BIOCYCLE

Promoting the Biobased Economy in the Province of South Holland

Margot
Fabio
Julie
Chaniek

COLOPHON

Group 5.2
Chaniek Mellink | 4469348
Fabio A. Alzate Martinez | 5510406
Julie A. Noorman | 5669731
A. Margot Schouls | 4820584

Biocycle | Promoting a biobased economy in the province of South Holland

April 2022
Julianalaan 134, 2628 BL, Delft, The Netherlands

AR2U086 R&D Studio | Spatial Strategies for the Global Metropolis
AR2U088 | Research and Design Methodology for Urbanism
TU Delft | Faculty of Architecture and the Built Environment - Urbanism Track

Project Teachers
D. A. Sepulveda Carmona | R. J. Van Der Veen
Methodology teachers
dr. Roberto Rocco | dr. Marcin Dabrowski

Disclaimer | *All of the figures in this document are selfmade unless stated otherwise. If by acci-dent any references are missing contact*

TEAM

The woman from left to right; Chaniek Mellink, Margot Schouls, Julie Noorman and Fabio Alzate Martinez

ABSTRACT

There is an urgent ongoing transition towards sustainability in built environments. In accordance with the European Green Deal and the Sustainable Development Goals it is important to; reduce greenhouse effect emissions; increase biodiversity; promote clean energy; and mitigate climate change effects. This transition will significantly impact South Holland, which has almost half of its surface dedicated to the agricultural sector. Also, it will impact the Port of Rotterdam, the area's most important economic asset, which heavily relies on the petrochemical sector. Furthermore, the land-use of these industries creates a conflict of space between urban areas, agriculture, and nature - whereas lack of ecology is leading to a dangerously low biodiversity.

In this sense, this report proposes to relief the environmental pressure of the agricultural and petrochemical industries, whilst ensuring the continuity of its economical relevance and job offering to the province of South Holland. To tackle this, this research aims for a biobased transition that also creates a more balanced land-use and reduces emissions of the current petrochemical industries. With this the spatial implications were explored by researching on how to ignite the biobased transition in South Holland by linking its agro-urban structure with new potential bio-industries, promoting optimized cascade flows, and sustainable land use.

After an iterative process of designing and research, the BIOCYCLE strategy comprises all the key aspects to achieve social, industrial, environmental, and agricultural sustainability by integrating the spatial structures of South Holland with its main actors. Therefore, allowing a responsible transition towards the bio-economy model that reinforces the current economic competitiveness of the region by incorporating the full potential of the agro sector as an economic generator by empowering local actors.

Keywords: biobased economy, port of Rotterdam, conflict of space, knowledge hubs, bio-energy

INTRODUCTION

The world has to change. In order to reverse the effects the climate crisis has had on our planet, we need to make behavioural. Research has shown that citizens are willing to change their behaviour but are often waiting for companies and governments to take action (NOS, 2022).

The province of South Holland has announced a change in direction in their policy. They aim to create a circular economy through a bio-based transition (PZH, 2019). They are joined by the Port of Rotterdam, which is also looking to make their industry more sustainable (Port of Rotterdam, 2019).

This regional plan is created according to the visions of both the province of South Holland and the Port of Rotterdam. By following values as described below, the plan aims to contribute to a more sustainable province and hinterlands.

Sustainability is understood in its three fundamental dimensions: social, economic and environmental (Dillard, Dujon & King, 2009; Larsen, 2012). To ensure sustainability within this vision, there has been made use of the concept of communicative planning. Through communicative planning, the plan aims to satisfy all stakeholders within the province of South Holland. Communicative planning ensures that the planning process is democratic through inclusive argumentation (Healey, 1996). By following this process, all voices will be heard, leading to an equal, inclusive vision. Sustainability in this manner is applied to the three key concepts that are used in this vision: circular economy, bio-based transition, and land-use battles.

Circular economy

This vision will use the European Parliament's definition of circular economy, which reads as follows: The circular economy is a model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible. In this way, the life cycle of products is extended. (European Parliament, 2021). BIOCYCLE focusses mainly on materials such as oils, fresh produce and cascade flows within the circular economy.

Bio-based transition

The biobased transition is the transition from the current economy to one that is biobased. A biobased economy is founded on the concept of a circular economy, with the addition that the materials used by various industries are of natural sources. This implies an elimination of the use of fossil fuels.

Land-use battles

In the province of South Holland, every square centimetre has been given a function. This is for example housing, greenhouses, nature (woods, dunes or parks) or port area. Some areas will have to be transformed in the future in order to form a sustainable landscape. Because of this, land-use battles will emerge. Often, the three dimensions of sustainability (social, economic and environmental) will be in direct conflict with each other. In order to solve these conflicts, pro's and cons on all scale levels will be considered.

CONTENT

1 Context

The first chapter will be the context of BIOCYCLE; Promoting the Biobased Economy in the province of South Holland.

The challenges and opportunities of the province are explained, such as the United Nations Sustainable Development Goals and the European Green Deal.

These challenges and opportunities lead to the research questions.

The chapter ends with the terminology, to explain the most important terms that will be used in the report.

CONTENT

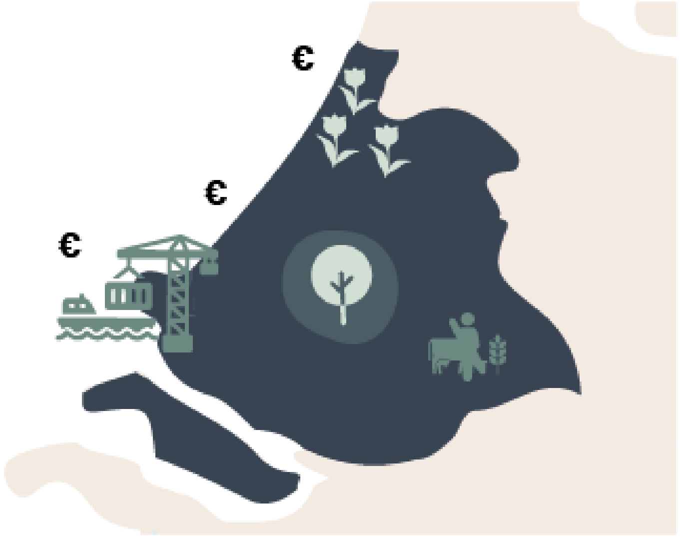
1.1 Problem Statement

There is an urgent ongoing transition towards sustainability in built environments. In accordance with the European Green Deal and the Sustainable Development Goals it is important to; reduce greenhouse effect emissions; increase biodiversity; promote clean energy; and mitigate climate change effects. This transition will significantly impact South Holland, which has 48% of its area dedicated to the agro-industry sector, which was responsible for 5.9 mi tons of C02 emissions in the Netherlands in 2017 (van der Velden, 2017). Also, it will impact the Port of Rotterdam, the area's most important economic asset, which heavily relies on the petrochemical sector being responsible for 20 mi of C02 in 2017 (Stichting LISA, 2021).

There is a big amount of land dedicated to agriculture and petrochemical industries and there is a high economical importance of these industries. It is necessary to relieve the pressure of the petrochemical and agricultural industries on earth for the transition towards a biobased economy, whilst also ensuring the continuity of the economical relevance and job offering to the province of South Holland. Right now the agriculture and petrochemical industries pollute with emissions and immense waste flows. Next to this the amount of land dedicated to these industries are in conflict with the amount of open space left in our country.
This conflict of space includes urban areas, agriculture and nature. In the urban areas there is a high housing demand which leads to urban expansions. Agricultural areas also need a lot of space for the amount of food that is needed. Nature has a high importance for the ecology and biodiversity of the Netherlands. However, urbanization and cultivation took in a big part of nature. The lack of ecological attention has caused a dangerously low biodiversity.

The agricultural landscape in the province of South-Holland needs to densify. New technologies such as vertical farming and aquaponics have created possibilities to make better, more efficient use of space, resources and energy (WUR, n.d.).

To create a better balance between housing, agriculture and ecology and to reduce emissions of the current petrochemical industries, the research question is: How to ignite the biobased transition in South Holland by linking its agro-urban structure with new potential bio-industries, promoting optimized cascade flows, and sustainable land use?



Strengths

Weaknesses

Opportunities

Threats

Strengths
- Economic value of the port of Rotterdam, the flower industry and agricultural industries.
- The Green Heart

Weaknesses
- Conflicts within spatial demand between urban areas, agriculture and nature
- Housing shortages

Opportunities
- Waste management
- Innovations by research centres and techniciens.
- Biomass as energy source

Threats
- Climate change
- CO_2 emissions
- Flooding risks
- Growing population

SWOT

The SWOT analysis helps to get an idea of the strengths, weaknesses, opportunities and threats of a design location This information can function as a starting point for building strategies and design.

The SWOT analysis is a quick and simple way to start to comprehensive a complex system or situation.

The results of a SWOT-Analysis can subjective and it can be difficult to think of strengths and opportunities separately, just as weaknesses and threats.

Nonetheless , the SWOT analysis is effective and will help to continue with a vision or strategy. (Dabrowski, 2022)

1.2 Actualities

Trouw

Onvrede

Boeren maken zich op voor een nieuw stikstofprotest in Den Haag

Een boerenprotest, eind vorig jaar, op het Malieveld in Den Haag. Beeld ANP

Boeren vinden dat de stikstofproblematiek op hun bordje wordt gelegd. Daarom gaan ze opnieuw demonstreren.

Joost van Velzen 7 juli 2021, 01:00

'Wij zijn het zat!', staat er op de website van boerenactiegroep Agractie. En: 'Veeg onze boeren niet van de kaart'. De site van Farmers Defence Force opent met een aankondiging die vooral als oproep moet worden gelezen: '7 juli 2021 wordt actiedag! Beide groepen organiseren demonstraties in het hele land. Boze en bezorgde boeren zullen de trekker pakken naar het Malieveld in

Port of Rotterdam   Shipping   Doing business

15 percent of the transhipment in Rotterdam is Russia-related

24 February 2022

62 million tons of the almost 470 million transhipment in the port of Rotterdam is Russia-oriented. Via the port of Rotterdam, many energy carriers are imported from Russia. Broadly speaking, at present 20% of the coal comes from Russia, 20% of the oil products, 25% of the LNG and 30% of the crude oil.

The province is currently dealing with a range of social, environmental and geo-political problems. These headlines reflect a selection of the problems: the housing crisis, farmers' protests against a reduction in livestock because of the nitrogen crisis, and Russia's share of the Dutch economy at the time of the war in Ukraine, which will mostly likely lead to for example higher prices for oil products.

Sources: Voermans, T. (2022), Obbink, H. (2021), Velzen, van, J. (2021) and Port of Rotterdam (2022)

Trouw

Jonge mensen die nu nog geen eigen huis bezitten, krijgen het lastig. En hun kinderen ook. Alleen wie rijke ouders heeft, redt het nog. Er dreigt een tweedeling, waarschuwt Hans de Geus.

Hanne Obbink 14 april 2021, 08:19

Het Parool

Nederland | Wereld | Kunst & Media | Sport

Plus **Achtergrond**

Een miljoen woningen erbij in tien jaar. Hoe gaan we dat doen?

