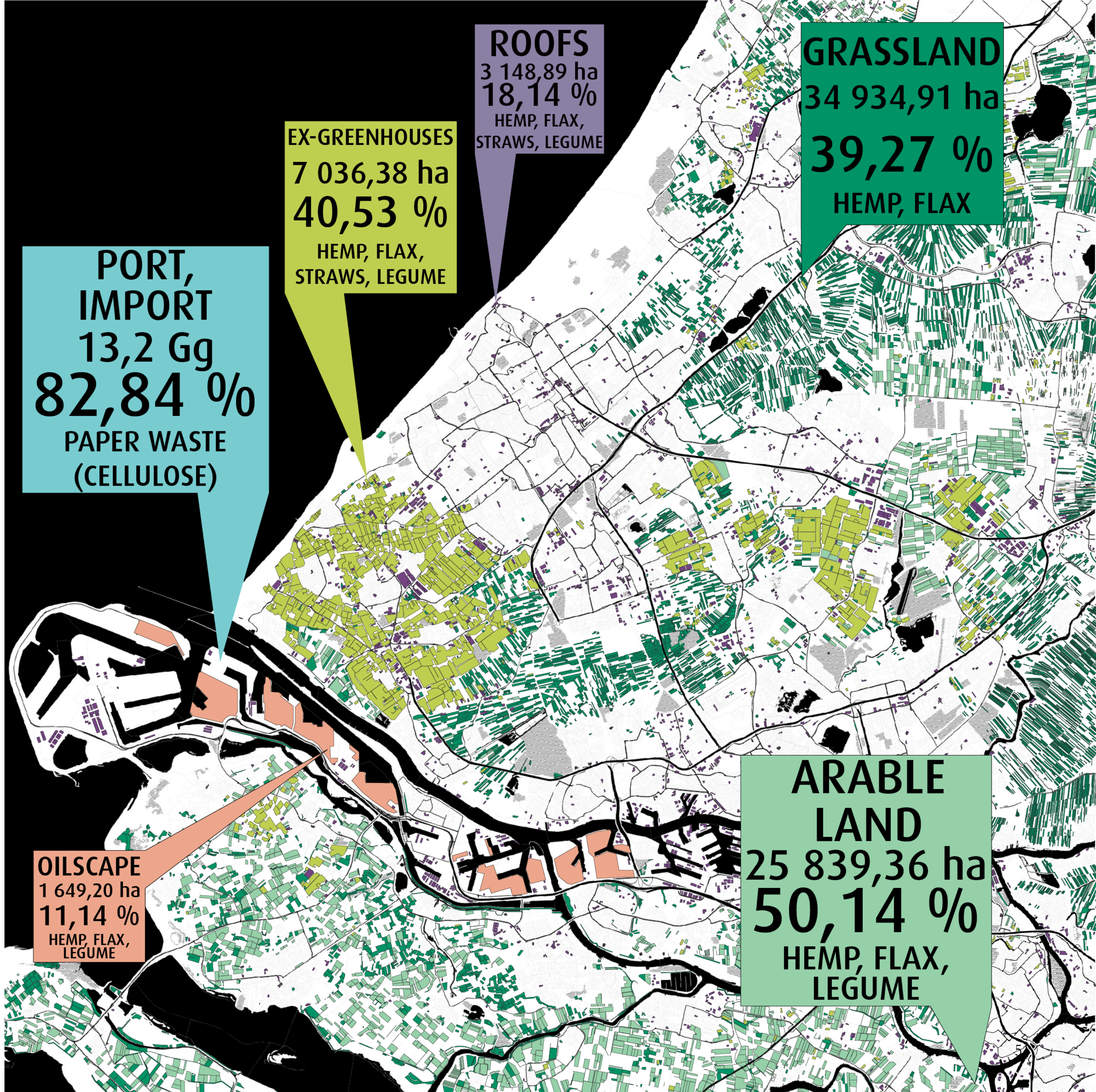


Figure 3.23. Diagram showing how much of total bio-based insulation demand could be supplied with use of fungi. Moreover, it represents that this could be achieved by using on average less than 1/4 of all potential products.

It is possible to supply 2.4 times more bio-based insulation than Province of South Holland demands. Therefore it is possible to manufacture other products, export it, and/or reduce amount of agricultural land.

>Figure 3.24. Map showing the potential raw material supply for bio-based insulation manufacturing from different areas and sources. Calculated for the needs of every decade after 2030, with use of fungi. Percentage shows supply of the total need from different locations.



3.3 Urbanisation

3.3.1 Urbanisation Strategy

The Province of South Holland has made a new urbanisation strategy, the "Verstedelijkingsstrategie 2.0", in which they state that there should be 230.000 new homes built by 2030. As of now, 80.000 of these homes have been realised. In addition to this the Province has stated that every year an estimate of 60.000 new homes are needed (Provincie Zuid-Holland, 2020). This adds up to about 270.000 new built homes by 2050.

Furthermore, the "Verstedelijkingsstrategie 2.0" (Provincie Zuid-Holland, 2020) is focused on the further densification and intensification of the existing urban structures and areas of the Province of South Holland. This focus is mainly aimed on the post-war neighbourhoods and mixed-use areas. In the post-war neighbourhoods, the dwellings have been designed on bigger areas of land. Most of these dwellings are in need of improvements or have even reached the end of their life. Which means that the post-war areas are in need of quite the transformation, not only for densification but also renovation.

In addition to this, post-war neighbourhoods where designed as monofunctional residential areas. This was the common or "go-to" design strategy when these neighbourhoods were designed. Since these neighbourhoods are designed as monofunctional residential areas, there is scarce space to incorporate more functions into the area. Incorporating more functions into post-war neighbourhoods was not a point of interest during the time of design of these areas. Nowadays this is no longer the case, as urban areas in the Netherlands are undergoing economic growth, this results in the need of a combination of employment opportunities and a sufficient supply of homes (Alkemade, Strootman & Zandbelt, 2019).

In order to create a more pleasant environment and improve the accessibility of urban areas, a function mix of living and working should be introduced. The "Verstedelijkingsstrategie 2.0" also identifies different major urbanization locations across the province. This strategy is used as the base of the urban growth for this project.

>Figure 3.25. Map showing the urbanisation strategy of Province of South Holland. Based on Provincie Zuid-Holland, (2020).

0 5 10 km

3.3.2 Urban & Agricultural Growth

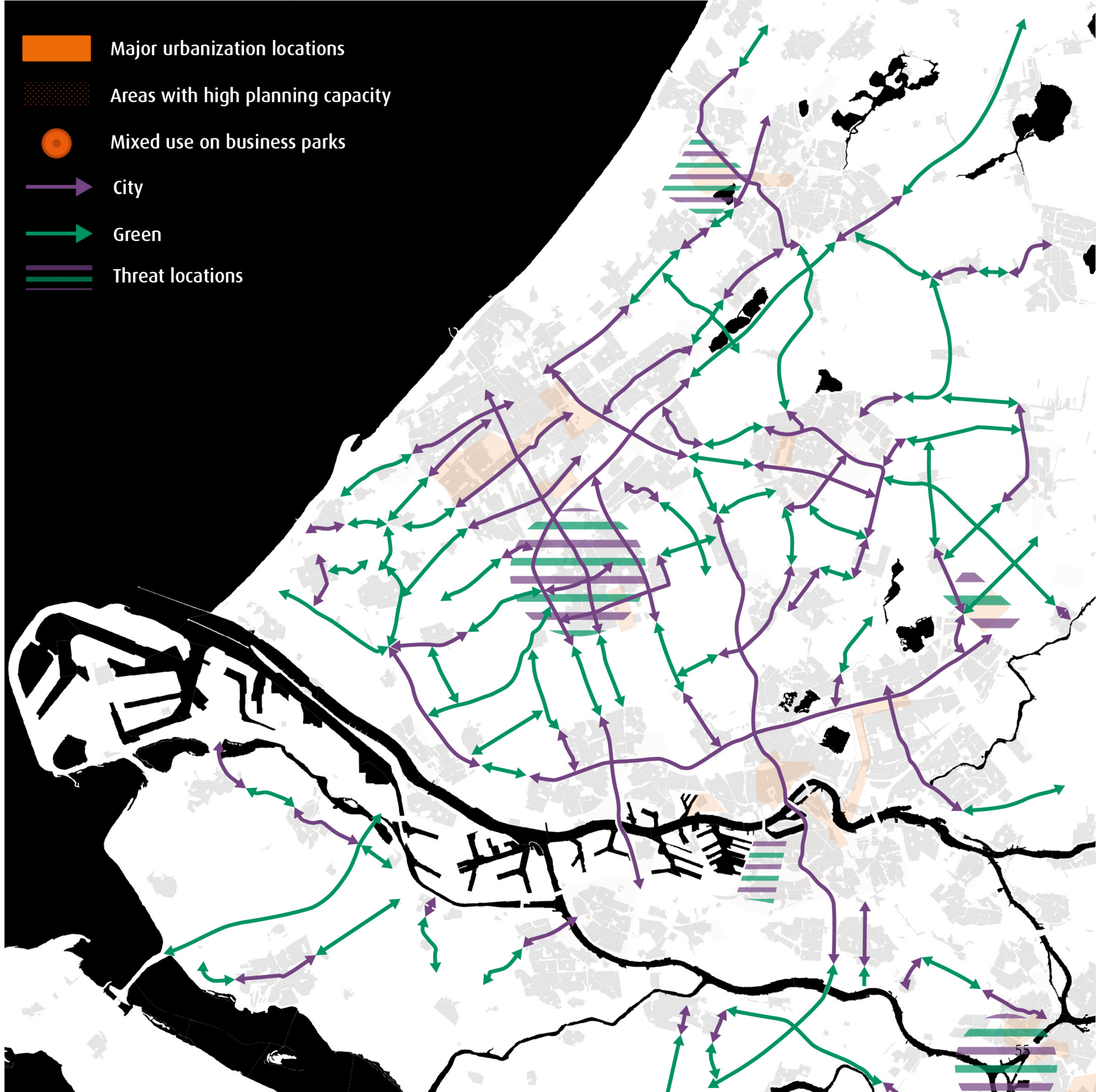
Looking at the estimated growth of the urban areas and the centres of these areas a growth direction can be established. In the case of the Province of South Holland the urban growth is sprouting from the centres, or in most cases, the origins of the urban areas and growing in the direction of bigger "green areas".

The agricultural growth of the Province of South Holland was estimated in the same direction as the urban growth. The takeaway from this is that the agricultural growth is also growing away from its place of origin, which in most cases is the heart of that specific agricultural area, with projected growth towards the urban areas.

Looking at both the urban- and agricultural growth of the Province of South Holland, it seems that they are naturally expanding towards each other. This means that at some point these two sectors will connect. Whether this meeting point or meeting area will result into a barrier or a clash still lies to question.

But that is not the aim of this project. These meeting areas provide ample opportunity to create a new mix of living and working environments.

These new mixes of living and working or "fringes" would be different from the mix of functions in the post-war neighbourhoods since these new fringes would be designed with the aim of mixing functions in mind. This would not be the case in the post-war neighbourhoods since they will have to be adapted in order to mix functions, whereas these new fringes will be designed specifically for the mix of living and working.



>Figure 3.26. Map showing directions of urban and agricultural growth with chalenging threat locations.

0 5 10 km

3.3.3 Fringes

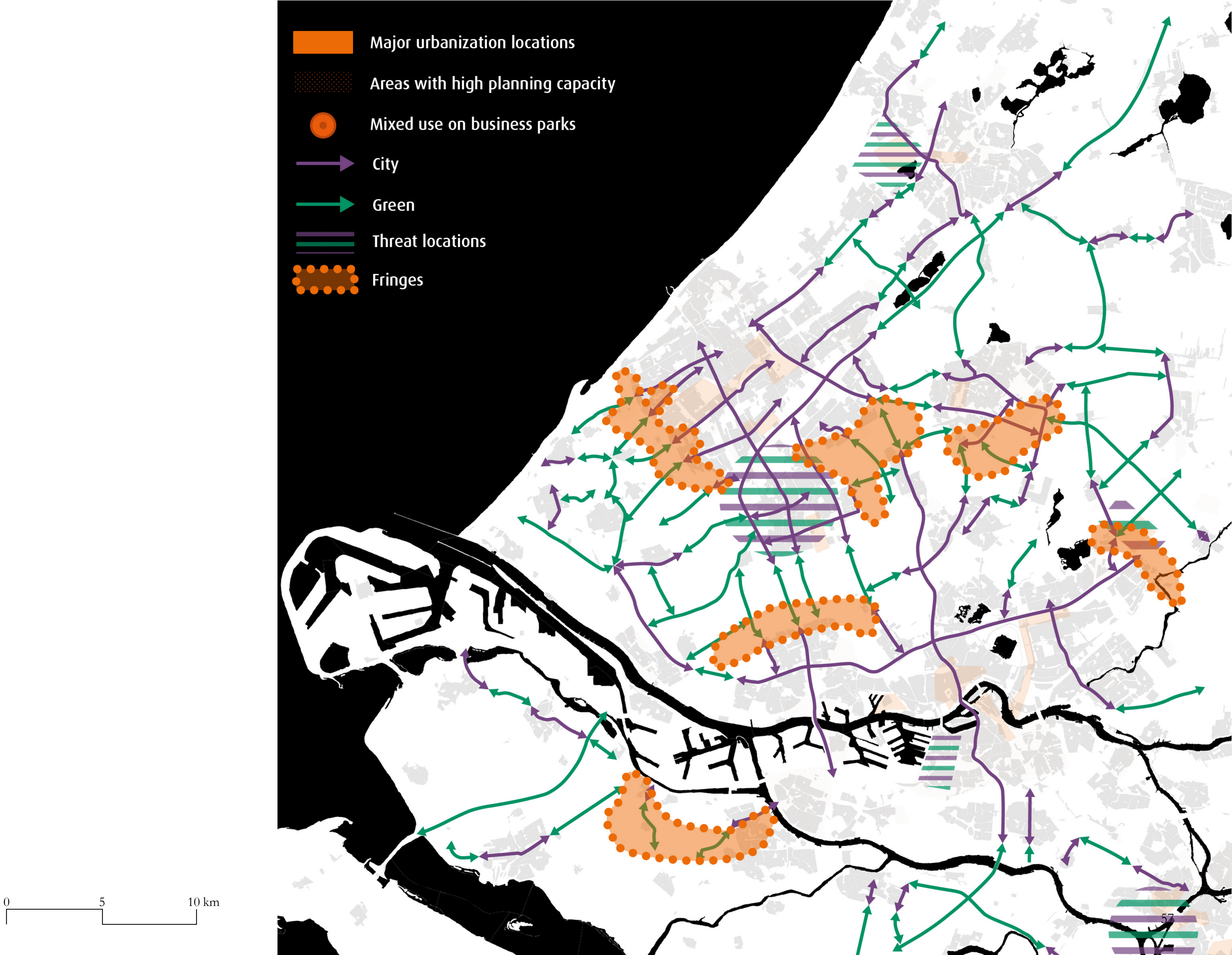
Since the 19th century separating functions in urban planning was the common planning strategy. Nowadays this is no longer the case, in most urban plans mixing of functions is a key component. In urban areas that are undergoing economic growth the combination of employment opportunities and a sufficient supply if quality homes are a necessity (Alkemade, Strootman & Zandbelt, 2019).

Therefore the mix of living and working environments is turning into the new "go to" strategy in urban planning. How this is implemented is still something that is experimented with, since the Netherlands does not have that much experience in this.

The Province of South Holland has already taken the mix of living and working environments into account by implementing this into the "Verstedelijkingsstrategie 2.0". While this mixing strategy is a step in the right direction and will be applicable in the whole of the Netherlands, it will not be applicable in every single case of mixing functions in urban areas.

In the "Verstedelijkingsstrategie 2.0" the mixing of functions is based on the transformation of monofunctional post-war residential neighbourhoods into more mixed urban areas. This means that the strategy focuses on taking existing monofunctional urban areas and transforming them into mixed urban areas. This still leaves to question how mixed urban areas would look like if they were specifically designed for the mixing of living and working, and what this would mean if in the future these urban areas would need to be transformed yet again. This project will focus on this type of mixing living and working as an extension of the "Verstedelijkingsstrategie 2.0".

The cities and agricultural landscape from which the fringes have grown will all be different in identity, type, atmosphere, origin, place, etc. Therefore this will result in all different fringes and all sorts of different mixes of living and working environments depending on the location of the fringe and the type of mix it will be.



>Figure 3.27. Map showing potential fringe locations.

3.4 Land Use Analysis

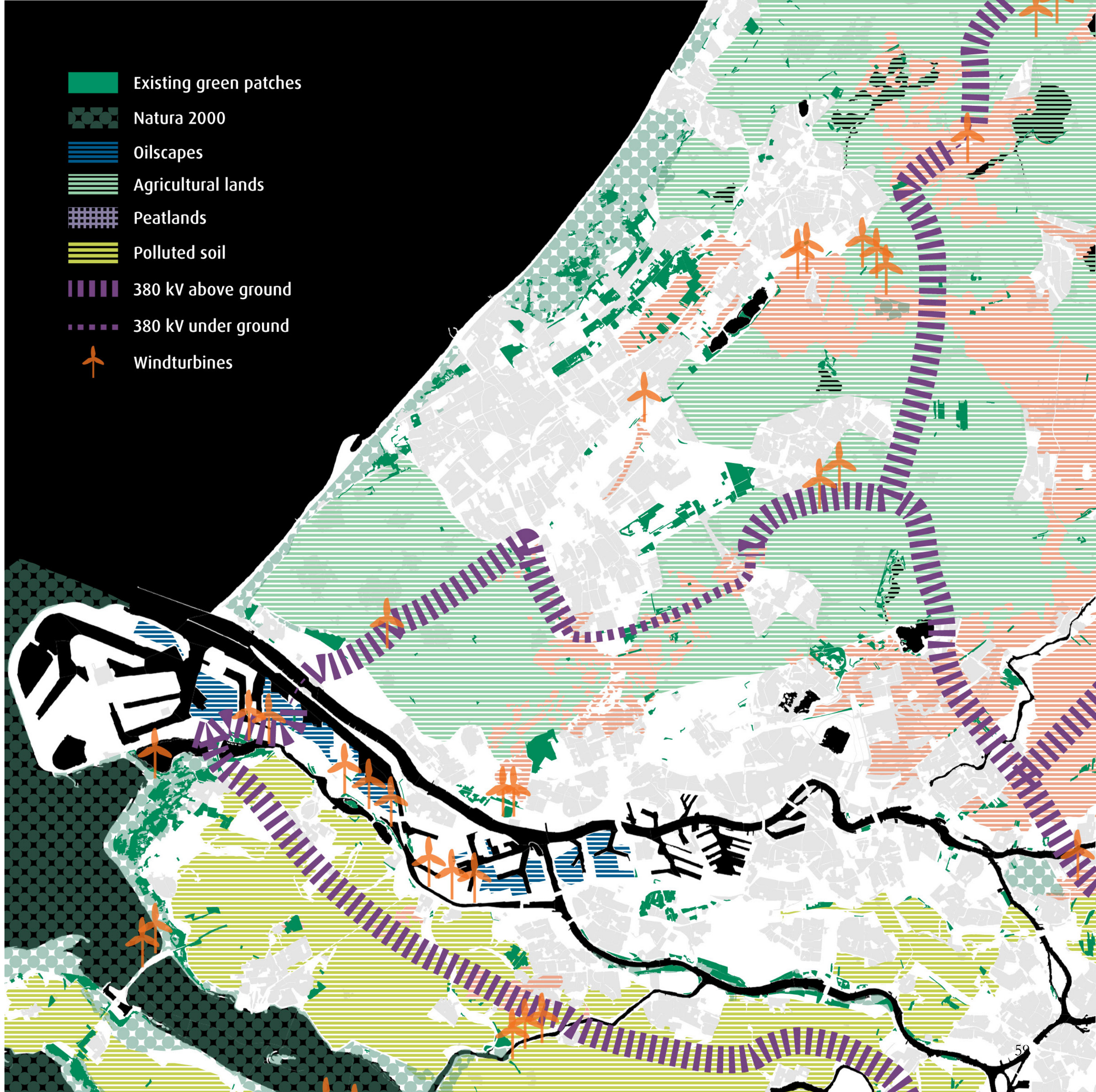
3.4.1 Is There Space for Biodiversity?

This analysis looks at the existing landuse in the Province of South Holland. In the problem statement the lack of biodiversity and the lack of access to green and recreational space came forward. In the province the average distance to a green recreational space is below standard. This lead to the implementation of a new biodiverse network for the Province of South Holland.

With this analyses we are looking into possible space for a green network. For this it is important took look at the current built environment. The biodiversity network will have to connect to the city to create a larger impact on the quality of life. The existing green patches can sustain the network and will be there for an important factor in the location of the network as a whole. Electricity cables and wind turbines can create a network through the province since these wastelands are unusable for other functions because of the high risk that is involved with these towers.

The different type of soils that are found in this area can create a opportunities for new green patches. With the potential reinterpretation of certain areas, the biodiversity network can be implemented simultaneously.

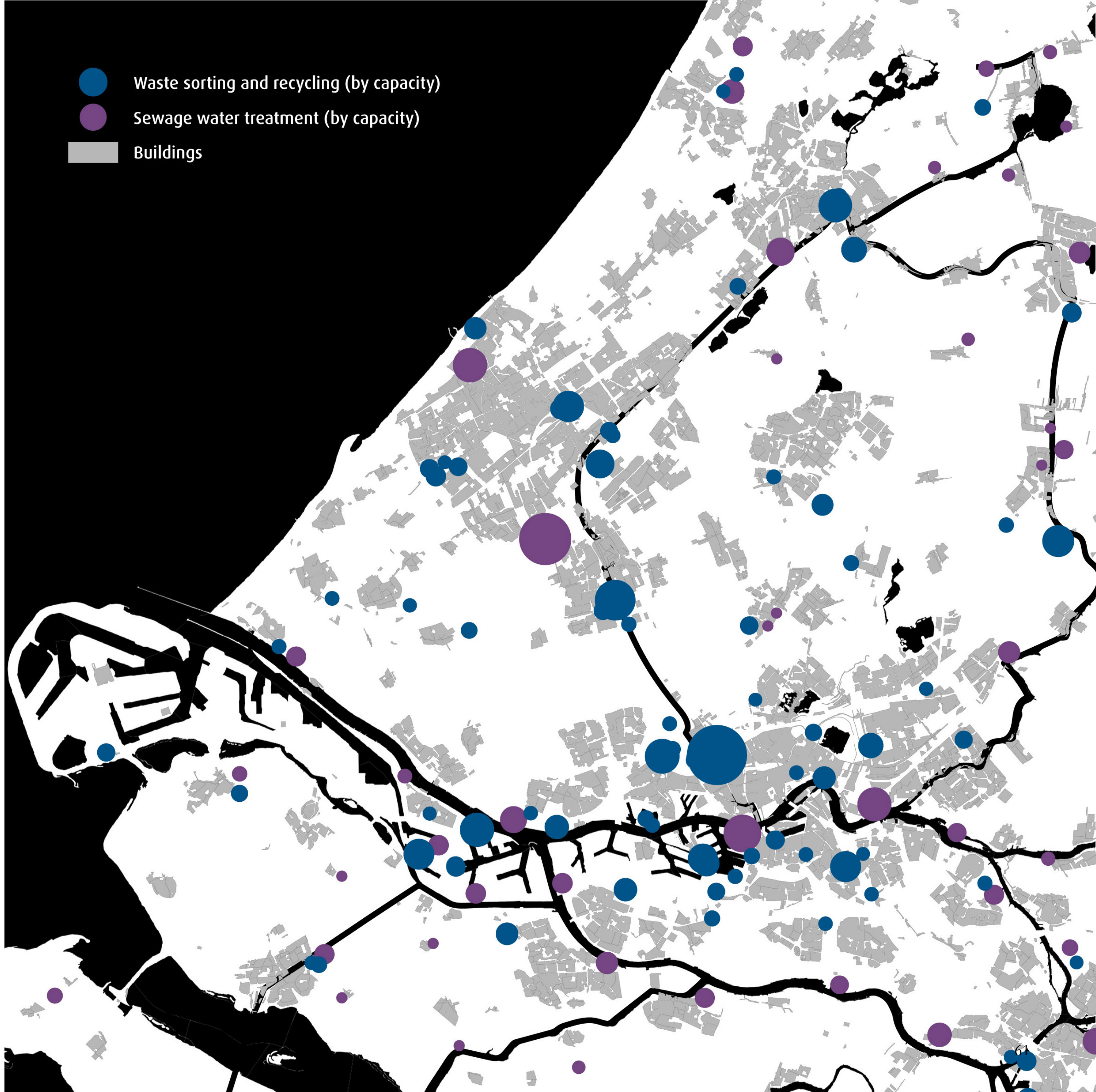
>Figure 3.28. Map showing available spaces for biodiverisity.



3.4.2 Waste and Sewage

This analysis looks at the implementation of waste sorting and recycling and sewage water treatment in the Province of South Holland. In the problem statement the lack of reuse of waste flows was assessed. With the port of Rotterdam striving to be the largest bio-based cluster in the world and the fact that food waste and biomass valorisation are considered high priority areas for the European commission, we looked into potential locations for biorefineries.

By assessing the current situation of the waste sorting and recycling and sewage water treatment by capacity, the potential locations for biorefineries can be appointed. The locations of waste and sewage water have the potential infrastructure needed to support new biorefineries. By looking at the existing built environment, the potentials for new biorefineries that can support either newly built housing or be part of the agricultural recycling process.



>Figure 3.29. Map showing waste sorting, recycling, and sewage water treatment facilities in PZH.

3.4.3 Biorefinery. What is It?

The transformation of biomass into a bio-based product takes place in biomass processing facilities. When a facility converts biomass into a spectrum of products, it is called a biorefinery.

EU Directorate-General for Research and Innovation (2018)

Biorefinery is an essential part of EU bioeconomy strategy (EU Directorate-General for Research and Innovation, 2018). It is a facility where material flows from different bio-based activities are connected in a circular way. In essence it uses the waste from one process as raw material in waste valorisation industry (Frosch & Gallopoulos, 1989), creating a spectrum of new products. Biofuels, often associated with biorefineries today, are only one of the potential products.

Figure 3.30. presents the potential inputs and processes involved in biorefinery. It is based on material cascading, where each element could be processed multiple times to achieve a greater variety of products. In this diagram we show the most popular processes and input materials today, but many more innovative elements are being tested.

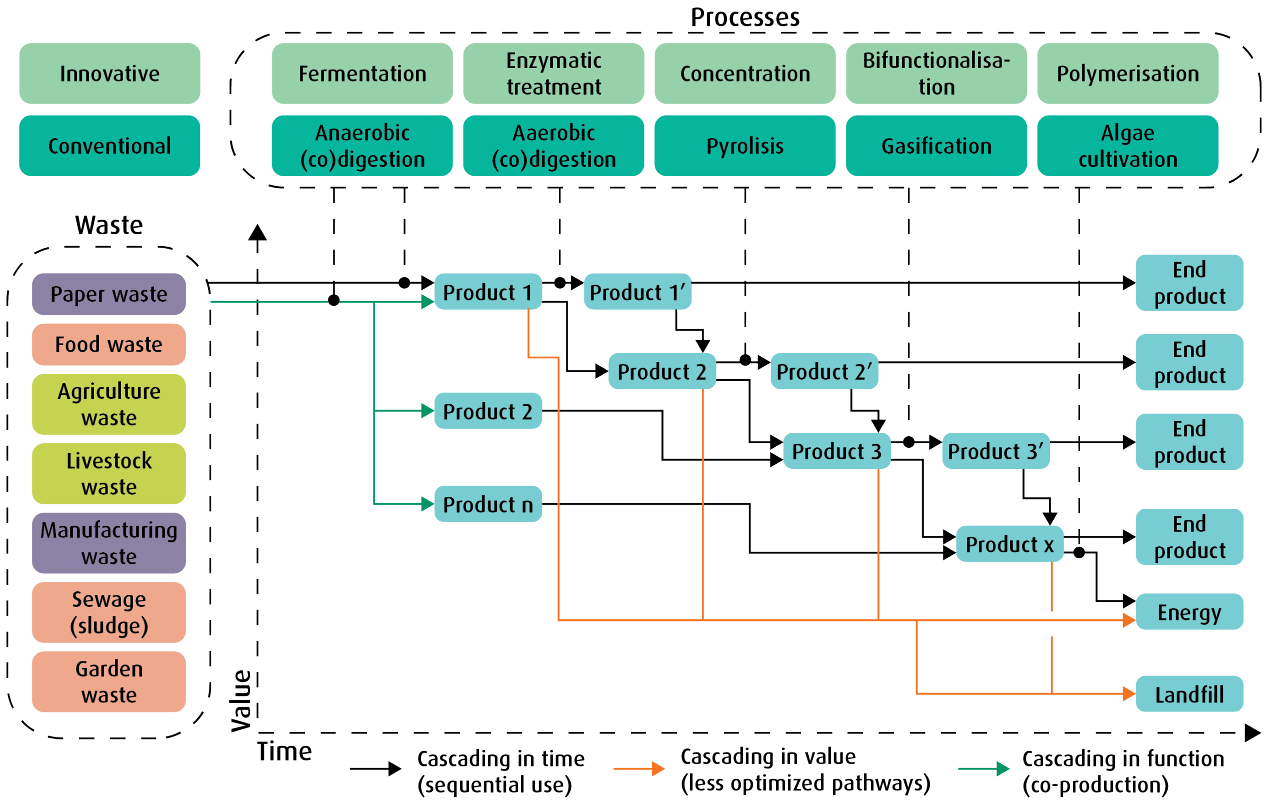


Figure 3.30. Diagram showing main working principle of biorefinery. Based on Jarre et al., (2020), Odegard et al., (2012), Gontard et al., (2018), United States Environmental Protection Agency EPA. (n.d.). Main imput is waste (most often organic, such as paper or food waste), that is being altered by various more conventional or innovative processes (most used today is anaerobic (co)digestion). By applying different actions for different start or intermediate products, cascading effect could be achieved, resulting in different end products with diverse values. Value in this context is not monetary, but rather fitness of the product for reusing, repurposing, remanufacturing, and/or recycling.

For the bio-based sector to deliver its benefits across regions and actor groups, and to ensure a balanced distribution of its benefits, different technologies and business models need to be developed, offering a portfolio of options. These range from the large and/or sophisticated biorefineries to smaller and simpler facilities with large replication potential.

EU Directorate-General for Research and Innovation (2018)

In EU bioeconomy strategy emphasis is placed on different scales of biorefineries. A network of small, medium, and large size facilities could potentially increase circularity, reduce transport flows and create local jobs. Local biorefinery products could be implemented directly in the area, while large regional facilities could valorise waste into higher value products (both in sustainability and monetary terms).

Therefore we analysed different scales of biorefineries to understand potentials (figure 3.31). Two of the biggest facilities today in Europe are Borregaard in Norway and Pannonia Bio in Hungary. Both are focusing on bioethanol and biochemicals, but their scale allows them to be very innovative in outcome products and efficiency.

Kompostwerk and Biowert are medium size facilities. They focus their production on energy and agricultural products, such as biodigestate and biofertiliser. They can still be very innovative in terms of material outcomes.

Anellotech and Biogas are the smallest scale and focus their production on locally used energy and agricultural chemicals.

Borregaard AS
Sarpsborg, Norway
Size: ≈28ha
Input: wood pulp
Output: bioethanol, biochemicals
(Borregaard, n.d.)

Pannonia Bio
Dunaföldvár, Hungary
Size: ≈22ha
Input: crop waste
Output: bioethanol, biochemicals, animal feed, nutrients, pharmaceuticals
(Pannoniabio, n.d.)

Kompostwerk Hellefelder Höhe
Sundern, Germany
Size: ≈4ha
Input: organic waste
Output: biodigestate, biogas
(Kompostwerk, n.d.)

Biowert Industrie
Brensbach, Germany
Size: ≈2.5ha
Input: grass
Output: biogas, bioplastics, insulation, biofertiliser, cosmetics
(Biowert, n.d.)

Anellotech
Pearl River, NY, USA
Size: ≈2ha
Input: non-food biomass
Output: bioplastics, biochemicals, biogas
(Anellotech, n.d.)

Biogas Eisborn
Balve, Germany
Size: ≈1.5ha
Input: organic waste
Output: biodigestate, biogas

Figure 3.31. Biorefineries of various sizes. Based on Google (2022).

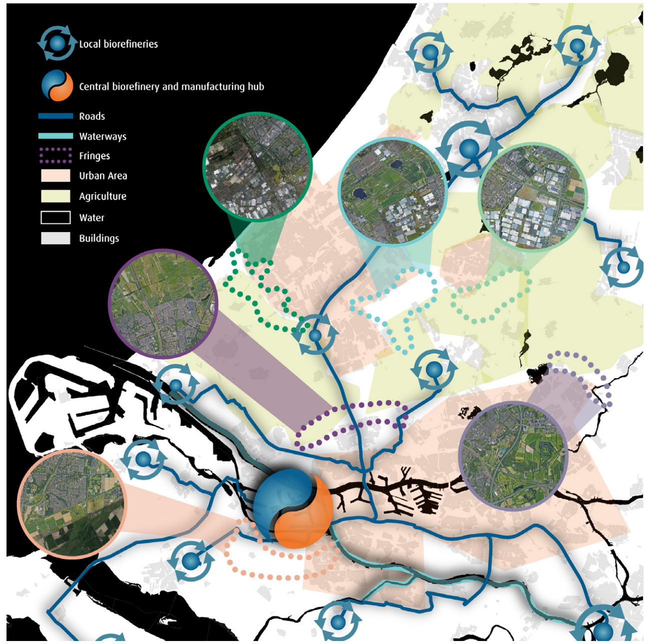
3.5 Potentials

Creating New Living & Working Environments

Creating a new mix of living and working environments in the so called fringes is a big opportunity for the province of South Holland.

These fringes all differ in type depending on their location, the urban area they origin from and the agricultural landscape they origin from.

These fringes not only give the opportunity to create new environments but also to improve the quality of life in the different communities of the fringes.

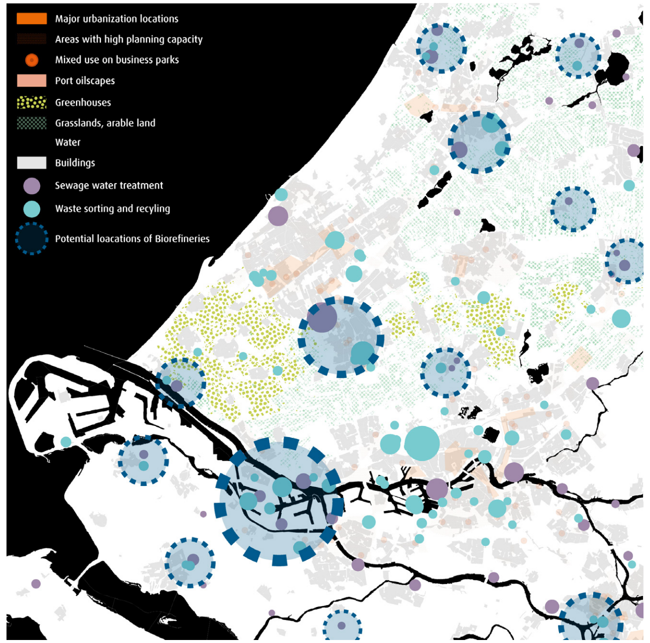


>Figure 3.32. Potentials of new living and working environments. 0 5 10km

Waste Valorisation Network & Port

The biorefineries are best located in the current waste facility clusters, this would be most useful since they share the same infrastructural needs.

The biorefineries do not only have the potential for a biorefinery network for the province of South Holland but are also versatile in that they can be implemented in both the newly created living and working environments but also in the new agricultural sector.



>Figure 3.33. Waste Valorisation Network potentials. 0 5 10km

Building Materials & Transition in agricultural landscape

The province of South Holland has enough space to cultivate enough raw materials in order to meet the demand needed for both new housing and renovations.

In addition to this the cultivation of these raw materials can be done in a way that would not compromise the food security of the province of South Holland by introducing crop rotation.

The space needed for the cultivation would not compromising the space planned for new urban development or urban growth of the existing urban areas.

We Can Supply

Without Fungi
TOTAL
134,52%

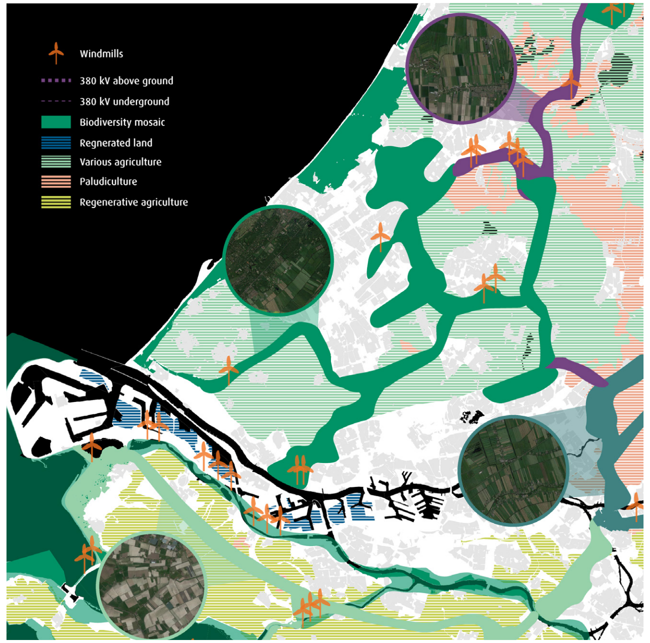
With Fungi
TOTAL
242,31%

Biodiversity Network

The biodiversity network can work in a way that connects the city to larger higher quality green patches, this will in turn have a positive impact on the quality of life.

The existing green patches and even corridors will form the basis for the biodiversity network. The basis can be formed further by combining the existing with the electricity cables and wind turbines. This also provides the opportunity to make sure that this network goes through the entire province and is also situated near cities.

The different soil types found in the province give the opportunity for different types of biodiversity, in combination with the surrounding functions this could result in many different types of biodiversity in the province of South Holland.



>Figure 3.34. Biodiversity potentials. 0 5 10km

3.6 SWOT - TOWS Analysis

The current situation has been analysed, and the potential has been identified.

PZH needs about 270.000 new homes by 2050, the demand for this many new dwellings leads to the need to produce more building materials in a short time that can be used to spark the transition to a circular bio-based building material industry.

The analysis shows that the resources to produce bio-based building materials can be cultivated and that the province has enough agricultural space to do so without taking out urban areas. This indicated that it is feasible for the PZH to transition to the bio-based building material industry. As the port is in the midst of an energy transition space will free up in port which gives the opportunity for the port to become the central hub for manufacturing, production, and waste valorization. In addition to this, the port is also a very strong logistical point to distribute bio-based building materials to the province and also exporting these materials to Europe.

The waterscapes are used as the infrastructural backbone of both the building sector and the agricultural sector. This is because as history has proved waterscapes are the most efficient way to transport materials.

With the proposed energy transition and the transition of agricultural jobs will be lost. The transition towards crop rotation cycles, waste valorization and bio-based building materials will have to happen quite quickly, in this way joblessness can be avoided, and employees should be re-educated and retrained on the job. There should also be education platforms and systems set in place to contribute to the future, bio-based building material sector and crop rotation.

OPPORTUNITIES

- A lot of greenhouses and unsustainable agriculture
- Un-used waste
- Boosting the biodiversty
- Bio-based building materials
- Energy transition

THREATS

- Emissions
- Soil pollution
- Municipalities and companies are hesitant to dive into the bio-based industry because there is a lack of knowledge in this sector

STRENGTHS

- The Port of Rotterdam is the biggest in Europe
- The logistial advantage of the Port
- A lot of research being done
- The amount of agriscapes in PZH

Making use of opportunities with the strenghts

- Demand and space for cultivation & bio-based building material and technology
- Growing raw material for bio-based industry to use demand as incentive
- The Port as a new bio-based manufacturing & cultivation hub

Preventing threats with strengths

- Mixed scapes (housing and agriculture)
- Using education and demand (supply) to strengthen and guide innovation

WEAKNESSES

- Monocultural scapes
- Lack of affordable living and working spaces
- Dependence on fossil fuel

Using the opportunities to minimise weaknesses

- Connected islands effect (to promote biodoversity)
- Affordable bio-based building materials
- Transition from fossil fuel to green energy

Minimising potential pitfalls where threats and weakness meet

- Removing greenhouses and creating mixed agriscapes to promote biodiversity
- Taking away the greenhouses and unsustainable agriculture

>Figure 3.35. SWOT - TOWS analysis.

VISION
BUTTERFLY EFFECT

4

4.1 Vision Statement

In 2050 affordable bio-based building materials will be grown and manufactured locally in the Province of South Holland. This will allow for multiple transitions. A strong and continuous biodiversity network will be formed. Circularity will be ensured by the waste valorisation network of biorefineries. Agriculture will be transformed to a diverse, organic, and sustainable landscape both visually and in practice. This will all be interconnected with new and existing housing areas, forming an unique mix of working and living. These four transitions will lead to new and diverse job opportunities, provide better access to local organic food, and natural areas. Butterfly Effect will create better and healthier living environment for everyone.

The four pillars are dependent on each other. They are interconnected, without one the other transitions would not happen (figure 4.1). The first essential proposed change is forming the biodiversity network. This would happen by connecting existing and new formed natural patches by biodiverse corridors. As a result the amount of species could be increased and access to green areas accessible for everyone.

The second pillar of our proposed transition is the regenerative bio-based economy. This is reachable by implementing waste valorisation. Collecting by-products from agri-food sector, food and sewage waste from the cities, and paper waste from port activities into local and regional biorefineries allows these by-products to be transformed into energy, other high value products, or used in bio-based building material manufacturing.

Connected to this the Port of Rotterdam will be transformed into an environmentally sustainable port. Instead as a centre of fossil fuel industry, the port will be acting as the "Central Hub" for bio-based building material manufacturing and waste valorisation.

The demand for materials increases the demand for raw products. This creates incentive to transform the current monocultural agriculture landscape to organic, sustainable, circular, multicultural agronomy, while at the same time increasing agro-biodiversity of the peri-urban areas.

The fourth pillar of the transition is the goal to improve the quality of life. This is achieved in multiple ways in connection with the other transitions. Locally produced bio-based building materials will create more affordable housing. Moreover, transforming agricultural landscapes allows to create new mixed transition areas between agriculture and cities.

What is more, a new multiscalar industry of construction material manufacturing, waste collecting, and processing will create new jobs both in peri-urban areas and in the port. Organic and sustainable farming will increase air and soil quality and reduce greenhouse gas emissions. It will improve access to healthy, organic food for everyone. Increased biodiversity will create justice not only for the planet and environment, but for civil society as access to green, healthy landscapes would increase.

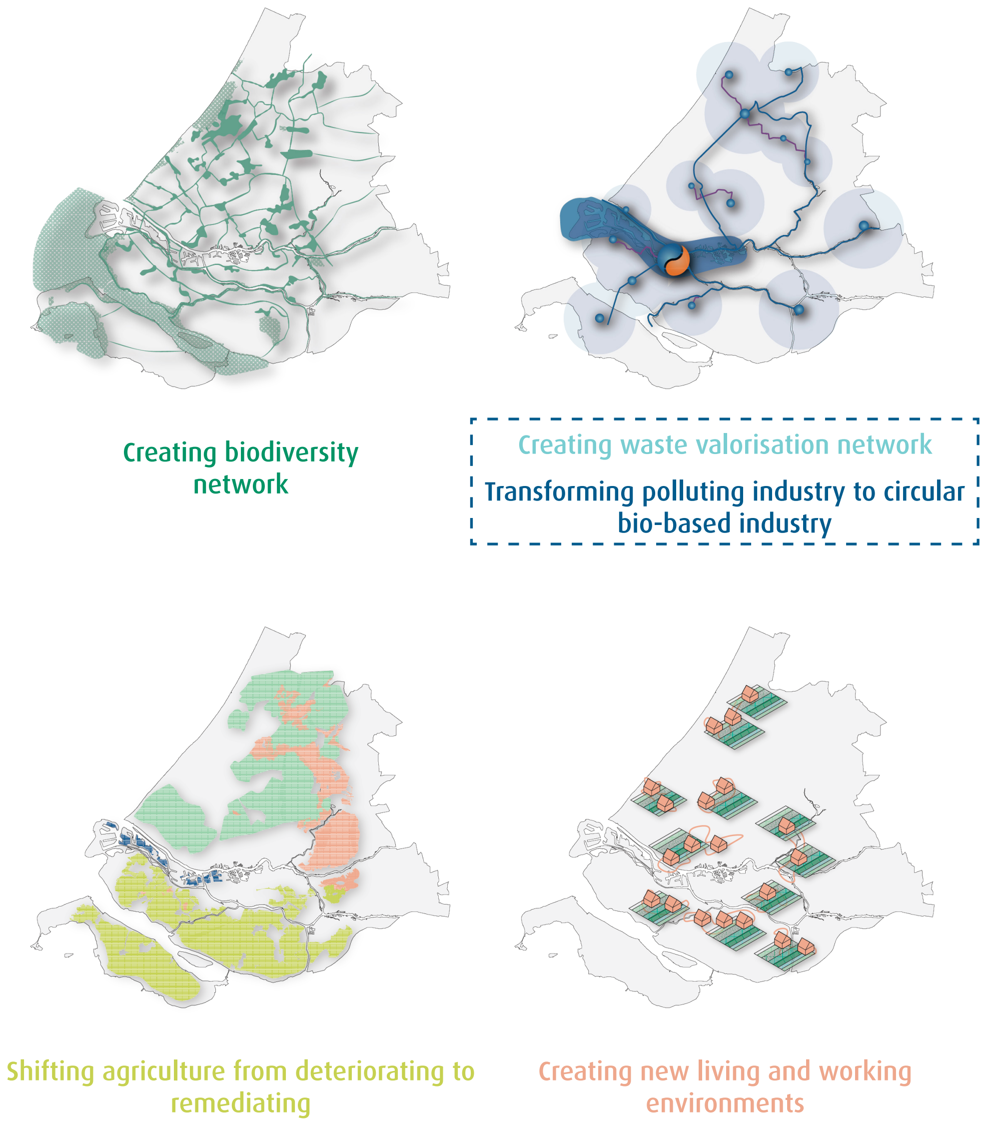


Figure 4.1. Four spatial pillars of the vision.

4.2 Vision 2040

Existing patches of biodiversity will be strengthened and new ones will be established. Firstly corridors will be implemented, therefore creating the first pieces of the network.

We offer biorefineries of different scales for waste recycling to be located where there are existing clusters of waste facilities. The biorefineries would differ in size depending on their location and function. This will form a network of waste valorisation hubs of different sizes and processes with a transport network to connect them. The transport network can go over roads or waterways depending on the most accessible route to take for distribution. The central biorefinery would be located in the port, close to bio-based building material manufacturing centres.

Because of the extensive energy transition, the petroleum industry on the port will be transformed into a central hub for manufacturing, processing and cultivation of the bio-based raw materials with a main central biorefinery and manufacturing facility. Placing the manufacturing, processing and main distribution centre on the port is logistically strategic in the sense that in the future the bio-based building materials can be exported from here. The raw materials for the bio-based building material industry come from organic cultivation and waste.

At this time most of the agricultural landscapes would be transformed. Organic farming practices, such as strip farming, diverse crop rotations, and agroforestry would be introduced. Biofertilisers would be provided from biorefineries. Polluted areas in the south of the province would practice regenerative agriculture, which would mean partial rewetting, extensive agrobiodiversity practices and cultivation of soil remediating plants, such as hemp or flax. Open peatlands would be completely rewetted and transformed into paludiculture, which would increase carbon sequestration, allowing biodiversity to thrive and peat to be regenerated while maintaining productivity. Oilscapes in the port would be regenerated.

The current cultivation of flowers in greenhouses in the Province of South Holland will be replaced by open land cultivating diverse plants that can be used as raw material for the production of bio-based construction materials. The greenhouses used for food cultivation will be relocated to the various fringes and be mixed with the open land agriculture and the urbanization.

Pilot project showing new ways of living and building with bio-based materials would be constructed. With policies changed and lessons learned, it could be upscaled in other fringe locations.

0 5 10 km

>Figure 4.2. Vision 2040

4.3 Vision 2050

After the remediation of the contaminated land and agricultural transition there is opportunity to strengthen the biodiversity by connecting existing and new patches with corridors. Parts of the corridors are based on the lines of the electricity cables. By using the electricity cables the biodiversity network is protected from other uses. Therefore this otherwise unusable space would be used in a more efficient way. Depending on the location, the type of biodiversity network will differ.

Waste valorisation network would be fully established. Different size and specialisation biorefineries would be connected, each with potentially conventional and innovative facilities and processes.

Port of Rotterdam would fully function as the "Central Hub" of our proposed bio-based industry, with manufacturing not only of bio-based building materials, but also of chemicals, pharmaceuticals, biofertilisers and other products from waste. The education center in the port would work on research in multiple directions, especially fungi. As a result of greatly increased demand, we assume that manufacturing using mycelium would be mainstream and there would be more products produced than needed locally. Export of bio-based building materials, while already happening from the beginning, could be increased over time.

The city and agriculture would be mixed. The way the city and agriculture are mixed depends on the location. How these two come together and start to function as one will also be influenced by the nearby biodiversity patches and corridors as well as types of agriculture.

>Figure 4.3. Vision 2050

4.4 Systemic Scenery

4.4.1 Existing systemic section and collage

Figures 4.4 and 4.5 summarises our analysis of the current systemic issues in the Province of South Holland. Today the building and agriculture systems are unsustainable and non-circular. It heavily relies on fossil fuels for transportation and material manufacturing. As a result, transportation emissions are a problem. Moreover, oil refineries in the port are highly polluting and contaminating.

Currently agriculture relies heavily on chemical fertilisers. This dependency increases soil contamination with phosphorus and nitrogen. Moreover, horticulture demands a lot of energy and seals the soil, reducing water quality and greenhouse (literally) gas emissions. This creates a monocultural, privatised landscape with no space for recreation or biodiversity.

The housing shortage problem today is emphasized by not up-to-code housing which requires intensive renovation to increase living quality, affordability, and to tackle climate change.

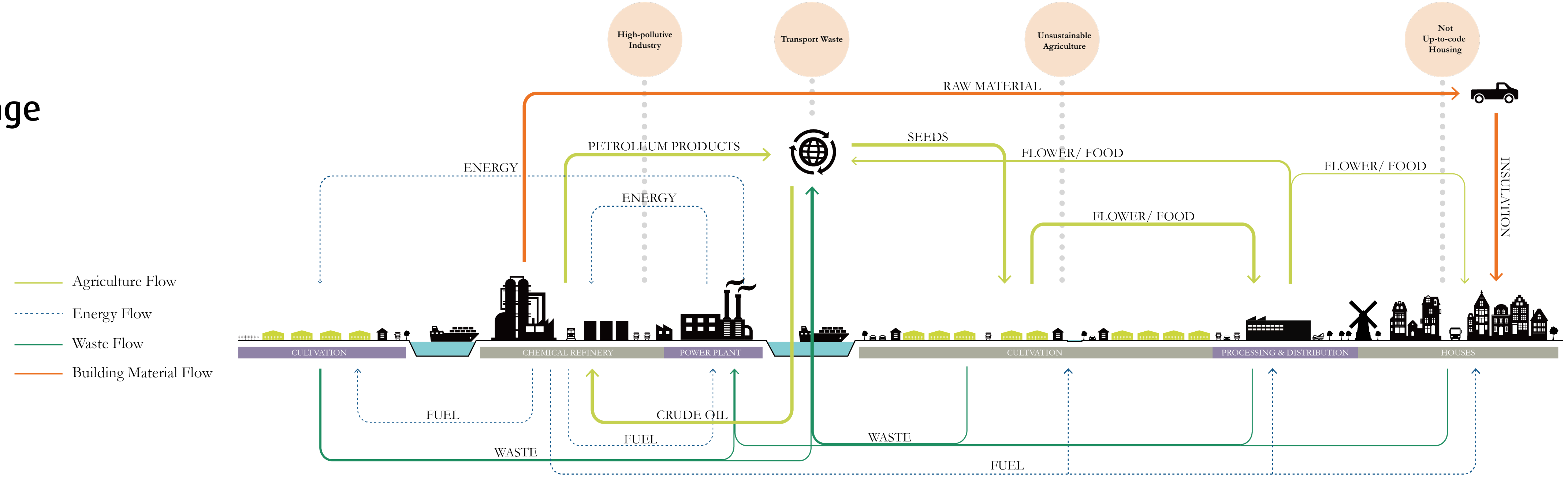


Figure 4.4. Systemic section representing material flows of the existing situation. Main problems today are high-pollutive industry in the port, transport waste from long supply chains, unsustainable agriculture, and housing that requires renovation.

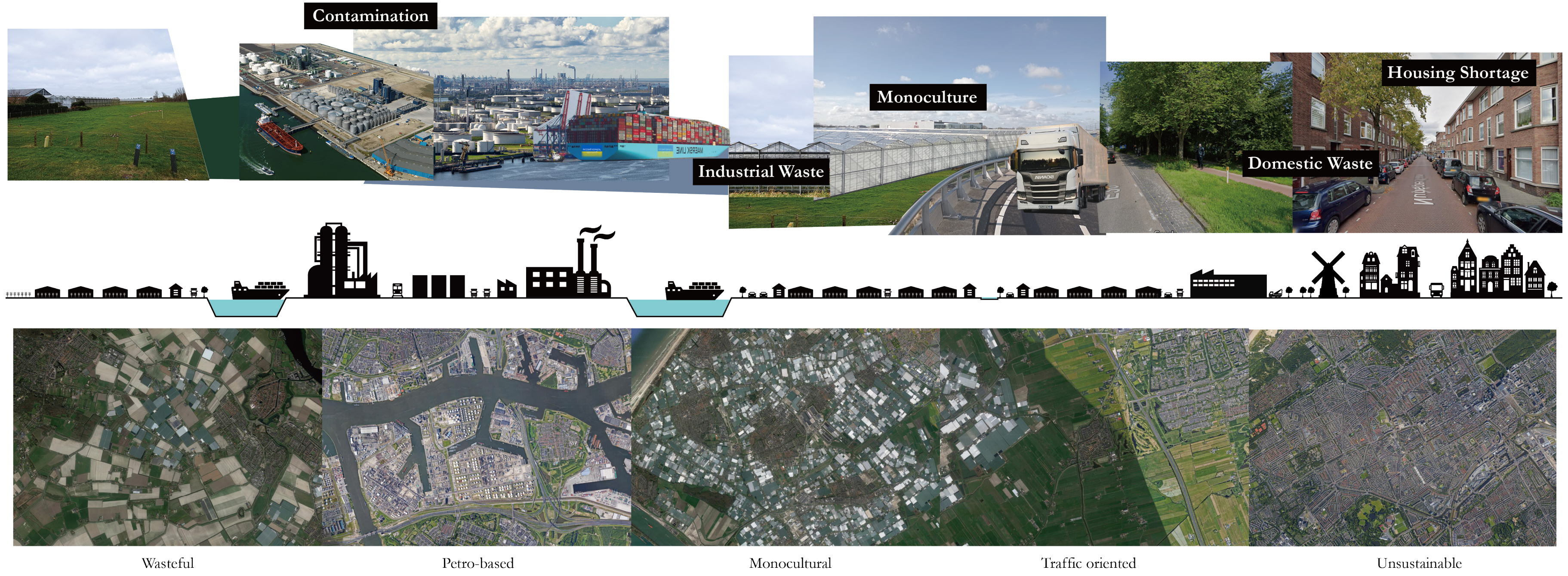


Figure 4.5. Systemic collage representing spatial quality of the existing situation. Today the landscape is wasteful "green desert", fossil fuel based, monocultural, traffic oriented, and in general unsustainable.

4.4.2 Systemic section 2050

Figure 4.6 shows our proposed changes in material flows. In general the main change would be increased circularity and locality. Network of biorefineries would connect agricultural and waste flows. Harvest by-products could be valorised into high value materials. To counteract lack of nutrients in the soil, biorefineries could provide biofertilisers for agriculture. Moreover, it could also provide energy from waste to farms.

Butterfly Effect proposes the transition of the port into "Central Hub" of bio-based industry. There manufacturing of building materials and the largest biorefinery would be located. Construction products would be produced from locally grown plants, fungi and cellulose in the port. This means less transport and dependency on global flows.

Agricultural transition to organic agriculture would reduce energy consumption, increase soil quality and increase biodiversity. Moreover, new and existing buildings could be topped-up with greenhouses, increasing local food production.

Bio-based building materials would increase circularity of the whole construction sector. It would happen because these products are biodegradable and reusable in multiple ways (for example fungi can grow on the same material multiple times). Building materials could be modular and reused without extra modifications.

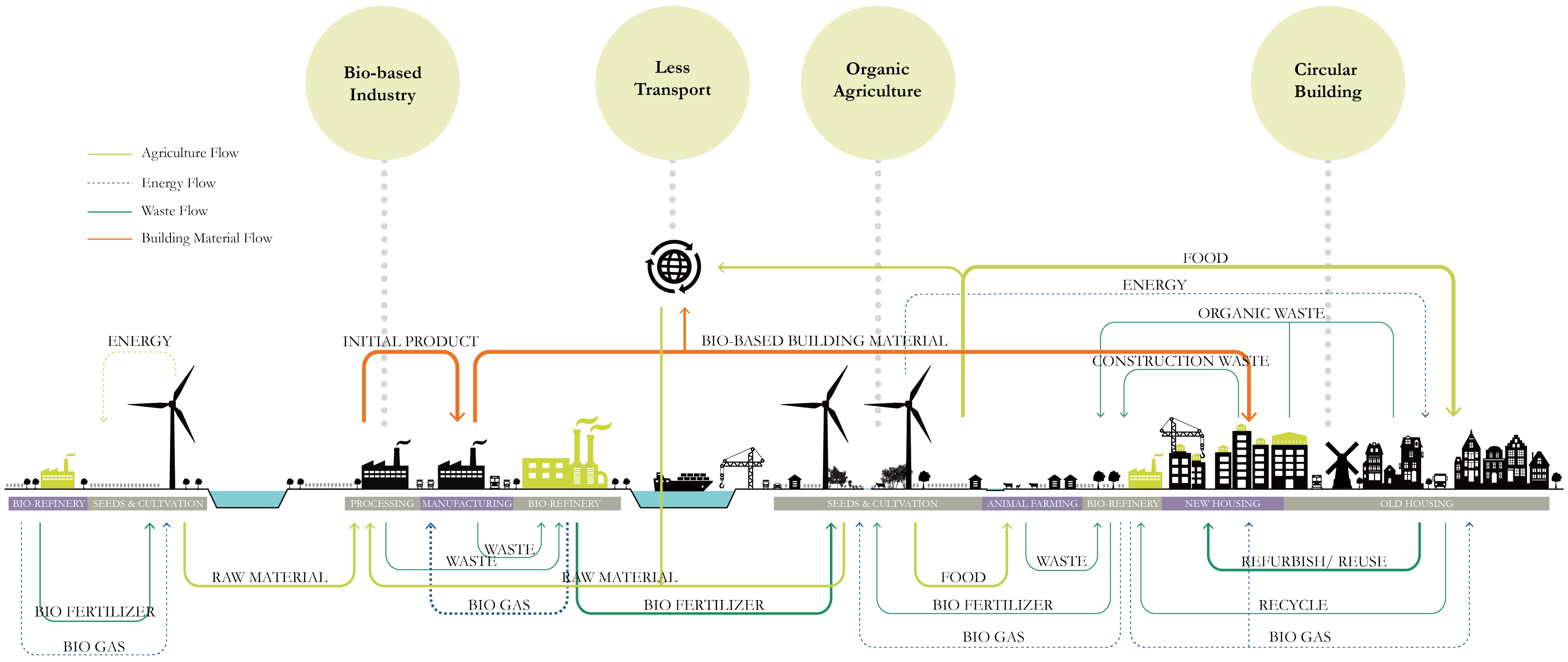


Figure 4.6. Systemic section representing material flows of the proposed new situation. In general main change would be increased circularity and locality of material flows. As a result there would be less transport. Port would transition into bio-based industry, agriculture into organic, and construction into circular.

4.4.3 Systemic collage 2050

Figure 4.7 represents spatial qualities of the proposed change. Overall the landscape would be diversified and more mixed as a result of the new biodiversity network and agricultural transition. Nature, animal grazing, crop farming would be combined. In addition to this, it could be mixed with industry or housing. In this way, better working and living environments could be created.

Furthermore, this landscape transformation would allow to strengthen visual and historical identities of the province. Extended views, from far distance visible old towns, and strengthened historical patterns could become a revived romantic norm of the landscape.

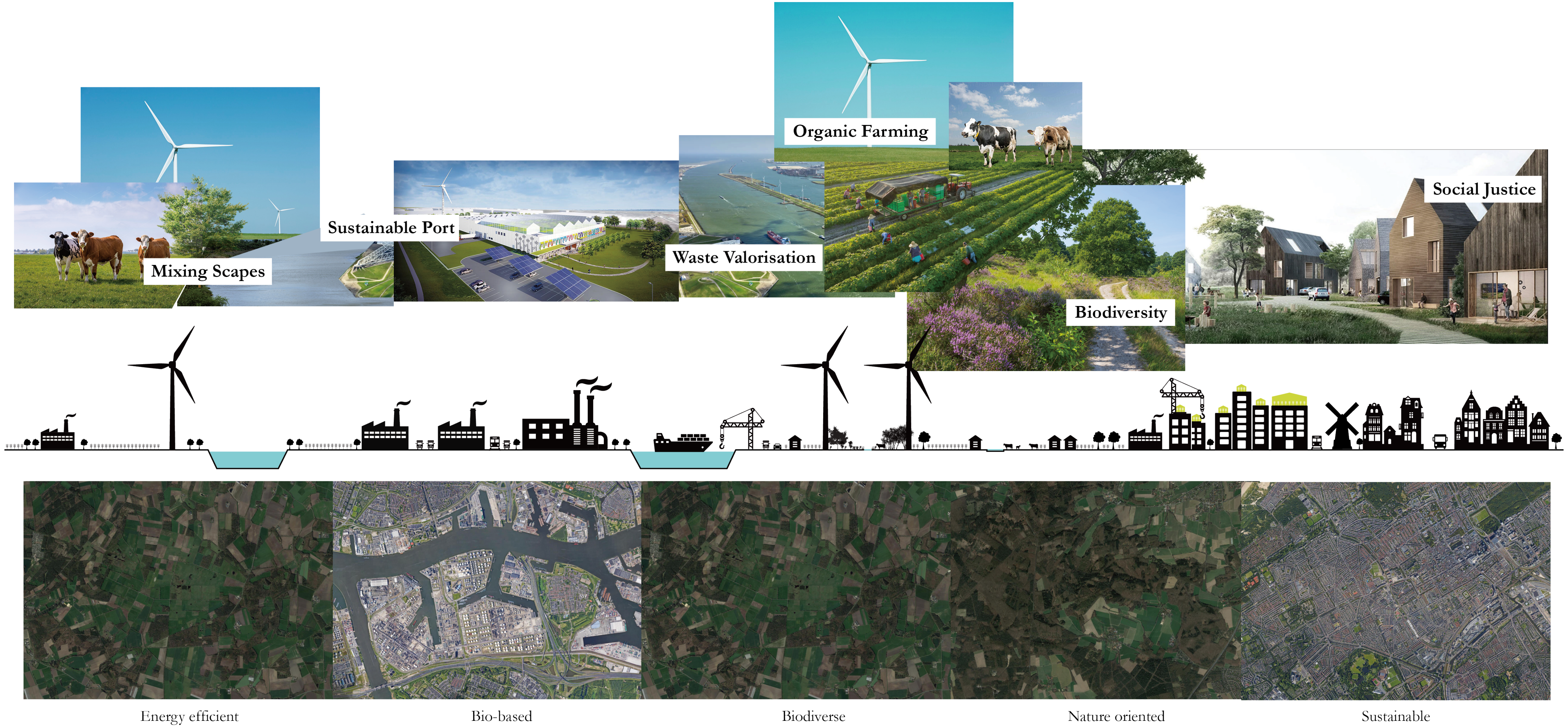


Figure 4.7. Systemic collage representing spatial qualities of the proposed new situation. In general main change would be diversification of the landscapes. It would be a result of multiple new biodiversity corridors and patches, agricultural transition, and new types of housing.

4.5 Circularity

Figure 4.8 represents building material lifecycle. It is the main process connecting the four parts of our proposed transition, namely agriculture, production, building, and waste valorisation.

New organic agriculture in the Province of South Holland would have multiple effects and outcomes on every agricultural plot. It could increase forestation, remediation, and biodiversity of land. At the same time with diverse crop rotation and animal grazing maximum efficiency and productivity could be achieved on every plot. Part of the harvest could be used as raw products in building material manufacturing. Other parts could be used in, for example, food production. Finally leftover waste could be valorised in biorefineries in exchange for biofertilisers.

Building material production would be located in the Port of Rotterdam. It would consists of sorting and processing of raw materials from agriculture, manufacturing, fungi growing warehouses, and research and innovation centres to speed up advancement in technology. Waste from this sector could be used in the largest biorefinery located in close proximity to the port in exchange to energy.

Bio-based building materials manufactured in the port would be transported into construction sites. After demolition and sorting, products could be immediately reused or recycled in the manufacturing centre. Organic waste from users (or from construction waste) could be used in biorefineries.

Waste valorisation network will consist of various sizes of biorefineries and located in whole Province of South Holland. In these facilities waste from agriculture, production, construction and housing could be refined into high value materials. As a basis it could provide energy for the manufacturing, as well as biofertilisers for agriculture. The latter is highly needed product, because removal of waste from current agricultural cycle means lack of nutrients in the soil. Biofertilisers could not only replace that, but increase soil quality.

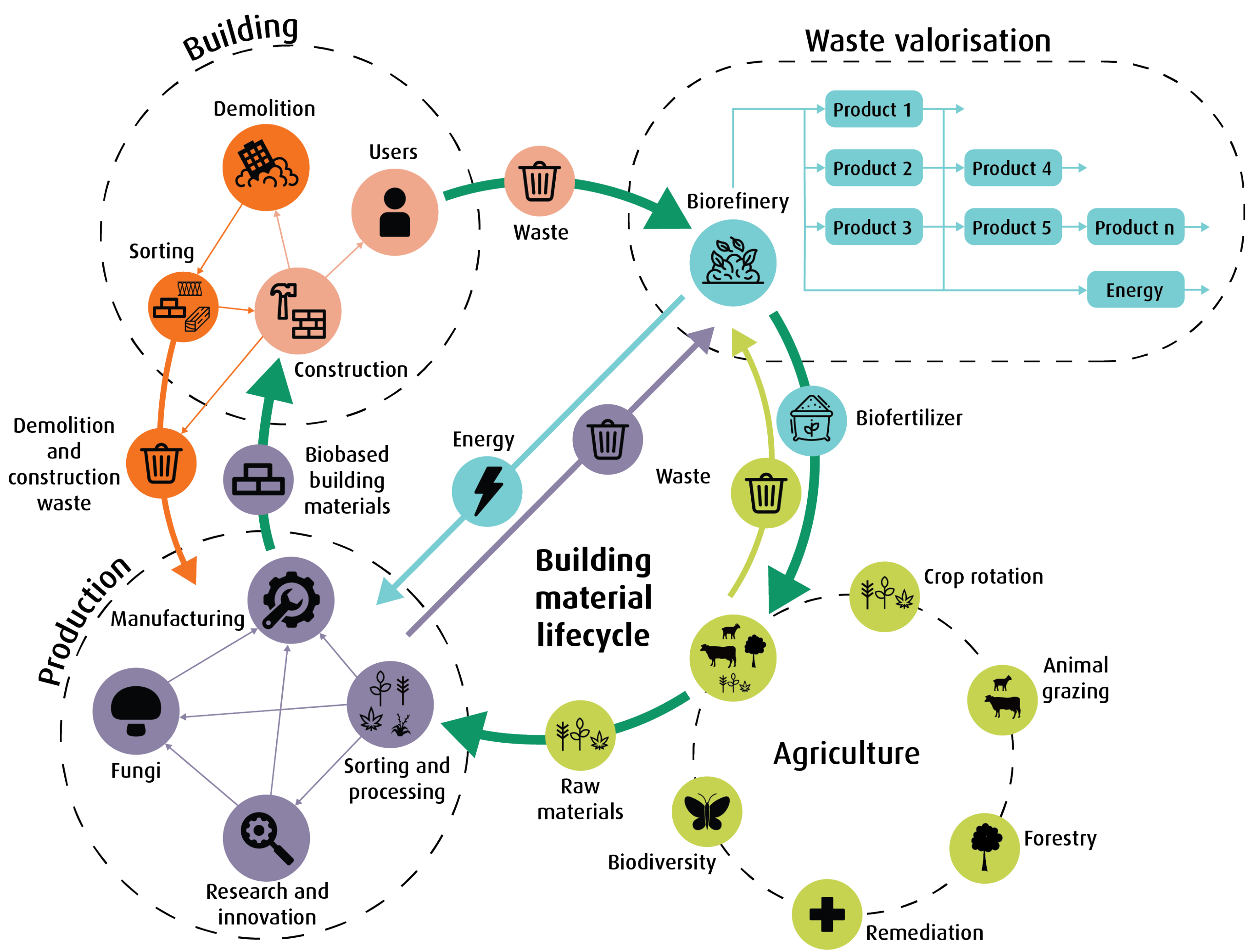


Figure 4.8. Building material lifecycle that represents circularity of our proposed change. It connects different fields of agriculture, production, building, and waste valorisation.

5

IMPLEMENTATION
BUTTERFLY EFFECT

5.1 Implementation Overview

5.1.1 Strategies & Phases

Our proposed vision for the Province of South Holland consists of four strategies (figure 5.2). Each strategy is a distinct layer of the overall transition. Therefore in the following pages we will describe each part separately. We will focus on principles, concepts, detailed actions and policies that would need to be undertaken, stakeholders that need to be addressed, and spatial implications and qualities. However, these strategies are interdependent to each other and in our opinion without one the others would fail. Each layer enables the others.

The main shifts that could result from each strategy are represented in figure 5.1. It involves the transition to bio-based construction, organic agriculture, full waste valorisation (higher in value than incineration), and the increase in protected biodiversity zones.

The transition is divided into four phases - initiation, spark, fundamental change, and the ripple. During the initiation soft changes could start, especially in education and policy change. The spark in our opinion would be the most important phase. In this period main actions would take place spatially and in governance. It enables the fundamental change phase, during which most of the transition would be finished. The ripple is the after effect and the strengthening of the transitions that would happen during the spark phase.

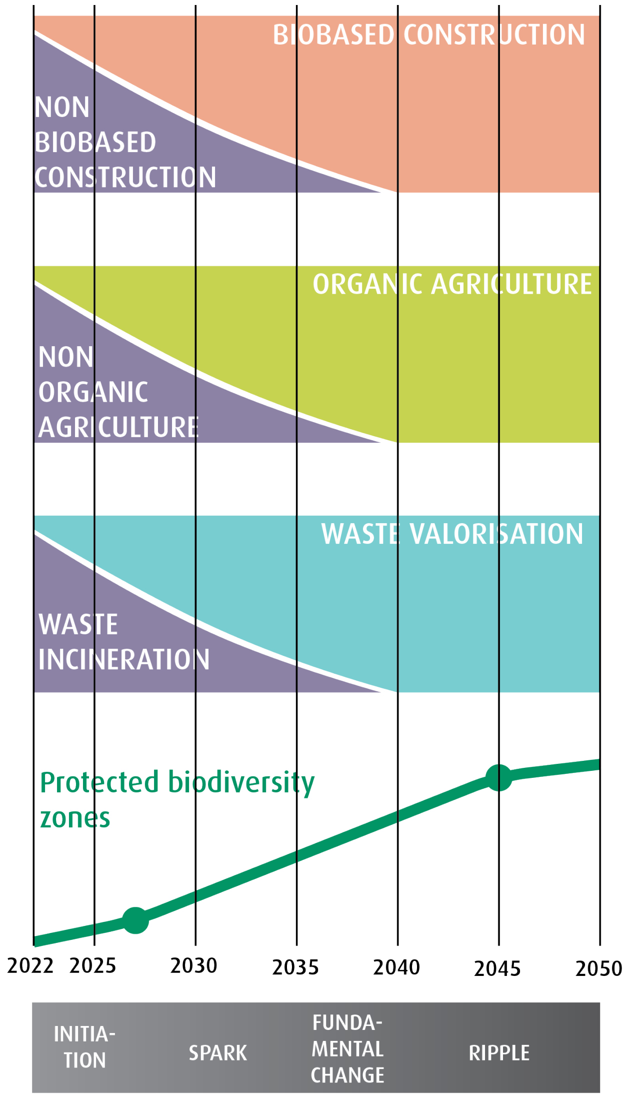


Figure 5.1. Diagram representing 4 phases of the transition and major shifts connected to different strategies. Spark is the most important phase for us. During it, we believe, biobased construction, organic agriculture, and waste valorisation will surpass by quantity current state of repsective fields. Moreover, in our opinion in this phase area of protected biodiversity zones would be increased greatly.

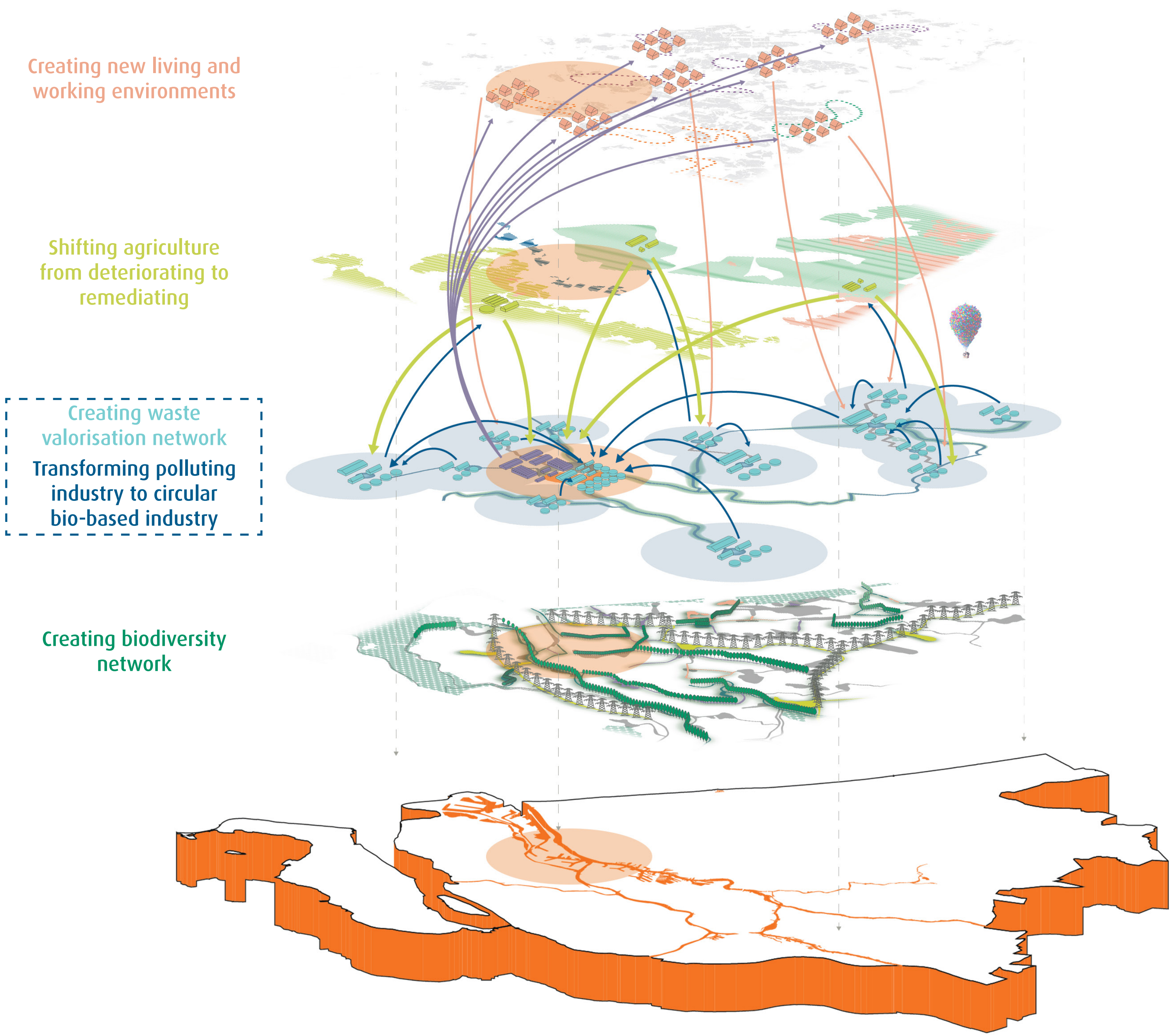


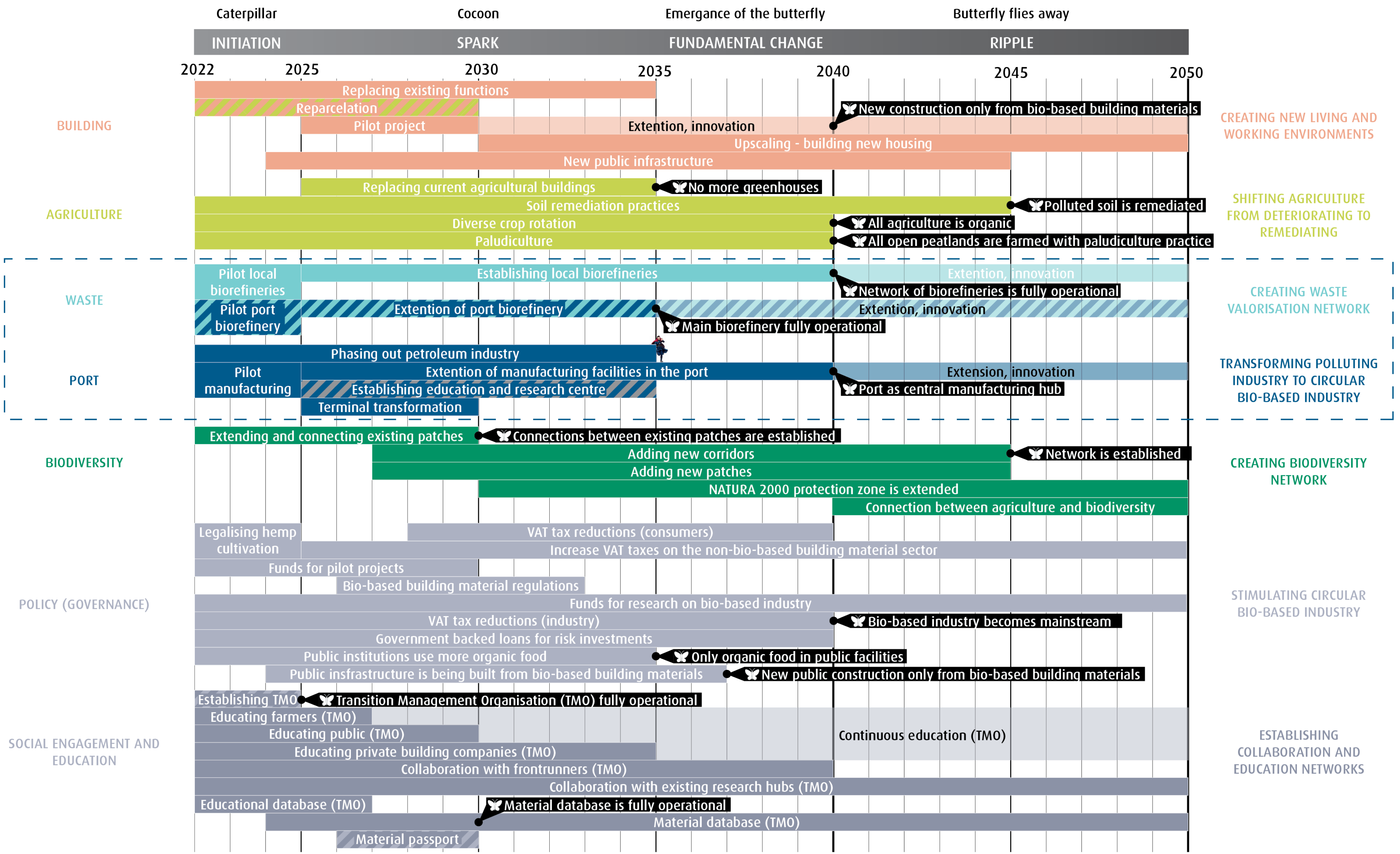
Figure 5.2. Scheme representing different layers of the our proposed vision. These layers corespont to four strategies that we propose to achieve desirable future.

5.1.2 Timeline

General timeline of Butterfly Effect (figure 5.3) shows main actions that would need to be made in the different sectors to achieve the vision. It is divided into main strategic layers as shown in the previous page. Creating a waste valorisation network and transforming polluting industry to circular bio-based industry in the port are two pieces of one strategy. In the Port of Rotterdam both bio-based building material manufacturing and the largest biorefinery would be located, connecting the whole network. Hence without the port transition waste network would not be established.

Main policies and actions in social engagement and collaboration are presented in the timeline as well. They are the enabling element of the transition. With these actions stakeholders could be addressed and, most importantly, included in detailed decision making.

Transformation starts from education, regulation changes and pilot projects. Lessons learned from this phase could be applied to actions in the next phase - spark - in which major shifts starts to happen. We believe that the results of it could be already visible in 2040, when most of the milestones would be reached. Afterwards it would ripple in other sectors to reach full transition.



>Figure 5.3. General timeline.

5.1.3 Talented Mr. Ripple

We believe that the essence of Butterfly Effect is that every action enables larger change to happen as depicted in figure 5.4. Just like throwing a stone into water (which is bio-based building material manufacturing) the whole environmental, social, and technical landscape of the Province of South Holland could be changed. Firstly it would incentive a waste valorisation network, a central biorefinery would be located close to manufacturing hub. Both of these actions would speed-up port transformation and agricultural shift. The next ripple would be new working and living environments - housing built from bio-based building materials and connected with new sustainable agriculture. Changing land uses would allow creation of biodiversity network. In the end collaboration and education structure would be established.

This ripple effect would happen constantly in multiple locations, scales, and times, constantly enabling and stimulating itself - circular bio-based industry.

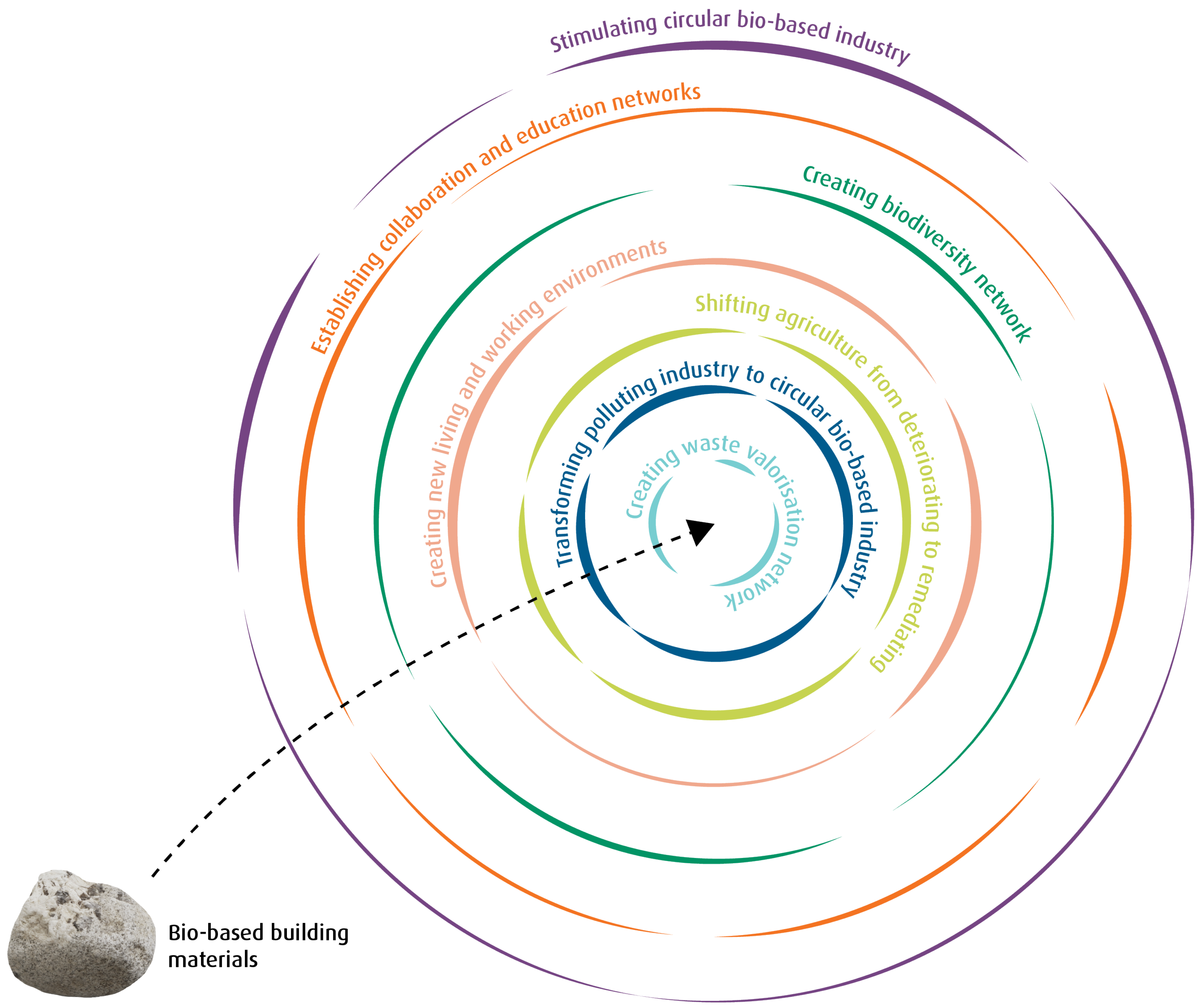


Figure 5.4. Ripple diagram representing effects of different strategies on each other starting from bio-based building material manufacturing as the spark.