Om het enorme woningtekort aan te pakken, zullen alle gemeenten met bouwplannen moeten komen. En traditioneel bouwen is er niet meer bij; woningen komen vooral uit de fabriek. 'Een miljoen huizen is veel, maar het kan omdat het moet. We hebben geen keuze.'

Ton Voermans 14 maart 2022, 03:00

1.3 International Sustainability Policies

1.3.1 European Green Deal

source: European Commision (2019b)

In 2019, the European Union made policy on the commitments they made in the Paris Agreement in 2016. In the Green Deal, they promise to spend 1 trillion euro's on making Europe climate neutral in 2050. In this deal, they focus on 8 different policy areas: biodiversity, sustainable food systems, sustainable agriculture, clean energy, sustainable industry, building and renovating, sustainable mobility, eliminating pollution and climate action (World Economic Forum, 2021).

By focusing on these 8 policy areas, the EU tries to achieve their three main goals: achieving net-zero emissions, decoupling growth from resource exploitation and the fostering of a just, inclusive green transition.

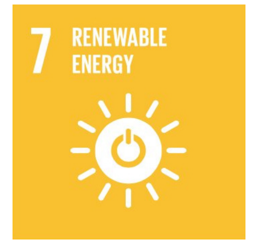
1.3.2 Sustainable Development Goals (UN)

In 2015 an agenda for sustainable development was created by the United Nations. Through 17 goals, they strive for sustainable development around the world before 2030. All countries that are part of the UN take action on these goals on both national and international levels (Rijksoverheid, n.d.). Within this the UN has a monitoring function: by using various indicators, it reports on the effects of implementing the goals. The main responsibility lies with the countries themselves. The Dutch government emphasizes on the cooperation between central governments and societal actors such as companies and social organizations.

The sustainable development goals will be used in this project to fit within the Dutch government's framework. All the solutions provided can be attached to either one or multiple goals. The strategy provided within this report touches upon the following goals: Clean water and sanitation; Affordable and clean energy; Decent work and economic growth; Industry, Innovation and Infrastructure; Sustainable Cities and Communities; Responsible Consumption and Production and Climate Action.

source: CBS (2018)

1.3 International Sustainability Policies



Renewable Energy
This vision aims to contribute to the supply of affordable and clean energy by optimizing and increasing the production of biofuels. By improving the way waste is collected, the province will be able to produce more and cleaner energy while closing the waste cycle.

Good Jobs and Economic Growth
While reforming the production and consumption landscape of the province Zuid-Holland, and more specifically, the port of Rotterdam, this vision takes into account the jobs of the future. As new production flows and cycles emerge, so do all kinds of jobs. Retraining of workers will be supported and facilitated by nearby educational institutions.

Industry, Innovation and Infrastructure
New infrastructures will be created to optimize cascade flows. By doing so, transport will become more sustainable and will interfere less with passenger transportation, resulting in less traffic and less nuisance. Moreover, these new infrastructures will not form a boundary for nature. Because of ecological corridors, they will not interfere with nature.

Sustainable Cities and Communities
Land-use battles are carefully unpacked, making sure that decisions on the future of the area are well-rationalized. When deciding on the future of an area, sustainability and equality are of paramount importance. These two factors have led to a plan which focusses often on locality.

Responsible Consumption and Production
By producing food and energy more locally, levels of responsibel production are increased. The closing of waste cycles contributes to this goal as well. The central government also tries to steer its citizens toward more responsible consumption through legislation and campaigns.

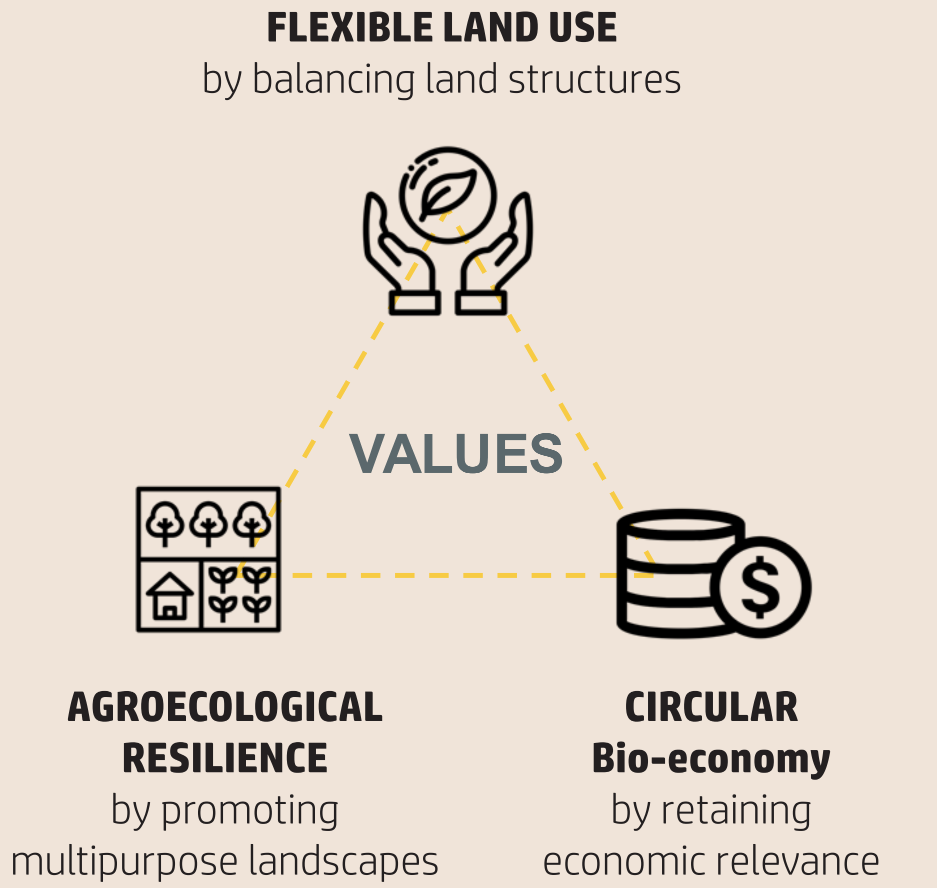
Climate Action
The Netherlands, and South Holland in particular, faces a lot of dangers that the climate crisis may bring. The area is prone to flooding, and anno 2022 the unsustainable agribusiness sector still covers a large part of the province. This vision aims to strengthen the province's coastal and inland waterway security while integrating sustainable offshore food production. Because of the strategies implemented by the central government to influence consumption patterns, the number of livestock in the area can be greatly reduced. The agribusiness sector will become more circular and effective through the influence of educational institutions and subsidies from the government.

Life on Land
By creating green corridors, it will become safer for animals to move around. Less animals will get killed by traffic or other human activities. Because of this, biodiversity will have the opportunity to flourish again. Next to this the introduction of native flora species in urban and natural environments will lead to increasing biodiversity numbers.

1.4 Values and Goals

Guiding values for South Holland

The initial definition of goals and values is the starting point to guide the vision and strategies during an interactive process of research and design. The research in bio-economy and potential new flows in chapter 3, applied to a deepened understanding of South Holland spatial structures and actors, transformed this initial parameters into more precise goals, values and concepts described in chapter 4.



Goals for 2050 South Holland

AGRO

Transform the Agrostructure to achieve balanced productive landscapes

Promote Biotechnology to enable future agro technologies, biochemicals and biofuels

SOCIAL

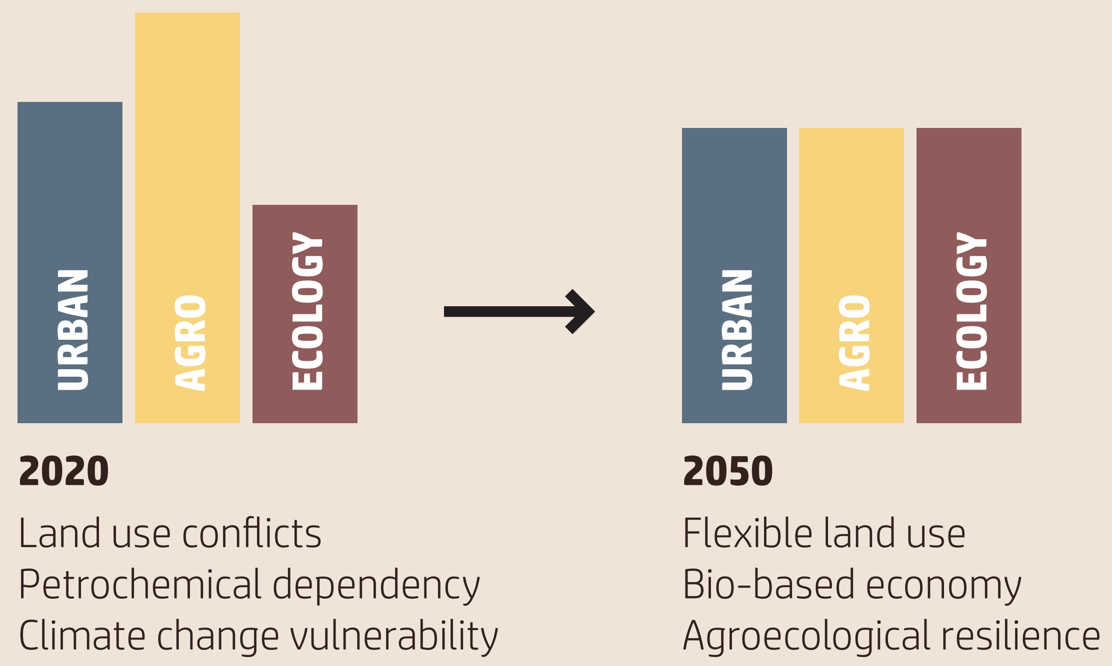
Guarantee socially just transitions to engage and empower local actors

Retain Port of Rotterdam economic relevance to enable flourishing jobs of the future

ECOLOGY

Expand ecological areas to promote biodiversity and climate resilience

Support renewable sources of bio-energy to achieve a fossil fuel free future



1.5 Research and Design Questions

Circularity has become a priority for the province of South Holland. The province has agreed with the national government that the Dutch economy should be fully circular by 2050 (PZH, 2019). The coming decades, the province focusses on the bio-based transition. They aim to close waste cycles, and extract high-value biomass (PZH, n.d.).

The spatial vision and the development strategy of the report aims to adhere to the vision of the province. Some assumptions have been made regarding to the future society and the impact of the climate change on the behaviour of society, like the assumption that society will eat more plantbased substitutes in the future, instead of cattle and calves meat and dairy products.

The regional vision of BIOCYCLE has three main focus points. First, it aims to reshape the province's agro-urban structure for the transition towards biobased products and bio-energy. Second, it will optimize cascade flows. Lastly, the vision is keen on preserving and enabling sustainable land-use. These three objectives, together with the province's vision, lead to the following main research question:

How can the biobased transition in the province of South Holland be ignited through the linkage of its agro-urban structure with new potential bio-industries, while promoting optimizing cascade flows and preserving sustainable land-use?