5.2 Participation & Collaboration

5.2.1 Stakeholders

We divided the involved stakeholders into four main categories - public sector, private sector, civil society, and knowledge sector. We believe that stakeholders in these groups could be addressed in the same way, which we will describe below.

Public Sector has a lot of power, but it needs to be attracted and convinced that our proposal is desirable and is worth working with.

Private Sector has variety of powers and in general low interest. We believe that awareness and knowledge of these stakeholders needs to be increased. Especially important would be educating building industry (contractors), because they are the ones who would use bio-based building materials mostly.

Civil Society has low power, especially individually, but without their participation transition would be impossible. People would make the choice whether to buy bio-based products such as organic food. Therefore in our opinion it is crucial to rise consumer awareness. Moreover, it is important to make transition accessible to everyone. Production could be made affordable by public procurement, subsidies, reduced transportation costs, and/or increased supply.

Knowledge sector has medium power, but a lot of interest. These stakeholders are the ones who could educate others, raise awareness, and participate in research and innovation development. Therefore it is important to give them more power by increased funding and new facilities. These would be located close to construction and manufacturing areas for direct involvement.

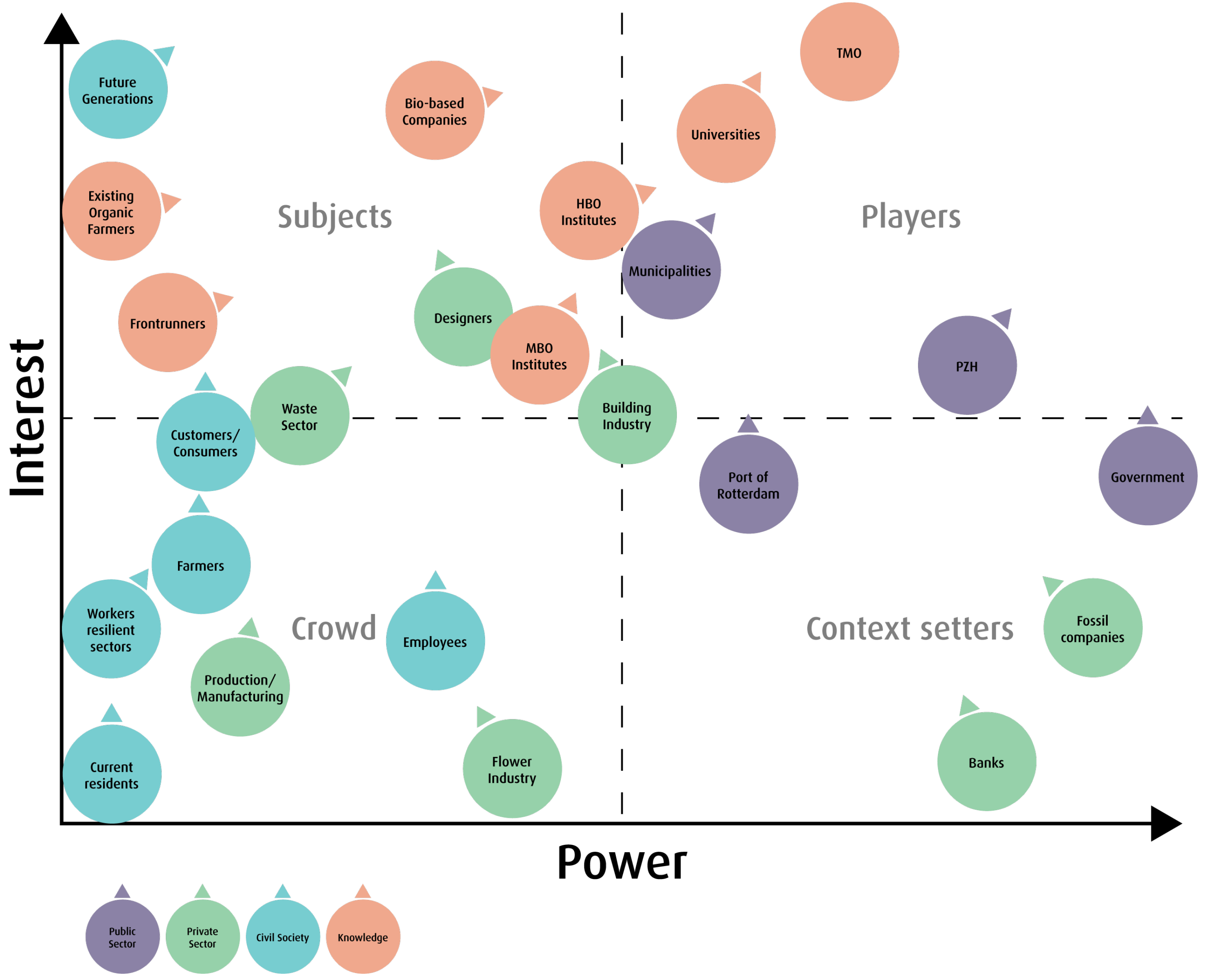


Figure 5.5. General power-interest matrix for involved stakeholders with direction to which we believe they need to be stimulated/convinced/informed.

5.2.2 Transition Management Organisation

In order to strengthen participation and power of most involved stakeholders, we propose to create new public-private partnership - Transition Management Organisation (TMO). This would be an organisation with full time employees facilitating the transition. They could be representatives of each stakeholder group. TMO would unite participants in four different ways which we describe below.

Education and Innovation field is focused on (re)education of farmers and building contractors. Important role in this aspect would play universities and frontrunners. In practice it could be achieved by education programs, lectures, practical exercises, and creation of educational database where various toolkits and methods could be explained. TMO would also allow interior knowledge exchange between stakeholders.

Common **finance** management would allow for separate stakeholders to apply for funds and loans together, potentially increasing security of investments and reducing interest rates. Moreover, we believe that participants could collect internal capital for small size risk management. Funding research and innovation is important to increase efficiency and productivity.

Partnership between different stakeholders could be established through TMO. We believe there could be two main types of partnerships. First one would be between different farmers that they could share land usage and equipment between each other, increasing efficiency and reducing investment needs. Second partnership would between farmers and building sector. In this way information on supply and demand could be shared. As a consequence crop rotations and material manufacturing could be planned, increasing efficiency, reducing transport and waste.

Online **Material Database** could be set up as part of TMO. In this database information could be shared between various stakeholders about current material situation. Moreover, it could facilitate issuing of material passports. Therefore re-usability of materials could be increased and transportation reduced.

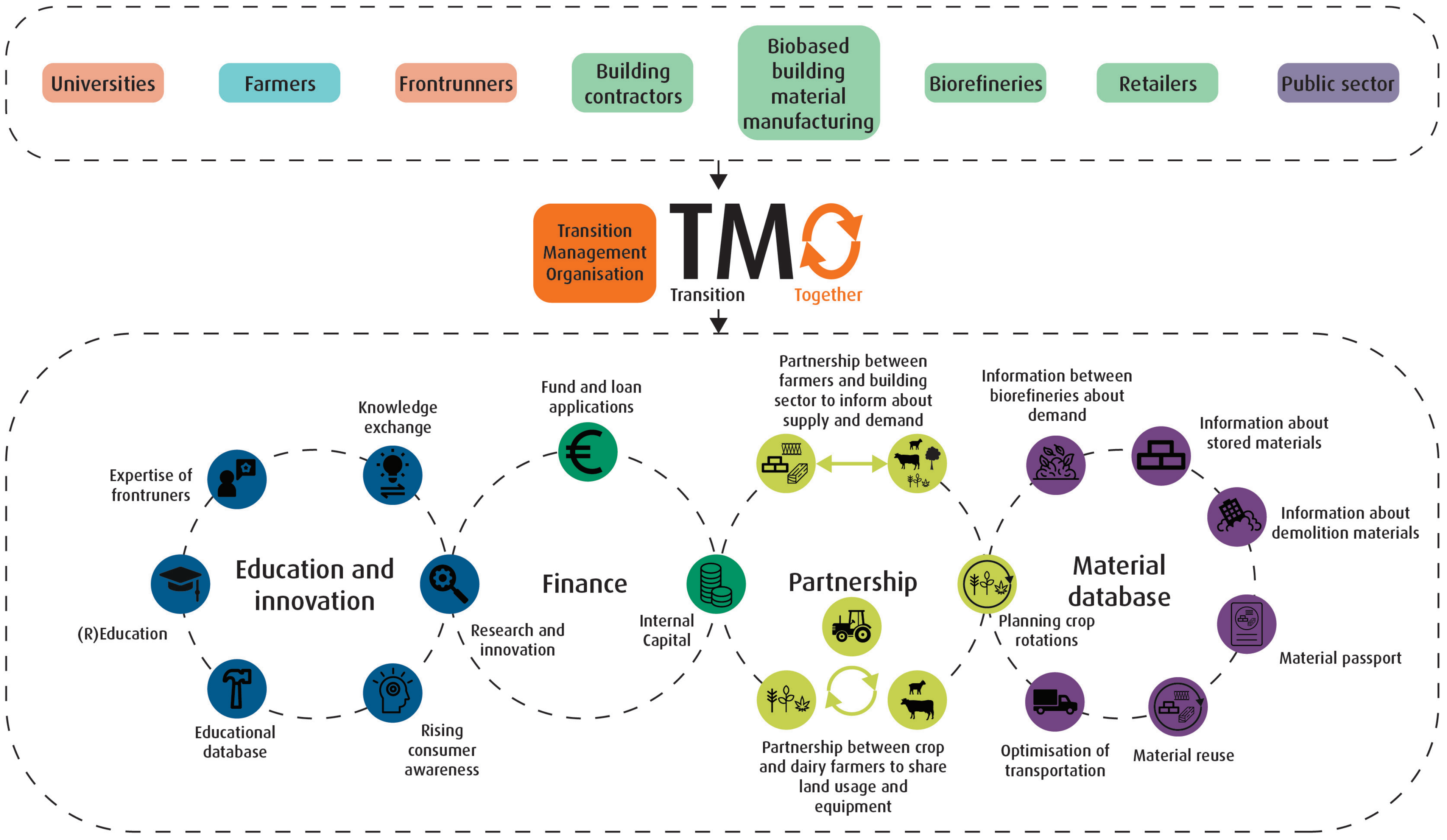


Figure 5.6. Stakeholders involved and operating fields of the Transition Management Organisation TMO.

5.4 Illustrative locations

In the following pages we will separately explain four strategies. In different scales we will describe their principles, challenges and opportunities, concepts, phases, stakeholders, and spatial qualities. In order to show how each strategy could be implemented we chose four illustrative locations describing different transitions. While each of the sites are presenting different topics, they all are united by the biodiversity network.

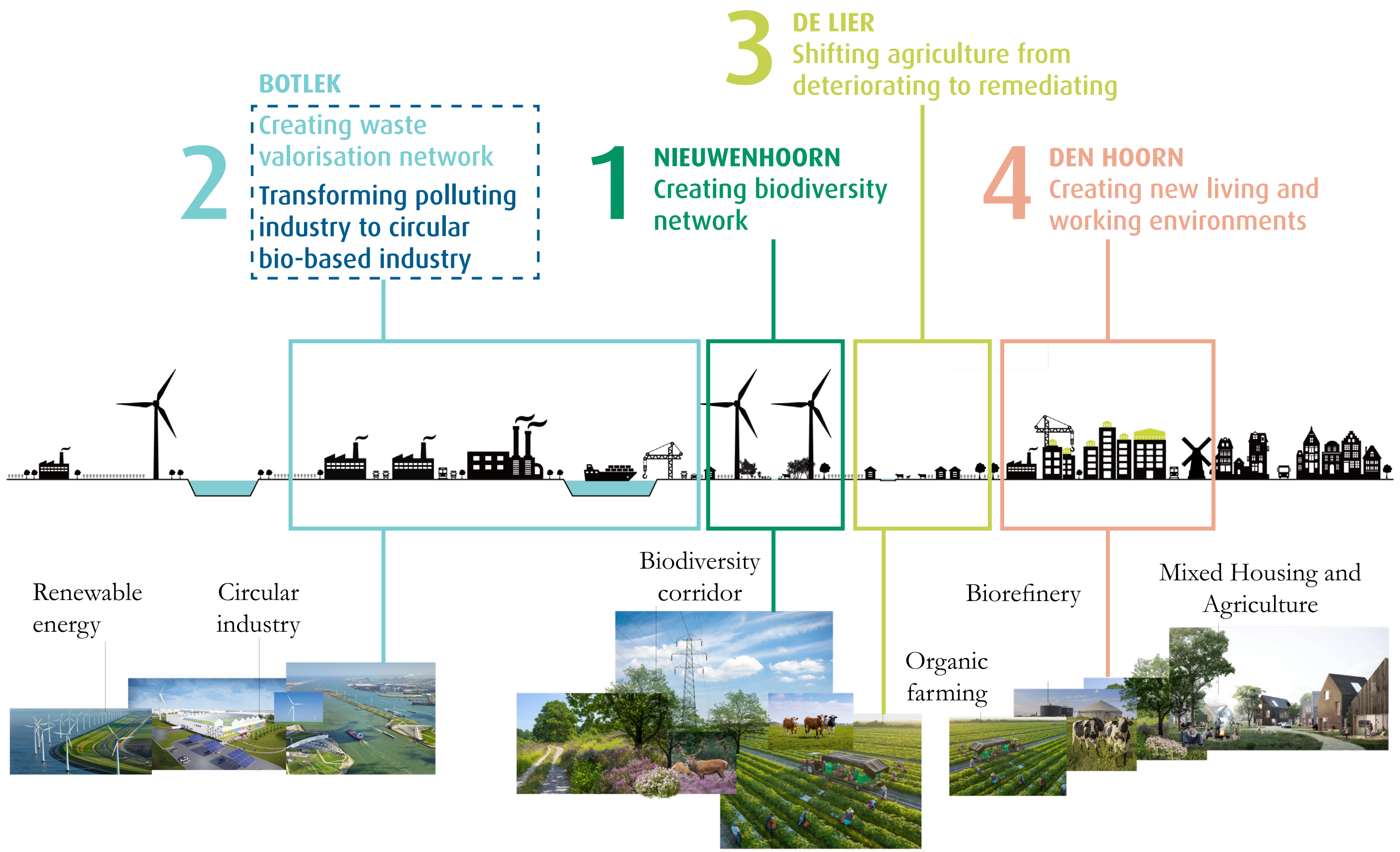


Figure 5.7. Map and systemic section showing and explaining choice of illustrative locations. Photograph of wind turbines (n.d.)., William McDonough + Partners. (2015), [Photograph of port]. (n.d.), NESTE. (2021) STEINMETZ, G. (2018), [Photograph of transmission tower]. (n.d.)., [Photograph of Plants]. (n.d.), [Photograph of Cows]. (n.d.)Cooper, R. (2019), Effekt. (2016), [Photograph of Plants]. (n.d.)

5.4.1 Strategy 1

CREATING BIODIVERSITY NETWORK

Strengthening the green blue structure of the Province of South Holland while creating a versatile, biodiverse network.

Creating four implementation strategies to support the structure of the biodiversity network. Adding new patches and corridors to strengthen the existing green blue structure. Connecting the biodiversity network structure to the exploration into a landscape park of the Province of South Holland. Enhancing the network by implementing seven biodiversity network principles. Leading towards a strong and versatile biodiversity, growth in biodiversity within the province, strengthening the organic agriculture, creating adaptability within the network, and improving the quality of life.

Principles for a strong and versatile biodiversity network
In order to achieve a strong biodiverse network we introduce seven principles based upon Dramstad, W.E., Olson, J.D., & Forman, R.T. (1996). By implementing these principles into our strategy the biodiversity network will become a versatile network that is adaptable depending on its location in the province. This adaptability will ensure the quality of life and variety of the individual places in the network. Together with the four implementation strategies, the seven principles can create a strong and diverse network.

Principles like enlarging existing patches, transitional edges and connecting existing patches are largely implemented and will be found back throughout the complete network. The principles for strengthening the connection with agriculture and reusing wasteland are implemented at specific strategy points. Lastly the principles sound barrier and recreational use have very specific placements in the network and are in need of specific elements in the surround to have an effect.

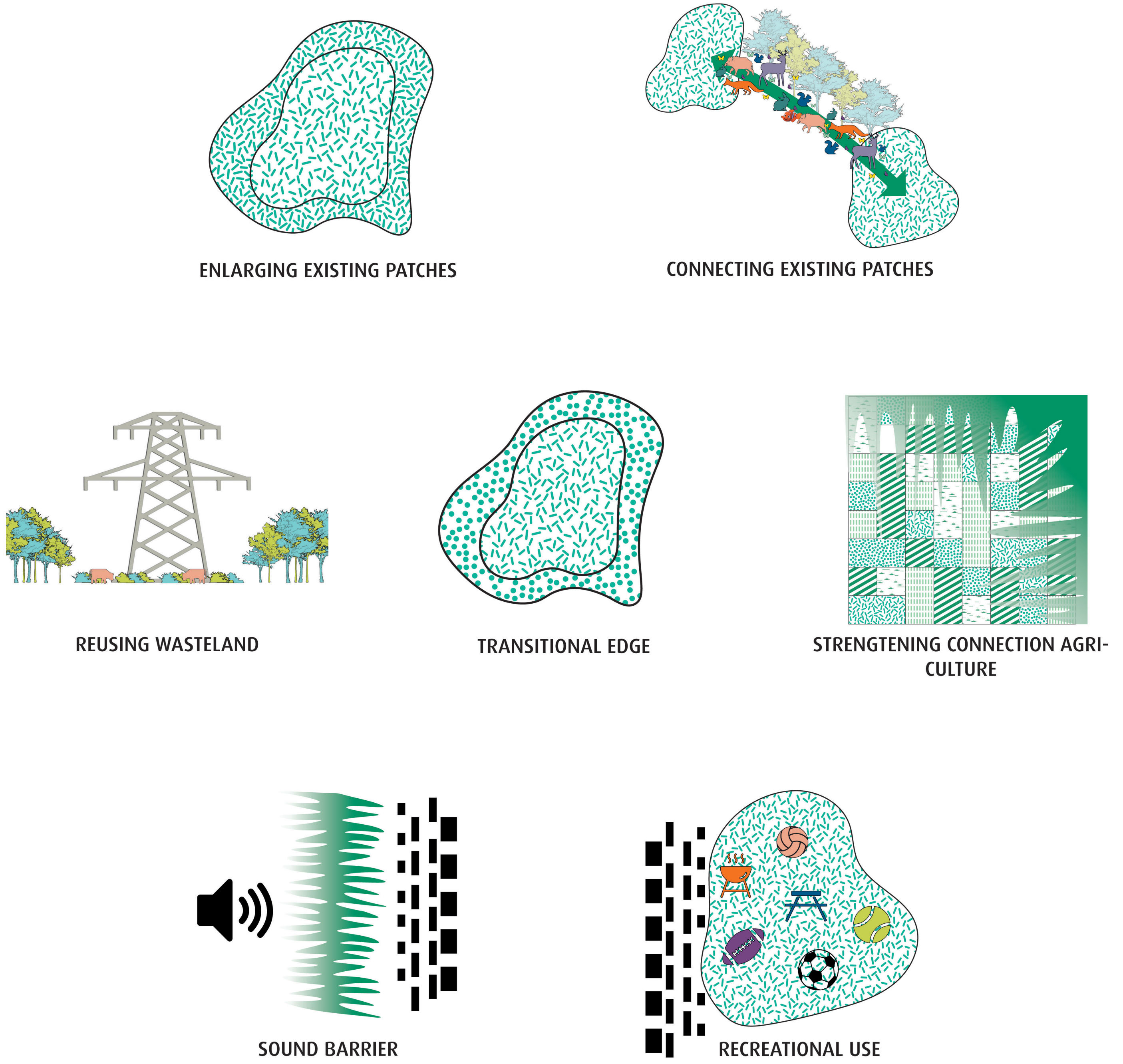
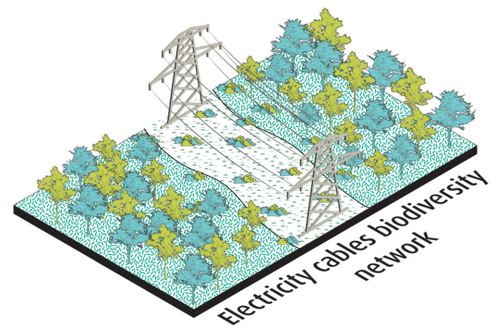


Figure 5.8. Principles of biodiversity network. Based on (Dramstad et al., 1996)

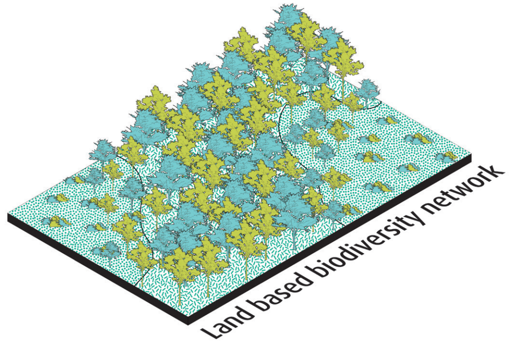
Biodiversity Network Implementation Strategies

Based on the current state of the green structure in the Province of South Holland, the limited access to green and recreational space in the region and the overall decline in biodiversity Butterfly Effect proposes a new biodiversity network. The network consist of four different implementation strategies.

1



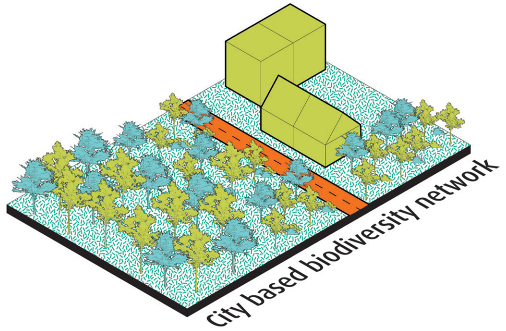
2



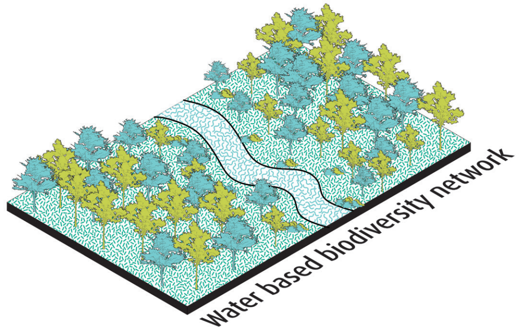
Electricity cables biodiversity network
After the analyses of the space available in the Province of South Holland, the usage of the unused land underneath the electricity cables came up as a solution. This space is very suitable for a biodiversity network since there is no built environment allowed.

Land based biodiversity network
Creating low and high density green patches and networks throughout the province will enhance the biodiversity greatly. Different types of patches will attract different types of species. This then will create a more diverse network in itself.

3



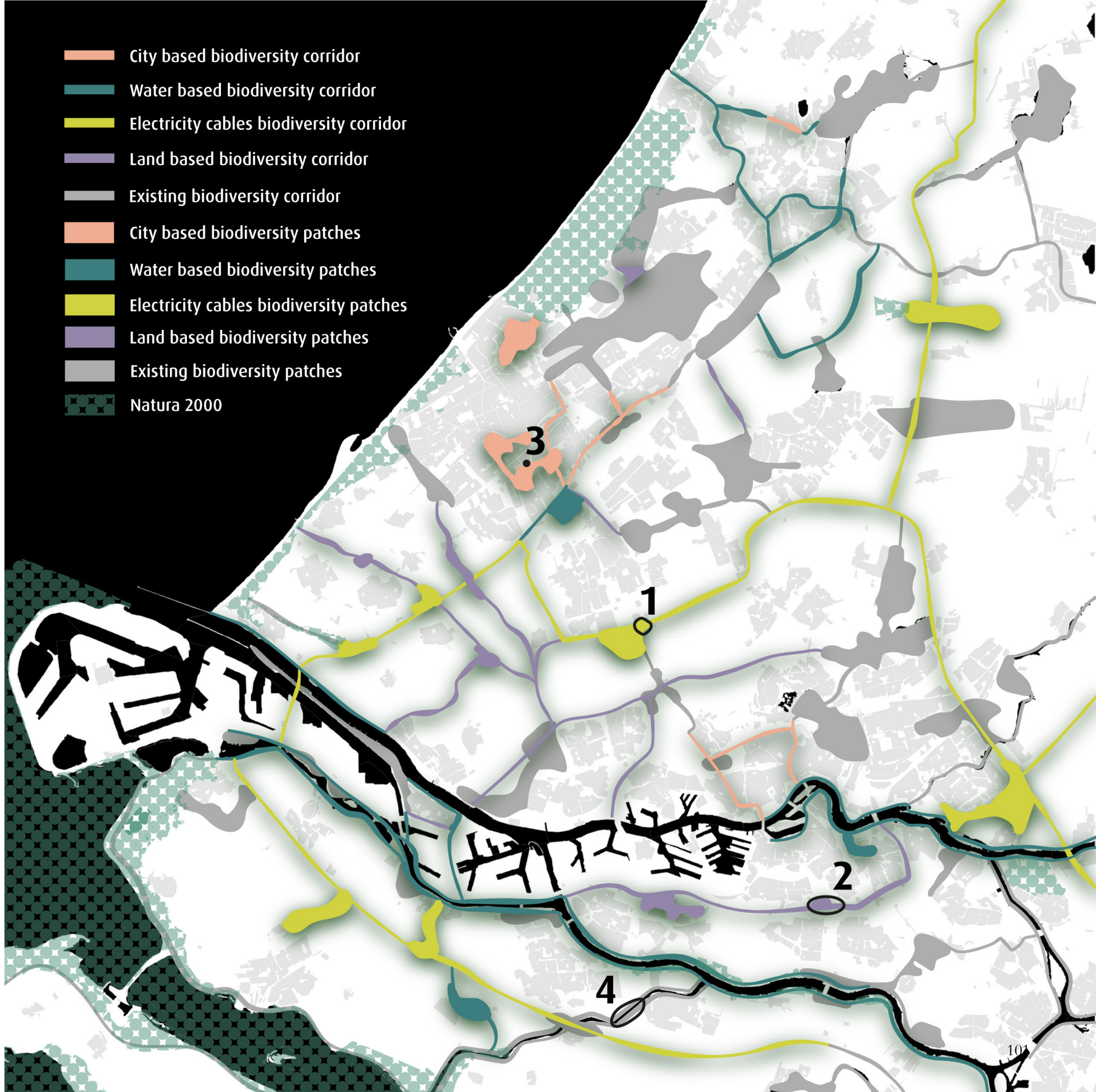
4



City based biodiversity network
Alongside and through cities a different strategy will be implemented. Here the connection with human activity will be emphasized. By creating more space for recreational use and creating green networks through the cities the connection will be strengthened.

Water based biodiversity network
By origin the connection to water is very strong in the Netherlands. By strengthening the biodiversity around the water connections, the water quality can improve this in turn can have many positive impacts for the province.

Figure 5.9. Strategies of biodiversity network implementation.



>Figure 5.10. Map showing implementation strategies of the biodiversity network.

0 5 10 km

Biodiversity network principles

For the Province of South Holland an exploration into a landscape park has been made. This park consists out of multiple layers; green blue main structure, interior landscapes, exterior landscapes and urbanized areas. With the urbanization challenge that the province faces, a new green structure is introduced. With this strategy the province wants to strengthen the urban landscape with the green blue structure(Marco.broekman et al., 2017).

The biodiversity network that is created for Butterfly Effect will strengthen and adjust the exploration into a landscape park of the Province of South Holland to our needs. When looking at the landscape park created for the province, most connections have been taken into account in our new network. However alongside the main river, less green is implemented, this is because for our strategy the industry will have an important role in this landscape which does not coincide with a biodiverse landscape. With the transition to organic agriculture more opportunities for biodiversity corridors arise. These strengthen the overall biodiversity network and create more corridors to existing patches. By implementing the seven principles to the biodiversity network, a versatile network will be created. The network will be adaptable per location, ensuring quality of life and the quality of each individual space in the network.

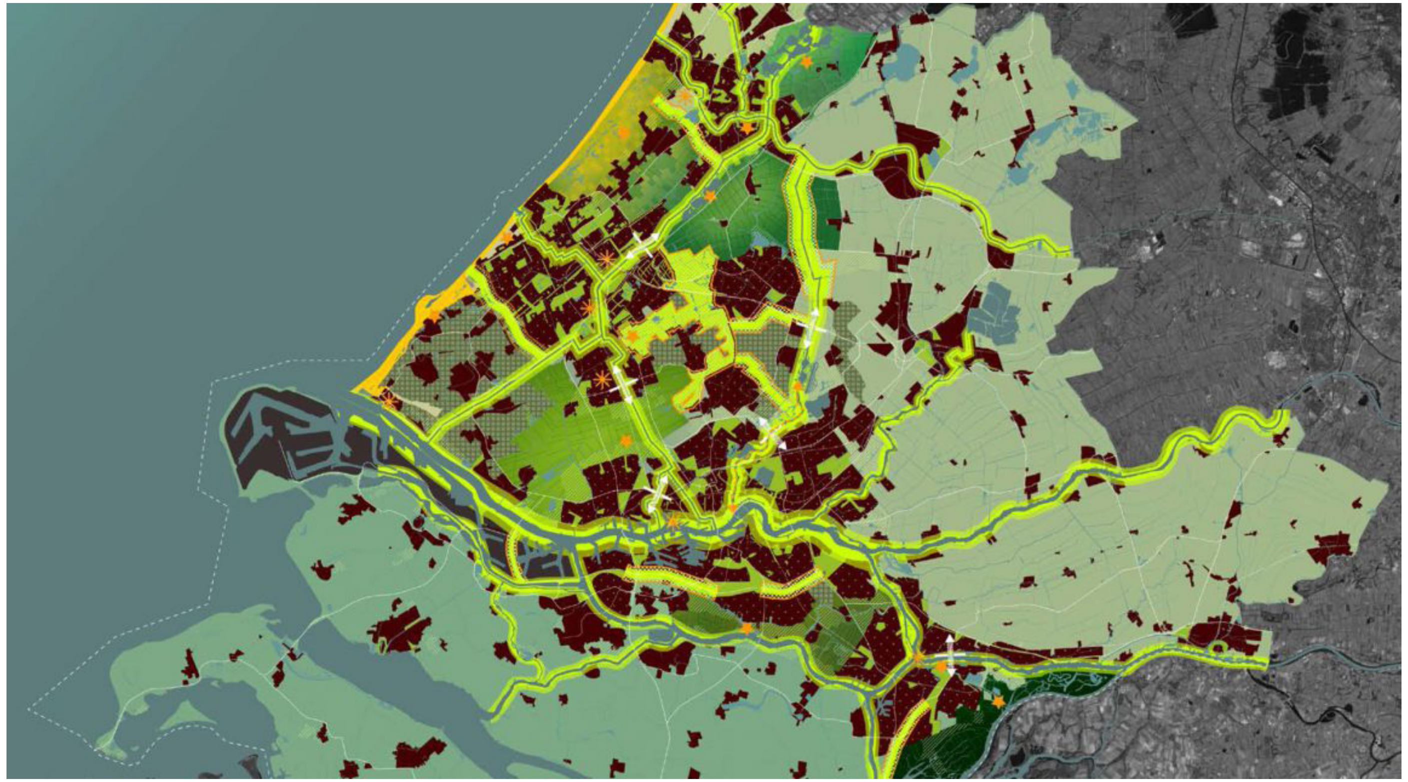
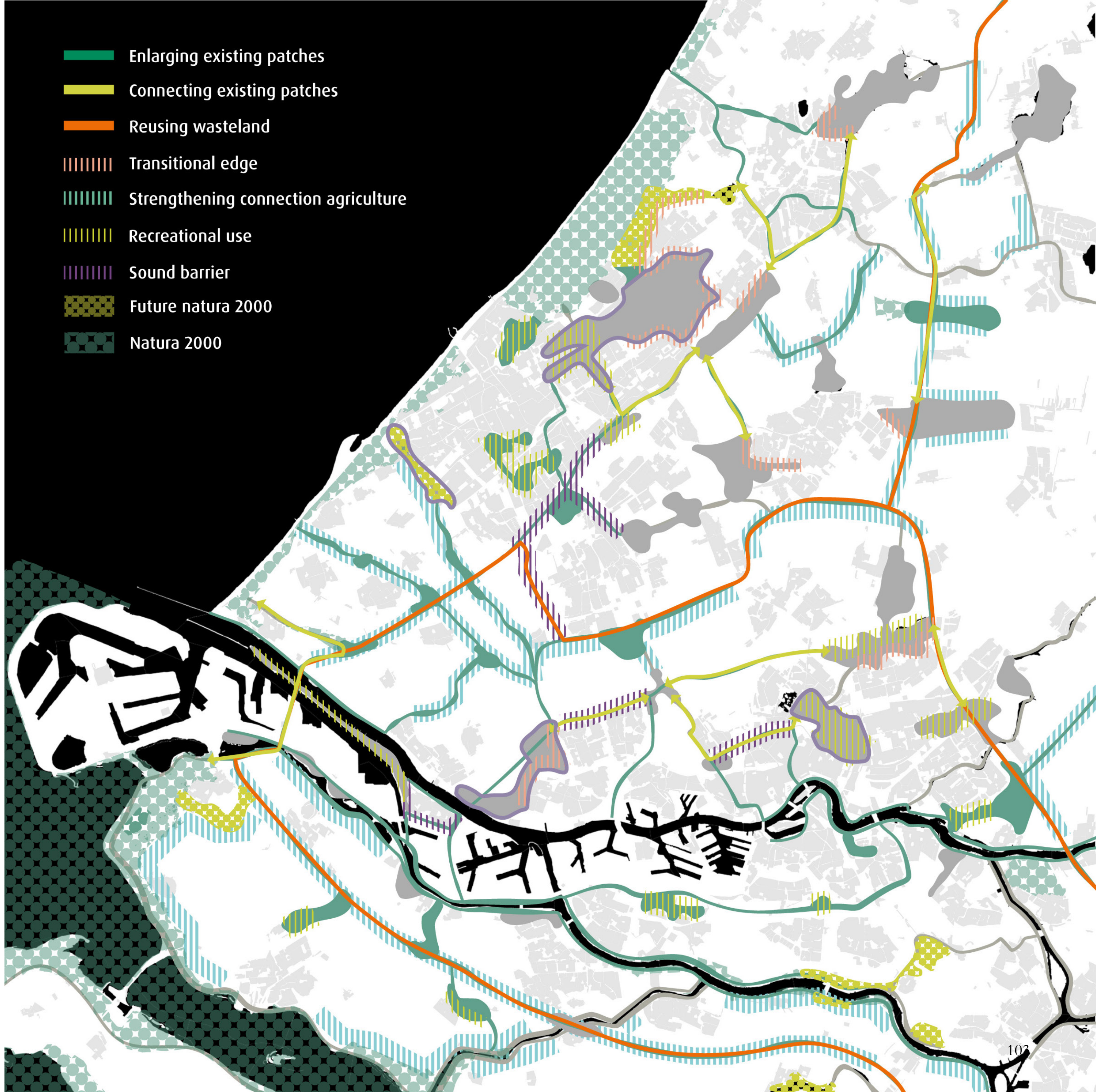


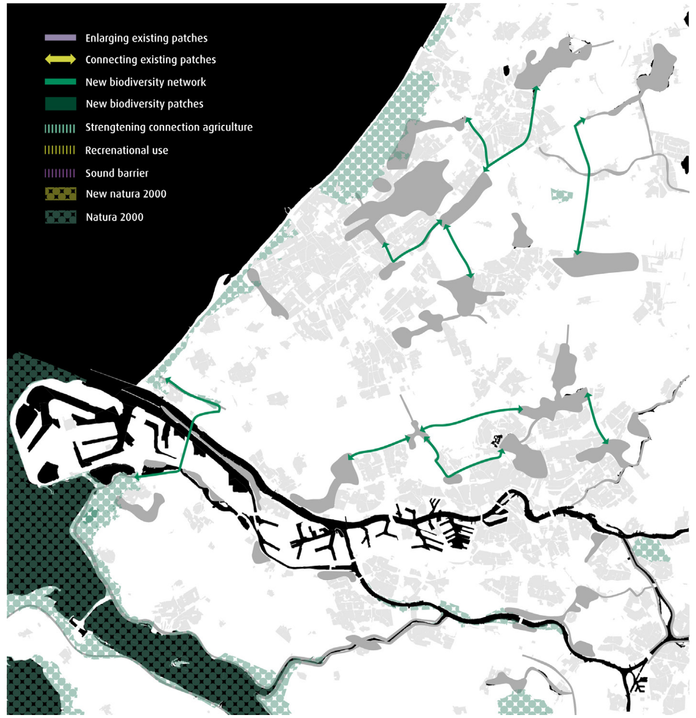
Figure 5.11. Exploration landscape park South Holland (Marco.broekman et al., 2017)

>Figure 5.12. Implementation of the seven principles.



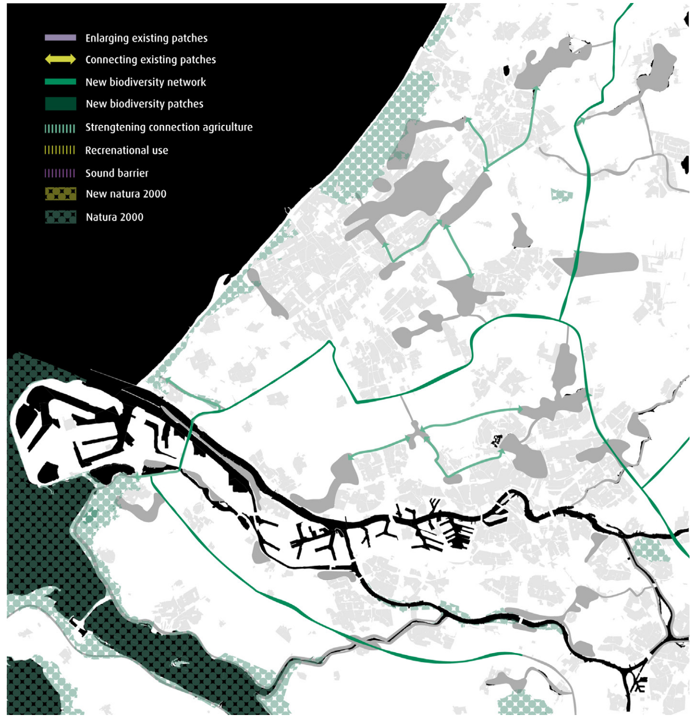
Phasing

2022 - 2026



In the first phase the existing patches will be connected. This will strengthen the existing biodiversity network. With the patches being close to each other already these connections are easier to implement in a short time frame.

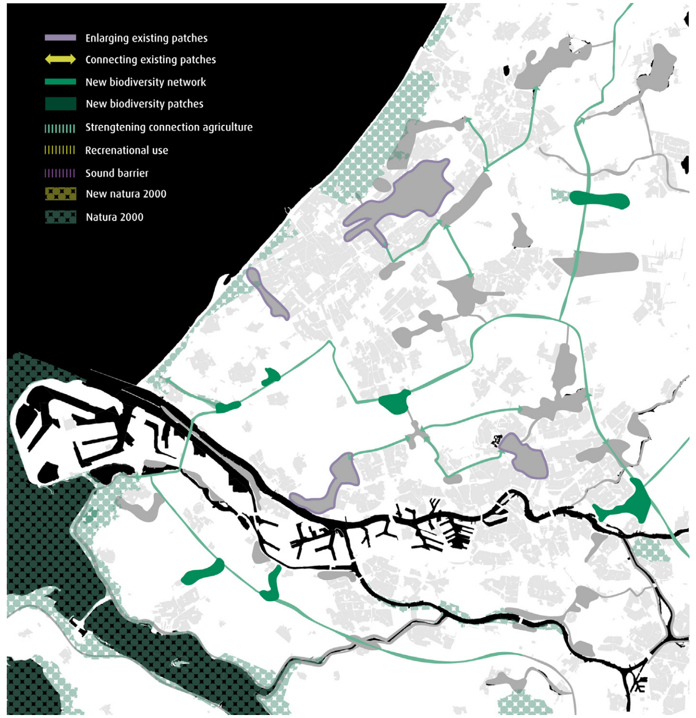
2026- 2030



The second phase consists out of creating the network underneath the electricity lines by reusing the wasteland here. This land has high availability and contains a lot of low density and low biodiverse green patches that can be easily enhanced.

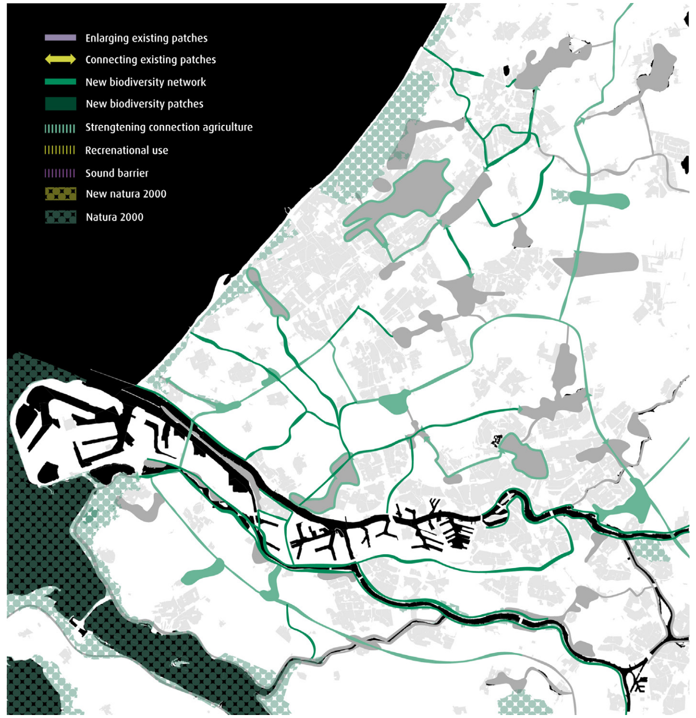
Figure 5.13. Phasing diagrams from 2022 to 2038.

2030- 2034



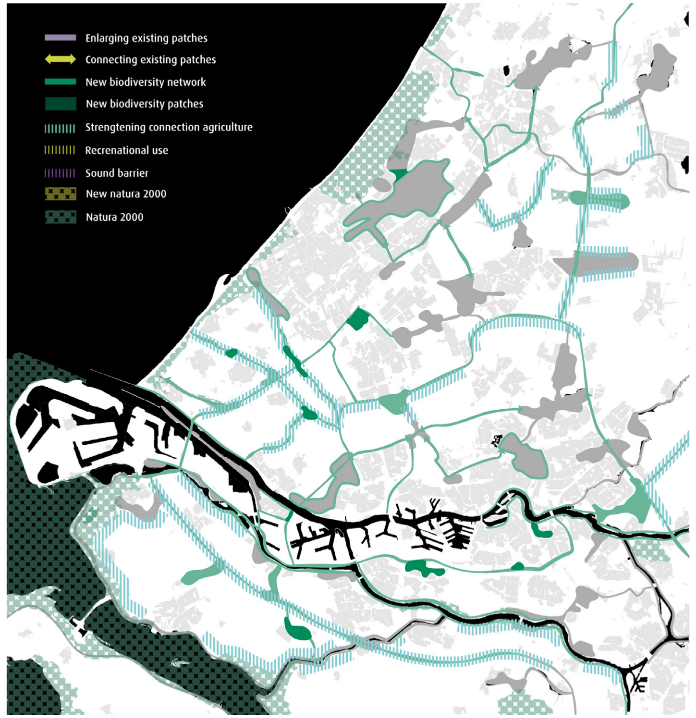
The third phasing is about enlarging existing patches and creating new patches along side the new biodiverse electricity network. By creating new patches the network will be strengthened. New places for biodiversity to expand will occur.

2034- 2038



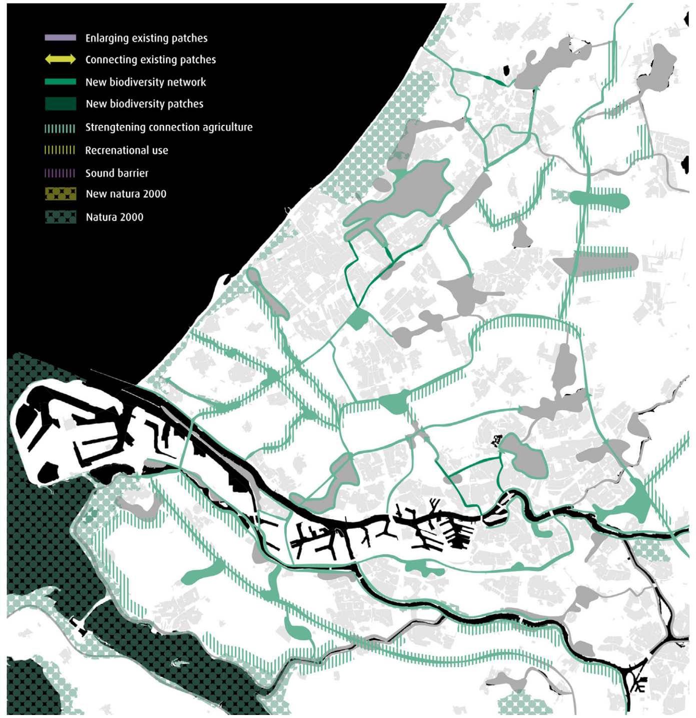
In the fourth phase new connections through land- and water based corridors will be implemented. With these new connections new opportunities for future patches will be created.

2038 - 2042



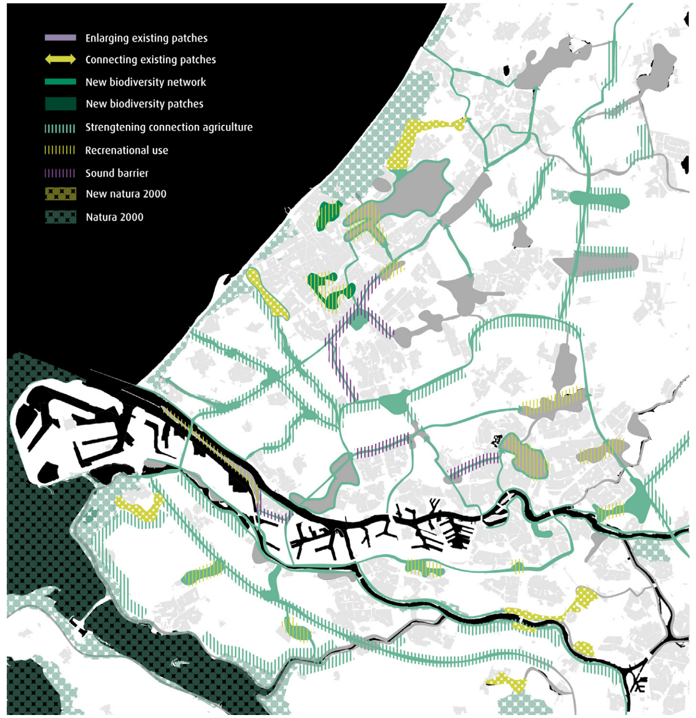
The fifth phase consist of new patches along the water and land based on biodiverse corridors. With this the strengthening with the agricultural landscape will also take place. By strengthening these connections the organic agriculture can benefit for the extensive biodiversity created in this network.

2042- 2046



Second to last is the implementation of the city corridors. New corridors within the city take longer to plan out and will strengthen the connection to nature in the city.

2046- 2050



Lastly the new patches in the city will be implemented. There will also be a transformation to more recreational usage of the green patches in this phase and the implementation of sound barriers. These principles will help solidify the network into the city landscape.

2050

Figure 5.14. Phasing diagrams from 2038 to 2050.

Stakeholders

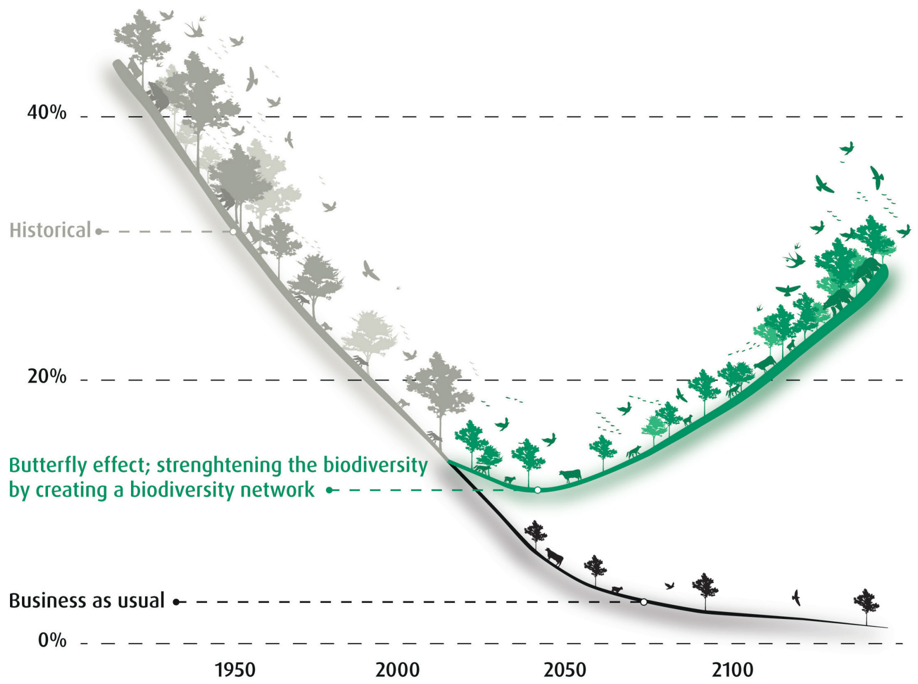


Figure 5.15. Decline of biodiversity in the Netherlands with business as usual and the influence of the implementation of butterfly effect on the biodiversity in the Netherlands. Based on (Netherlands Compendium voor de Leefomgeving, 2013; Alkemade, 2020) and won work.

Current situation

The figure of the decline of the biodiversity as shown above describes the situation if the Netherlands will continue with business as usual for the implementation of the green and blue structure. When business as usual will continue the decline of species will be detrimental and will impact the quality of life of the residents of the Province of South Holland. This will also have a huge impact on the existing agriculture and destabilize this sector. Existing green and blue structures are sustained by the municipalities. The atura 2000 is an important part of this existing structure and is regulated by the European Union.

Impact of the current situation

With the proposed strategy for a new biodiversity network throughout the Province of South Holland we believe that the biodiversity will be strengthened over time. To create a sound base for the new biodiversity network, new land will have to be procured. This land fall mostly under the agricultural sector at the moment. When the shift towards a organic agriculture will take place, this procurement will also take place. An extra driver for the farmers can be the improvement of biodiversity and the boost this can give to the organic agricultural landscape. Besides public procurement, nitrogen tax and the Transition Management Organisation can help with this process. Environmental organizations can be used to set foot in the governmental organisations by lobbying for this new biodiversity network. Current residence along the new corridors and patches will have to be informed about the benefits they gain by having access to green and recreational space. Next to that they will have to be informed about the health benefits.

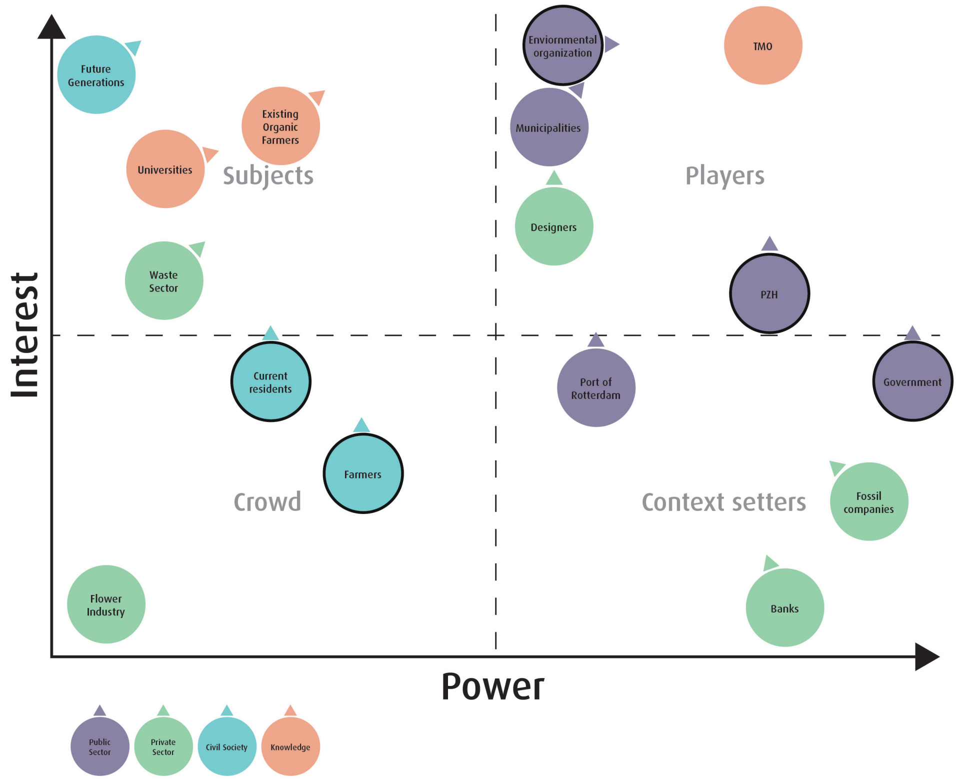


Figure 5.16. Stakeholders in biodiversity network transition with emphasis on the most important categories. Below we present main policies and processes that could increase participation in the transition.

Environmental organizations
Raise awareness, lobbying.

Farmers
Nitrogen tax, public procurement, TMO.

Current residents
Increased access to green spaces and recreational spaces. Green network throughout the province.

Province of South Holland & government
Raise awareness about the importance and impact for the Netherlands of one connected network.

Axonometry - Nieuwenhoorn

This axonometry around Nieuwenhoorn is a representation of the connection between the biodiversity corridor and new dense biodiversity patch. Here the possibility of an implementation of a recreational patch with an existing village is shown.

The axonometry shows the possibility of implementing a new large green patch in the landscape surrounded by the new agricultural landscape. Along the village lines, a recreational patch is represented. With more space to walk and good connection to the village itself. In this axonometric view the existing housing is still represented. By leaving open spaces in the landscape new edges can occur, creating a more diverse landscape. Alongside the new biodiversity corridor the possibility of a connection with the new agricultural landscape is represented. By creating small corridors into the agricultural landscape, biodiversity can expand and support the organic agriculture represented here.

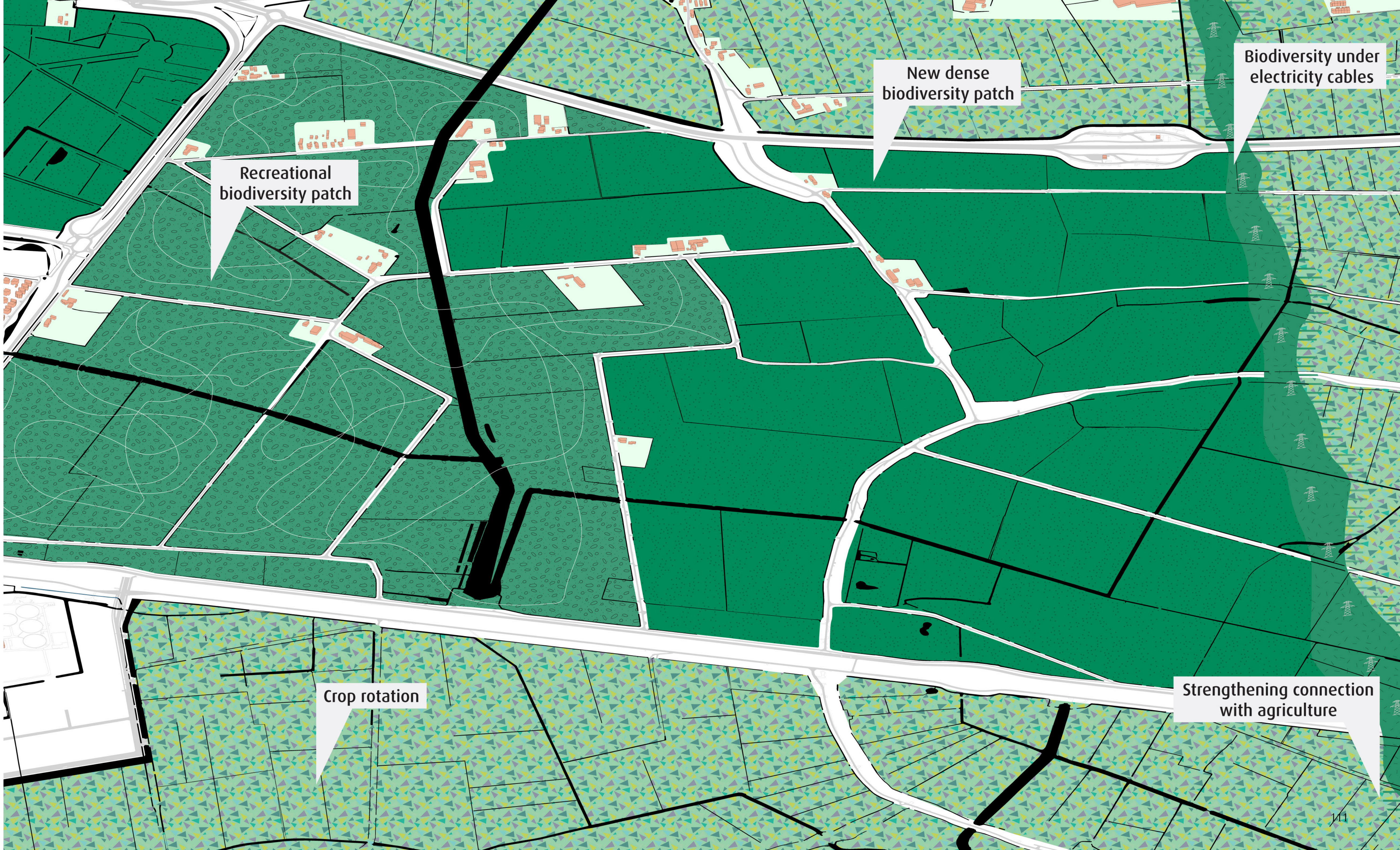


Figure 5.17. Axonometry of Nieuwenhoorn.

5.4.2 Strategy 2

WASTE VALORISATION NETWORK

Creating waste valorisation network and transforming polluting port industry to circular bio-based industry

In the future, the petroleum industry on the port will be replaced with a bio-based building industry. The raw materials for the bio-based building material industry come from organic cultivation and waste. In the Province of South Holland biorefineries of different scales for waste recycling will be located where there are existing clusters of waste facilities. The biorefineries will differ in size depending on their location and function. This will form a network of biorefineries of different sizes with a transport network to connect them. The transport network can go over roads or waterways depending on the most logistical route to take for distribution. The port will be transformed into a central hub for manufacturing, processing and cultivation of the bio-based raw materials with a main central biorefinery and manufacturing facility. Placing the manufacturing, processing and main distribution centre on the port is logistically strategic in the sense that in the future the bio-based building materials can be exported from here.

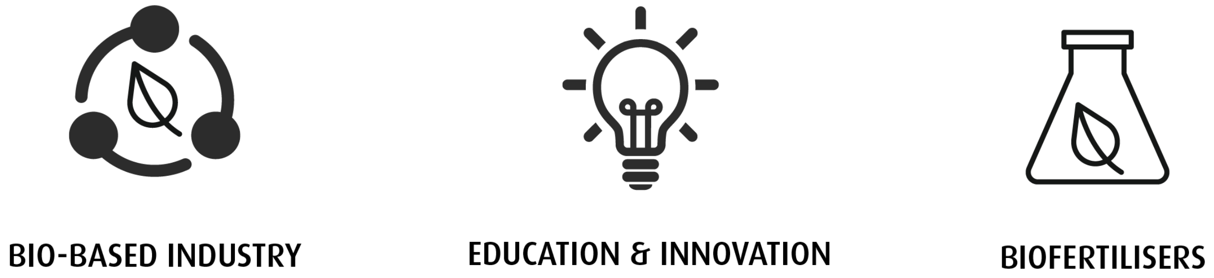


Figure 5.18. Main principles of the waste valorisation network and port transition.

Waste Valorisation Network

One of the main connecting pillars of our proposal is the creation of a waste valorisation network. It would consists of multiple biorefineries in three sizes. The smallest scale would be local facilities, closely connected to farms and the mixed living and working environments. In exchange for agri-food waste it could provide bioertilisers and energy. Medium scale facilities would connect small biorefineries and the main biorefinery, and provide space for more expensive processes.

Largest biorefinery would be located in the Botlek, Port of Rotterdam. Research, education, and experimentation would be essential for this facility. Moreover, it would have the most advanced processes, producing biochemicals, pharmaceuticals, and cosmetics, and be therefore highly increasing the input value.

All biorefineries would be interconnected through TMO, creating cascading process potentials. As a result, there would be no need to have the expensive technologies at one place.

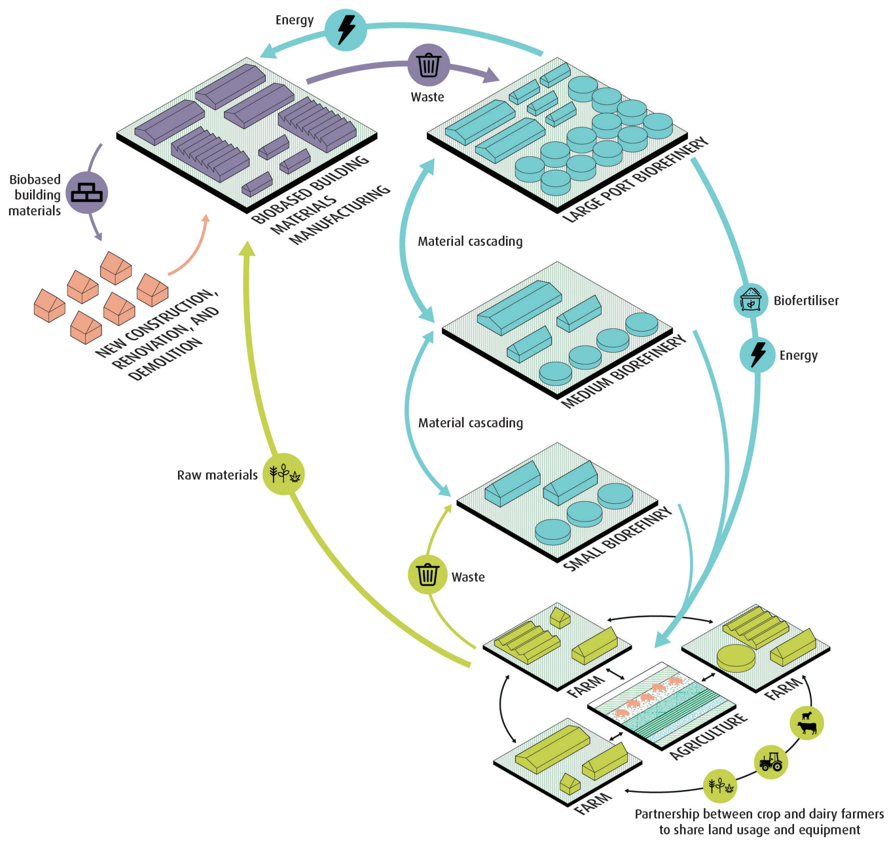
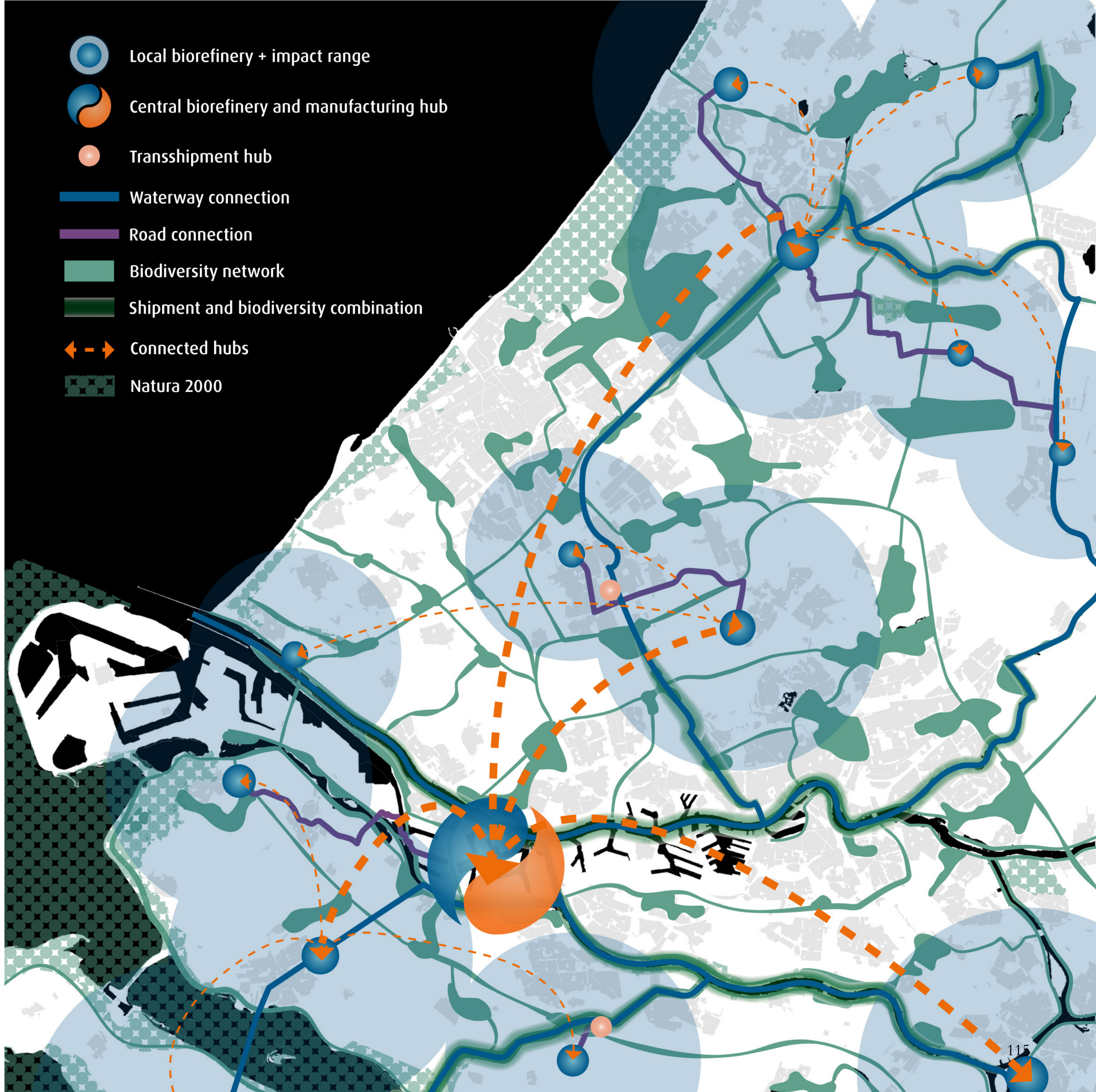


Figure 5.19. Diagram representing different facilities and scales of the waste valorisation network. Collaborative farms harvest raw resources from agriculture fields. Waste, or by-products, would be valorised in multiple different scales of biorefineries. Each biorefinery could have specific facilities hosting diverse processes, thus ensuring most effective and full valorisation. Since agriculture waste is important fertiliser for the fields, one of the necessary products from waste network are biofertilisers that could be used in agriculture industry. Manufacturing hub at the port is closely related with largest biorefinery, sharing processes and recources.

>Figure 5.20. Map of the waste valorisation network.

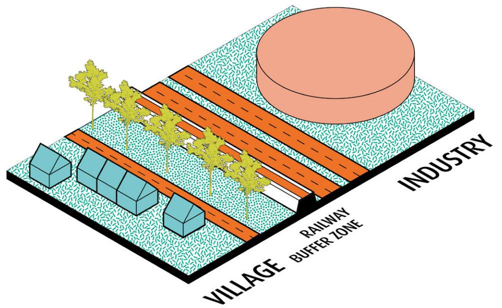
0 5 10 km



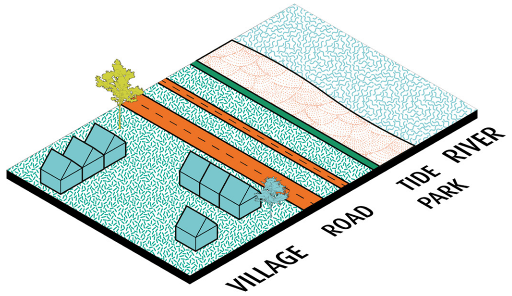
Opportunities & Challenges
Port of Rotterdam

This map depicts the current industries in the port. Polluting industries are currently posing a challenge to the port. There are also opportunities, as fringe areas among different landscapes have the potential to connect to the biodiversity network in the Province of South Holland.

There are three types of landscape in general: residential, industrial, and water. The three sites we chose represent current conditions on the outskirts of those three landscapes, demonstrating the potential for connectivity with the biodiversity network.

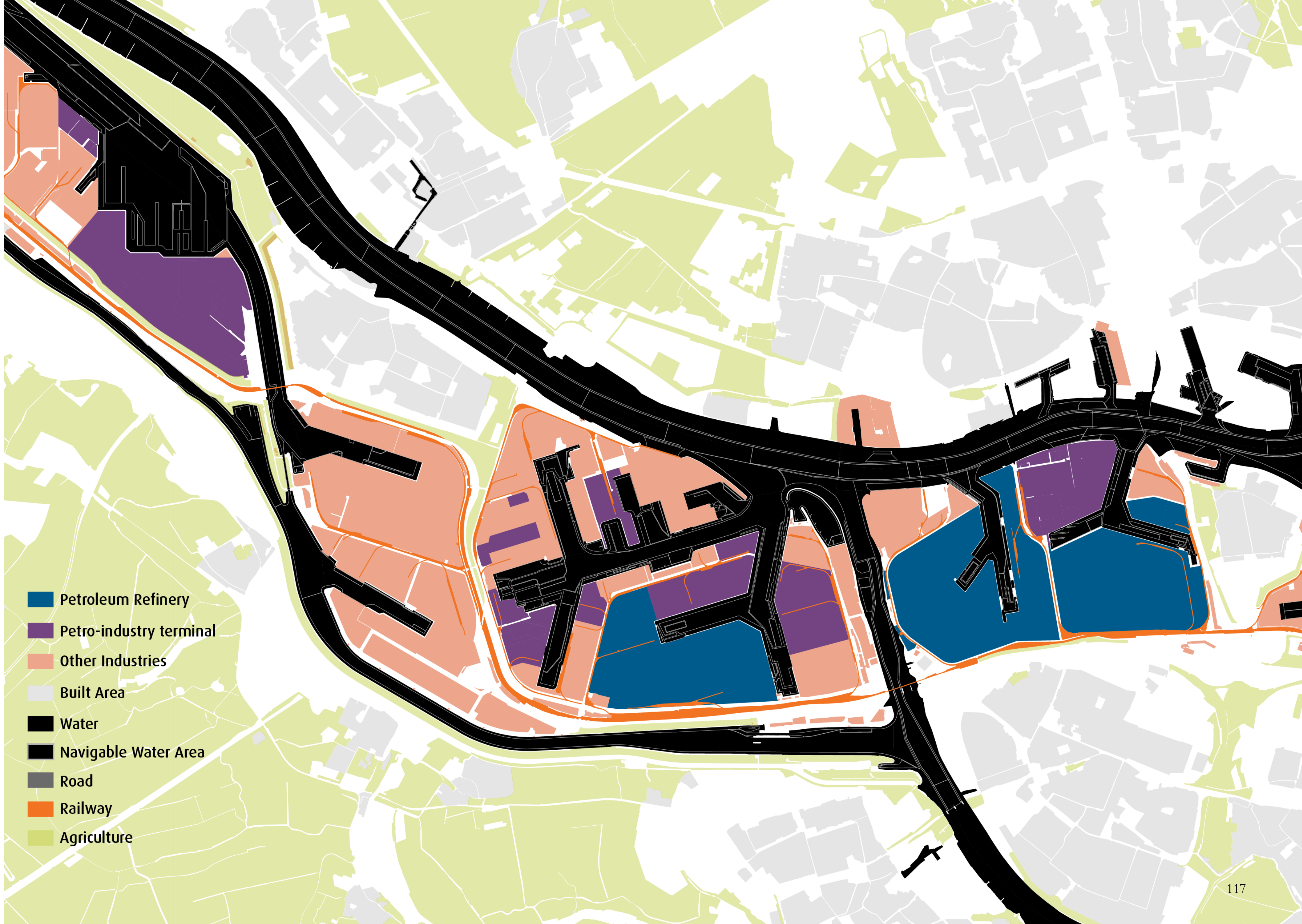


Village & Industry



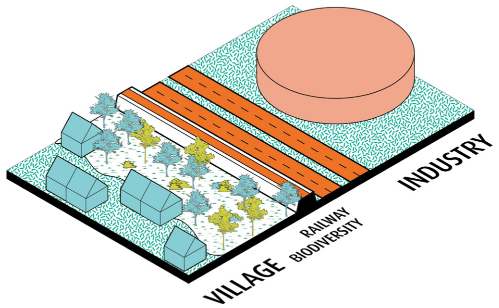
Village & Water

>Figure 5.21. Map and diagrams depicting opportunities and challenges of the port

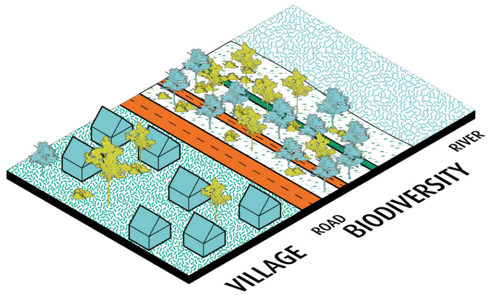


Transition
Port of Rotterdam

The map depicts the port's landscape transition, how the port connects to the biodiversity network, as well as its industry transition. The main strategy here is to convert the polluting petroleum industry to a bio-based industry, so the main actions are to eliminate petroleum processing and transform petroleum terminals to a bio-based building materials industry. As a result, the petroleum processing site on the map have been transformed into a bio-based building material manufacturing, biorefinery, and innovation and education center. Other petroleum processing sites are used for agriculture in order to provide raw materials and make the port future-proof.



Village & Industry



Village & Water

>Figure 5.22. Map and diagrams depicting transition of the port.

Illustrative location - Botlek

To see what happens in this area, we zoom in on the illustrative location that will be transformed into a bio-based building material manufacturing, biorefinery, and innovation and education center. For the design, new facilities for the three programs are built, and the biodiversity network extends to and combines with them. Furthermore, petroleum terminals are being converted to serve the bio-based industry, so some terminal facilities are being re-used.

>Figure 5.23. Plan depicting final results of the transition in the Botlek area.

Timeline

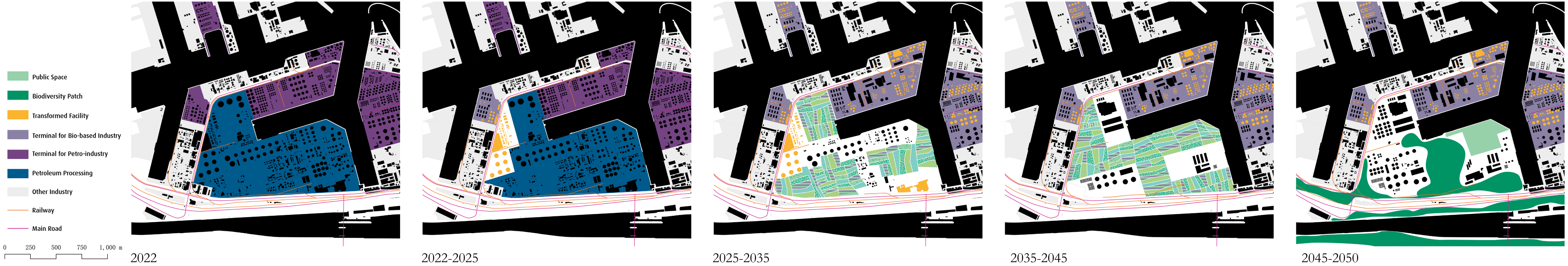


Figure 5.24. Phasing of the Botlek transition.

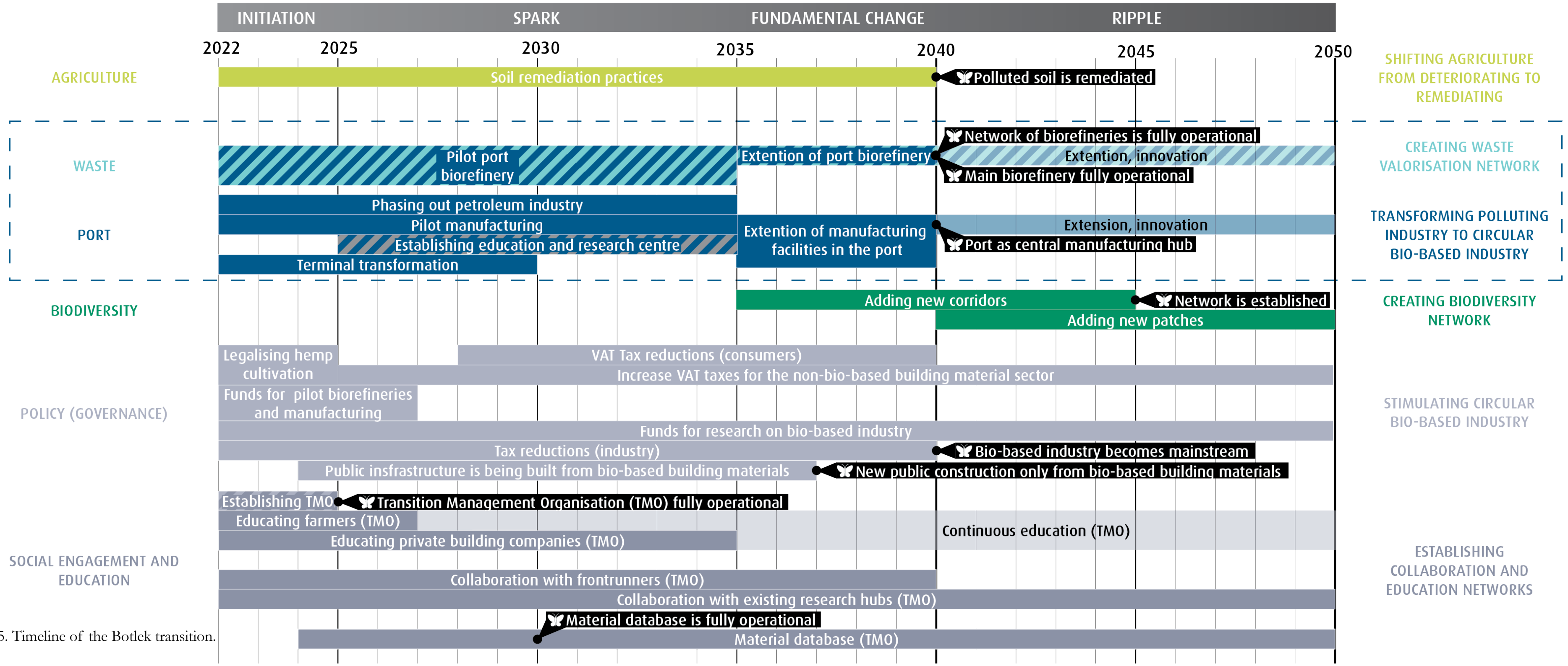


Figure 5.25. Timeline of the Botlek transition.

Stakeholders

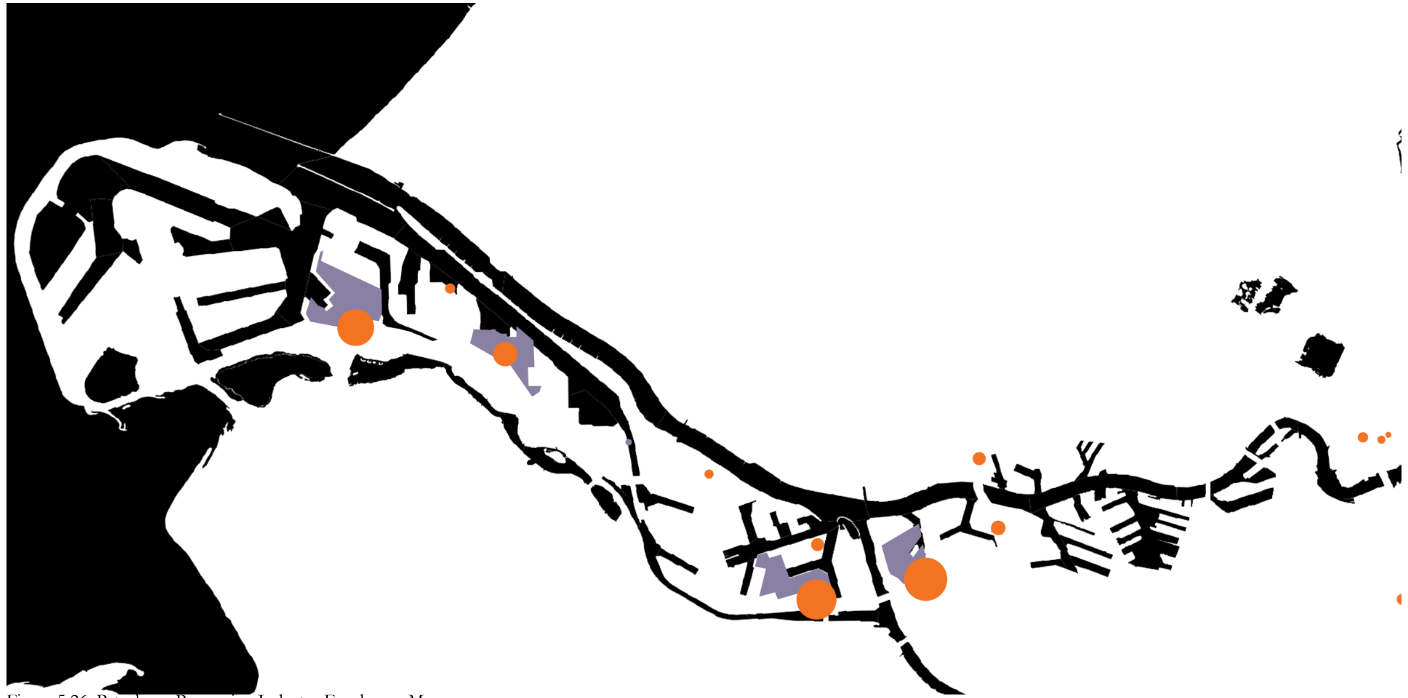


Figure 5.26. Petroleum Processing Industry Employees Map.

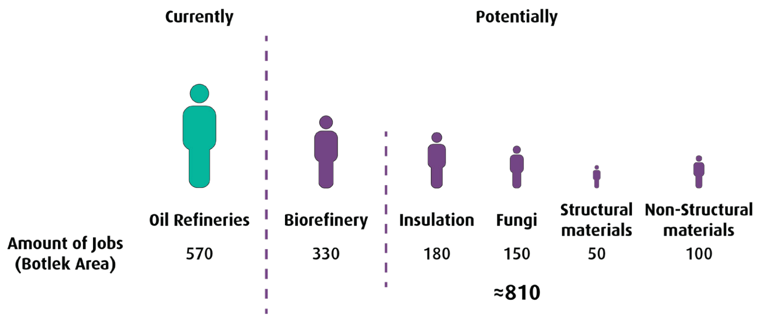


Figure 5.27. Diagram depicting the port's current and potential employment. Based on Shokhitbayev, 2019 ; Craft (n.d.); D&B Business Directory, (n.d.).