In order to answer the research question, it is divided in three sub-questions. These sub-questions will be answered throughout the entire vision, but more specifically in chapter 4.

How can biomass play a role in reducing the use of petrochemicals in line with the biobased transition of the province of South Holland?

How can sustainable land-use contribute to the biobased transition?

How can we optimize cascade flows to help the biobased transition of the province of South Holland?

To get more insight on the matter, the second chapter of this document is dedicated to research the current situation within the province. In this chapter the province's economy, spatiality and opportunities will be explained. Then, in the next chapter, the concept of the bio-based economy will be further clarified. Chapter 4 will outline the specific content of the vision and strategy, taking into account the three sub-questions. The vision and strategy are supported by local and national policies, which are outlined in Chapter 5. All of the given information leads to the regional design in chapter 6, since the spatial vision can be tested with a spatial design. The final chapter describes the achieved goals that this vision will have accomplished when fully implemented in 2050.

1.6 Method

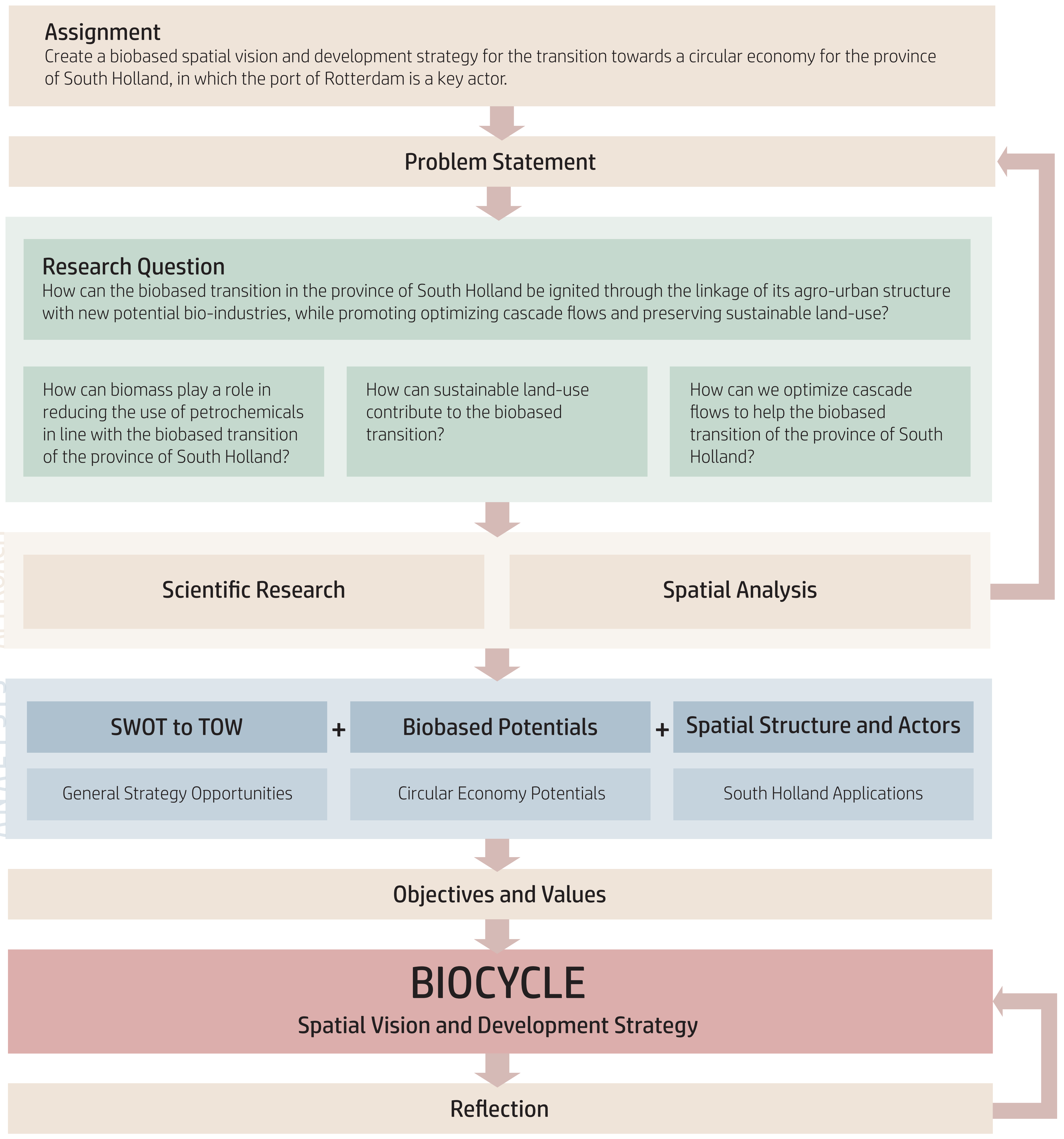
The process of BIOCYCLE is visualized in the scheme on the right. The process started with the assignment, which lead to the problem statement after discussing what the problems are of the current situation.

This problem statement lead to the research questions in which the biobased economy theme is integrated with the general circular economy objective.

The method of answering the research questions can be divided in two different approaches. The first is scientific research and the second spatial analysis. In the analysis that is mentioned underneath, both approaches are used to answer the questions.

The analysis consists of three main elements. First the SWOT to TOW which lead to the general strategy opportunities. This analysis mostly consists of literature research. Second the biobased potentials in which the different potentials are researched for the transition towards a circular economy. This analysis is mostly scientific research. Third is the analysis about the spatial structures and the actors, to research the South Holland applications. This analysis is mostly mapping and scientific research about different flows and values. All these elements of the analysis are input for the objectives and values.

These objectives and values eventually lead to BIOCYCLE, after regularly reflecting and changing the spatial vision and development strategy.



2 Analysis

The second chapter will explain the current situation of both the province and the port of Rotterdam. This includes analyses about infrastructures, urban areas, (protected) nature, land-use, sustainability and economic values.

The chapter ends with the opportunities as a starting point for a transition in the future.

CONTENT

2.1 Explain the Province

2.1.1 Urban Areas

In the map on the left is an overview of the urbanization of the province of South Holland. Shown are the locations of important cities and the land coverage of the port of Rotterdam.

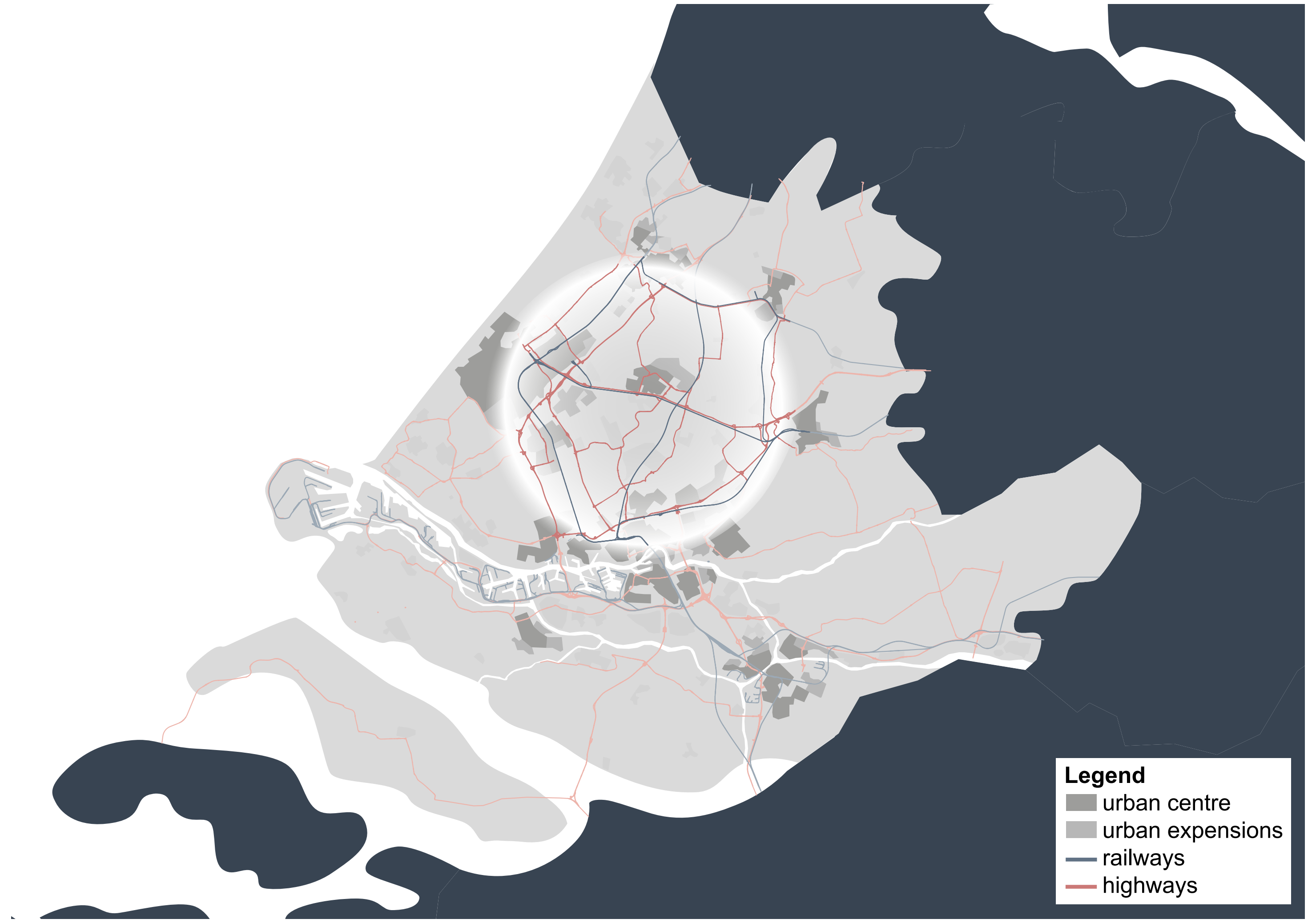
The port of Rotterdam has a worldwide relevance and is responsible for 6.2% added value to the Dutch economy. The total export value being €45 billion euros. (Lemmers, O., 2022)

2.1 Explain the Province

2.1.2 Infrastructure

The image above shows the railways and the highways in South Holland. The urban areas in the province are connected to each other with the railways and highways. Only the east and south of the province as less connected. These are the area's with the most agricultural land, later referenced to in paragraph 2.1.3.

The extensive railway network are not only used for passenger transport, but also include a high amount of freight-rain tracks connecting the province with other countries in Europe, like Germany.