The map depicts the petroleum processing industry's locations on the port as well as the number of employees. The number of employees is represented by the size of the circle. Oil refineries employ approximately 570 workers on the port. The new bio-based sector is planned to employ approximately 810 people in the future.

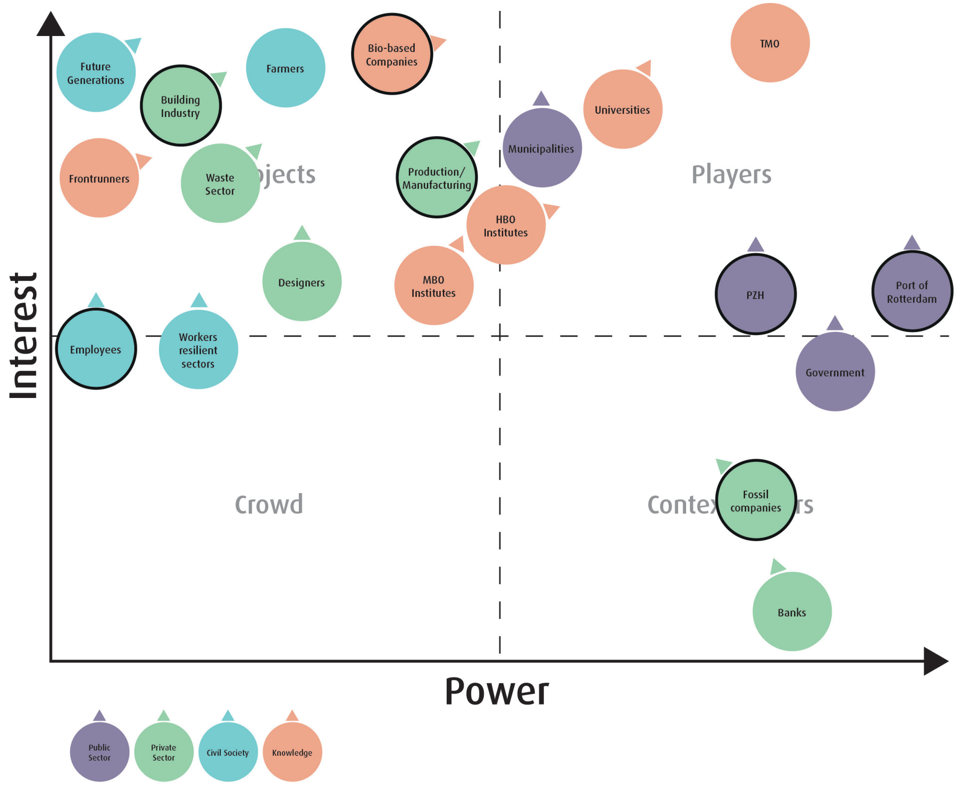


Figure 5.28. Stakeholders in port transition with emphasis on the most important categories. Below we present main policies and processes that could increase participation in the transition.

Fossil companies
Increased VAT, Nitrogen taxes, Inform

Bio-based companies
Increased funding, education, Government backed loans, TMO.

Building industry
Bio-based building material regulations, education.

Employees
Rise awareness, education, TMO.

Production/Manufacturing
Increased funding, education, Government backed loans, TMO.

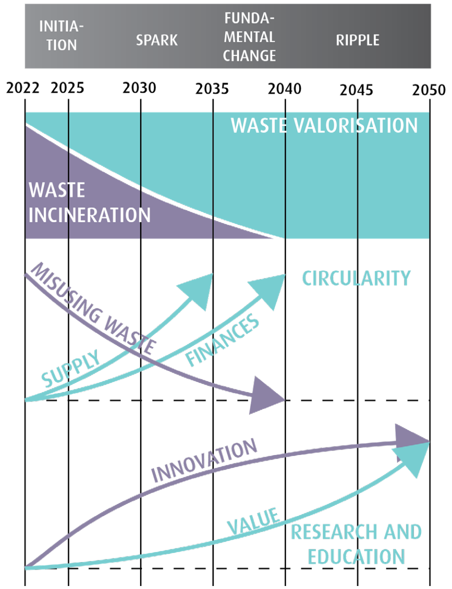


Figure 5.29. Diagram depicting the port's primary transition mechanisms. Waste incineration is predicted to be completely replaced by waste valorisation by 2040. As a result, waste misuse would dropp rapidly until it become completely eliminated.

Axonometry Botlek

Figure 5.30 portrays future spatial circumstances in Botlek, which will have been turned into a central hub for bio-based building materials manufacture, biorefinery, and education & innovation. The biodiversity network expands inside the site and becomes intertwined with the programs, resulting in a more pleasant working environment.

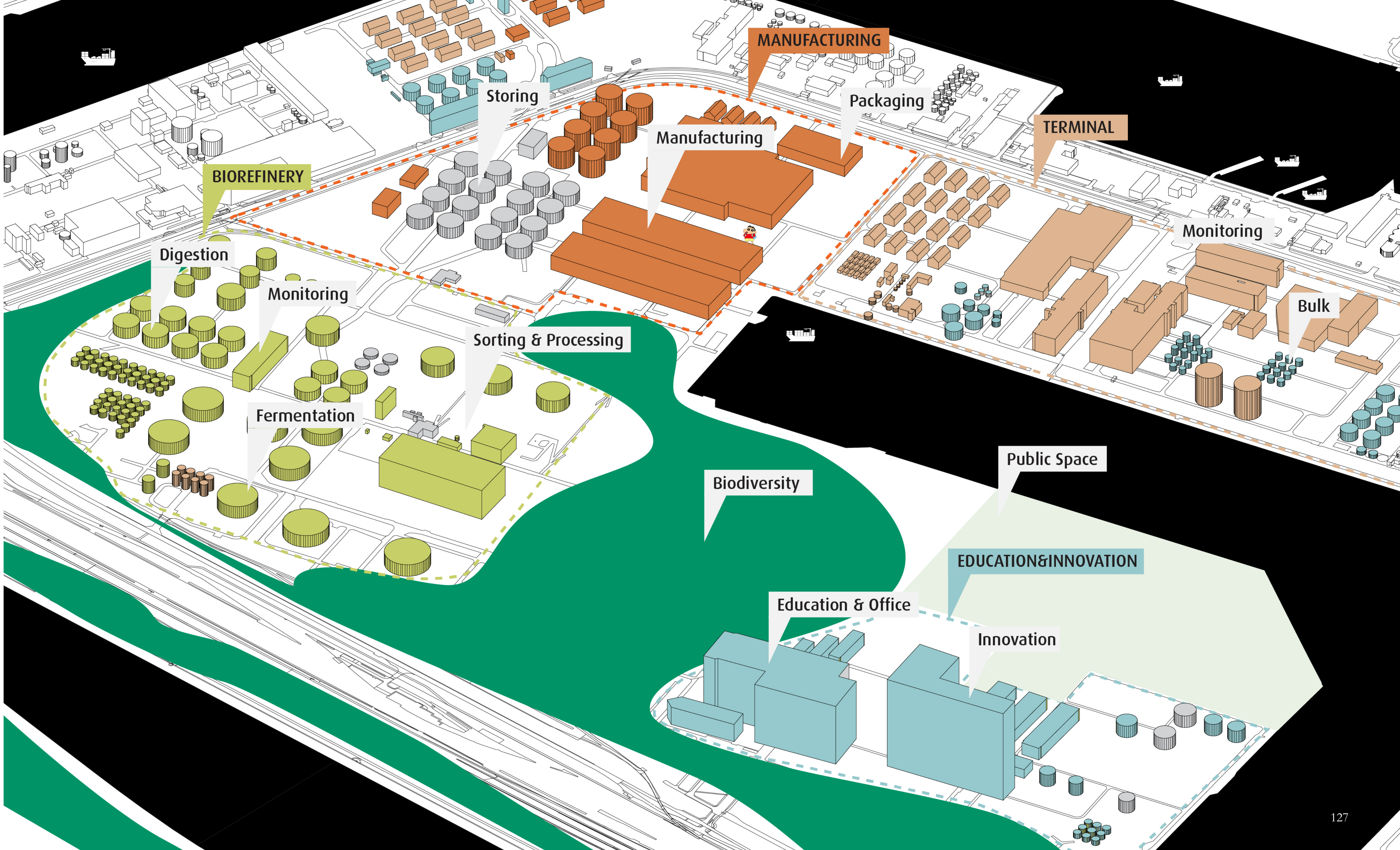


Figure 5.30. Axonometry of Botlek.

Spatial Quality

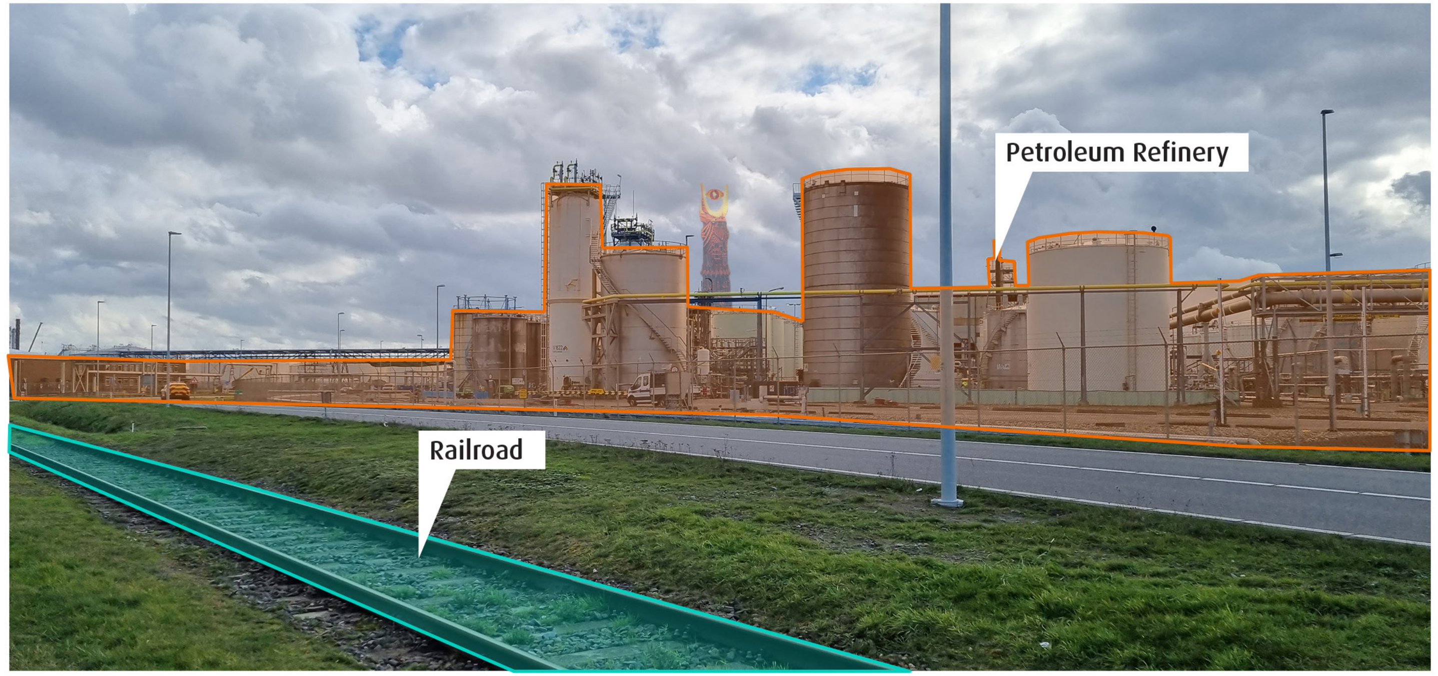


Figure 5.31. Oil refinery in Botlek, South Holland. (Google, 2021). The current situation is the facilities in petroleum refinery, as well as a raiway serving for the industry. The greening area along the road is lifeless due to soil contamination caused by the petroleum industry.

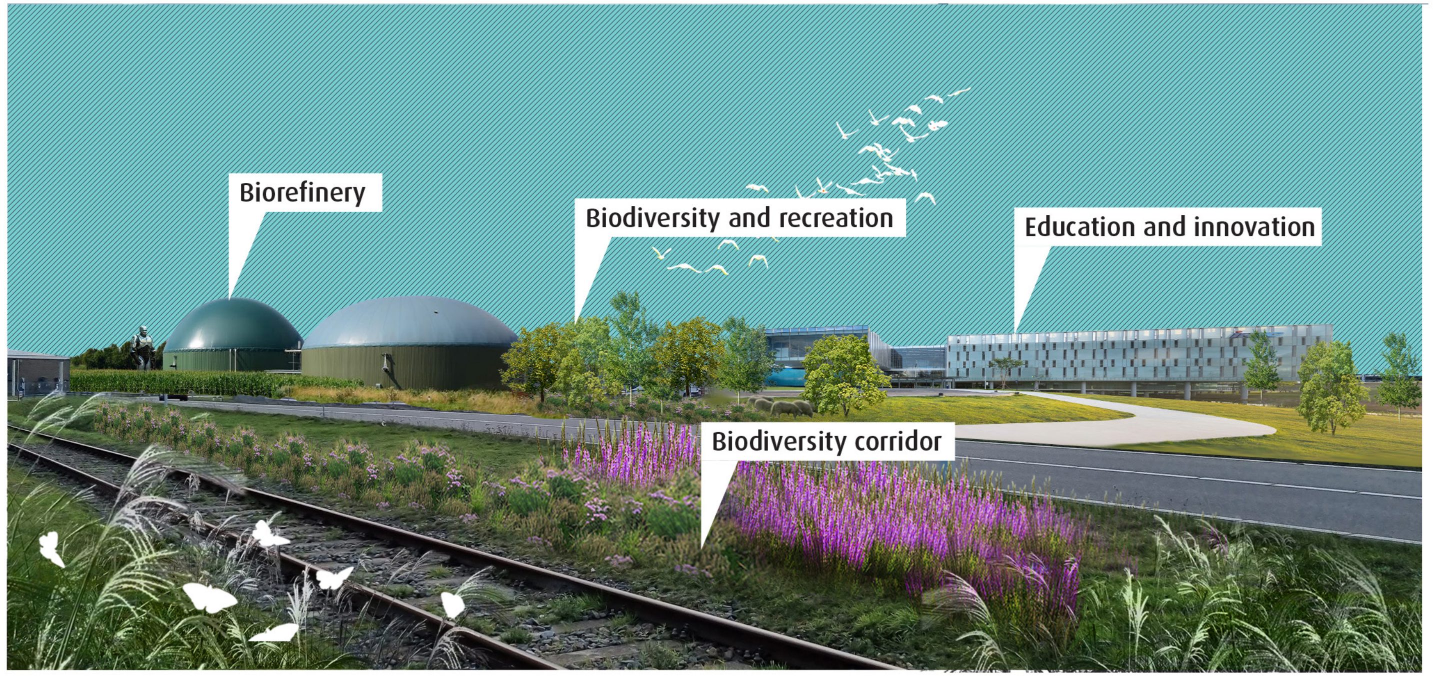


Figure 5.32. We propose that in the future, petroleum refineries be removed and new biorefinery, education, and innovation centers be constructed on the site. The railway will be preserved to serve the emerging bio-based construction materials industry. Furthermore, the lifeless road greening will be replaced by a biodiversity patch, thanks to the soil being remediated.

5.4.3 Strategy 3

SHIFTING AGRICULTURE FROM DETERIORATING TO REMEDIATING

Transforming agriculture to more regenerative, sustainable, organic, and circular industry

The definition of circular economy in agriculture is defined by Velasco-Muñoz et al. (2021) as "*the set of activities designed to not only ensure economic, environmental and social sustainability in agriculture through practices that pursue the efficient and effective use of resources in all phases of the value chain, but also guarantee the regeneration of and biodiversity in agroecosystems and the surrounding ecosystems*". Based on this, sustainability, regeneration, and ecology are an essential part of our principles of agriculture transition.

Principles of new pathway for agriculture

In order to achieve sustainable, regenerative, and biodiverse agriculture in the future, we propose to follow 12 main principles summarised below, based on Sukkel & Hommes (2009), Velasco-Muñoz et al. (2021), Puglia et al, (2021). The essence of the transition is to increase peat regeneration, soil remediation, and biodiversity. The new agriculture needs to rely on usage of natural biofertilisers, that could be provided by the network of biorefineries. Furthermore, it would be necessary to have diversity of land usage both timewise and in space. Crop and animal grazing rotations would shift functions of plots timewise, while strip farming, cover crop usage, wet farming, communal agriculture, and agroforestry (planting trees, flowers, or/and bushes between stripes) would do the same spatially. This could revolve around zoning principles of permaculture, which would mean different level of naturality in different zones.

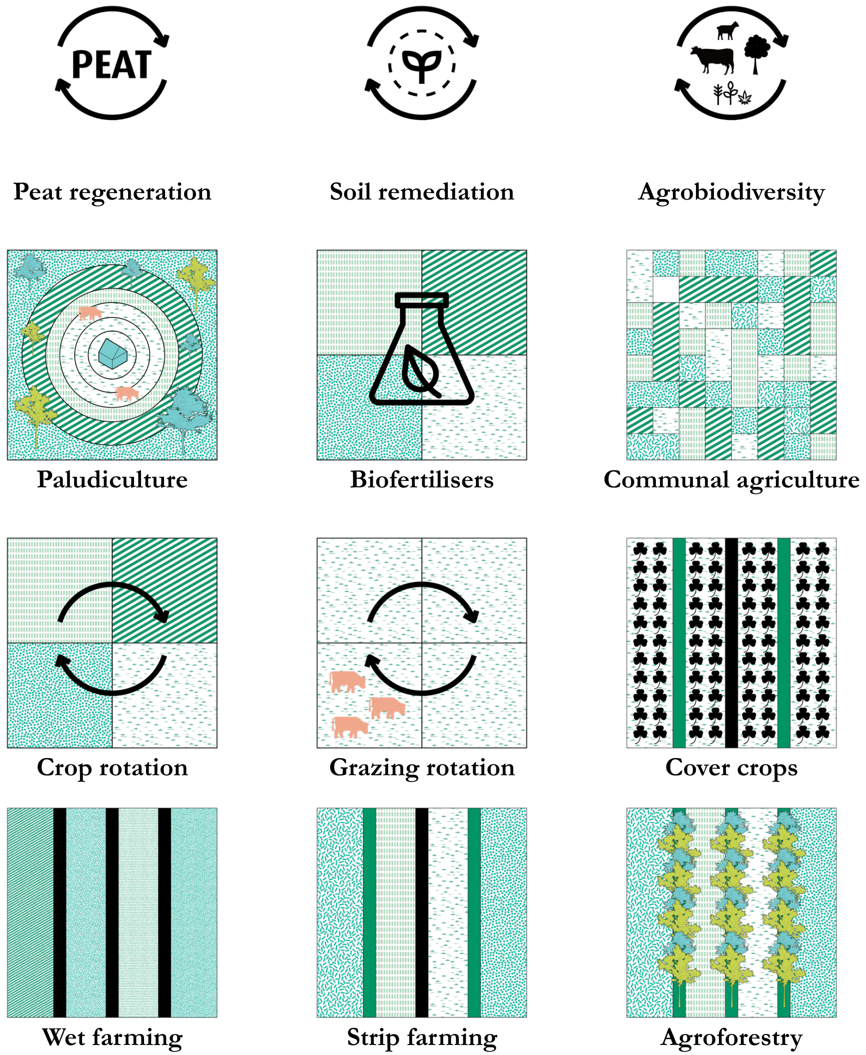
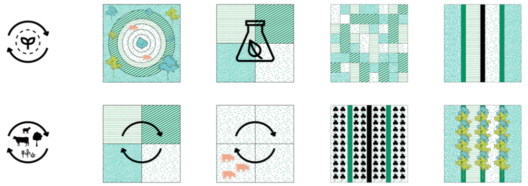


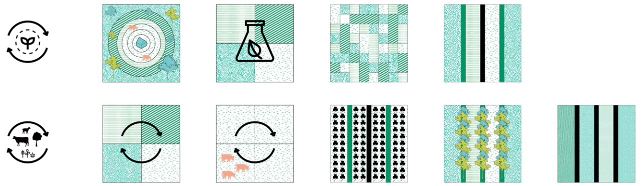
Figure 5.33. Principles of the remediating agriculture.

Based on current soil, usage, and proximity conditions we propose four main types of agricultural practices in the Province of South Holland, namely paludiculture, regenerative agriculture, oilscapes and general agriculture. It would differ in used principles, crop rotations, and practices. Each type is described below.



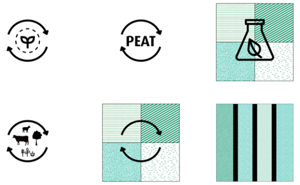
Common agriculture

Located in the areas where no soil pollution is observed, the main target for these places is not to remediate the soil, but to increase the resilience of the agricultural practices in order not to pollute landscapes and become more organic. At the same time it is important to increase sustainability of the farming practices and mix agriculture with biodiversity strips and corridors. This could be achieved by applying permaculture ideas, introducing a rotating crop cycle (with cover plants) and animal grazing areas, strip farming, agroforestry, communal agriculture, and strengthening usage of biofertilisers.



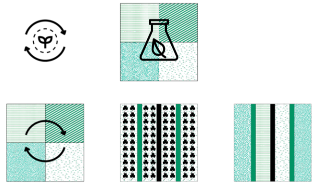
Remediating agriculture

The main objective for the areas where soil pollution is reaching high levels (mostly south of Rotterdam), is to remediate and regenerate the soil with natural processes. That would mean using very specific (depending on the types of pollution in each site) bioferitilisers. Important would be the usage of crop and animal grazing rotations, preferably on the same plot, with remediating cover and main plants, such as Alfalfa or Hemp. Furthermore, increasing agrobiodiversity would greatly increase potentials of remediation. Strip farming, and specifically wet farming, would strengthen remediation processes.



Paludiculture

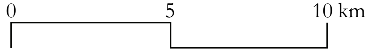
Wichtmann et al. (2016) defined paludiculture as "*productive land use of wet [or rewetted] peatlands that stops subsidence and minimises emissions*". According to Greifswald Mire Centre (2019), paludiculture provides opportunities to increase ecological qualities of the landscape while maintaining productivity. It relies on wet farming, specific crop rotations and biofertilisers (Tanneberger et al., 2021). As a result, polluted soil could be remediated, peat regenerated, and agrobiodiversity increased.

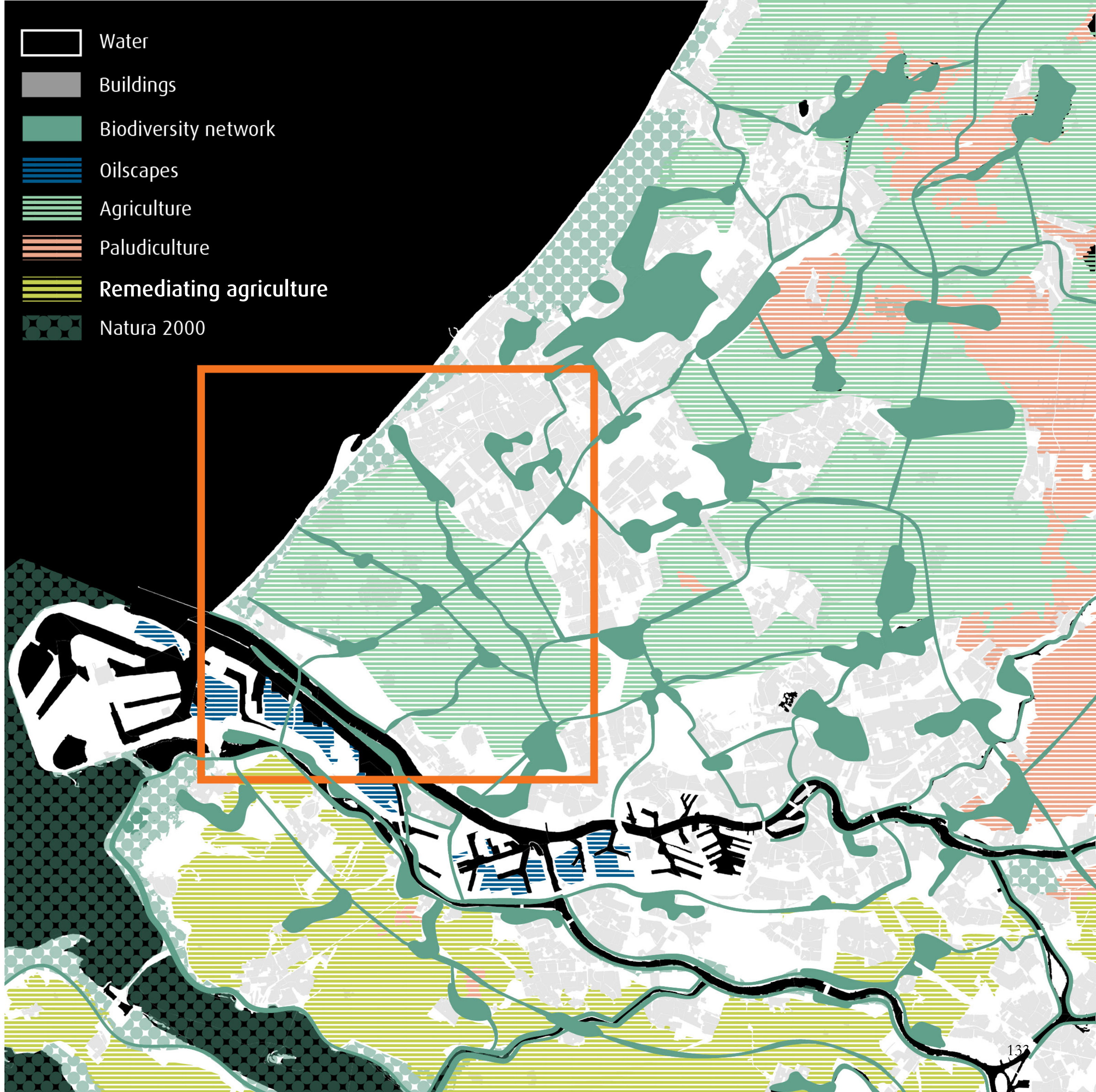


Agriculture in oilscapes

Butterfly affect assumes that because of the energy transition from fossil-fuel to renewables, oil refineries in the Port of Rotterdam will be phased out. Potentially heavily contaminated sites will need to be remediated. Instead of using chemical and mechanical processes, we propose to use intensive agricultural regeneration practices, which would include specific crop rotation cycles (f.e. hemp and flax) while including cover crops in the process (Mańkowski et al., 2020). Scientifically precise use of biofertilisers could speed up the process. Mańkowski et al. demonstrated, that in 6 years soil quality could be increased by bioremediation, however chemical practices could increase the speed where necessary.

>Figure 5.34. Map of the agriculture strategy for Province of South Holland.



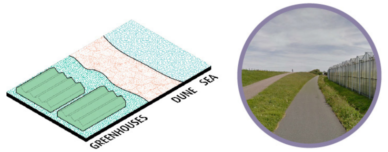


Challenges & Opportunities - Westland

To find out spatial challenges and opportunities and how aforementioned principles of agricultural transition could be applied, medium-scale analysis is necessary. For this project we chose Westland area, because it would undergo one of the biggest transformations from greenhouse to organic open-field agriculture.

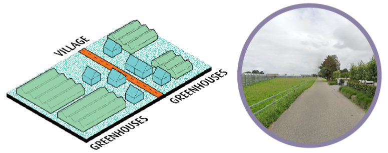
In general, main challenges are the borders of urbanised territories, which raises questions how new agriculture would connect to the city in a just way. On the other hand, our proposed biodiversity network offers potentials for ecological, diverse agriculture. Below we listed 7 main types of challenges and opportunities.

1



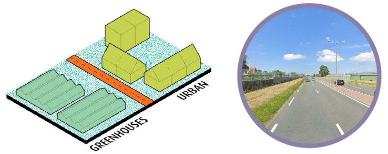
Currently there are greenhouses located close to the seaside, which creates potential for the extension of the habitats for seaside species into the agricultural area.

2



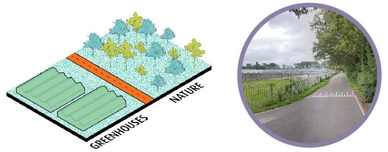
Linear villages poses a challenge for a just agricultural transition, because new path of agriculture would need to include soft transition areas for these villages.

3



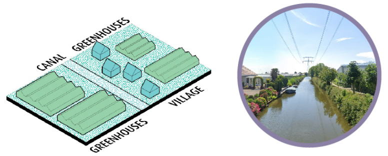
Currently, separated urban and agricultural environments create a challenge for a just transition to organic agriculture, because it involves rethinking of spatial relationships.

4



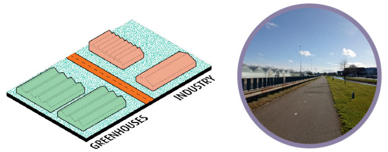
Greenhouses today form a hard edge around existing fragmented biodiversity patches. Replacing them offers a potential for creating a network.

5



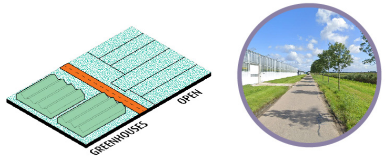
Canals today offer poor conditions for biodiversity. Our proposed transition would allow for canals to be used as biodiversity corridor, creating better living environment for new and existing housing.

6



Greenhouses bordering industrial zones poses a challenge of what type of agriculture would be sustainable and efficient close to areas with nuisances.

7



Areas where greenhouses form a hard edge in front of open agricultural land poses a question how the enlarged open landscape could be diversified visually and agriculturally?

Figure 5.35 Challenges and opportunities for agriculture transition in the Westland area.

>Figure 5.36. Map of challenges and opportunities for agriculture transition in the Westland area.

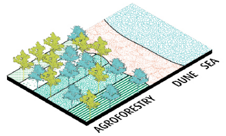
0 1 2 km

Concepts - Westland

To find out spatial challenges and opportunities and how aforementioned principles of agricultural transition could be applied, medium-scale analysis is necessary. For this project we chose Westland area, because it would undergo one of the biggest transformations from greenhouse to organic open-field agriculture.

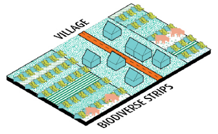
In general, main challenges are the borders of urbanised territories, which raises questions how new agriculture would connect to the city in a just way. On the other hand, our proposed biodiversity network offers potentials for ecological, diverse agriculture. Below we listed 7 main types of challenges and opportunities.

1



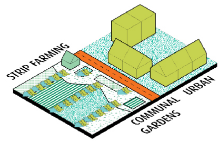
Currently there are greenhouses located close to the seaside, which creates potential for the extension of the habitats for seaside species into the agricultural area.

2



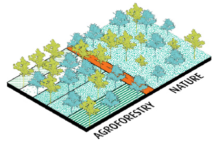
Linear villages poses a challenge for a just agricultural transition, because new path of agriculture would need to include soft transition areas for these villages.

3



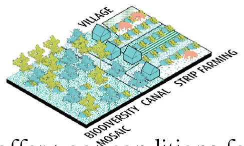
Currently, separated urban and agricultural environments create a challenge for a just transition to organic agriculture, because it involves rethinking of spatial relationships.

4



Greenhouses today form a hard edge around existing fragmented biodiversity patches. Replacing them offers a potential for creating a network.

5



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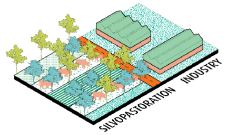
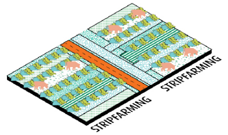


Greenhouses bordering industrial zones poses a challenge of what type of agriculture would be sustainable and efficient close to areas with nuisances.

7



Areas where greenhouses form a hard edge in front of open agricultural land poses a question how the enlarged open landscape could be diversified visually and agriculturally?

Figure 5.37. Concepts for agriculture transition in the Westland area.

>Figure 5.38. Map of concepts for agriculture transition in the Westland area.

0 1 2 km

Illustrative location - De Lier

De Lier area is the illustrative location of the transition that could happen in the same timeframe around the whole Province South Holland. In the following pages we will describe the spatial results of the new pathway for agriculture, as well as phasing and main guidelines.

Reviving historical patterns

It is believed that in order for the agricultural transition to be the most beneficial for both natural and social environments, it needs to be based on historical developments and identity. By looking back at the development of the area (figure 5.39), the main aspects of the local identity can be identified. In illustrative location De Lier the main takeaways from historical analysis are dense, linear stripes of agricultural land and housing developments around main streets.

We propose to base new parcellation of farms on the historical types, while at the same time diversifying it even more. This would revive the romantic, picturesque image of the Dutch landscape while keeping production efficient.

Furthermore, we offer to densify peri-urban and rural areas not by patches, but by linear developments as a continuation of historical patterns. In this way identity would be strengthened. This would reduce investments into public infrastructure, because existing roads would be reused.

Biodiversity network

New pathways for agriculture would support the creation of biodiversity network. In the case of De Lier removal of greenhouses open up spaces around canals and under electricity cables for biodiversity corridors. Moreover, new types of agricultural practices could strengthen green areas by extending it into the land with the practices of agroforestry. This could reduce soil corrosion and greater habitat diversity (Dramstad et al., 1996).

Communal agriculture

Figure 5.40 represents potential locations of agricultural commons, such as communal gardens. As stated before, it would create a soft, socially sustainable transition from urban to agricultural areas and create potentials for citizens to produce their own organic food.

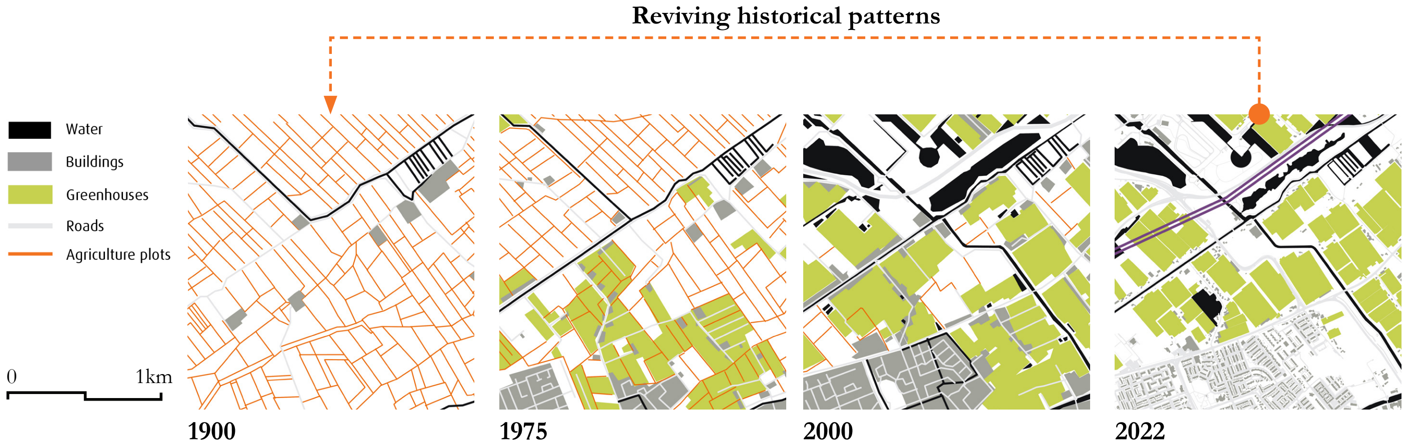


Figure 5.39. Historical development of the area. In 1900 the location was a typical dutch agricultural area, with diverse plots enclosed with dikes, usually long and narrow. 1975 shows the switch of production to greenhouses, while in 2000 this process is only more emphasized. However already in 2022 the area of greenhouses is already replaced by housing. In this sequence it is visible that the main developments continued along main infrastructure lines.

>Figure 5.40. Agriculture transition results in the location of De Lier.

0 250 500 m

Axonometry - De Lier

Figure 5.42. represents the potential spatial conditions of the agricultural transition. An important take away from this image is the demonopilsation, specialisations, and localisation of farms.

As a consequence of the spatial conditions of organic, biodiverse farming, there could be an increase in small farmsteads that are located closer to the fields. In this way production and harvest could be more local, increasing efficiency.

However, smaller farms means smaller financial capabilities. Our proposed Transition Management Organisation could create conditions for farmers to collaborate and share their facilities, land, and equipment. Therefore each unit could be specialised in certain activity and overall have multiple potentials available.

Finally, small scale farmers would be more local not only spatially, but also socially. Scale of their operations and potentially risen demand for organic food locally would create incentives for farmers to sell their products themselves. As a result, overall prices for consumers could be reduced by cutting-out middle man costs.

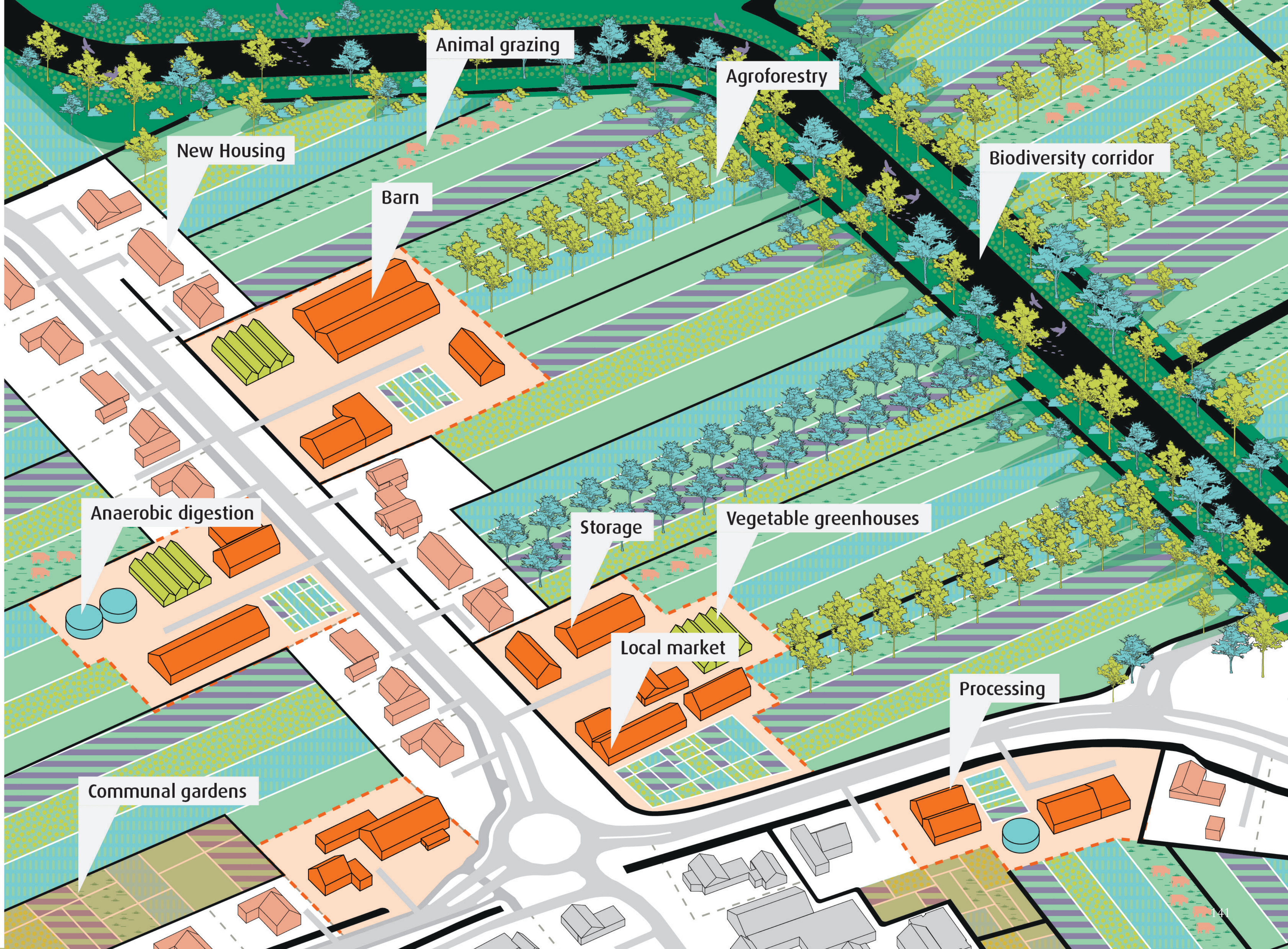
Aerial view of Wakelyns agroforestry system. From *"Soil Association,"* by Martin Wolfe, n.d.

Harvesting of organic strip farming. From *"Weblog,"* by Wageningen University & Research, n.d.

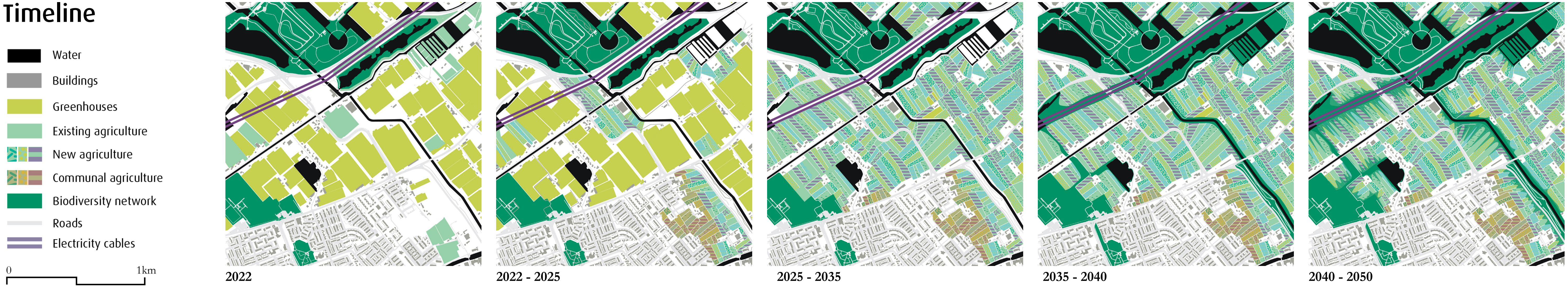
Harvesting of agroforestry system in Southern France. From *"WUR,"* by Christian Dupraz, n.d.

Figure 5.41. References representing real life examples of how new agriculture and harvest would look like.

>Figure 5.42. Axonometry of the proposed strategy in the location of De Lier.



Timeline



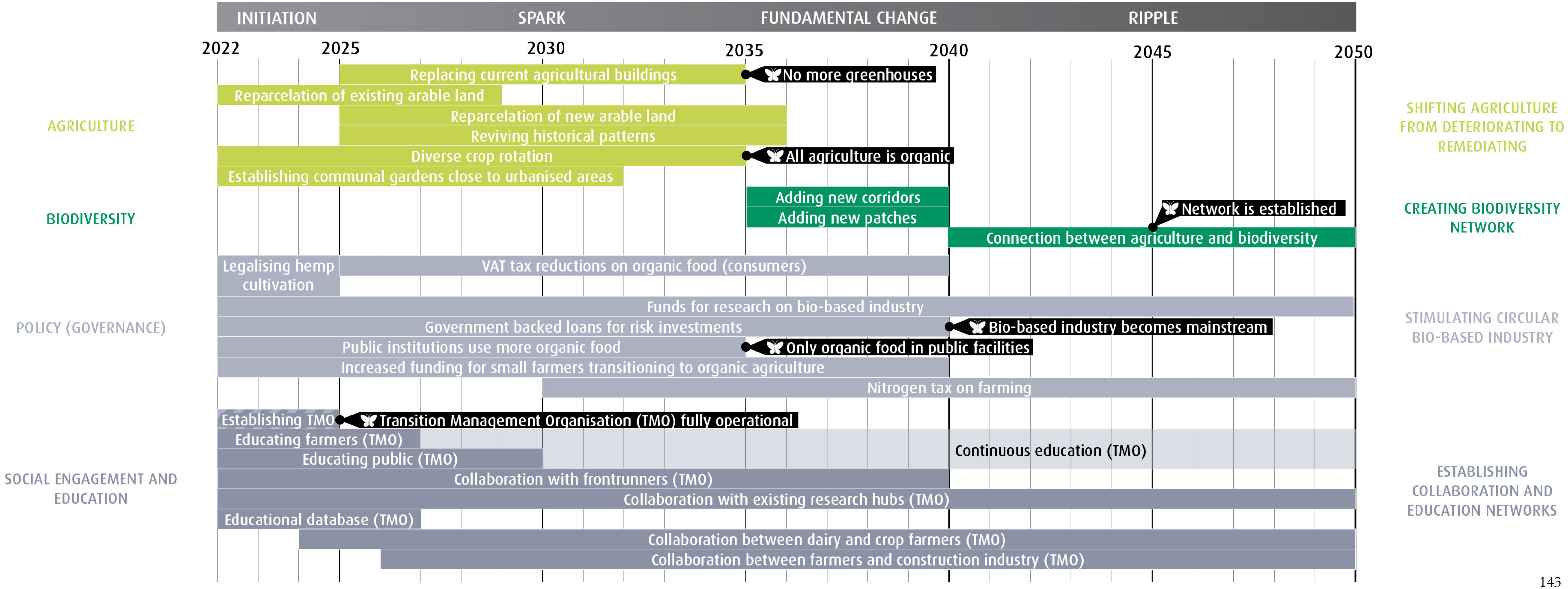


Figure 5.43. Timeline and phasing of agriculture transition.

Stakeholders

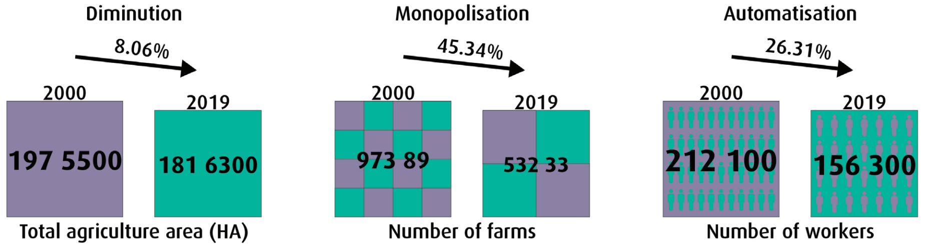


Figure 5.44. Trends in agriculture sector. Based on Meulen & Berkhout (2021). This diagram shows that in past 20 years total agriculture area diminutiated by 8%, while number of farms and workers shrinked by 45% and 26% respectively. In our opinion it is a result of monopolisation and automatisation in this sector. Total area shrinked potentially because of urbanisation.

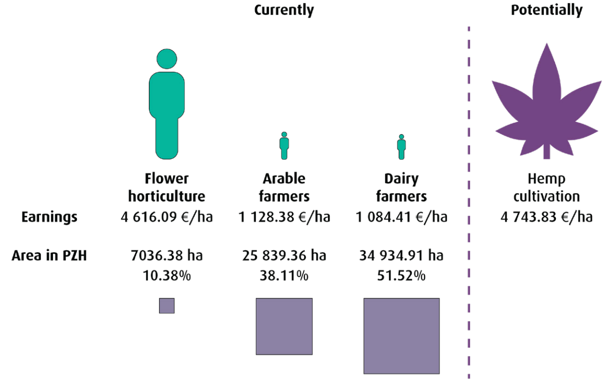


Figure 5.45. Current and potential earnings of the farmers in the Netherlands. Based on Meulen & Berkhout (2021; 2020); Berkhout (2019; 2018; 2017), Moscariello et al., (2021). Detailed calculations are presented in appendix, tables 9-11. This diagram shows the income inequality between farmers as well as potentiall earnings increase by using implementing hemp cultivation only 2 times per 5 year crop rotation.

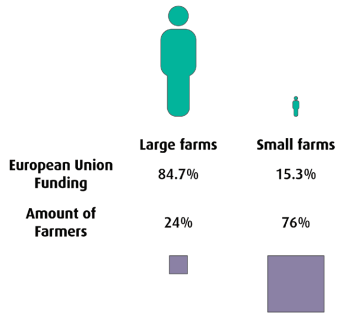


Figure 5.46. EU funding inequality. Based on Utrecht University of Applied Sciences (2019). This diagram shows that 24% of total farmers that are considered large (above 15ha) gets almost 85% of funding. This inequality could explain monopolisation trends.

Current situation

Figures above describe the overall trends in the agricultural sector in the Netherlands. It is monopolisation, automatisation (figure 5.44), and increase of income inequality (figure 5.45). Both income inequality and monopolisation are strengthened by the fact that most of EU funds are given to the larger farms (above 15 ha of area) (figure 5.46). By using this information we were able to find a more informed strategy how to stimulate stakeholders to participate in the transition.

Impact of the transition

We believe that our proposed strategy will tackle with main negative trends.

Firstly while diminution is not negative trend in itself, a fight for scarce land space is a regional challenge. Our proposal includes more efficient shared land use in agriculture (using TMO) and phasing-out unsustainable industries (flower horticulture), relieving space for other functions. Furthermore spatial framework of organic agriculture creates better conditions for smaller farms to be established. Finally while mostly the same equipment could be used for organic agriculture, transition would still create more jobs, since crop diversification and biodiversity elements require more hands-on processes.

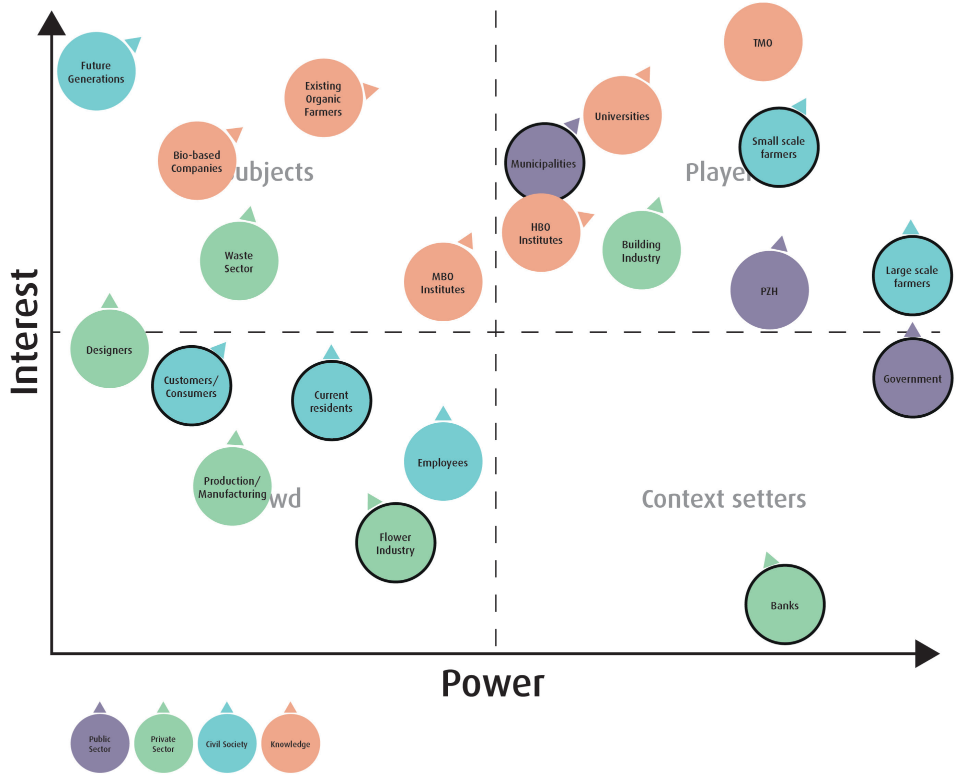


Figure 5.47. Stakeholders in agricultural transition with emphasis on the most important categories. Below we present main policies and processes that could increase participation in the transition.

Large scale farmers
Nitrogen tax, education, public procurement, TMO.

Small scale farmers
Increased funding, education, public procurement, TMO.

Current residents
Inform that there will be increased organic food availability, increased access to green spaces

Customers, consumers
Rise awareness

Flower industry
Increased VAT and Nitrogen taxes

Banks
Government guarantees loans

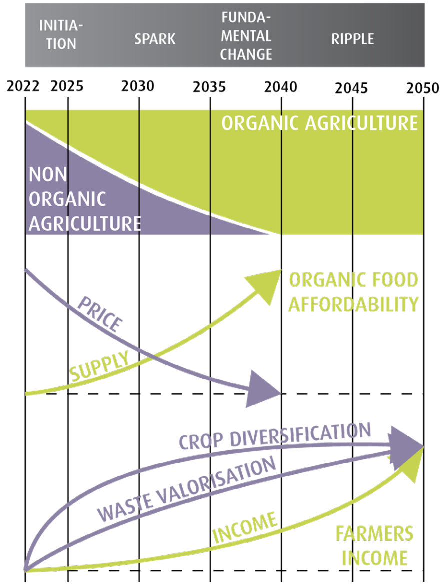


Figure 5.48. Diagram explaining main expected changes in the transition. We believe that organic agriculture could be mainstream already in 2040, which would result in cheaper products because of the increased supply. Moreover, implementation of waste valorisation network and crop diversification could gradually increase farmers income in time.

Farmers

We believe that farmers are the most important stakeholders in the agricultural transition. Based on different income we propose to divide farmers into small scale, large scale farmers, and flower industry. We offer different strategies for each category (figure 5.47). In general main argument is potentially increased income for all farmers, for example by diversifying crops and cultivating high value plants like hemp (figures 5.45 and 5.48), as long as all products are valorised. As a result, strengthening of the waste network is essential for agricultural transition to convince farmers.

Spatial Quality

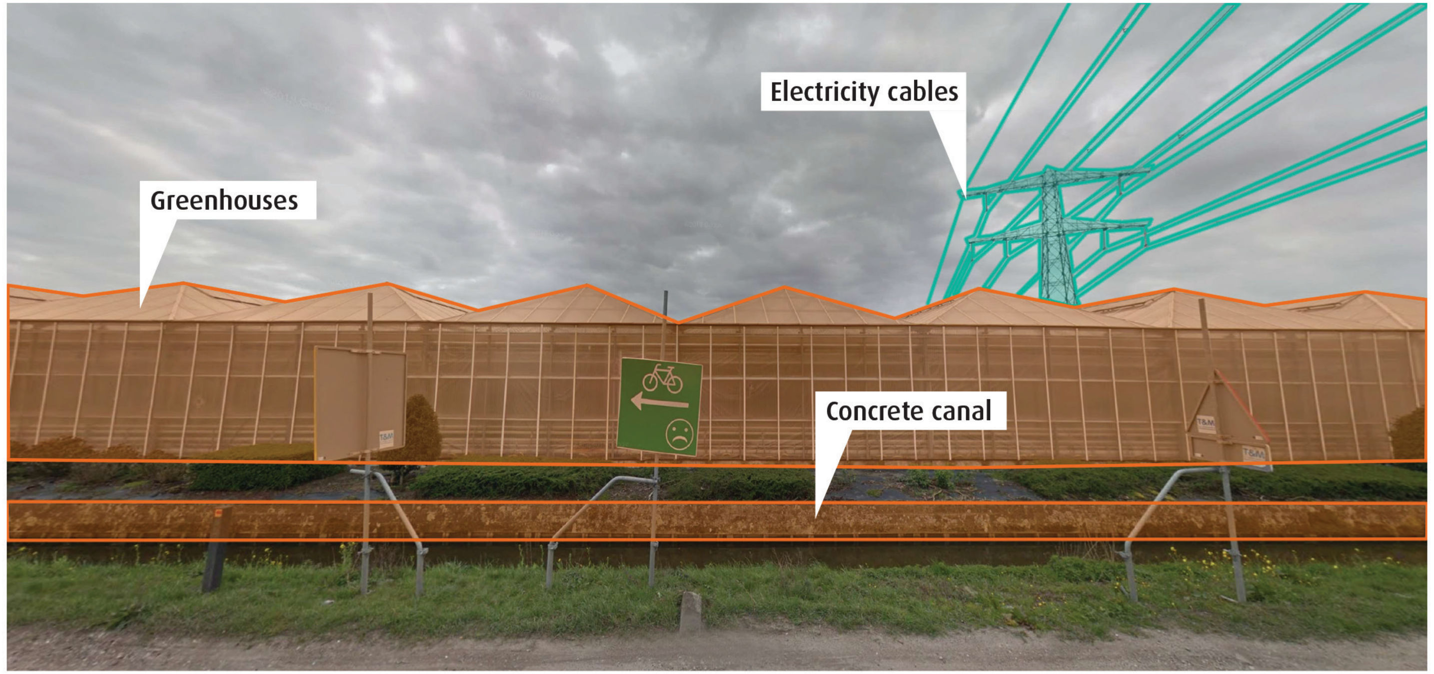


Figure 5.49. Greenhouses in Naaldwijk, South Holland. (Google, 2019). The current situation is the landscape of unsustainable, monocultural greenhouses. They keep most of the soil sealed. What is more, water network is unfriendly to biodiversity: fragmented, borders are concrete walls. High voltage electricity lines, today going above greenhouses, could be used to create legal protection zone for biodiversity.

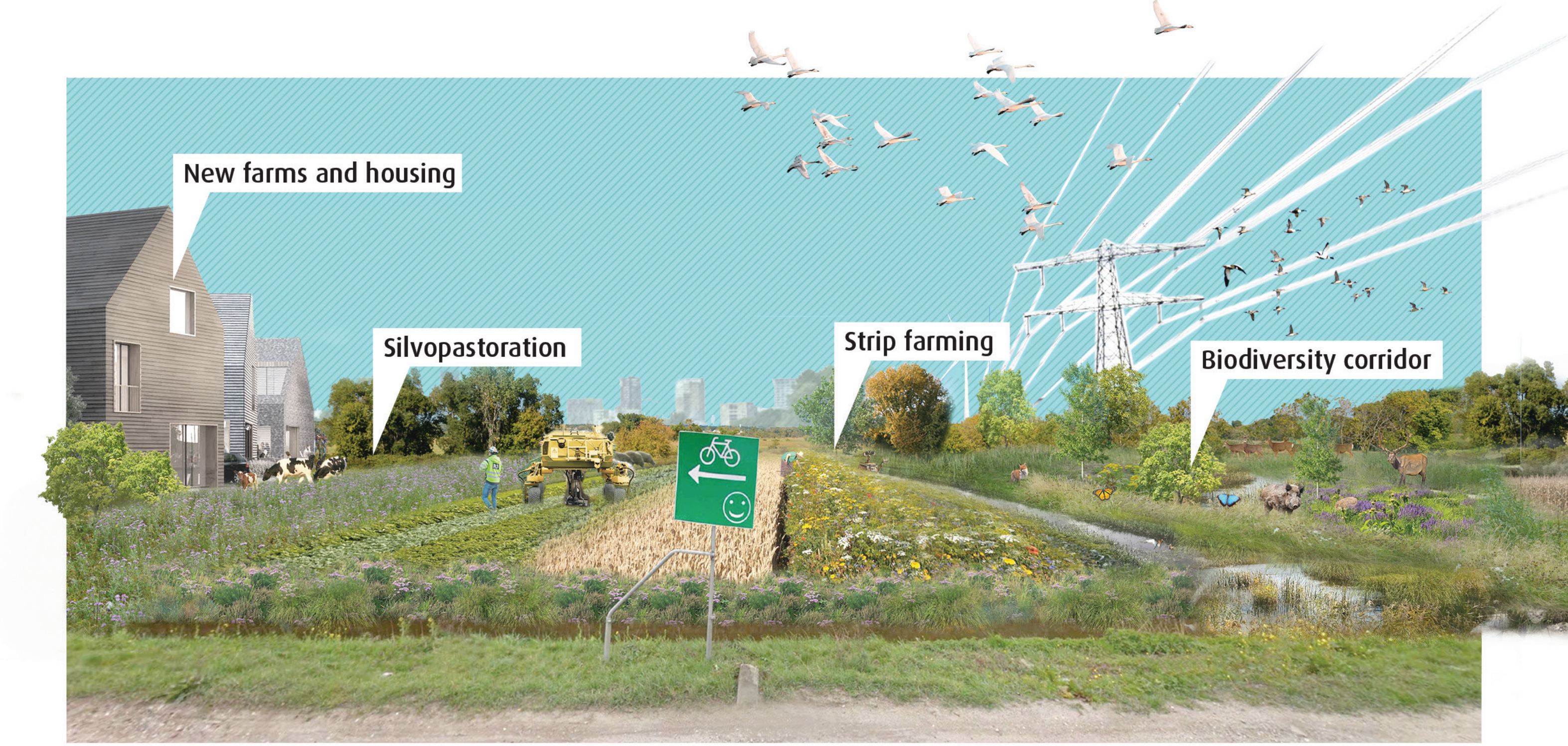


Figure 5.50. We propose to remove greenhouses in future and instead to create multicultural, diverse organic agriculture landscape. It would be based on strip farming, crop rotation, agrobiodiversity, agroforestry, silvopastoration. Under high voltage electricity line low heigh biodiversity corridors could be formed, that would extend into the agricultural areas with elemets of agrobiodiversity. This transition would also create possibilities for densification along the existing roads.

5.4.4 Strategy 4

New Living & Working in Den Hoorn

Creating new living and working environments

The fourth strategy shows how creating new living and working environments would be implemented in the Province of South Holland. These new environments are located in the fringes around the province.

For this particular example of the implementation of this new living and working environment the location Den Hoorn is chosen.

Den Hoorn was a good location to show the implementation of living and working environments because there is also a small biorefinery in this city.

In addition to this Den Hoorn is also the location of one of the pilot bio-based villages throughout the Province of South Holland.

Since building with bio-based building materials is still a relatively new thing and bio-based building materials itself are still in the experimental phase the implementation process needs an in between step.

In this project pilot bio-based project new bio-based building materials will be used to build different housing types. This will be the testing for the new spatial quality these housing types will have. In addition to this there will be innovation, education and testing facilities in these pilot villages.

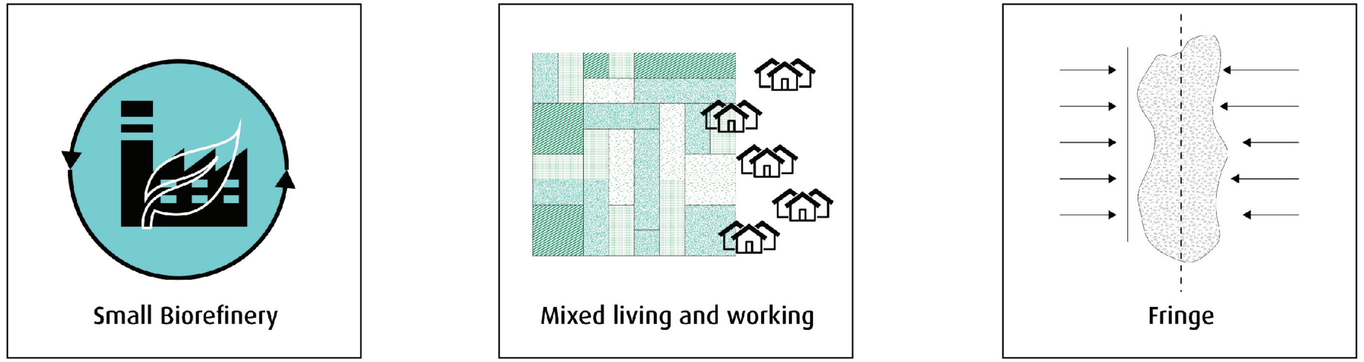


Figure 5.51. Principles of new living and working environments.

Location - Den Hoorn

To illustrate what the implementation of the strategy creating new living and working environments would look like a location in the Province of South Holland is chosen.

The requirements for this destination are that there needs to be a possible fringe and a smaller biorefinery.

Butterfly Effect has chosen to use the location Den Hoorn to illustrate this strategy.

Den Hoorn has a possible fringe that is originated from the urban growth of the existing city and agriculture that will be transitioned to crop rotation. The area in between the border of urban growth and agriculture is now housed by greenhouses. This gives the opportunity for new urban development and mixing it with the surrounding agriculture.

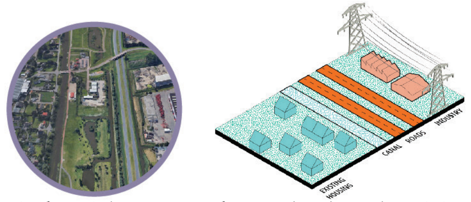
In addition to this the border of the urban growth of Den Hoorn houses an industrial area. This area also has some waste facilities which already have the right infrastructure needed for smaller biorefineries.

The so-called fringe area also has space for a pilot bio-based village. The combination of all these components is why Den Hoorn is a good place to illustrate the strategy of creating new living and working environments.

>Figure 5.52. Map depicting the illustrative location - Den Hoorn.

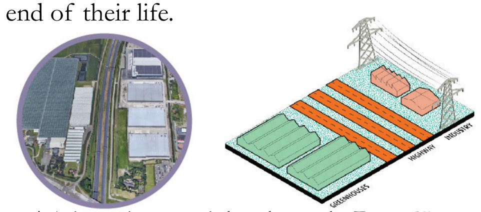
Challenges & Opportunities

1



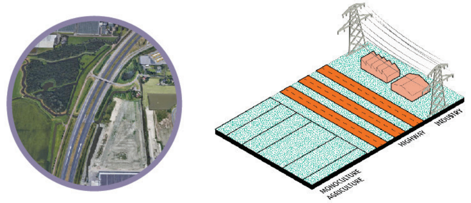
There is an industrial area underneath the electricity cables. This industrial area has a negative impact on the environment of the area. On the other side of the road and canal there are free-standing dwellings that are either in need of renewal or have reached the end of their life.

2



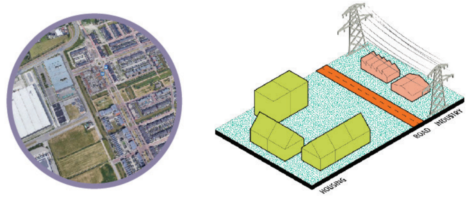
The highway A4 is going straight through Den Hoorn and is creating a barrier right through the city. In this case the A4 is creating a barrier between the industrial area with electricity cables and greenhouses on the other side.

3



In another case the A4 is creating a barrier between the industrial area and open agriculture on the other. This isn't necessarily a bad thing as industry and agriculture are the best mix of functions, but the A4 is a sound nuisance by itself.

4



In Den Hoorn itself there is a quite dense residential area bordering on the industrial area. This isn't the best living environment.

Figure 5.53. Challenges and opportunities in Den Hoorn.

Mobility Industry

As Den Hoorn is not situated along a waterscape that is accessible for container ships that distribute the bio-based building materials throughout the province of South Holland, the city has to rely on a different distribution source.

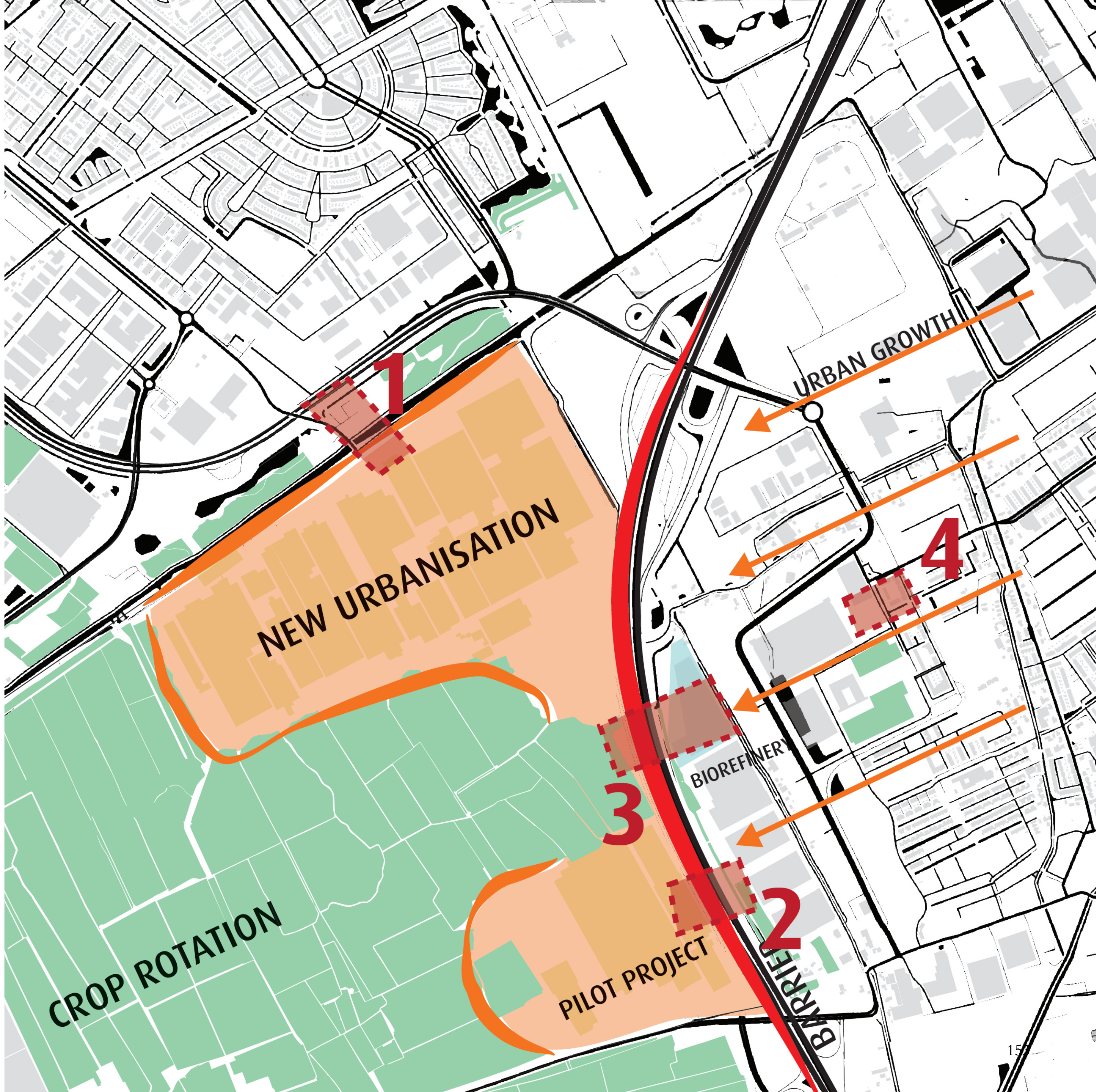
Den Hoorn does have the A4 which is going straight through the city. The A4 gives the opportunity for the bio-based building materials to be distributed to Den Hoorn. From the port of Rotterdam the bio-based building materials would be transported via container ships to a transshipment location and from there it would be transported via roads to Den Hoorn.

Mobility People

Taking the current and future residents of Den Hoorn into account, the accessibility of the existing and more importantly the new urban areas are of great importance. As this project is not assuming that each and every resident will be in possession of a car it's important that the new urban areas are accessible by public transport. The project also assumes that not every single household will have a car in the future. Cars in the future will also have moved off of gas and will run on electricity. Den Hoorn does have a public transport base including buses. Its neighboring city Wateringen also has a good public transport base including buses and trams. These public transport sectors can be expanded into the new living and working environments of Den Hoorn in order to make it more accessible for the residents.

0 250

0 250 500 m



Densification

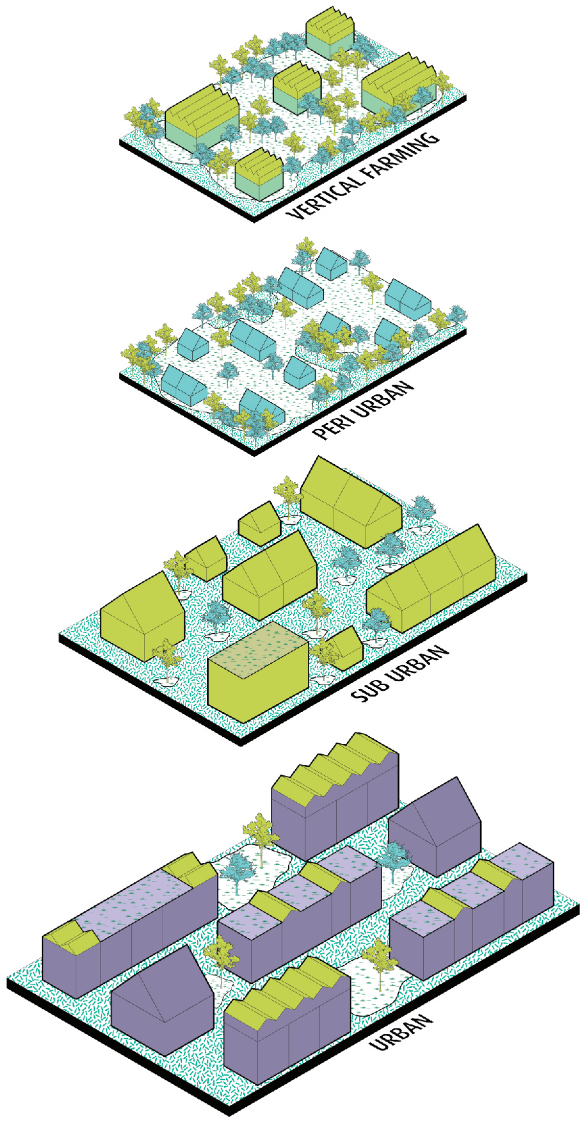


Figure 5.53. Types of the densification.

The new living and working environment of Den Hoorn will be situated where the greenhouses are currently. In the case of Den Hoorn the greenhouses will be replaced by new urban developments. This is done because the area surrounding these greenhouses is open agriculture. This open agriculture is transitioned into crop rotation more easily. The best area for new urban development was therefore the areas of the greenhouses. This also brings other opportunities with it since this area gives the perfect base to mix agriculture with the urban area.

As it is, the area has two patches of greenhouses, the smaller of which will be used to house the pilot bio-based village and the bigger one will be a new urban development area of Den Hoorn. The industrial area alongside the A4 will house a smaller biorefinery where the waste of the crop rotation will be re-purposed as biofertilizer etc.

The biggest challenge of this area is the A4, which is already a noise nuisance for the area, but as the greenhouse areas will be new urban development areas and these areas are situated right alongside the A4. These areas will suffer from this noise nuisance. In this case the biodiversity network which is also going straight through Den Hoorn and running alongside the A4, will be used as a noise barrier.

As for the new urban development areas the next step is to decide where what form of density would be best for the area. For the pilot project the densest area will be right in the center of the area, as this is where the innovation, education and research facilities will be situated. The rest of the pilot village will be less dense since there needs to be room for further experimentation with bio-based building material housing types.

For the new urban development of the bigger location, the most density will be right by the main access point of the area which is along the Zwetkade Zuid. Moving more towards the crop rotation the density will decrease and will eventually meet the agriculture with peri-urban density and vertical farming.

>Figure 5.54. Locations of the densification types.

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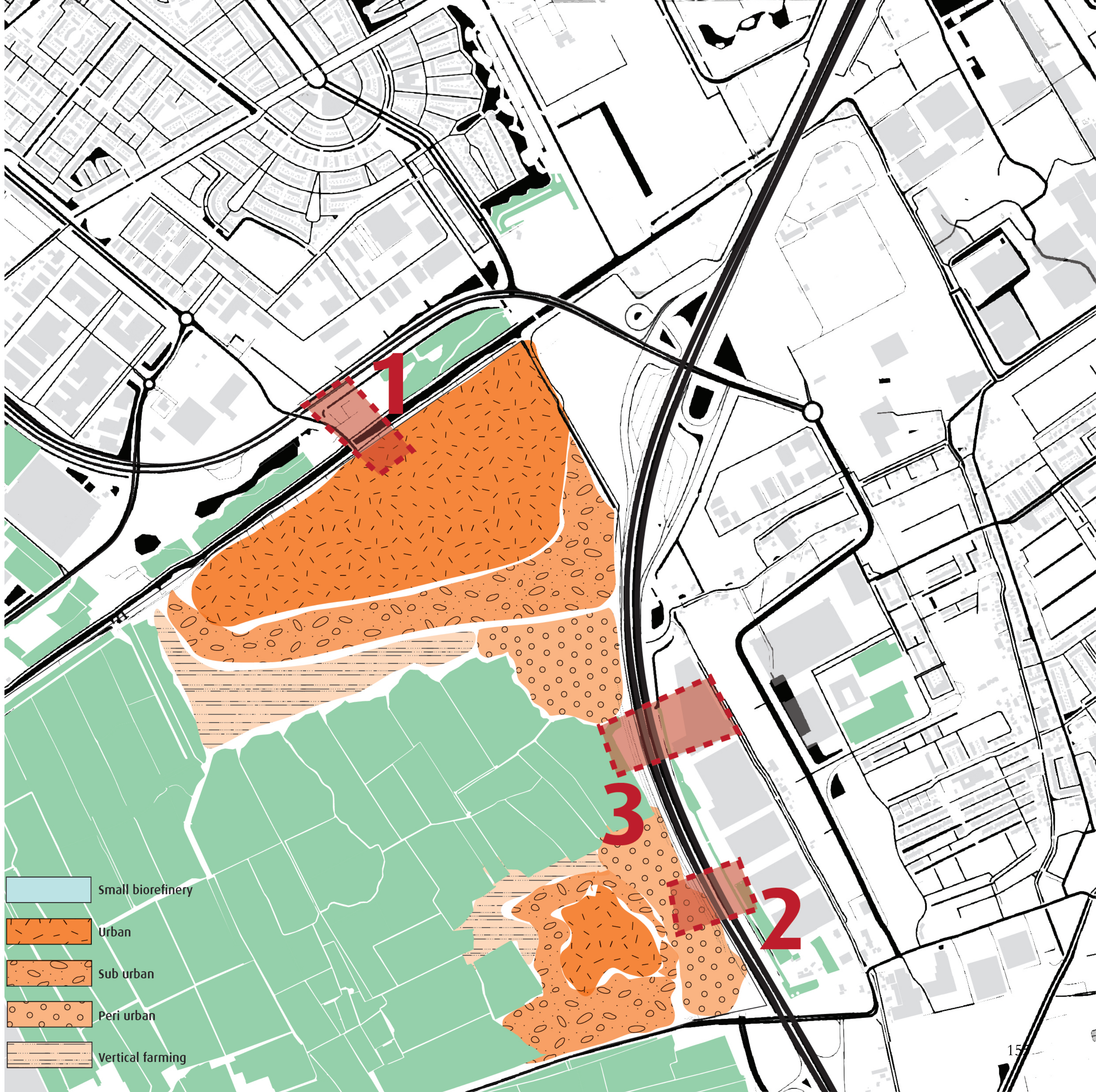
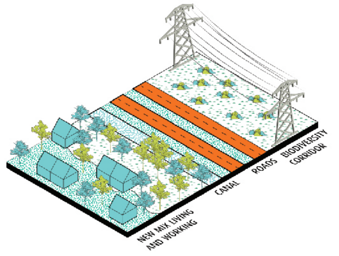


Concepts

1



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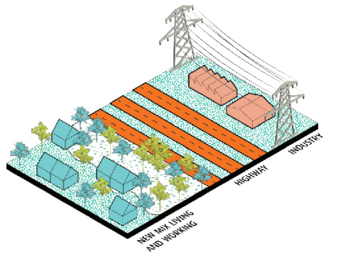

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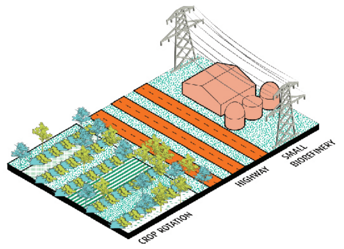


Figure 5.55. Concepts of new way of living and working.

Looking at the 3 main challenging locations of the area and how they will be transformed in this new urban development area. The first location is where the alone standing dwellings are situated across an industrial area that is right under an electricity cable. The biodiversity network is running right under the electricity lines in this particular location, which means that the industry will be removed here. This will not only have a positive effect on the living and working environment of the new urban development but also on the residential areas above it in Wateringen. As for the alone standing dwellings these are in need of either renovation or have reached the end of their life. For the new urban development these dwellings will be replaced by more dense urban areas. As this is also where the Zwetkade is situated which is the main access to the area.

The second location is in the pilot bio-based village. The part of the biodiversity network running alongside the A4 will function as a noise barrier to kind of shield the pilot village from the noise nuisance of the A4. The density of the village along this biodiversity network will be a bit more sparse, in fact the density of the whole village will be more sparse. Since there needs to be enough space for growth, in the form of further testing of bio-based building materials in different housing types.

The third location is where the new crop rotation will border the A4. The biodiversity network will run alongside this agricultural patch but will kind of "bleed" more into the agriculture as opposed to the biodiversity alongside the pilot village.

>Figure 5.56. Locations of the concepts.

0 250 500 m

Illustrative location - Den Hoorn

In the new urban development area of Den Hoorn the highest density area will be near the main access point, the Zwetkade Zuid, as the urban development grows more towards the crop rotation the density becomes less. The density borders the crop rotation with a combination of peri-urban housing and vertical farming.

The part of the density network that runs through the area has different types depending on its exact location and the needs of that particular location. Along the Zwetkade, the biodiversity will run underneath the electricity cables, with a lower density green. The part of the biodiversity network running along the A4 bordering the new urban development, the crop rotation and the pilot project will be in the form of a noise barrier.

In the new urban development there will be a biodiversity corridor running through the city and connecting to the network. This corridor will be higher density and quality green and will form the base of the green areas in the city. The city infrastructure will also be flowing from this corridor. The public spaces of the city will run alongside the corridor, with the green public spaces parallel to the corridor and the non-green public spaces in the infrastructure grids along with the green public spaces. The green public spaces parallel to the corridor will gradually become less dense green the farther they are situated from the corridor.

The pilot bio-based village will be lower in density than the new urban development with the highest density in the center consisting of the innovation-, educational-, research facilities and public space. The rest of the village will be in lower density with peri-urban and vertical farming housing types near the border with the crop rotation. And more suburban near the roads.