From the infrastructural analysis of the province the next image shows a conclusion next to a potential. When looking at the total of logistics, the infrastructure between the different urban areas form a ring. This logistic ring is formed not only by highways, but also by railways. Within this current structure lays the potential to use this network as a transport system for products, waste-flows and others. The fact that this ring is not only formed by highways, but also by a railway, makes it even more interesting. Railways have the potential to take up a lot of the transport demand. One freight train can transport around the same amount of products as 56 trucks. Next to this 1 ton of products gives 5 times less amount of CO2 emissions when moved by train. (ProRail, 2021)

2.1 Explain the Province

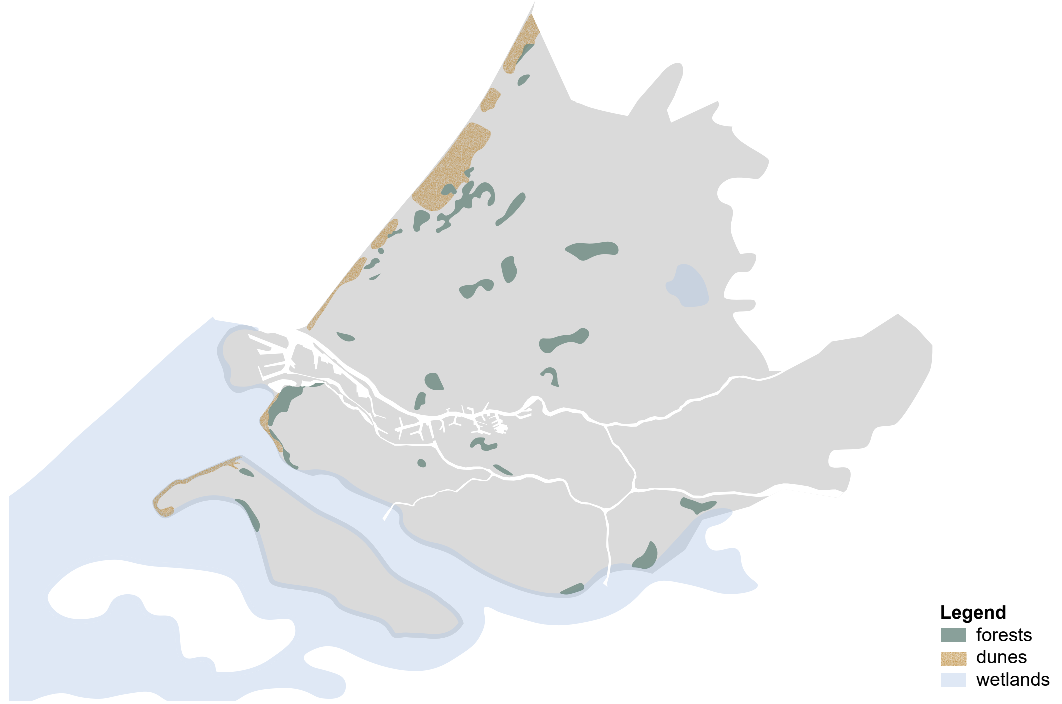
2.1.3 Agriculture and Protected Nature

Image ? shows the protected nature areas in South Holland. The protected areas consist of the dunes, forests and wetlands. Especially the forests in the province are really fragmented, but also the dunes.
In the conclusion map, image ?, the total of the protected nature areas are showed.

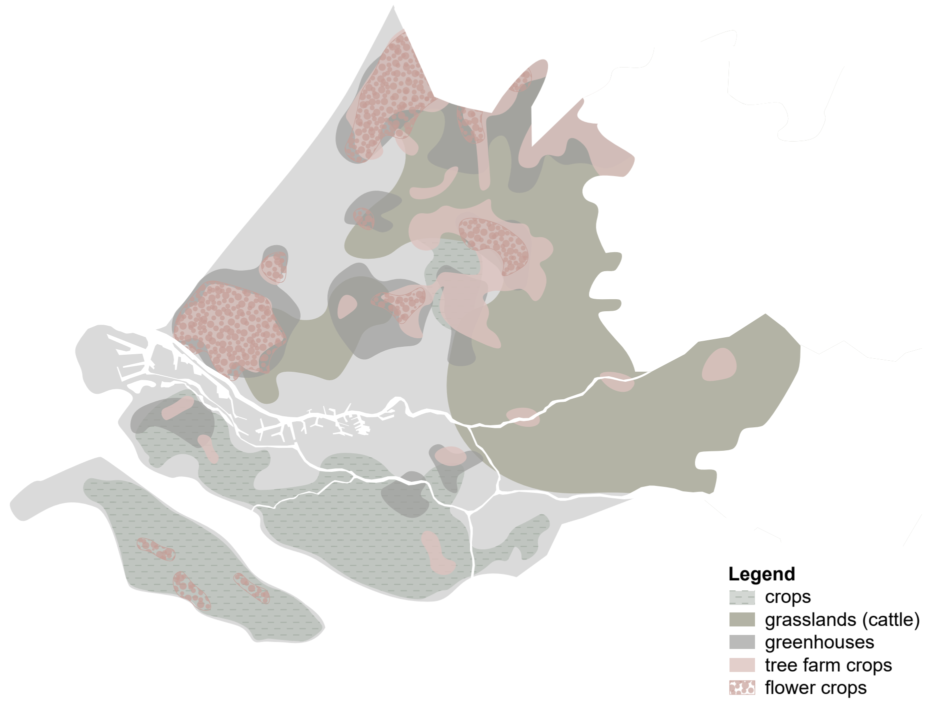
Image ? shows the agriculture in South Holland. The agriculture in this map consists of crops, grasslands for cattle, greenhouses, tree nursery and flower crops.

These areas are responsible for many agricultural products for the food industry and are important for the import and export of the Netherlands.

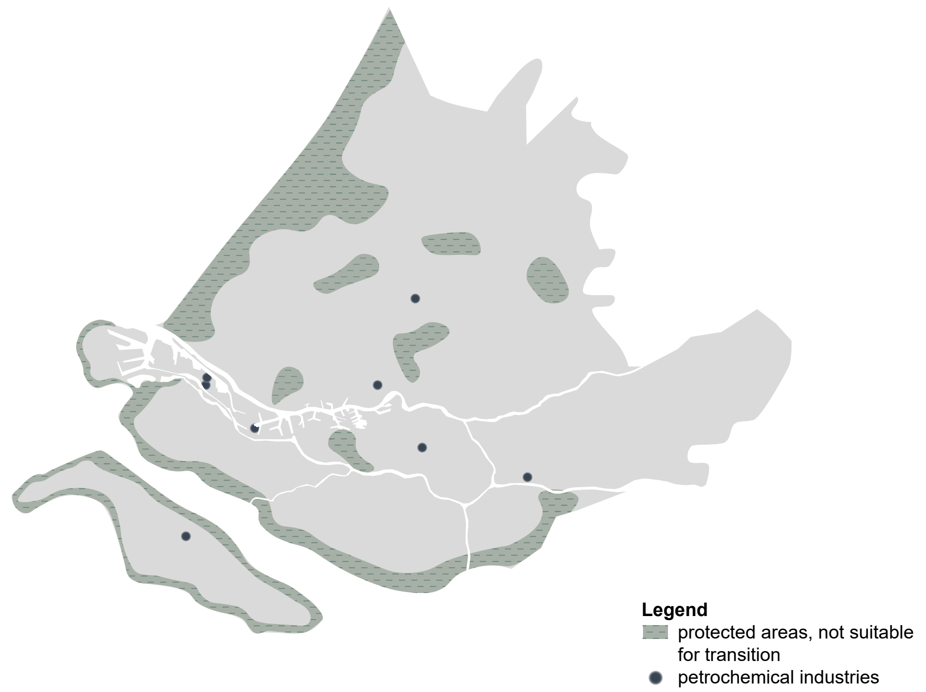
In the conclusion map, image ?, the protected nature areas and parts of the agriculture are visible. These agriculture areas have the potential for transition in the future.



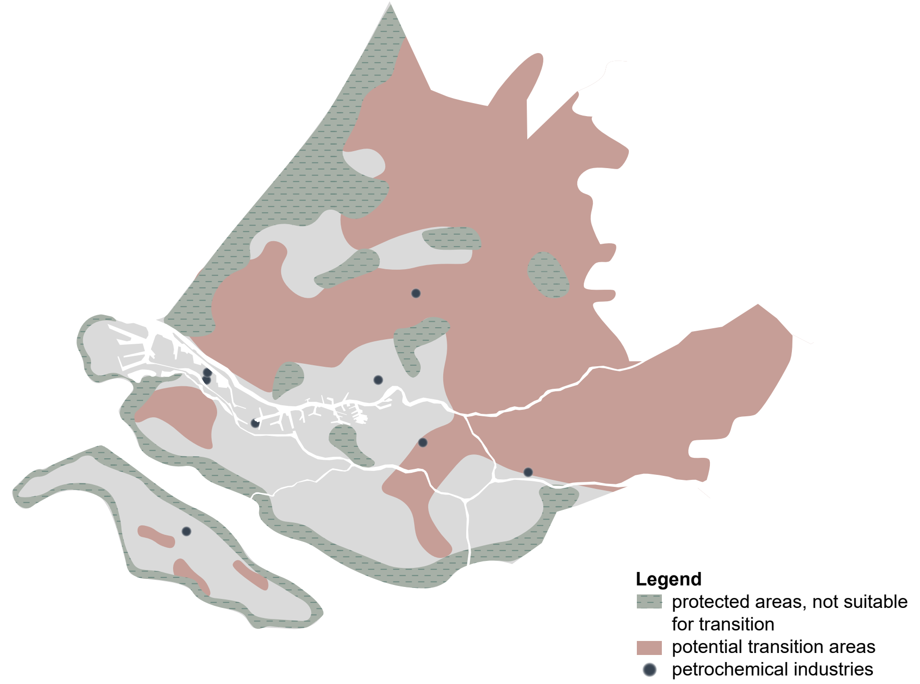
Protected nature areas in South Holland



Agricultural areas in South Holland



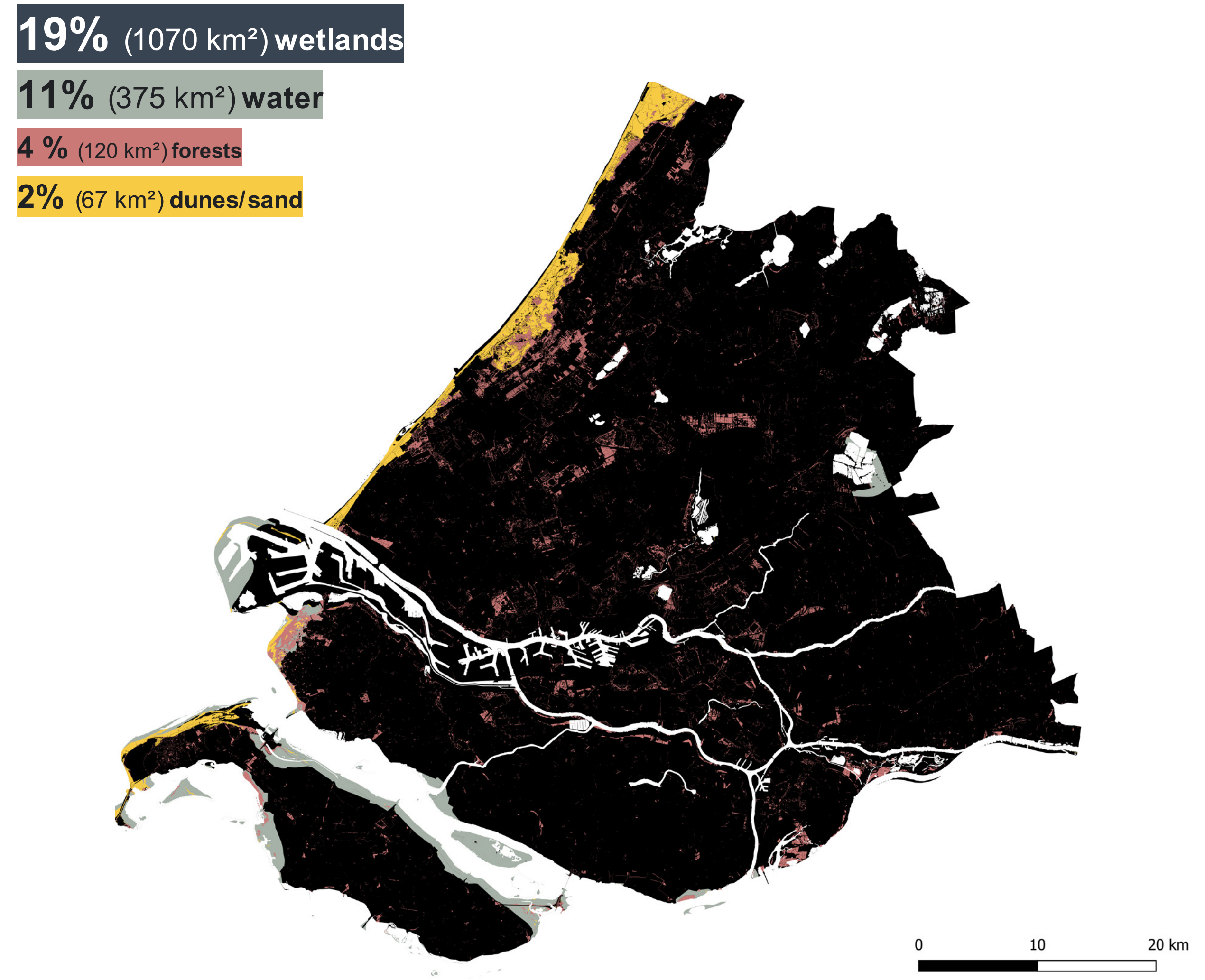
Conclusion protected areas in South Holland

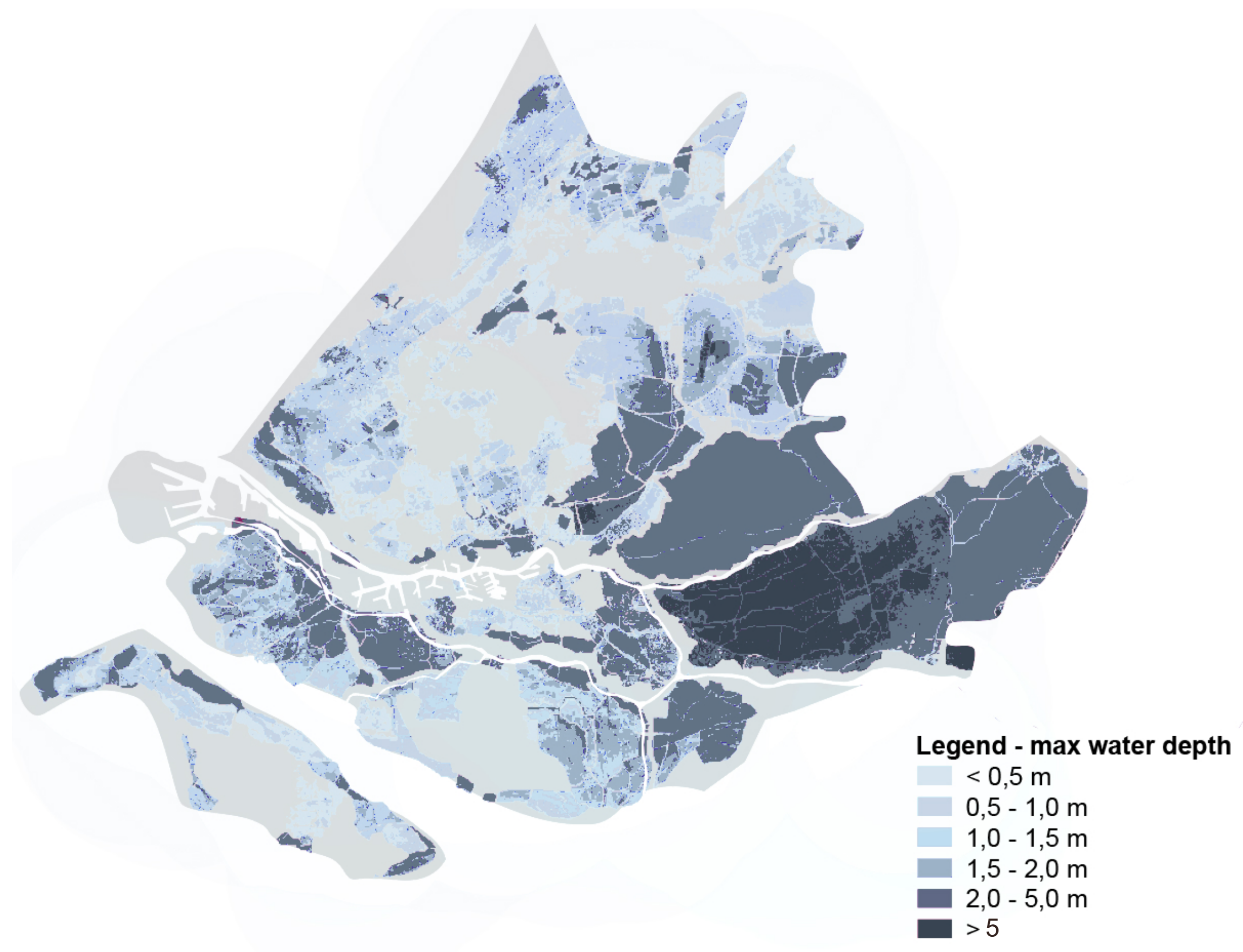


Conclusion transition areas in South Holland

2.1 Explain the Province

2.1.4 Ecology





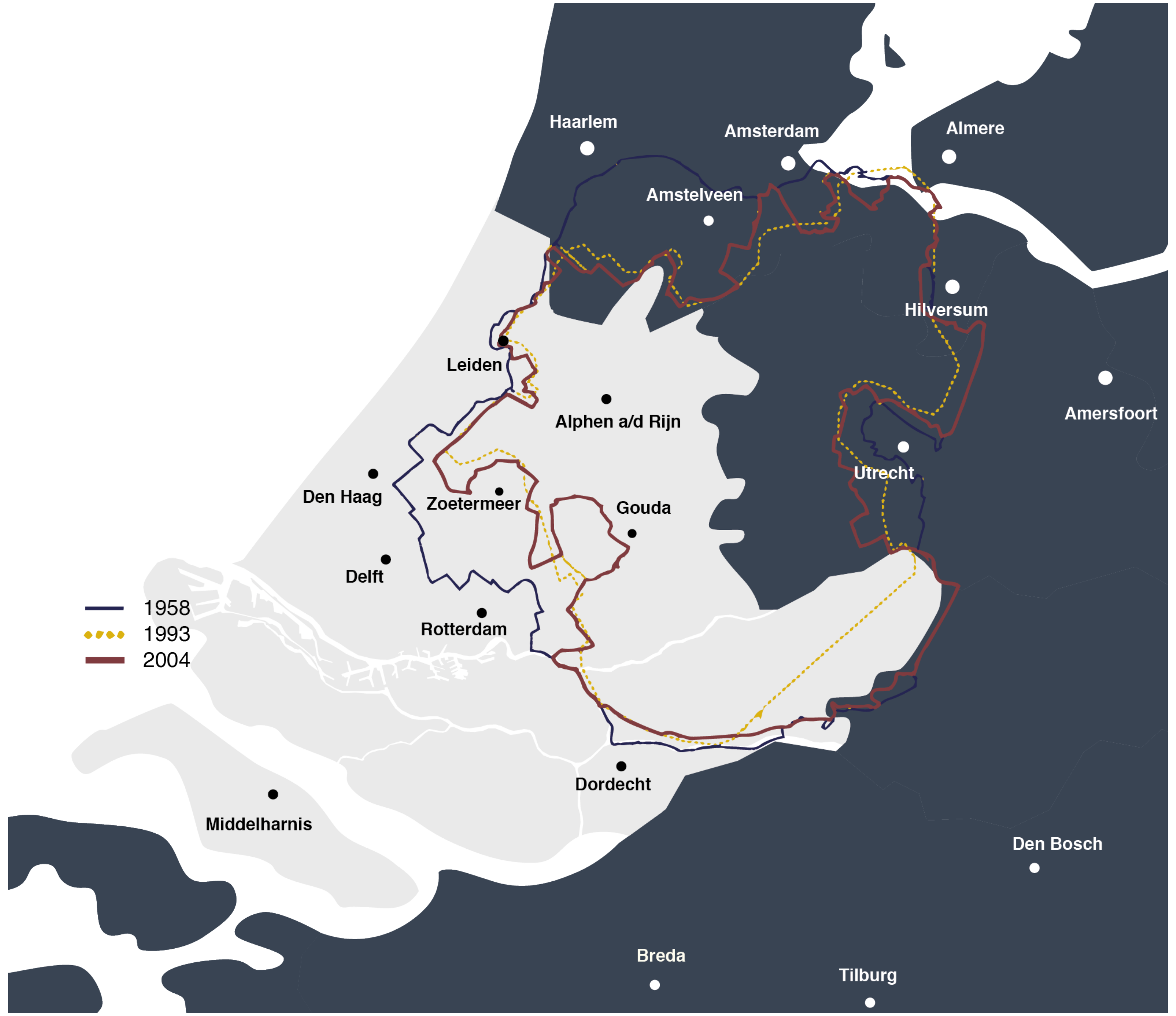
Maximum waterdepth after floods. Source (Atlas Leefomgeving, 2021)

In Figure x. the parcels with a natural function have been highlighted. Natural functions like, wetlands and dunes are very scarce in the province. Therefore some of them are a part of protected natural area's (paragraph 2.1.3). The low amount of non-cultivated lands is an interesting aspect of the land-use of South Holland.

On the map on the right the maximum water depth when South Holland would flood is shown. On the east side of the province there is a big area with a maximum water depth of 2,0 - 5,0 meter and even more than 5,0 meters. The area near the coast have a lower maximum water depth. These areas are protected by the dunes. The challenge therefore lies with the agricultural lands in the east of the province that lay next to the river.