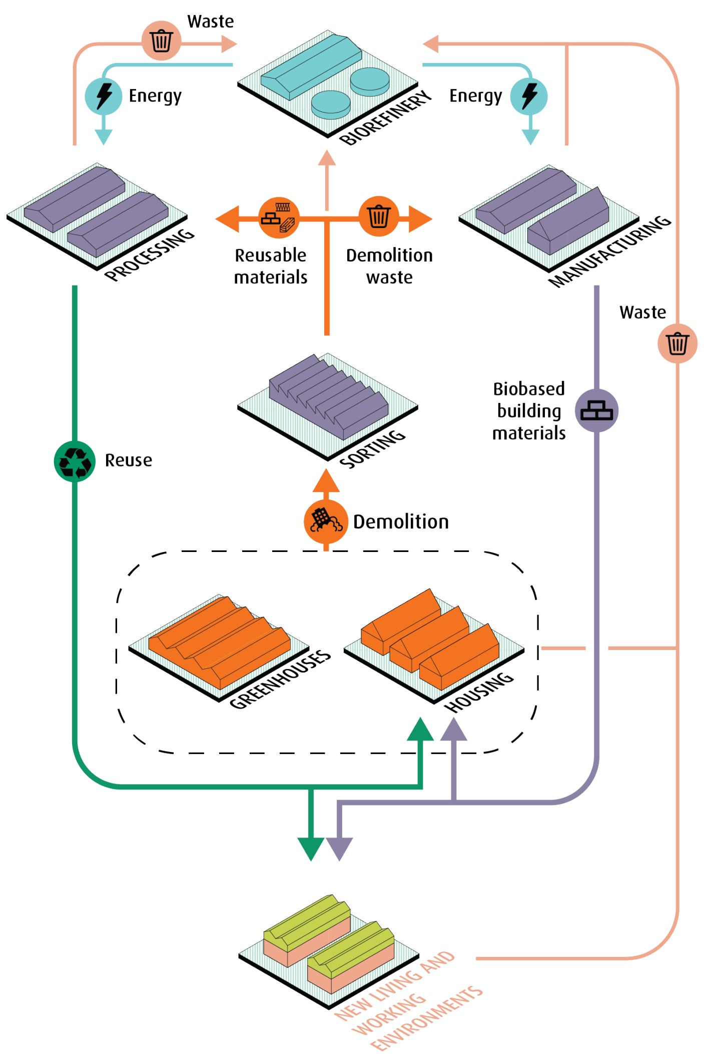
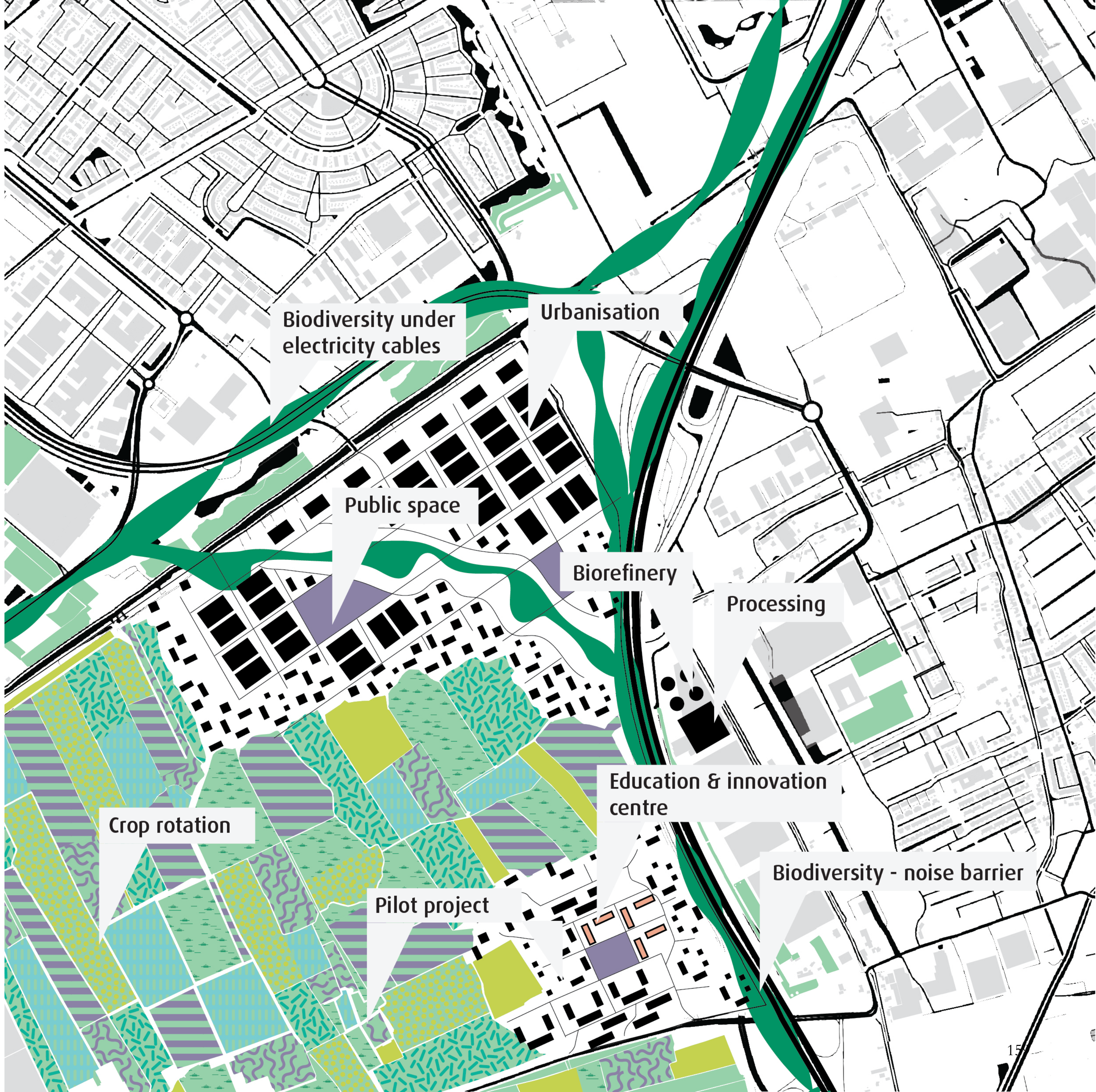


Figure 5.57. Diagram depicting circular demolition. Materials from demolished greenhouses or other buildings would be sorted in decentralised facilities. Afterwards it would be divided into three ways. First reusable materials would undergo processing and cleaning and could be directly reused in new contruction and renovation. Recyclable waste could be introduced in manufacturing processes again, from which new bio-based materials could be made. Finally, leftover waste could be valorised in biorefineries, therefore using all potentials of demolition waste.

>Figure 5.58. Results of the transition in Den Hoorn area.

0 250 500 m



Timeline

2022 | 2022-2025 | 2025-2035 | 2035-2040 | 2040-2045 | 2045-2050

In the first phase the crop rotation will start in between the two locations of the greenhouses.

In the spark the greenhouses on the location of the pilot bio-based village will be removed and the pilot village will be developed. In the industrial area across the highway the small pilot small biorefinery will be set up. The biodiversity network will be established for the area.

During the fundamental change the greenhouses will be fully removed. The biodiversity corridor running through the new urban development will be established. The infrastructure of the new urban development will be built. And the densification will start with the housing near the main access point of the area.

In the fourth phase there is further densification of the new urban development area. the rest of the monocultural agriculture is transitioned to crop rotation. In addition to this the pilot small biorefinery is has grown into a main small biorefinery.

In the ripple the rest of the new urban development is densified, and the public spaces will also be established in this phase.

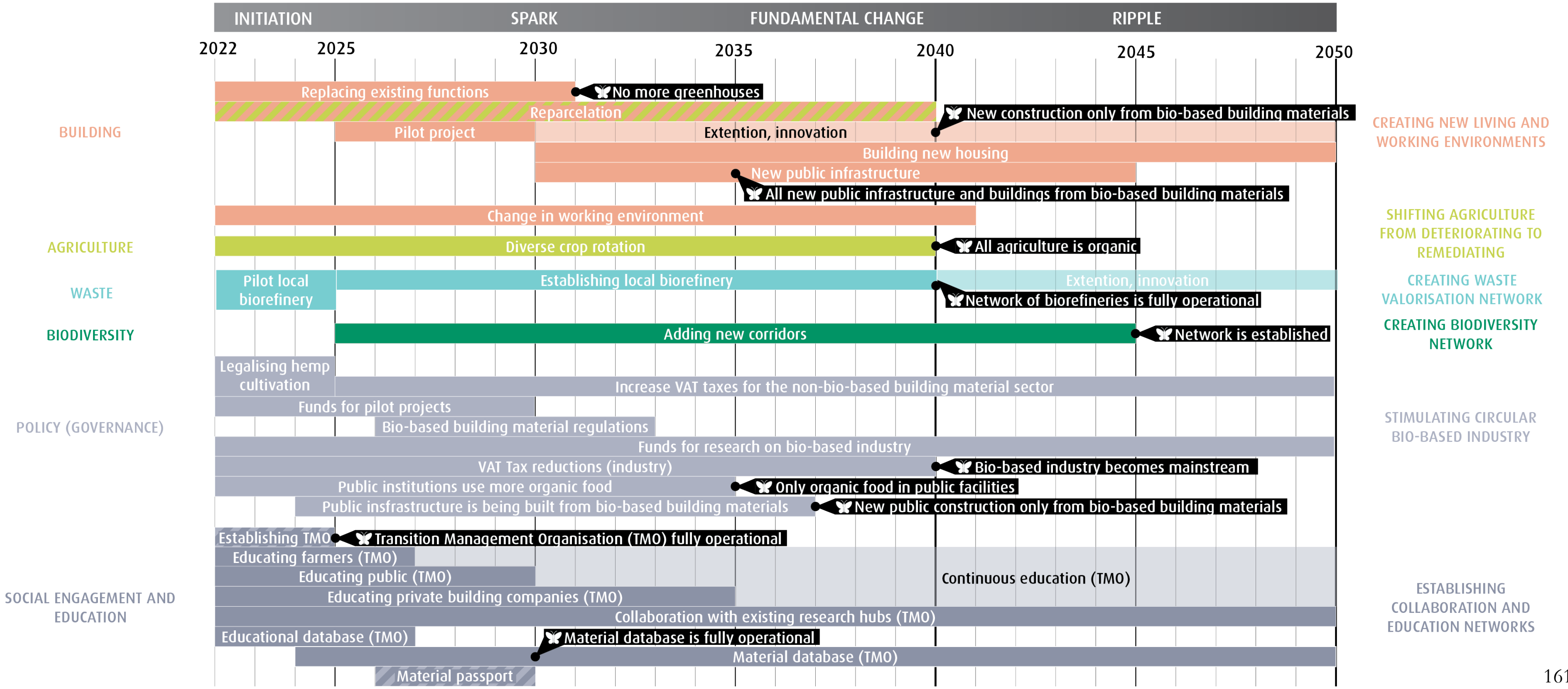


Figure 5.59. Timeline and phasing of new ways of living and working transition.

Stakeholders

In Butterfly Effect the transition from non-bio-based building materials to bio-based building materials will happen. In the beginning the costs to produce the bio-based building materials will be higher, but this will be evened out by the start-up funds set in place by the governmental stakeholders. This will result in the bio-based building materials being affordable from the beginning.

Opposed to this the costs of the non-bio-based building materials will go up due to the higher-taxed for this sector.

This will really sway the non-bio-based building material industry to make the transition to bio-based building materials.

As the province of South Holland has more than enough space to cultivate the raw material to produce and manufacture about 2.4 times the amount that is needed to meet the demand. The province will not have to import raw materials to produce bio-based building materials. In turn the entire manufacturing and producing process will happen in the port, the distribution will happen mainly on the waterscapes and then branch over to the roads in order to reach the destination. This means that the entire industry is based and functioning in the province. There would not be extra costs of external forces that would need to assist in this industry. This would in turn not turn up the price of bio-based building materials.

In addition to this the start-up costs and prices of products in start-up sectors in mainly higher than the existing sectors. In Butterfly Effect this is eliminated due to the start-up funds the governmental stakeholders offer. This would all result in more affordable bio-based building materials.

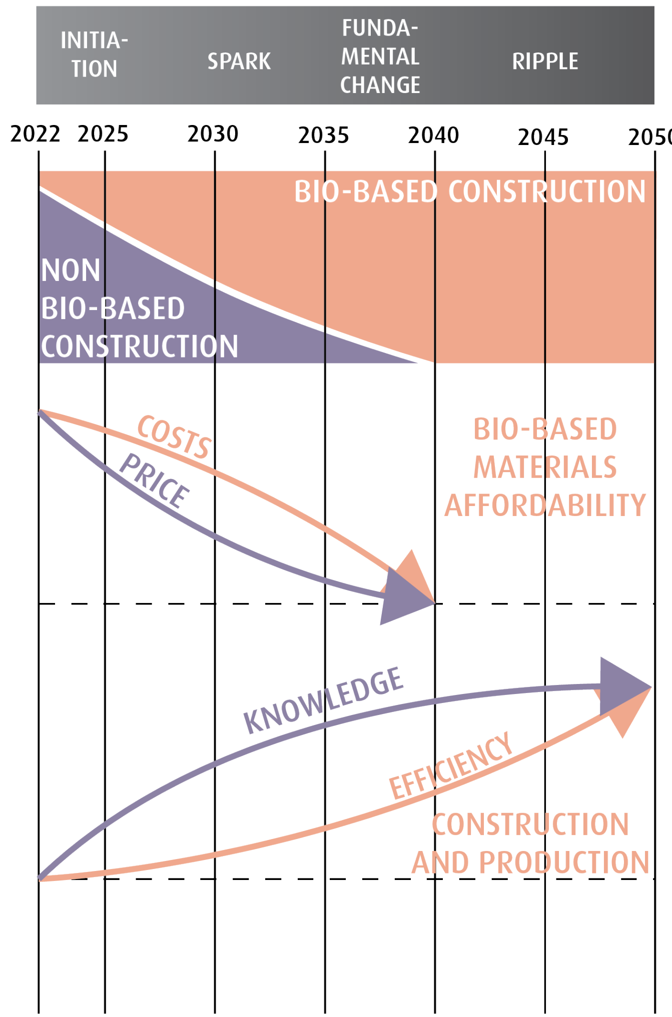


Figure 5.60. Diagram representing main shifts in bio-based construction. We believe that by 2040 all building in Province of South Holland will be built or renovated with bio-based building materials. What is more, in time it could become more affordable. It would be result of decrease in costs (transportation and manufacturing) and increase in efficiency and knowledge.

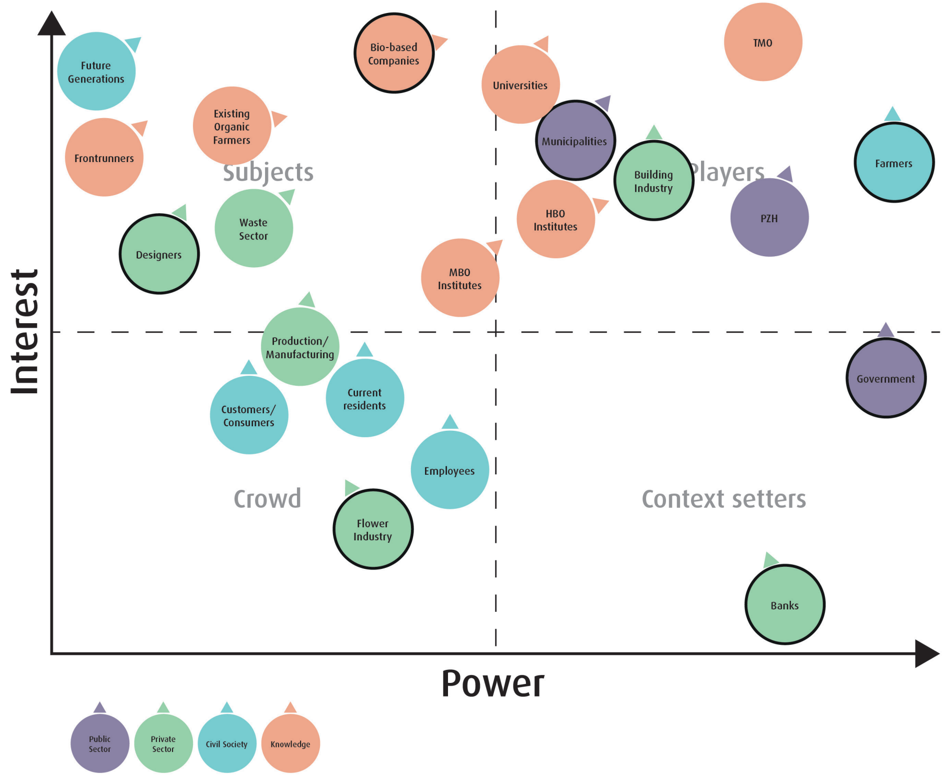


Figure 5.61. Stakeholders for creating new living and working environments with emphasis on the most important and influential. Below the main policies and processes that could increase the participation in the transition.

Bio-based companies
Want to raise awareness and have the opportunity to further develop the sector and become the new norm.

Municipalities
Aim to involve the citizens and have their voices heard. The opinions and wishes of the people will be taken into account during the transition.

Government
Must spark the interest of other stakeholders to invest in the newly transitioned sectors.

Banks
Is willing to invest in the new sectors and give loans to frontrunners. Their interest needs to be sparked.

Flower industry
Needs to slowly transition away from greenhouses, the employees will be re-educated and offered new jobs in the new sectors.

Designers
Are working to create new environments that will improve the quality of life and create new atmospheres

As of now, there are a lot of stakeholders interested in the prospect of a bio-based building material industry. They are even willing to transition to this bio-based building material industry given that there is ample testing done and these new building materials are incorporated into the building regulations of the Netherlands.

This essentially means that these stakeholders want to skip the start-up step of this newly introduced building materials industry. This means that there is quite a margin for error. Meaning that if the building materials are not tested properly and enough and taken into account in the building regulations the stakeholders would not be so eager to get on board. Mainly because it would be quite an investment to transition from the current building material sector to a bio-based building material sector.

To help these stakeholders get on board, the governmental stakeholders could put up start-up funds for the bio-based building material industry. This will not only get the ball running for the testing, producing and eventually incorporating the building materials into the building regulations. But it will also spark the interest of not only the stakeholders of the current building sector but also the front runners. The so-called start-up funds would act as a safety net for all the stakeholders involved.

Now looking at the stakeholders in the building material sector that are not too eager to transition towards a bio-based building material sector Butterfly Effect recommends increasing the taxes for these stakeholders so that they would be more swayed towards the bio-based building material sector.

The educational stakeholders who also have quite a lot of interest in the bio-based building material industry could also spark the attention of the more reluctant stakeholders by investing more time and energy in the innovation and research of bio-based building materials.

Axonometry Den Hoorn

Looking at the new urban development area, the different densities of housing are clear. The biodiversity network is seen in it's different types. The pubic spaces are visualized. The agriculture shift is also shown.

Figure 5.62. Axonometry of Den Hoorn.

Spatial Quality

Figure 5.63. Greenhouses in Den Hoorn, South Holland. (Google, 2019). The current situation is the landscape of unsustainable, monocultural greenhouses and "grass desert". However, area has good access.

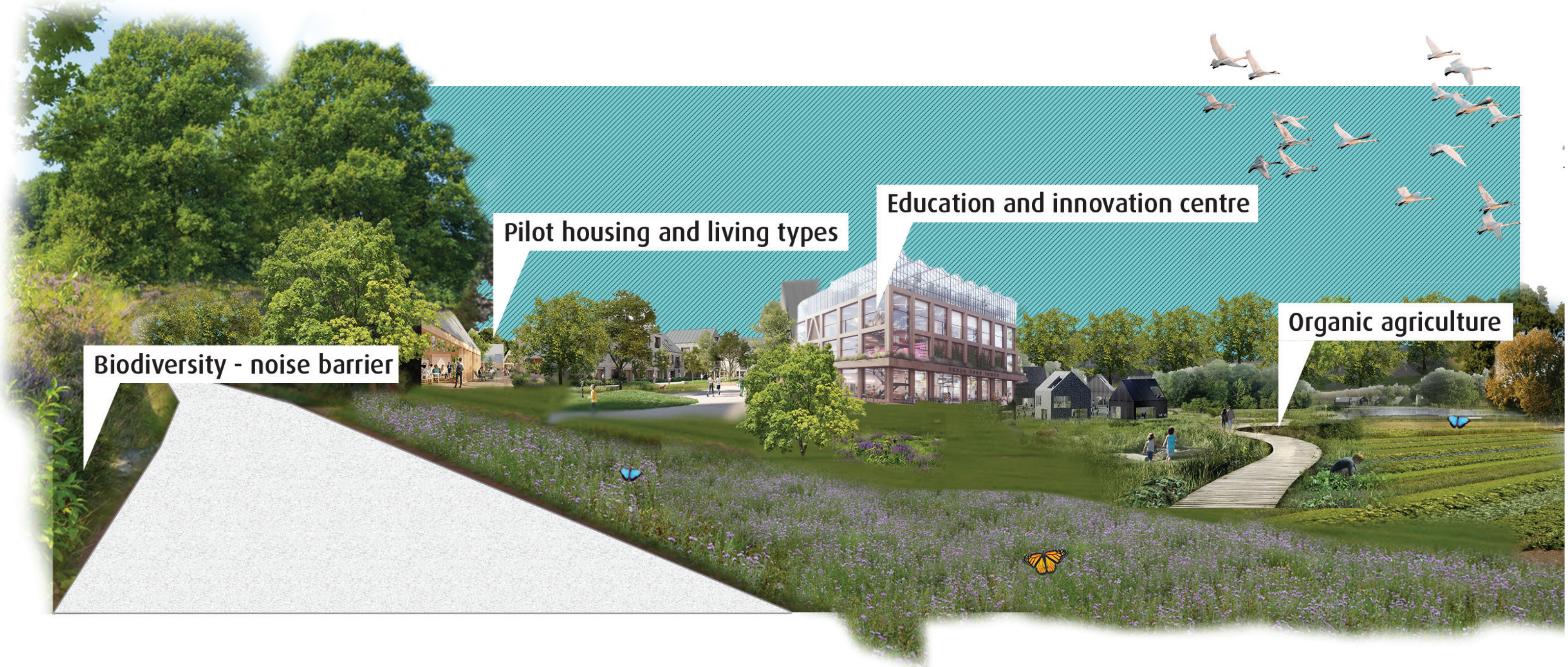


Figure 5.64. In this location we propose to remove the greenhouses and create pilot project, where bio-based building materials and construction could be tested and later upscaled in other locations. Mix between living and agriculture would also be tested here. Education and innovation centre positioned in the location would allow for direct research and implementation of innovation. Biodiversity network would act here as noise barrier.

DISCUSSION & CONCLUSION

6

6.1 Discussion

Current Plans
Circularity and producing more sustainable building materials faster are two goals the Netherlands has had for many years.

These goals and how to possibly solve them are often the subjects of conversation. To achieve circularity and produce sustainable building materials a few problems need to be solved first.

The Netherlands, like the rest of the world, produces a lot of waste, which is not reused. In addition, the population of the Netherlands is growing faster than housing is being produced. Delivering buildings more quickly and with a minimal amount of waste would tackle a big part of the goals set. If reusing and recycling waste would be factored into this equation the goals would be achieved.

Butterfly Effect is a strategy in which these goals could be achieved. It does not take away from the existing plans of the PZH, but rather adds to them and suggests a possible solution.

Expectations
The implementations suggested in Butterfly Effect will have a big impact on many different layers of the province. Butterfly Effect combines transitions on a network scale, the port scale, agricultural scale, and living and working scale to achieve the goals.

The proposed four strategies are based on the layers of which the vision consists. The effectiveness of strategies is dependent on the success of the spark phase as this lays the foundation for the rest of the phasing. The biggest change in the province will happen in the fundamental change. Butterfly Effect will becomes visible in the ripple phase.

The success of Butterfly Effect is dependent on the energy transition. The transformation of the port is of high importance here as the energy transition will free up manufacturing space for this project. The function shift of the whole port is also dependent on this. The port already has a plan to become more involved with bio-based. The only thing holding it back from reaching this goal is the energy transition.

The success of the pilot projects (biorefineries, manufacturing, and bio-based building testing facilities) is of great importance to the success of this project. These pilot projects are used to spark the interest of stakeholders to invest in the new industries and the viability of the whole implementation of the project.

Furthermore, establishing Transition Management Organisation (TMO) and ensuring that this platform is up and running properly, is of utmost importance for the success of Butterfly Effect. TMO is the platform that will aim to ensure the proper collaboration and communication among the different sectors included in the transition to bio-based building materials and organic agriculture.

Social Justice
The transition in the economy of the Port of Rotterdam will cause a shift in the type of jobs that will be necessary to sustain the port. Because of the energy transition, all the people employed in this sector are at risk of losing their job. Butterfly Effect proposes that these people transition with their respective sectors and are re-educated into the new jobs the port will have to offer.

This re-education will be directed by the TMO, which will not only re-educate the employees but also keep everyone informed and bring the different sectors together to promote collaboration and proper communication.

The energy transition will allow for new jobs in the bio-based manufacturing, agricultural, and waste valorisation sectors. These new jobs in the diverse sectors will ask workers for different levels of expertise, which is why Butterfly Effect proposes the TMO, a collaborative platform that will assist and guide workers in their re-education.

In addition to this, Butterfly Effect proposes the implementation of a biodiversity network, which will not only connect and strengthen the existing biodiversity corridors and patches but will also connect the biodiversity with the strengthened agrobiodiversity.

As a result, higher quality green and recreational spaces in the Province of South Holland would be more accessible, which could contribute to creating much more pleasant living and working environments.

The transition from deteriorating to remediating agriculture will also have a positive impact on food safety.

Organically grown food will eventually become the new norm. More access to high-quality, locally produced food will improve the health of the people in the Province of South Holland.

Importance
Butterfly Effect does not only aim to achieve desirable results for the Province of South Holland, but it also provides the chance for further development of the vision in the surrounding provinces.

The Province of South Holland would be an example for other provinces to implement a circular bio-based building materials industry. It is the location of the spark project because the Port of Rotterdam could open the gates not only to the Netherlands but also to Europe and the globe.

Recommendations
Further research could be done on how this project can be adapted or further developed to include more structural bio-based building materials.

In addition, it would be interesting to research how the integration could happen into other sectors within the Circular Economy. The ideal outcome would be a synergy of numerous sectors on a larger scale.

In Butterfly Effect it is said that the waterways form the main infrastructure for the distribution network of the bio-based building materials. The waterways that would be qualified to transport these materials were not analyzed to the extent that they should have been. Therefore this requires further research and analysis. In doing this, one would get a much better view of what the actual distribution network would look like.

As for the biodiversity patches incorporated in the biodiversity network, the so-called "patches" were not thoroughly analyzed in at a smaller scale. Here the potentials of the existing patches are not fully mapped. This also calls for further research and analysis.

Furthermore, the waste, where it is, where it goes, what exactly happens to it, and what the role of the Port of Rotterdam is in this process needs further investigation and definition. With this the potentials of the biorefineries could be better determent.

It is also very important to look further into biorefinery potentials. There are plenty of potentials in this field. New improvements and technologies could drastically increase waste reusability and valorisation.

The calculations done for Butterfly Effect are still very general and hypothetical, these would have to be re-done by experts to determine the exact numbers the province could produce.

Furthermore, the transition from deteriorating to remediating agriculture is a very scientific approach and requires a lot of detail that is out of the scope of this project. This would require further research in site-specific crop and grazing rotations, species of plants to be cultivated, pest and nutrient management, and biofertilisers to be used.

Mycelium and its growing process also require further research. Big advancements in this industry could drastically speed up bio-based building material implementation. In our belief, mycelium is the future.

6.2 Assessment

In the methodology chapter certain goals have been set according to the Sustainable Development Goals from the United Nations and the European Green Deal from European Commission.

As this is the end of the project these goals have to be assessed to ascertain whether the goals were accomplished.

No Poverty
UN Goal: End poverty in all its forms everywhere
Butterfly Effect proposes a variety of new jobs and suggests that the employees of the phased-out sectors are re-educated and offered jobs in the new fields.

In addition to this Butterfly Effect transforms several economies to promote and take the first step to achieve a circular economy in the Province of South Holland.

Good health and well-being
UN Goal: Ensure healthy lives and promote well-being for all at all ages
Butterfly Effect proposes transition to remediating organic agriculture. This means that all the food cultivated in the province will be organic which will improve the health of all inhabitants equally.
Furthermore, the proposed biodiversity network would increase access to green recreational areas. It would also increase air and water quality in the province.

Quality Education
UN Goal: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
Butterfly Effect has set some strategies in place to ensure quality education in the Province of South Holland. The employees of the fossil industries will be re-educated so that they would not become unemployed.
Furthermore, Butterfly Effect proposes to establish a platform, TMO, which will ensure the collaboration and education of different sectors. It will keep every sector educated as the different industries involved in the project further develop.

Decent work and economic growth
UN Goal: Promote inclusive and sustainable economic growth, employment, and decent work for all
Butterfly Effect assimilates the different industries that will undergo a transition.

With the creation of new living and working environments, Butterfly Effect aims to create urban developments that will not only have a positive influence on the economy but will also provide a variety of job opportunities for the people of the Province of South Holland.

Industry, innovation, and infrastructure
UN Goal: Build resilient infrastructure, promote sustainable industrialization, and foster innovation
The main aim of Butterfly Effect is to promote the circularity of the building sector and the agriculture.

Therefore Butterfly Effect is focused on the transition from the fossil industry to the bio-based building industry. In addition to this Butterfly Effect propose to establish a platform TMO, that will promote and help incorporate the collaboration of the education and innovation, finances, partnerships, and material database.

Reduced inequalities
UN Goal: Reduce inequality within and among countries
Butterfly Effect aims to achieve equality in the extent of equal job opportunities and better living and working environments which would improve the quality of life.

To make sure that there is a sense of equality it is of utmost importance that everyone's voice is heard. This calls for a platform that will promote collaboration between the different sectors and will take the wishes of the people into account. Butterfly Effect has done this by setting up TMO.

Sustainable cities and communities
UN Goal: Make cities inclusive, safe, resilient, and sustainable
Butterfly Effect aims to create new living and working environments in the so-called fringes of the Province of South Holland.

The new urban developments will be focused on mixing living, working, and recreational functions. This will result in a healthier and more pleasant urban area.

Responsible consumption and production
UN Goal: Ensure sustainable consumption and production patterns
Butterfly Effect does not only take the need for new housing into account but also the need for renovation of existing housing.
The need for bio-based building materials not only for new housing but also for renovation projects was taken into account. Therefore we believe that our proposal would be able to supply the demand for both new construction and refurbishment at affordable prices.

Climate action
UN Goal: Take urgent action to combat climate change and its impacts
With the transition to bio-based building materials and remediating, Butterfly Effect is tackling two of the sectors with the most emissions and making them more environmentally friendly.
Moreover, the proposed biodiversity network could increase carbon sequestration by reforestation and rewetting of peatlands and wetlands.

Life on land
UN Goal: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss
With the introduction of remediating agriculture, Butterfly Effect is promoting not only the cultivation of raw materials needed for the bio-based building sector.
It also promotes increasing soil quality and strengthening biodiversity in agricultural land. Moreover, the proposed biodiversity network would increase the number of protected areas and habitats for various species.

Partnerships for the goals
UN Goal: Revitalize the global partnership for sustainable development
Butterfly Effect has established a platform that will constantly promote the collaboration of the different actors involved.

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6.3 Conclusion

At the beginning of this project the main research question was formulated **"How can the PZH synergize the circular bio-based building industry and organic agriculture to improve the quality of life in a just way?"** To answer this question several sub-questions were formulated

The first question is **"Does the Province of South Holland (PZH) have enough space to cultivate enough raw material to meet the demand?"**

With the analysis of the Province of South Holland completed it was concluded that there is potential to cultivate the raw materials needed to produce bio-based building materials on the land previously used for greenhouses, arable land, large rooftops, grassland, and petroleum industry. The analysis also concluded that paper waste from the port could be used to produce bio-based building materials. Some of the land used for cultivation, where there is the opportunity to cultivate the raw materials needed for bio-based building materials is badly contaminated. A large part of this land is the land previously used for greenhouses. All of this soil needs to be remediated, at the same time there is a need for the transition from monocultural agriculture to more multi-functional regenerative practices. For this reason, remediating agriculture was introduced not only for the cultivation of raw materials for bio-based building materials but also for organic foods and other high-value products.

Calculations were made to estimate if it is feasible to cultivate enough to meet the demand for raw materials for bio-based building materials demand in the province. These calculations concluded that the province does indeed have enough space to cultivate, produce, and manufacture enough bio-based building materials to meet the demand. Now if the growth of fungi is factored into this equation the province can produce more than twice the amount of bio-based building materials needed. This gives ample opportunity to export these building materials for not only the rest of the Netherlands but also the globe.

The next step is to consider **how bio-based building materials can be produced, manufactured, and distributed.**

With the energy transition of the Port of Rotterdam came an opportunity for a big functional shift. The port already has a plan to become the biggest bio-based cluster in Europe. Since the port is also the strongest logistical point in the province it was chosen to establish a central hub for manufacturing, production, waste valorisation, and distribution. The Port of Rotterdam will be the center point of the manufacturing and waste upscaling network connected to smaller biorefineries in the province. All facilities in this network would have different functions and technical capabilities depending on the location.

This leads to the next question **"How can the Province of South Holland (PZH) form a network to improve the flows of materials, agriculture, and biodiversity?"**

The waterscapes will be used as the main infrastructure to distribute the bio-based building materials across the Province of South Holland. The roads will be used as the branches of the distribution infrastructure. The center of the network would be the port as it is the most connected place for the flows of materials to the province, the Netherlands, and eventually the rest of Europe and the globe. Proposed biorefineries would be located near either the waterscapes or the roads to ensure the proper and efficient flow of materials. As for the accessibility of so-called fringes, it was made sure that these will be near the main road, with the preference to be located closer to public transport as the more important form of transport. Butterfly Effect predicts that in the future the world will no longer be dependent on cars.

To show the implementation of mixed living and working and improvement of the quality of life, it is important to consider **"How can the housing crisis be solved in a just way?"**

Butterfly Effect proposes creating a new mix of living and working, this is done in combination with a biodiversity network. The biodiversity network that runs through the entire province is designed in a way that there are more areas of high-quality green spaces near and even within neighbourhoods. This creates a more pleasant environment to live and work in. By mixing living and working the province is moving away from monofunctional neighbourhoods and incorporating mixed neighbourhoods which in term also improves the general atmosphere.

The new bio-based building material sector aims to manufacture and produce materials that will be more affordable than building materials are today. This will allow the people of lower means to invest in their homes and bring them up to code and for the new housing to be more affordable.

These new living and working environments will have consequences on their surroundings. **What will the spatial and social implications of the transition to the circular bio-based building industry mean?**

The new mix of living and working will be located in the "fringes" (where the urban growth and new mixed agriculture meet), which will be a new example of how living and working can be mixed. The province has made strategies to mix living and working but these are all for existing neighbourhoods. Butterfly Effect will be focused on how to design these mixed neighbourhoods from the ground up. New neighbourhoods will have a very different look as a result of the extensive use of bio-based building materials (hemp and wood replaces steel and bricks).

The biodiversity network that runs throughout the entire province will have several different functions depending on its location. It can be a noise barrier, recreational area, transitional edge, connected to agriculture, etc. The type of function the network has will depend on the location. The biodiversity network is very versatile and is adjustable to the needs of each location. The raw materials will be cultivated in the new remediating agriculture. From there the materials will go to be processed in the port, while the waste from the cultivation and harvesting process will go to the smaller biorefineries where they will be recycled into biofertilisers etc. The material flows will happen via road and waterway. There will be transshipment locations where the transport of the roads and waterways are connected.

Finally the question **"How can the transition be equal and fair to everyone?"** can be answered.

Because the Province of South Holland is undergoing such a significant transformation, equality in the whole process and the outcome are crucial. In general, there are two types of justice: distributive justice and participatory justice. For the former one, Butterfly Effect aims to improve the quality of life for people who not only work but also live in the province by implementing new fringe housing and a biodiversity network in the province. This will have a positive effect on the quality of life for people who not only work but also live in the province. Furthermore, by establishing a bio-based industry, building materials will become more affordable, allowing people of all socio-economic classes to live in code-compliant homes.

For participatory justice, Butterfly Effect created a platform Transition Management Organisation (TMO) that will ensure that all stakeholders are heard during the transition.

With the information acquired the main research question **"How can the PZH synergize the circular bio-based building industry and organic agricultural industry to improve the quality of life in a just way?"** can be answered.

To solve the housing crisis building materials need to be manufactured faster and in bigger quantities. To meet the circularity goal the Netherlands and the EU have set sustainability goals, according to which there needs to be a transition in many different sectors, starting with the building sector and the agricultural sector. Transitioning the building sector into a circular bio-based building sector will result in a more environmentally friendly and faster way of building. The transition from deteriorating to remediating organic agriculture will not only be of profit to the sector but will also have a strengthening effect on the biodiversity of the province. Moreover, this would increase access to organic food for everyone, greatly increasing the health of inhabitants.

Because the province is undergoing such a big transition there needs to be proper education, knowledge, and innovation about this transition. Butterfly Effect has also taken this into account and created a platform Transit Management Organisation (TMO) that will ensure proper communication and collaboration between the stakeholders, education centers, etc. The employees involved in the transition will not be out of a job but will be re-educated and offered a job in one of the new sectors. Furthermore, Butterfly Effect aims to create a better living and working environment by implementing mixed fringes and a biodiversity network in the province which will have a positive effect on the quality of life for the people who not only work but also live in the province.

"In short, by transitioning to bio-based building material industry Butterfly Effect will be created."

Butterfly Effect (2022)

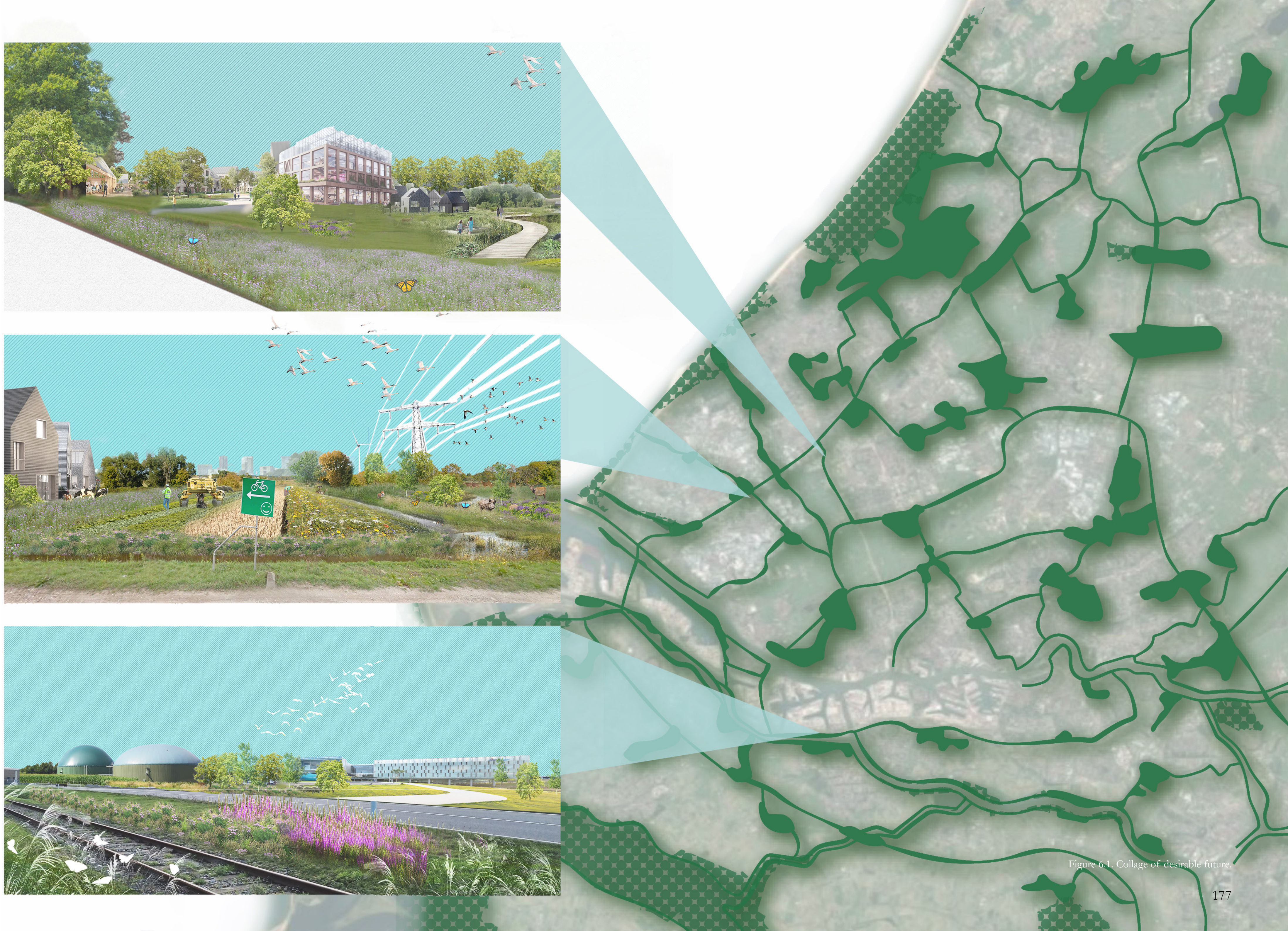

Figure 6.1. Collage of desirable future.