2.1 Explain the Province

2.1.5 The Green Heart

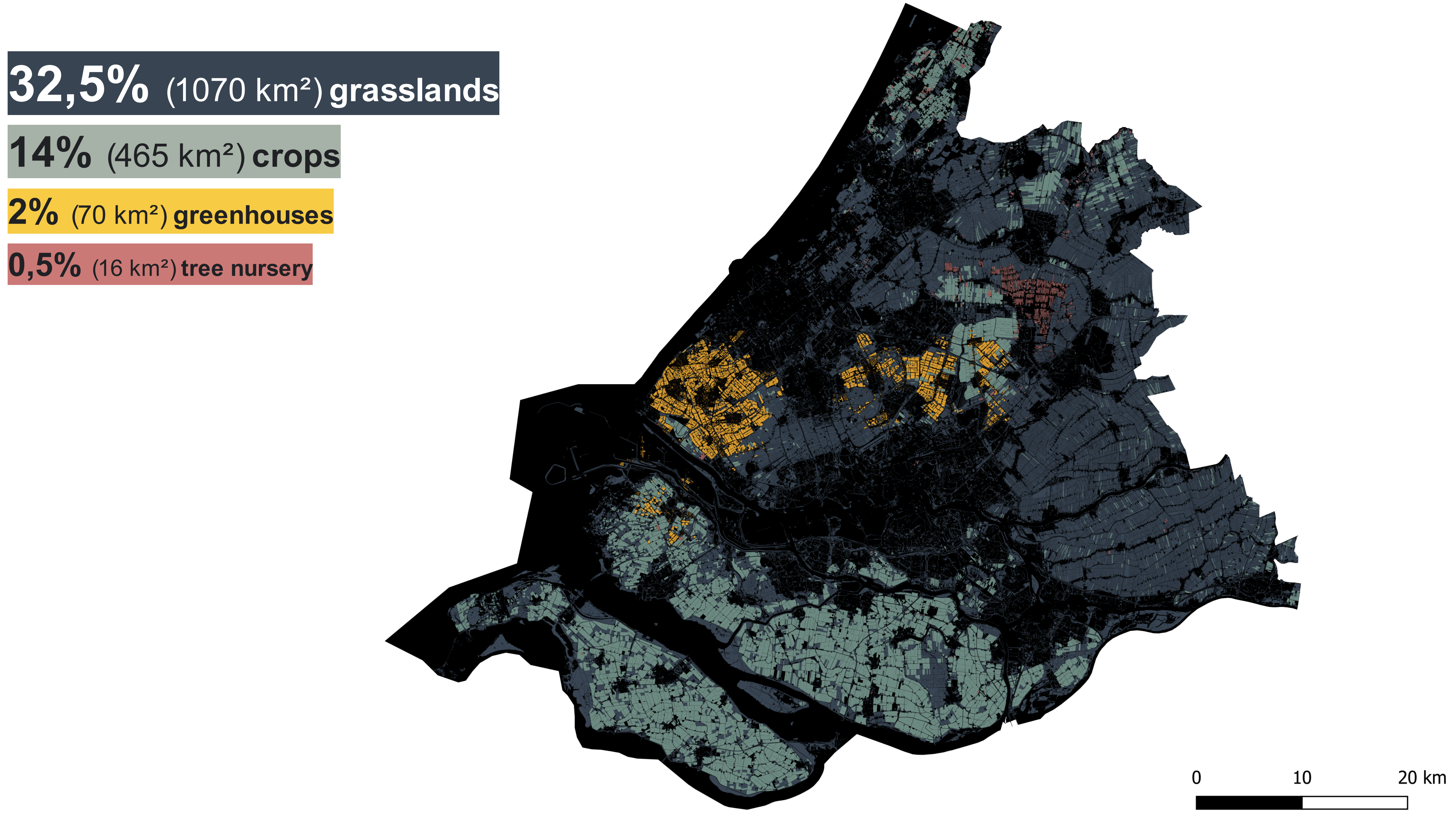


Traditionally, the Green Heart has always been an area where nature could take its course. This was the case, until many city dwellers moved to the area. As industrialization and innovation took place, cities became polluted by the factories and poor hygiene of the time. This caused wealthy city dwellers to leave the city and build (vacation) homes in the Green Heart. Those same wealthy city dwellers had enough influence in municipalities and provinces to build a tramline that would take them from the city into nature. Slowly, the built environment began to expand within the Green Heart.
People wanted the building in the area to stop, but there was no one directly responsible for the area, because it was spread out over different municipalities and provinces. Therefore, it was hard to create and implement policy on the area. (SteenhuisMeurs, 2021)

When governments where scared that urbanization would take over the natural areas in our province they made policies protecting the green heart from parcellation. This is interesting because nowadays, when again natural areas are scarce, policies have to be made to introduce a balance in our urban environments. This project aims to introduce an extension and renewed expression of the green heart within the province of South Holland.

2.2 Unsustainable Land-use

2.2.1 Disbalance



In the image above you can see the amount of land covered by agriculture within the province. Already looking at this image the question rises, what else is even there? 48% of our provincial land is filled with agricultural functions like greenhouses and grasslands filled with cows. This comes to a total of 1620 km2. In paragraph 2.1.4 the area of natural elements is discussed. Now, comparing this to the amount of agricultural lands, we can see that there is an enormous disbalace resulting from cultivating our lands. Natural areas have become scarce and this does not have the wanted effect on our climate. Connecting to the “farm to fork” strategy of the EU, we know that making our agricultural lands more sustainable is really high on the list of things that need to change.

This might now, only come across as a bad thing, but where it does leave us with a disbalance in land-use it is also one of our countries main economic drivers. (Paragraph 2.4) And where money is involved, there is also a lot of people depending on a job in these fields. This will make the transformation of these areas a complicated social and economic matter as well.

2.2 Unsustainable Land-use

2.2.2 Land-use Battles

In the province of South Holland, every square centimetre has been given a function. This is for example housing, greenhouses, nature (forests, dunes, lakes or parks) or industrial areas. With a growing population the demand for urbanization rises, but space is something very scarce. Next to a demand in housing development, areas have to be transformed in order to form a sustainable landscape. For example the builds-capes of solar panel fields or wind-energy parks.. Because of this, land-use battles will emerge. Often, the three dimensions of sustainability (social, economic and environmental) will be in direct conflict with each other. In order to solve these conflicts of space, pro's and cons on all scale levels will have to be considered.

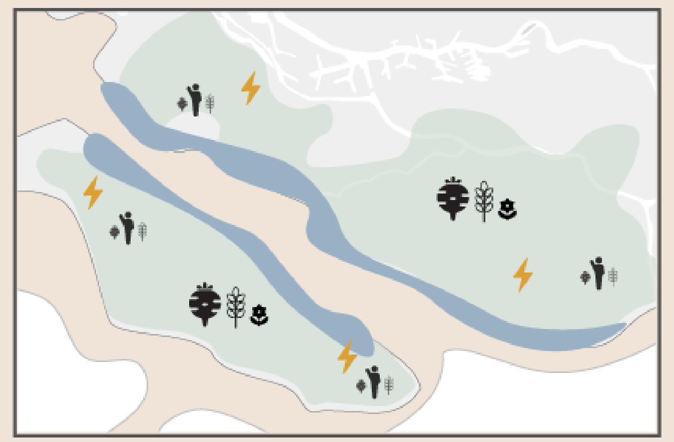
Land Use Battles

- Industries Vs. Housing
- Agro Vs. Housing
- Nature vs Housing
- Agro vs Nature

Extra Challenges

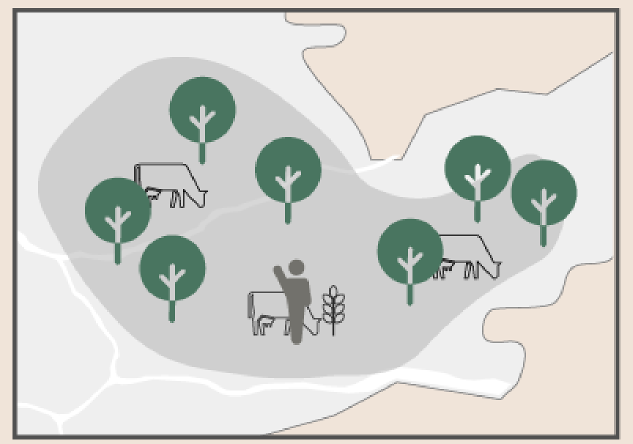
- Vs. Housing
- Vs. Energy
- Vs. Nature

2.2 Unsustainable Land-use

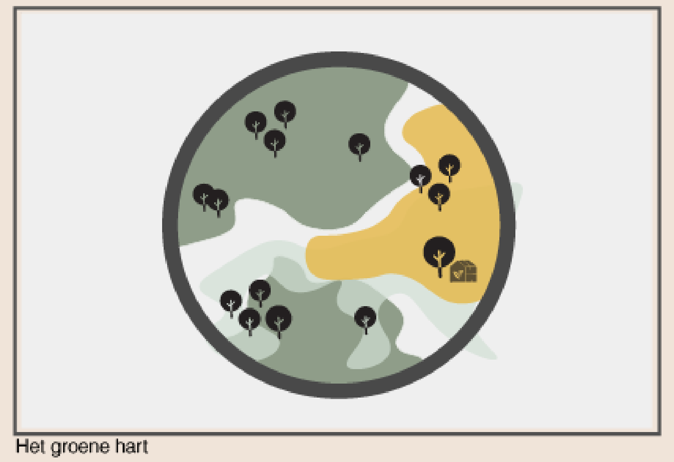


On the island of Goeree-Overflakkee and it's surroundings most of the land is currently used for agriculture. By cultivating these area's nature has in a way been pushed out of the equation. Next to this new innovations for solar-panel fields and wind-energy production also demand space on these lands.

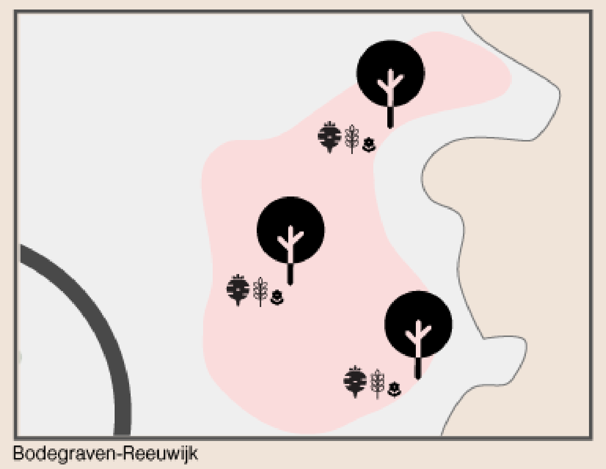
The Westland mostly exists out of greenhouses. The urban area's are filled with people who work in these industries, but for growing population there is no space left let alone space for natural area's.



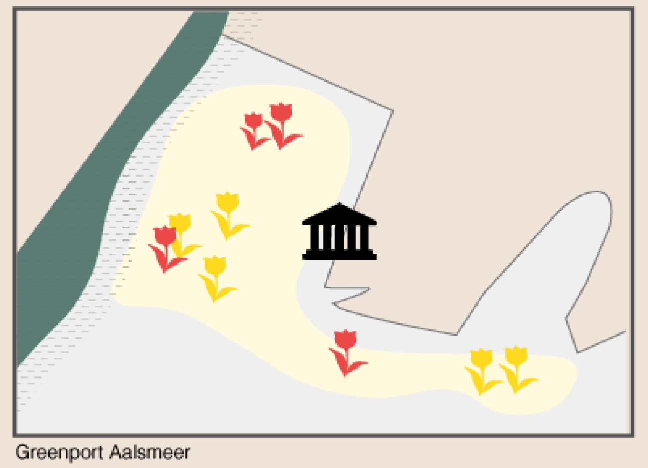
Within Krimpenerwaard the cattle area is huge. Because of the cattle industry land has been cultivated into grasslands an biodiversity has shrunken to dangerous lows. There is a high importance to bring nature back into these lands.



Within the heart of our area, surrounded by infrastructure we have an area which is still covered by natural lands. However, greenhouses and housing have infiltrated this area and battles with the natural lands for space.



Around the west of the province cultivated lands are very diverse. Crops, Cattle and Tree nurseries are taking up a lot of space. What does this leave for housing and nature?



The flower industry in the area around Lisse is famous for its tulips. The Keukenhof is visited yearly by thousands of people and have become a Dutch heritage. Question is, does this leave us with enough space for urbanisation and green.

2.2 Unsustainable Land-use

2.2.3 Consequences Cultivated Lands

source: Google Earth (n.d.)

The crop areas are unsustainable, because they need multiple products to grow vegetables efficiently. In the first place there is a lot of water needed to water all the vegetables, but next to that the crops need fertilizer and pesticides. The growing of vegetables also affects the soil nutrients, which also affects the soil quality. (Jhariya & Meena & Banerjee, 2021)

source: Google Earth (n.d.)

The cattle areas are mostly unsustainable, because of the nitrogen emissions that are caused by the cattle and calves. Also, there is a lot of water needed for feeding and meat and dairy production. The soil quality is also affected by the cattle and calves. (Jhariya & Meena & Banerjee, 2021)

source: Google Earth (n.d.)

The tree nurseries are mostly unsustainable because there is a lot of water needed to grow the different plants and trees. There is an opportunity for the tree nurseries to grow native tree species to increase the biodiversity. Non-native tree species are a risk, since these species can affect the ecosystem and the biodiversity. (Gemeente Rotterdam, n.d.)

source: Google Earth (n.d.)

The greenhouses are unsustainable for multiple reasons. The greenhouses cause different kinds of emissions and also light pollution, which causes biodiversity loss (Svensson, n.d.). The greenhouses also cause subsidence of the soil, because of the big amount of space that is needed. Therefore the water cannot infiltrate into the soil at the locations of the greenhouses (PBL, 2016). To grow the vegetables efficiently there is also a need of water, fertilizer and pesticides which is unsustainable (Jhariya & Meena & Banerjee, 2021).

source: Google Earth (n.d.)

The flower industry in greenhouses is also unsustainable for multiple reasons. Since the flower industry is partly in greenhouses, the same problems emerge as the greenhouses sector. There are emissions and light pollution (Svensson, n.d.), but also subsidence of the soil (PBL, 2016). The flower industry needs water to grow the different flowers which is also unsustainable (Jhariya & Meena & Banerjee, 2021). The cut flowers of the industry are unsustainable, since these flowers are grown to last for two weeks and are then thrown away.

source: Google Earth (n.d.)

The flower industry on the open field is mostly unsustainable, because of the amount of water that is needed to grow the flowers (Jhariya & Meena & Banerjee, 2021). Next to that, the cut flowers are unsustainable, since these flowers are grown to last for two weeks and are then thrown away. The tulip fields are considered as heritage though, because the fields are beautiful. All these flowers in different colours attract all kinds of people that love to take pictures in between the fields.

2.3 The Port

The total surface of the port of Rotterdam is about 12.500 ha. This includes the water parts. The surface of the land parts is around 8.000 ha (Havenbedrijf Rotterdam, 2021). This surface includes also the villages that lay in between the industries of the port, for example Rozenburg and Pernis.

When only the industry functions are included in the surface, the port is around 4.000 ha. This also excludes infrastructures. The different functions in the port are mostly chemical and petroleum-based, with companies like Shell. The percentage of the surface of petroleum-based industries in the port of Rotterdam is 70%. The bio-based industries in the port take in 10% of the total surface and 20% are other functions, like the industries for energy and metals. This means that there needs to be a huge shift is the port needs to be completely bio-based.

The port has lots of companies and also includes some key players for the transition towards a biobased economy. Some examples of these companies are:

Esso
Esso is an industry leader in the energy and chemical manufacturing business. They operate facilities or market products in multiple countries and explore for oil and natural gas on six continent. (Esso, n.d.)

Shell
As an energy company, Shell is active in the entire chain of energy resource exploration, refining and finally the sale of end products such as petrol and diesel through a network of pumping stations. (Shell, n.d.)

Cargill
Cargill buys, processes and distributes grain, oilseeds and other commodities to food makers for food and animal nutrition products. They also provide crop and livestock producers with products and services. (Cargill Netherlands, n.d.)

Rubis
Rubis is a terminal for the storage of mineral oil products and chemicals. They are a subsidiary of the international, publicly traded company Rubis Group. Rubis has a vision of being flexible and offering customized solutions. This will might make them an option for change towards biobased oils. (Rubis Terminal, n.d.)

Source: Own Pictures

2.4 Understanding Economic Value
2.4.1 Import and Export Values

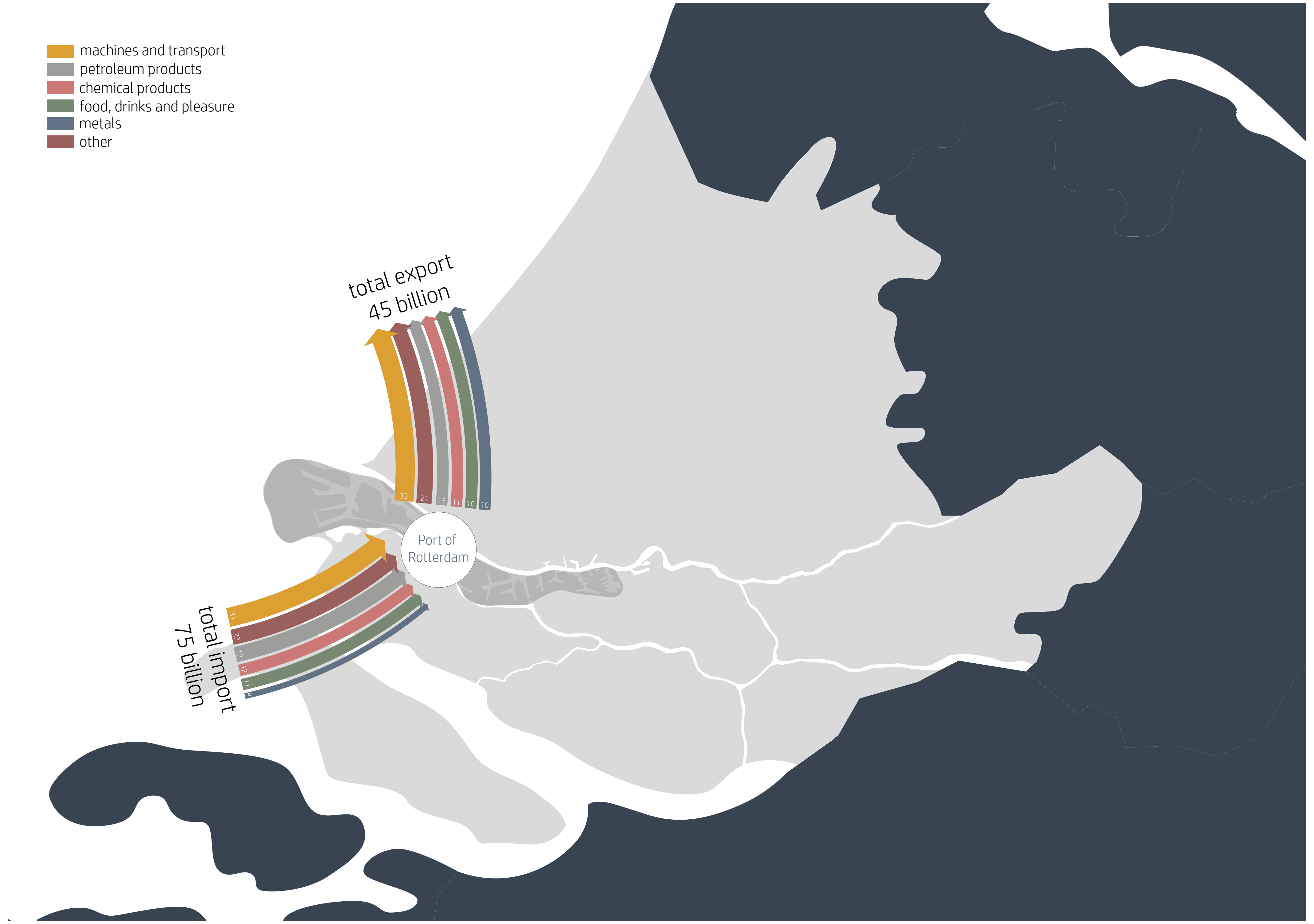
Because agriculture takes up such a huge amount of space in our country it is also the basis for our economic structure. The import and export value of agricultural goods in 2018 was € 90.3 billion. Which makes the Netherlands the top one country for export of agricultural products in Europe. Most of the products we transport are moved to Germany and Belgium. (WUR,2019) Transport of this products focuses on inland shipping and rail transport. Next to the export and import of agricultural products the port of Rotterdam focuses mainly on petrochemical industries.

> “Export figures once again show that the Dutch agriculture and horticulture sector is a major player when it comes to producing food for a growing world population. We’re keen to put our expertise and powers of innovation to good use in order to make the transition to circular agriculture. This will give a boost to the agricultural innovation in the Netherlands that continues to bolster our position on the global market. And that’s urgently needed, in view of the global issues vis-à-vis growing demand for food on the one hand and our responsibility for the landscape, biodiversity and climate change on the other.”
>
> - Minister for Agriculture, Nature and Food Quality Carola Schouten

The (petro) chemical industries of the Port of Rotterdam are responsible for 20% of the added value to the Dutch industry sector. It provides over 13.000 direct jobs and 60.000 indirect jobs. By this, the port has proven to be an outstanding hub in the petrochemical sector. The part of this sector focused on oil and oil refineries has a part of 3,5 thousand jobs in this. Just counting the throughput of fuel oils in 2015 alone the port has moved over 59 billion mega-tonnes. The current amount of product throughput of biofuel, like biodiesel, is a lot lower at the moment. In 2015 it counted 2,8 mega-tonnes of biodiesel. The biofuel sector provides for a number of 260 jobs, which i a lot lower than the current other industries. (Port of Rotterdam Authority, 2016)

2.4 Understanding Economic Value

2.4.1 Import and Export Values - The Port of Rotterdam



Total of direct economic values Rijn- en Maasmond Ports (Lemmers, 2022)

2.4 Understanding Economic Value

2.4.1 Import and Export Values - *products of cattle and calves*

Chosen products
The products chosen for the value calculations are the main products related to cattle and calves. Most attention is paid to cattle and calves because they occupy the most space of the grasslands in the province of South Holland. The table shows multiple uses of cattle and calves products, such as butter, cheese and other milk products.