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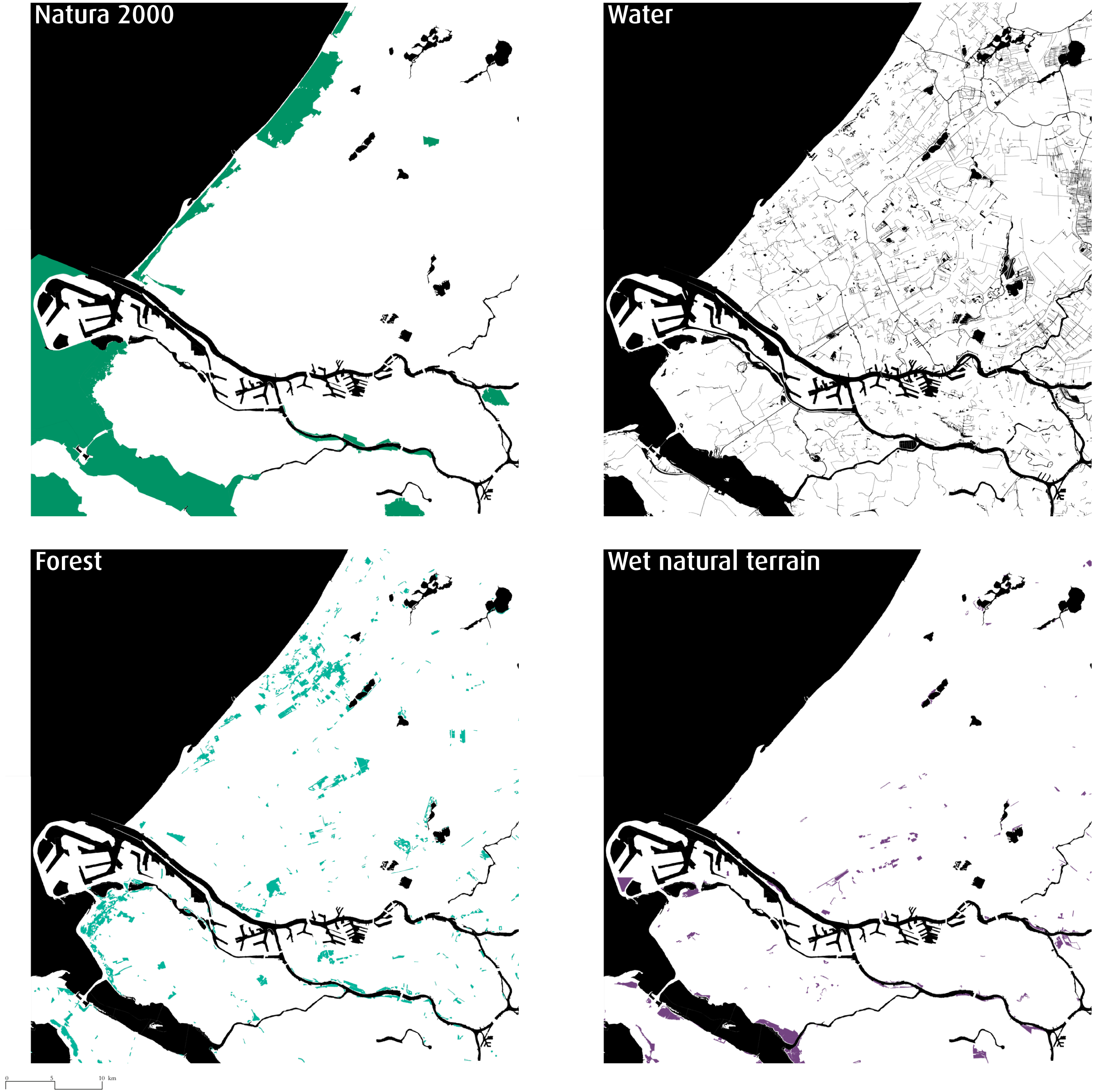
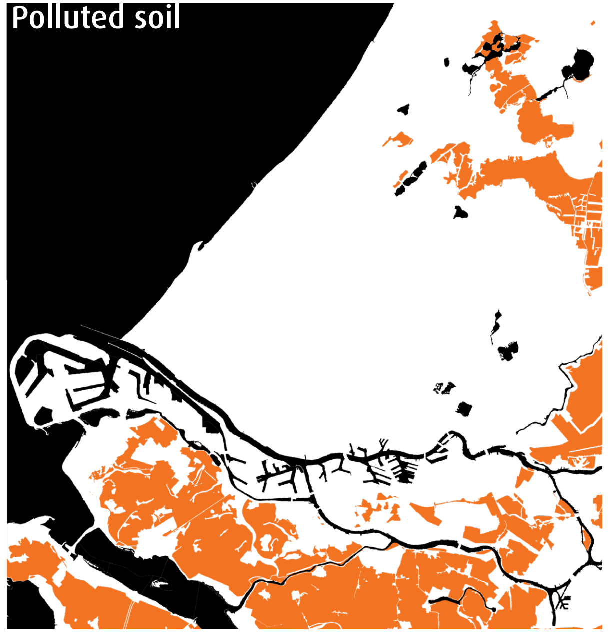
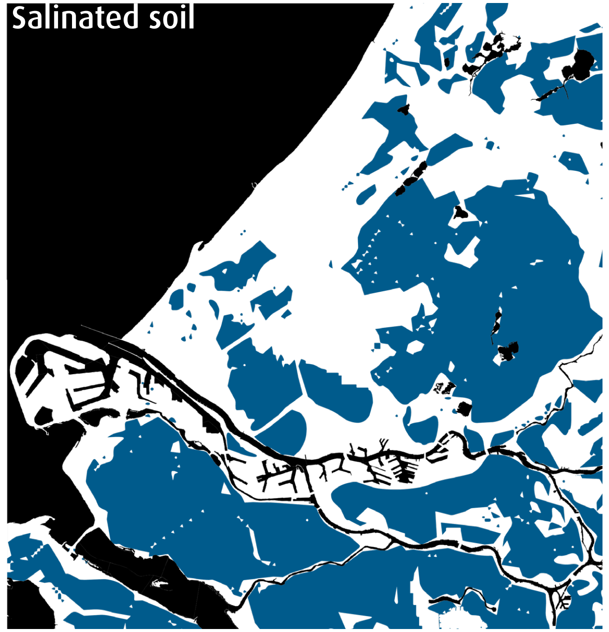
APPENDIX

8.1 Nature

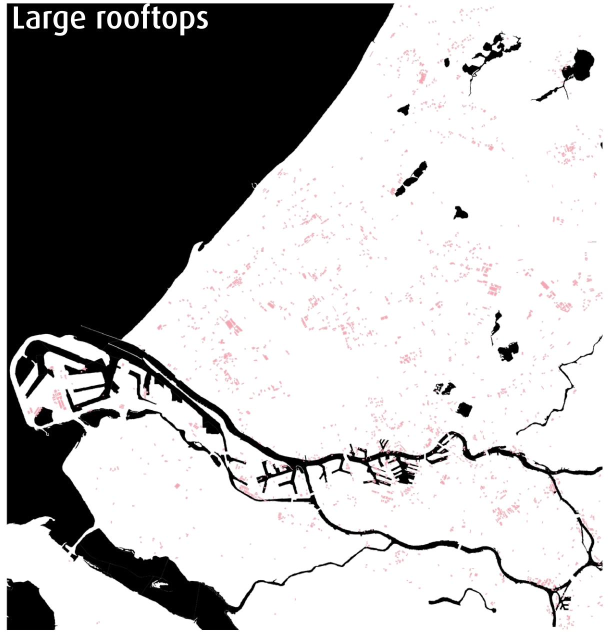


8.2 Soil

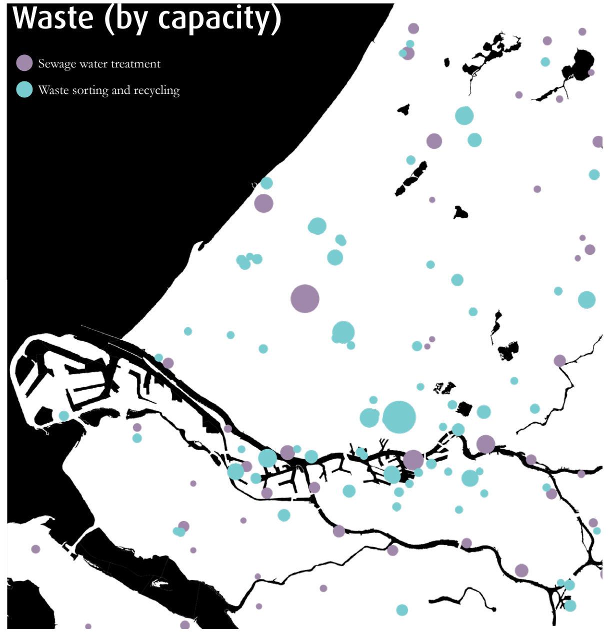


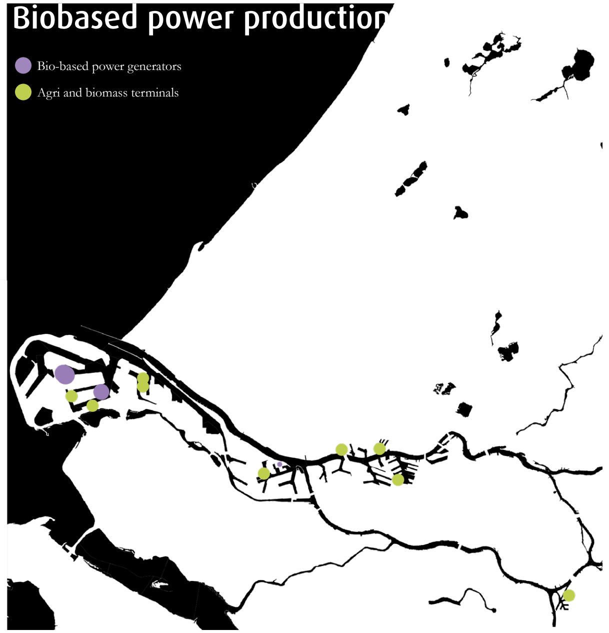


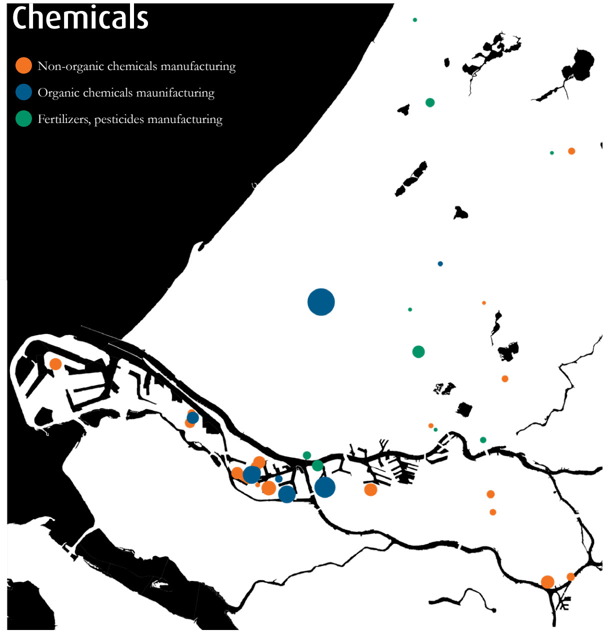
8.3 Agriculture



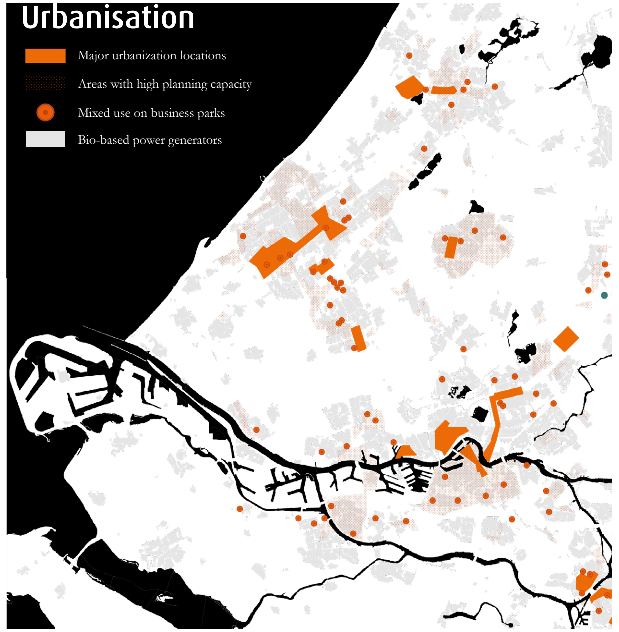
8.4 Port structures

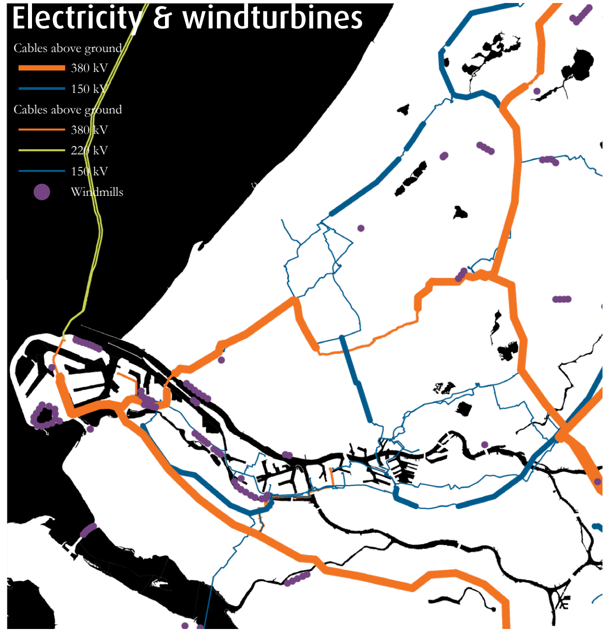


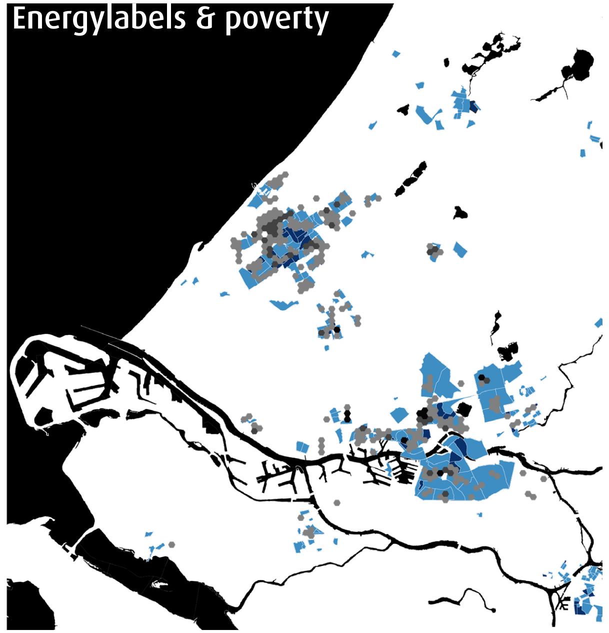




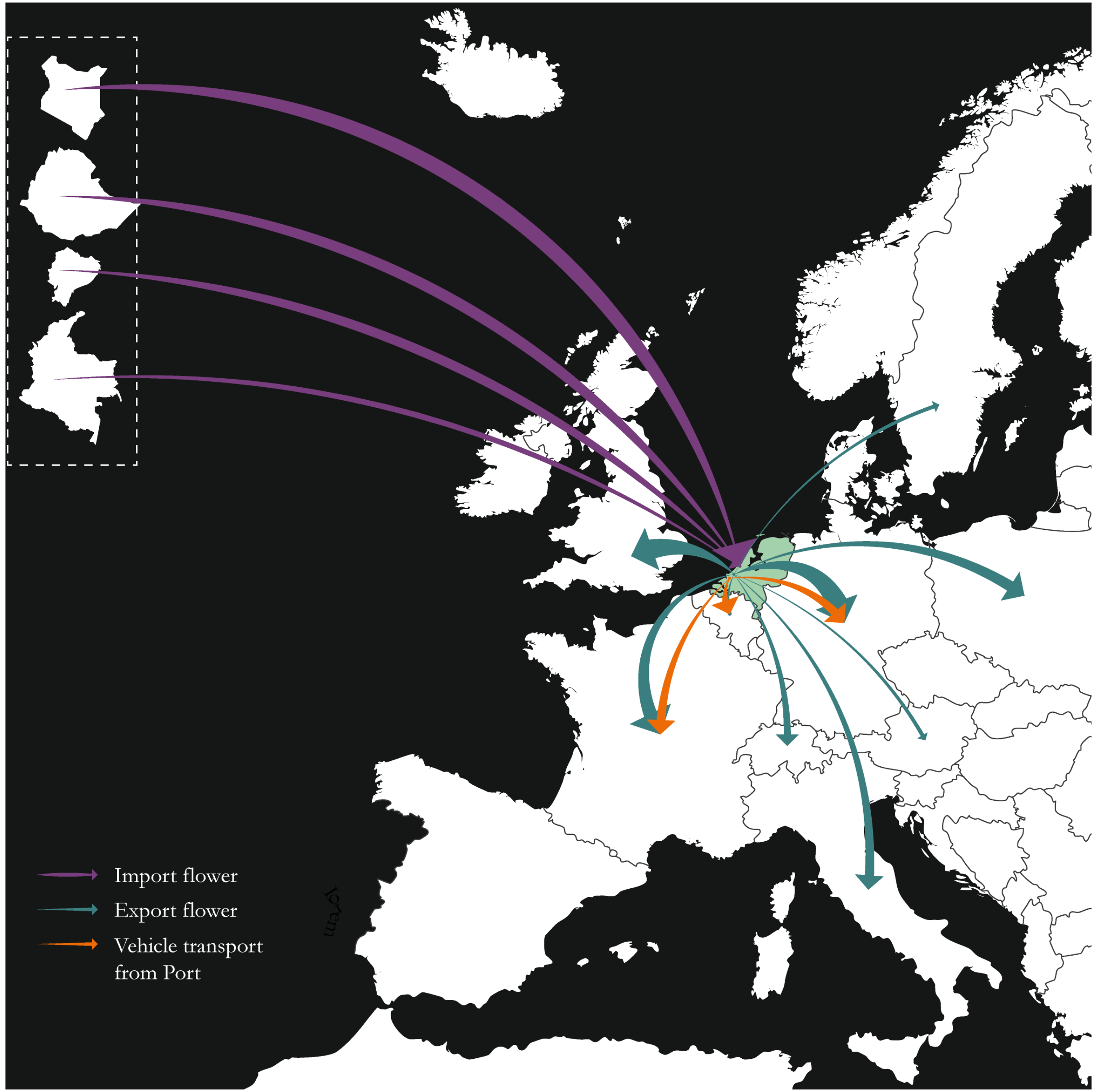
8.5 Human activity



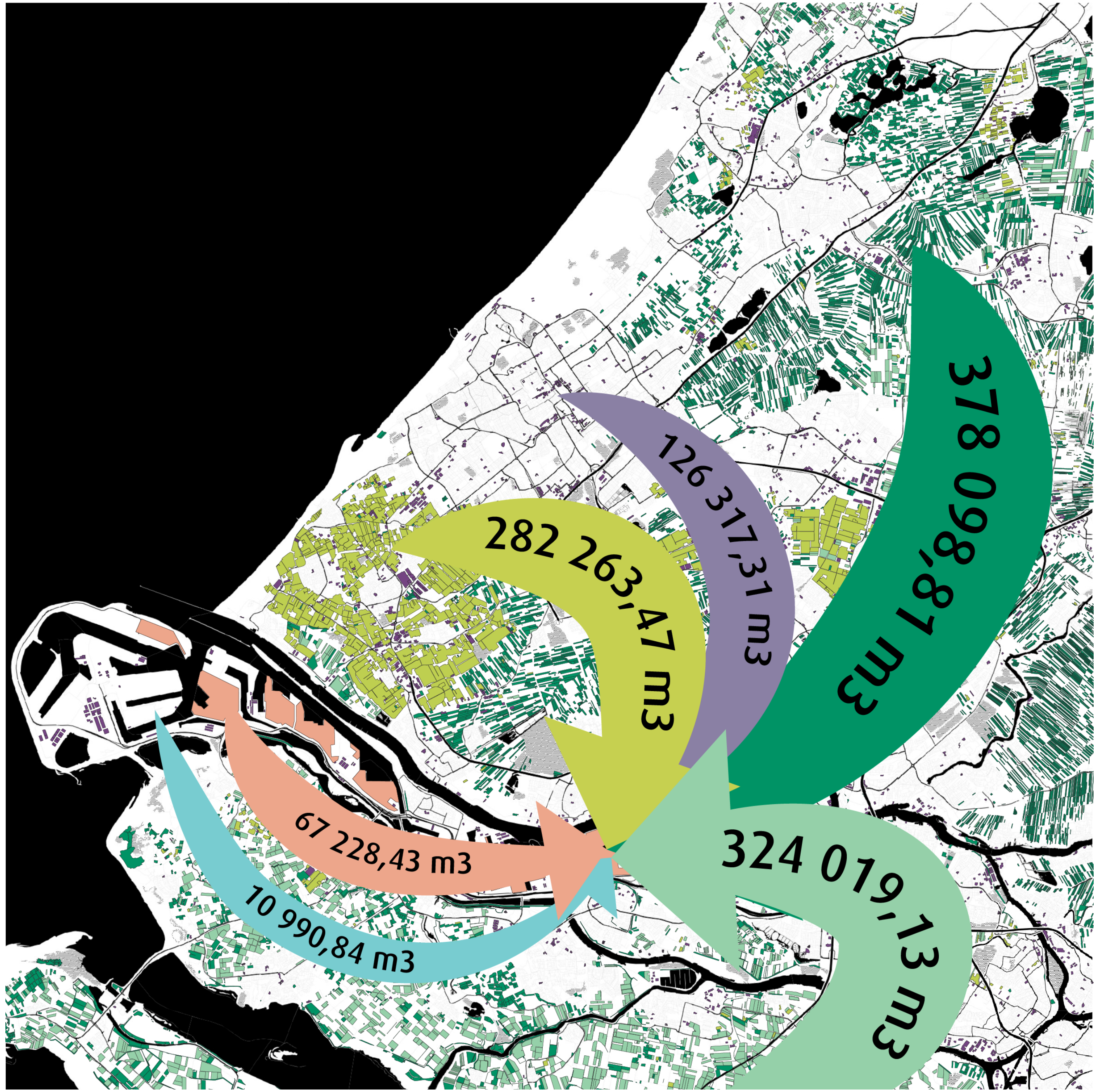




8.6 Flows of the Province of South of Holland



8.7 Supply flows



8.9 Calculations

Demand

Total floor area (t.f.a)	20 139,00	m2		per t.f.a.
Foundation	8 686,56	m3	0,43	m3/m2
Concrete pillars	277,57	m3	0,01	m3/m2
Exterior wall	8 759,35	m2	**0,43**	m2/m2
Interior partition	46 466,47	m2	2,31	m2/m2
Roofing	6 021,05	m2	**0,30**	m2/m2

Table 1. Exterior wall and roof surface ratio to total floor area. Based on Sáez et al., (2012).

people per house:	2,14	people										
avg. m2 per person (randstad)	55,00	m2										
avg. house size:	117,70	m2							Without Fungi		With Fungi	
Period	Amount of houses	Amount of total m2 needed	Exterior insulation, m2	Roof insulation, m2	Sum, m2	Sum with renovation, m2	Years	m2/year	average m2 coverage from 1 ha	needed ha/year	average m2 coverage from 1	needed ha/year
till 2030	150 000,00	17 655 000,00	7 678 947,53	5 278 397,03	12 957 344,56	23 707 871,09	7	3386838,728	**23,80**	142 324,03	**39,35**	86 075,14
2030-2040-2050...	60 000,00	7 062 000,00	3 071 579,01	2 111 358,81	5 182 937,82	15 933 464,36	10	1593346,436	**23,80**	66 956,68	**39,35**	40 494,26
renovation per decade	105 000,00	12 358 500,00	5 375 263,27	5 375 263,27	10750526,54							

Table 2. Amount of insulated surfaces needed in square meters for different periods. Amount of land cultivated for raw materials used in insulation manufacturing needed in ha/year. Provincie Zuid-Holland (2017); CBS (n.d.a); CBS (n.d.b); CBS (2018);

Coverage, without the use of fungi

	Average yelds kg/ha	Amount used for b.m., %	Amount used for b.m., kg/ha	Density kg/m3	m3/ha	Thickness of insulation, m	surface coverage, m2/ha
Winter Wheat	9 360,00	27,10%	2 536,56	302,4	8,39	0,5	16,78
Winter Barley	9 140,00	22,99%	2 101,15	302,4	6,95	0,5	13,90
Fibre flax	5 100,00	23,33%	1 190,00	330	4,51	0,3	15,03
Linseeds	790,00						
Hemp	7 630,00	46,37%	3 538,03	330	13,40	0,3	44,67
Legume (alfafa)	14 000,00	27,62%	3 866,67	500	8,58	0,3	28,61
	Total possible amount, kg		Available amount, kg		m3	**AVERAGE:**	**23,80**
Paper waste	33 000 000,00	40,00%	13 200 000,00	50	264 000,00	0,4	660 000,00

Table 3. Average yearly yealds of different plants converted into insulation coverage m2/ha. Without use of fungi.

Areas	Ha	1/5	2/5	4/5	Hemp, m3	Flax, m3	Wheat, m3	Barley, m3	Legume, m3	Hemp, m2	Flax, m2	Wheat, m2	Barley, m2	Legume, m2
Greenhouses	7 036,38	1 407,28	2 814,55	5 629,10	37 719,59	6 343,40	11 804,37	9 778,10	48 320,23	125 731,97	21 144,68	23 608,73	19 556,20	161 067,43
Roofs	3 148,89	629,78	1 259,56	2 519,11	16 880,11	2 838,77	5 282,64	4 375,85	21 624,06	56 267,02	9 462,57	10 565,28	8 751,70	72 080,19
Arable land	25 839,36	5 167,87	10 335,74	20 671,49	138 515,84	23 294,57	43 348,60	35 907,64	177 444,05	461 719,48	77 648,58	86 697,21	71 815,29	591 480,18
Brackland	29,95	5,99	11,98	23,96	160,55	27,00	50,24	41,62	205,67	535,17	90,00	100,49	83,24	685,58
Grassland	34 934,91	6 986,98	13 973,96	27 947,93	187 273,93	31 494,35	58 607,47	48 547,27	239 905,01	624 246,44	104 981,17	117 214,94	97 094,53	799 683,38
Port oilscapes	1 649,20	329,84	659,68	1 319,36	17 681,58	1 486,78	2 766,73	2 291,81	11 325,39	58 938,59	4 955,93	5 533,46	4 583,62	37 751,29

Table 4. Amount of different landscapes in ha, converted into total insulation coverage m2 based on crop rotation. Without use of fungi.

Location/product	Total coverage of insulation surface, m2/ year	Total coverage of insulation surface, %/year	volume, m3/year
Greenhouses	351109,0073	22,04%	282 263,47
Roofs	157126,7672	9,86%	126 317,31
Oilscapes	101645,8099	6,38%	67 228,43
Arable land	456378,3651	28,64%	324 019,13
Grasslands	417104,3875	26,18%	378 098,81
Paper waste	660000	41,42%	10 990,84
Total:	2143364,337	134,52%	1 188 917,99

Table 5. Amount of insulation coverage m2/year, %/year of different landscapes. Bulk volumes that would need to be transported yearly. Without use of fungi.

Coverage, with the use of fungi

	Average yelds kg/ha	Amount used for b.m., %	Amount used for b.m., kg/ha	Density kg/m3	m3/ha	Thickness of insulation, m	surface coverage, m2/ha
Winter Wheat	9 360,00	27,10%	2 536,56	220	11,53	0,5	23,06
Winter Barley	9 140,00	22,99%	2 101,15	220	9,55	0,5	19,10
Fibre flax	5 100,00	23,33%	1 190,00	220	6,76	0,3	22,54
Linseeds	790,00						
Hemp	7 630,00	46,37%	3 538,03	220	20,10	0,3	67,01
Legume (alfafa)	14 000,00	27,62%	3 866,67	220	19,51	0,3	65,03
	Total possible amount, kg		Available amount, kg		m3	**AVERAGE:**	**39,35**
Paper waste	33 000 000,00	40,00%	13 200 000,00	25	528 000,00	0,4	1 320 000,00

Table 6. Average yearly yealds of different plants converted into insulation coverage m2/ha. With use of fungi.

Areas	Ha	1/5	2/5	4/5	Hemp, m3	Flax, m3	Wheat, m3	Barley, m3	Legume, m3	Hemp, m2	Flax, m2	Wheat, m2	Barley, m2	Legume, m2
Greenhouses	7 036,38	1 407,28	2 814,55	5 629,10	56 579,39	9 515,10	16 225,64	13 440,44	109 818,70	188 597,96	31 717,02	32 451,27	26 880,88	366 062,34
Roofs	3 148,89	629,78	1 259,56	2 519,11	25 320,16	4 258,16	7 261,23	6 014,81	49 145,59	84 400,53	14 193,86	14 522,45	12 029,62	163 818,62
Arable land	25 839,36	5 167,87	10 335,74	20 671,49	207 773,77	34 941,86	59 584,62	49 356,69	403 281,94	692 579,22	116 472,87	119 169,25	98 713,38	1 344 273,13
Brackland	29,95	5,99	11,98	23,96	240,83	40,50	69,06	57,21	467,44	802,76	135,00	138,13	114,42	1 558,13
Grassland	34 934,91	6 986,98	13 973,96	27 947,93	280 910,90	47 241,53	80 558,63	66 730,42	545 238,67	936 369,66	157 471,75	161 117,26	133 460,85	1 817 462,23
Port oilscapes	1 649,20	329,84	659,68	1 319,36	26 522,37	2 230,17	3 803,00	3 150,20	25 739,51	88 407,89	7 433,89	7 605,99	6 300,39	85 798,38

Table 7. Amount of different landscapes in ha, converted into total insulation coverage m2 based on crop rotation. With use of fungi.

Location/product	Total coverage of insulation surface, m2/ year	Total coverage of insulation surface, %/year	volume, m3/year
Greenhouses	645709,4697	40,53%	282 263,47
Roofs	288965,0775	18,14%	126 317,31
Oilscapes	181640,1643	11,40%	67 228,43
Arable land	798830,7636	50,14%	324 019,13
Grasslands	625656,5813	39,27%	378 098,81
Paper waste	1320000	82,84%	10 990,84
Total:	3860802,057	242,31%	1 188 917,99

Table 8. Amount of insulation coverage m2/year, %/year of different landscapes. Bulk volumes that would need to be transported yearly. With use of fungi.

Coverage calculation are based on these sources: Villoria Sáez et al., (2012); Demir & Dogan (2020); Hurtado et al., (2016); Goswein et al., (2021); Dias et al., (2021); Platt et al., (2020); Kazachenko er al., (2021); Bouaesker et al., (2014); Sam-Brew & Smith (2017); Zhang et al., (2012); Liu et al., (2019); McCullough (2019); Guna et al., (2021); Cerbu (2015); Jayas & Cenkowski (2006); Lam et al., (2008); Gelaw et al., (2014); Provincie Zuid-Holland (2017); CBS (n.d.a); CBS (n.d.b); CBS (2018); Lisa (2019);

Farmers income

	2000	2005	2010	2018	2019	difference	ha per farm
Nr. of farms (x1000)	97,389	81,75	72,324	53,91	53,233	45,34%	**34,12**
Workers (x1000)	212,1	174,7	169,6	153,4	156,3	26,31%	
Area (x1000ha)	1975,5	1937,7	1872,3	1822,4	1816,3	8,06%	

Table 9. Amount of farms, workers and agricultural workers. The difference is negative and between 2000 and 2019. Ha per farm is calculated in 2019 by dividing area from total amount of farms. Based on Meulen & Berkhout (2021; 2020); Berkhout (2019; 2018; 2017).

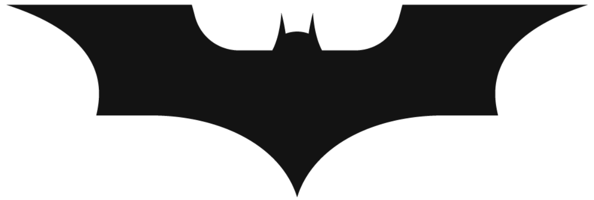
Earnings (per awu) euros	2015	2016	2017	2018	2019	2020	Average	Average euros per ha	Average flower industry	amount of land in PZH, ha	amount of land in PZH, %
Multianuall average				51 000,00	52 000,00	59 000,00					
Average	**47 000,00**	**53 000,00**	**70 000,00**	**42 000,00**	**57 000,00**	**54 000,00**	**53 833,33**	**1 577,77**			
Piglet farmers					250 000,00	lower	250 000,00	**7 327,12**			
Arable farmers					37 000,00	40 000,00	38 500,00	**1 128,38**		25 839,36	**38,11%**
Dairy farmers					31 000,00	43 000,00	37 000,00	**1 084,41**		34 934,91	**51,52%**
Broiler farmers						44 000,00	44 000,00	**1 289,57**			
Horticulture:										7 036,38	**10,38%**
Vegetables					290 000,00	260 000,00	275 000,00	**8 059,83**			
Cut flowers					170 000,00	150 000,00	160 000,00	**4 689,36**	**4 616,09**		
Potted/bedded plants					130 000,00	180 000,00	155 000,00	**4 542,82**			
									Total agriculture land in PZH, ha	67810,65	

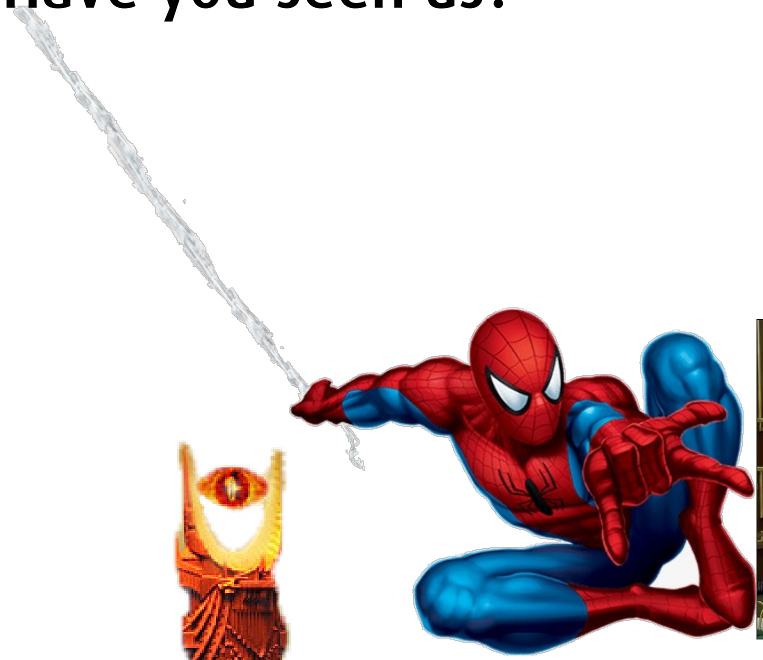
Table 10. Average yearly income in different agricultural sectors. Based on Meulen & Berkhout (2021; 2020); Berkhout (2019; 2018; 2017). AWU - annual working unit.

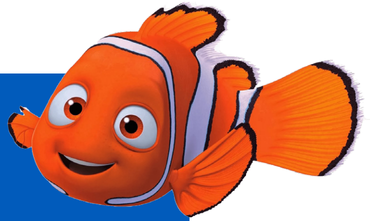
Income of hemp, euros/ha	Min	Max	average	2/5	3/5	Total hemp + current agriculture
Conventional	4 221,00	7 918,00	**6 069,50**	**2427,8**		**3 104,83**
Innovative	7 311,00	13 023,00	**10 167,00**	**4066,8**		**4 743,83**
Current agriculture average			**1 128,38**		**677,03**	

Table 11. Potential average income from hemp yearly per hectare in euros. Based on Moscariello et al., (2021). Calculated with assumption that 2 out of 5 plots will be used for hemp cultivation every year.

Have you seen us?







When you find us, send Butterfly Effect an email with screenshot to:
algirdasram@gmail.com or anna.berg@xs4all.nl

8.10 Individual reflections

You Can Never Put It Back Together Like It Was
Anna van den Berg

Going into this project I was a bit apprehensive about working at this large of a scale. Having done a project on regional design before, I knew that it was a difficult scale to comprehend. Starting this course with the SDS lectures helped with the scale and the comprehension of this exercise. The first week we got to choose our theme and with that our subject for the next nine weeks. By going on the excursion our interest in this project was really sparked. The immense size of the Port of Rotterdam, and the monotonous landscape of horticulture really got us to find our subject. Finding our research question and narrowing down the story we were going to tell turned out to be quite a hassle. We were all very involved in the story and kept losing track of the main subject. Through this we did manage to create a storyline that fits all of this and has, in my opinion, a strong story to tell.

During these nine weeks, I felt like the methodology course helped us structure our story. By doing the exercises during the lectures, we were forced to think and talk about our storyline. This really helped us go forward and make decisions we were apprehensive to make beforehand. For me the discussions we had in the first weeks of the methodology course were the most interesting ones. Through these topics I learned more about my group mates and how they felt about these important topics. This helped us define the subject for our project, Butterfly Effect. The course helped us to take subjects into account that are often forgotten in our sector, but nonetheless very important to make the story work.

When we first started our research into the topic of bio-based building materials, we looked into the problems the world is facing right now. During this time we ran into some mental problems. By doing this deep dive into the current situation of the world, we became aware of the current state of affairs. Which is, in our opinion, not that positive (expressed lightly). We became highly aware of the fact that seemingly no larger companies or governmental bodies were holding them self-accountable for doing something about the climate crisis we are headed towards. After we recovered from this, we got really motivated to make our story succeed. This gave me the motivation to continue on the path we had chosen and complete this project together.

Working within this team from four completely different backgrounds was a fun and educational experience. I have learned a lot from my teammates during this course about the way they experienced urbanism from their perspective. This project was the first where we really had to work together intensely. This type of course can lead to a lot of problems and friction, but I feel like our group clicked together from the beginning and really made things work. With a similar sense of humour and a passion for the environment we made this course our own. You can't have group work with all work and no play.

Fake It Untill You Make It
Nicole Chang

When starting this course, I had some trepidation since this is the first course in the Master track where we worked on such a large scale. From the beginning, in the lectures, it was brought to our attention that there were many different things we would have to take into account that do not factor in on the other scales we have previously worked in during the Master track. In the very first week, we were given a theme. Now it was quite important to try and pinpoint what exactly we were going to focus on in the upcoming 9 weeks since the course is quite a short one. Making this decision was a bit tricky as the time for the research for this was quite lacking. The excursion we went on did spark our interest and is how we came to our first topic of interest, the greenhouses and flower distribution centers in Westland were of great interest to us. After the excursion, we started doing research on these two sectors and discovered that there is so much more than meets the eye. The greenhouses led us to emissions, emissions led us to the building sector which led us to the bio-based building where we landed. The bio-based building is something everyone in our sector and especially in our faculty has had many conversations about, the interest in this topic is high, but since this is still quite an underdeveloped and under implemented sector, there was quite the knowledge gap when looking up information for this project.

Another thing that was quite the eye-opener during this project was the methodology course, which has a whole different insight. Not a new one per se, but it shined a much-needed light on certain topics that people in general, myself included tending to overlook, or forget. Which is not the best to do, so the methodology course really helped me stay aware of this and try to look at the project not only as a designer but also try to place myself in the shoes of the different actors. For example, in projects, we as designers tend to get carried away in the excitement of simply designing something that we tend to overlook the social justice aspect of the project. In some cases, it's even brought up as an afterthought, something that was just taped onto the project last minute. But raising awareness for topics like this, makes you take a step back and look at it from another viewpoint.

During the whole master's, this was the first time we really worked intensely in groups, this is always interesting since you never know in what group your gonna end up. Of course, the aim is to be able to work with everyone, but this is not always realistic. Now I did have the luck of ending up in a group that always worked together and communicated well. In my opinion, I had the ideal group experience. We didn't only have work very hard, but we had fun too. You can't have group work with all work and no play. What was interesting was that because we like to work together at the faculty every day it was quite the challenge to have hybrid sessions when I had Covid. In my opinion hybrid sessions are never the best experience when you're the one behind the computer. It's not only difficult to feel present, but also to hear what everyone and especially the tutors is saying.

This course was very specific about some things for example you need a vision and then a strategy with a timeline and stakeholder and key locations, but it was also vague on how much detail these things needed to have. So it was quite difficult for me to envision to end result as I didn't really know what we were working towards exactly. It also became clear that in regional planning products will only be done by the end since everything still changes throughout the entire project. It's such a large scale that even a small change will affect more things than you anticipate. So it was very interesting to get to play and plan on this scale and to design and get our hands dirty on this new scale.

All Work and No Play Makes the Al a Dull Boy
Algirdas (the Al) Ramonas

I come from a long architectural background. I studied architecture as my bachelor's and worked for some time as an architect. Everything I did before was basically the opposite of what we were doing in this quarter. It was quite a big mental leap from the scale that I was used to - building - to the complexity of the region. Therefore for me it was quite tough to comprehend, grasp and even think in such territory. However, the fact is that I missed holistic and bigger scale thinking in architecture I chose to study urbanism, and I am glad that I have done that.

Moreover, there is another difference that was tough for me to overcome. In architecture, no matter how complex the project, it usually comes down to a concrete building. Therefore it is very connected to the human eye perspective and the level of pedestrians. In other words, architecture deals with details. In my opinion urban planning is in a way opposite of that - it deals with changes of larger quantities, with transitions that could have the biggest impact, and, importantly, with much longer terms. However, both ways of thinking are interconnected one informing the other. Architecture is not only the strategy laid down on the site, but also informs the planning. The regional design does not deal only with "big visions", but needs to become concrete at one point. Therefore I believe that the lessons I learned in this quarter broadened and complimented my thinking, while my knowledge of architecture helped to think of concrete solutions for the vision.

Furthermore, Research and Design Methodology course impacted the way I think about the built environment. It helped me to deepen my understanding of the main values of urban planning. I would sum it up in two words - ethics and morality. For me social and spatial justice, just transition, and equality fall under those two words. We as humanity comprehend what is our rights and what means to be equal through our ethical and moral norms of the current time. Because these norms are constantly changing, it is even more important to find the essence of what equality means and especially how it is or can be translated into space. Only then we can guarantee fairness for future generations.

No matter how hard this quarter was physically and mentally (which was a lot), I believe that our proposed vision and strategies could be implemented in reality (with more detailed calculations) or at least give ideas for further research on what fields biggest impact could happen. Moreover, I believe that we concluded an extensive analysis of the spatial, social, and environmental conditions in the province, therefore creating a strongly evidence-based vision. This was another lesson that I took out from Research and Design Methodology course - that urban planning needs to be scientific.

I really appreciated working in the team. It was possible to connect our group work process directly to the lectures of the Methodology course because, in my opinion, our team dynamics were similar to real-life situations of participatory urban planning practice. Compared to the individual, straight-line-like working style the process was bulky - a lot of discussions, disagreements, and writing on the whiteboard. Yet I believe that our different backgrounds, expertise, and opinions, while increasing the working hours, allowed us to make a much better product than I could have done individually.

The final lesson that I took both from the Methodology course and the Design studio (especially the process of the project) is that science (and urban planning) is changing and it should be more fun, playful and therefore accessible. That is what we tried to do in our report and presentation because in the current age we want to be engaging and also make the process interesting for ourselves. "All work and no play makes the Al a dull boy". We don't want to be dull, don't we?

Regional Planning: Comprehensive and Exhausting work
Kemeng (Mia) Zhao

The most impressive thing I take away from this regional planning studio is the comprehensiveness, in many ways. First and foremost, the comprehensiveness refers to the complex objects of our work. From a spatial perspective a lot of stuff, both inside and outside the region, goes into regional planning. From a historical perspective, a region's current situation is the result of many events that occurred in the past, so we must look back in time. In the future, regional planning will have a long-term impact. As a result, we must also look ahead in order to envision the future. Furthermore, there are numerous intangible factors to consider. Furthermore, there are also a lot of intangible things we should consider. It's like the triangle from methodology class, with three vertices: sectors, technology, and institutions, which should be considered when designing new systems (Rocco, 2022).

Second, the comprehensiveness of the work is reflected in the work process. As previously stated, the objects we study are so complex that they cannot be completed by a single person. Furthermore, because the entire area serves a diverse population, different voices should be heard. These two points place a high value on being open to new ideas, perspectives, and knowledge, as well as communicating fully with experts from various fields, the general public, and teammates. In this regard, I think the lectures and workshops in the Methodology course, Capita Selecta, and Spatial Development Strategies (SDS) greatly aided us in obtaining the insights and skills required in the studio within the limited time.

Last but not least, it is difficult to envision the future, particularly in an era of rapid change. We could never have predicted a pandemic in the past. There are so many unintended events. As a result, rather than following a rigid blueprint plan with limited imagination, we should make our project adaptable for the future. I believe I still have a lot to learn for this part in the future. In a nutshell, I find it fascinating that regional planning involves so many variables. I really like the on-class exercises about what kind of urbanists we want to be, and I do think the role of urbanists is defined by our work as urbanists.

It's also worth mentioning our work process. We were excited about a variety of industries that are involved in the bio-based industry, our assigned topic, during our first group meeting talking about our understanding of it. It does, in fact, provide us with opportunities to make transitions in the agriculture, urban development, port, and construction industries, etc. However, it also makes it difficult to determine our primary focus. But, in the end, we made it. The whole thing reminds me of the diagram in Remon's lecture, which appears to be a jumble at first but eventually leads in the right direction (Rooij, 2022). It takes a lot of time and effort over the course of the project, and we don't have time to play. In this regard, I believe it's detrimental for a planner's growth and health, both physical and mental.

Sources:

Rocco, R. (2022) Socio technical systems. [Methodology lectures on 10 Feb] retrieved from https://brightspace.tudelft.nl/d2l/le/content/398766/viewContent/2603715/View

Rooij, R (2022) Methods of regional planning and design. [SDS lectures on Monday 21 Feb] retrieved from https://brightspace.tudelft.nl/d2l/le/content/398764/viewContent/2609086/View