Cheese
Cheese is an important dairy product in the Netherlands. The numbers of dairy products are based on the amount of Dutch products handled in Dutch dairy factories. A total of 972,734,000 kg of cheese is manufactured in Dutch plants. This is 45% of all cattle and calve products made in the Netherlands.

The export value of cheese is €3,5 billion.

Bovine meat
Bovine meat includes all the meat of cattle and calves. There are 432.835.000 kg of bovine meat produced annually. This amount is 20% of all cattle and calve products produced.

The export value of bovine meat is €2,4 billion.

Milk
The milk products category includes both milk powder and condensed milk. The total weight of those products combined is 641,967,000 kg, which is 29% of the total cattle and calve products.

The export value of milk is €2,3 billion.

Butter
The total weight of butter produced is 133,605,000 kg. This is 6% of the weight of all products from cattle and calves. T

he export value of butter for the Netherlands is €1.3 billion.

2020

butter (1000 kg)	factory cheese (1000 kg)	powdered milk (1000 kg)	condensed milk (1000 kg)	bovine (1000 kg)
133.605	972.734	248.115	393.852	432.835

Weight of products of cattle and calves manufactured in the Netherlands. Source (CBS, 2022c) and (CBS, 2022d)

The products of cattle and calves will be compared with their value per kilogram. The figures below are based on the weight of the various products (produced in the Netherlands) compared to the export value.

- Cheese has a value of €4 per kilogram
- Bovine meat has a value of €6 per kilogram
- Milk has a value of €4 per kilogram
- Butter has a value of €10 per kilogram

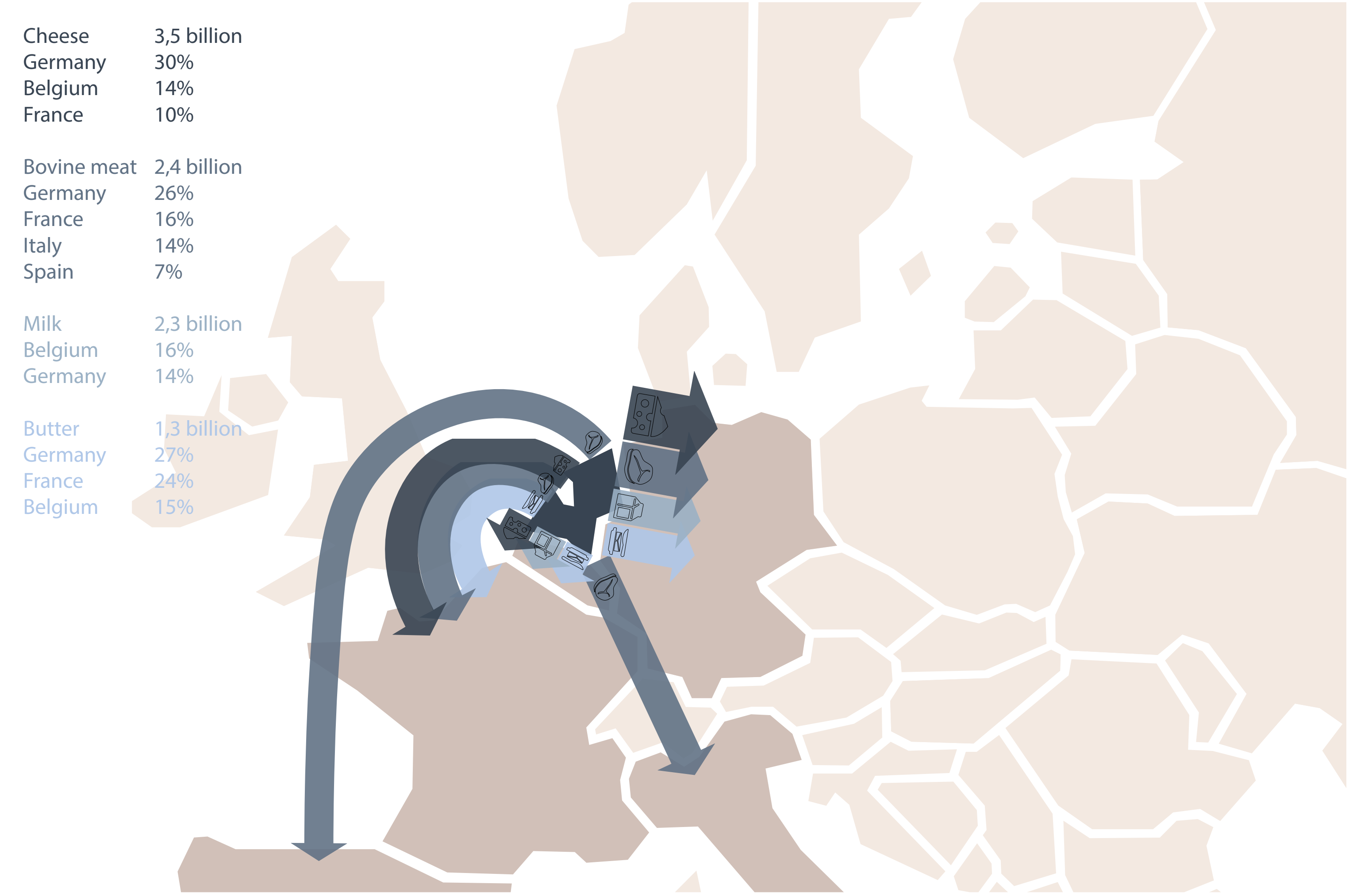
These values show that butter is a relatively high-value product which comes from cattle and calves.

The export and import maps show the main countries to which the Netherlands imports and exports.

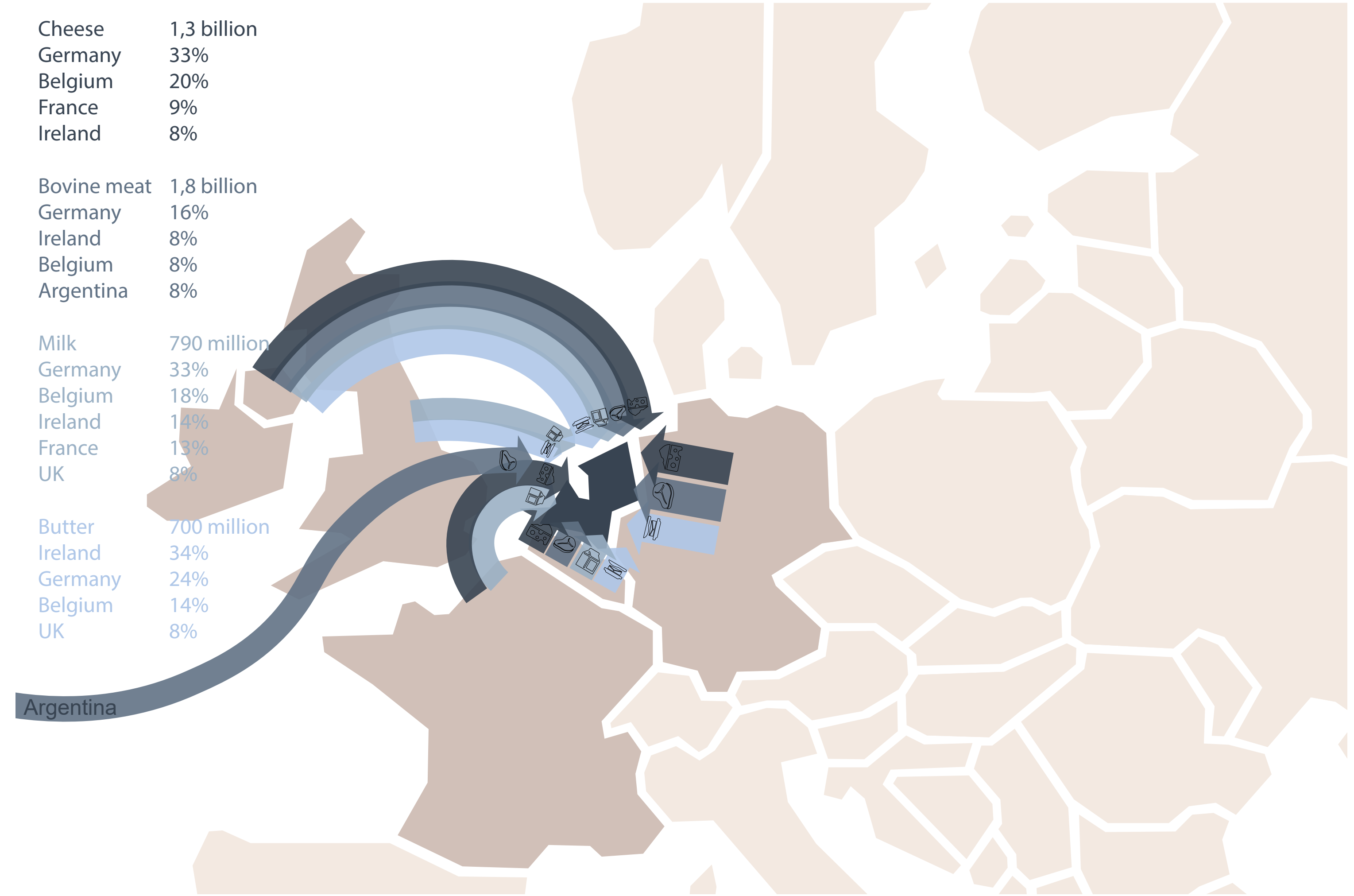
On the export map we see that the main export countries are all within Europe. Cheese has the highest export profit, but all products produce a high profit for the Netherlands. The import map also shows that the main countries that the Netherlands imports from are within Europe. A deviation in this pattern is Argentina: a lot of beef is imported from this country.

If one looks at the differences between the value of imports and exports, it is striking that much more is exported than imported. The Dutch cattle and calve industry is therefore a large and important industry within the country.

The Dutch cattle and calve industry may be big, but when looking at the same industry within the province of South Holland, meat industry does not appear to be the same size. The province of South Holland has 13,220 cows for the meat industry and 101,865 cows for the dairy industry plus another 55,851 young cattle for the dairy industry (Province of South Holland, 2018). This means that the dairy industry is quite a bit larger than the meat industry in the province of South Holland.



Export of products for cattle and calves. Source: own map, based on data from (OEC, n.d.)

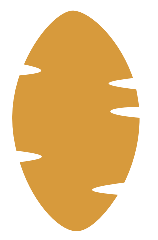


Import of products for cattle and calves. Source: own map, based on data from (OEC, n.d.)

2.4 Understanding Economic Value

2.4.1 Import and Export Values - *products of crops*

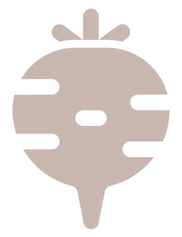
Chosen products
The products that are chosen for the value calculations are based on the production scale in the Netherlands.
Potato, corn, wheat and sugar beat are the four biggest vegetable industries in the Netherlands (Provincie Zuid-Holland, 2018).



Potato
Potato is a very common crop within the province of South Holland. In the table it is shown that potato fields in the province of South Holland take up around 10.000 ha. The yield of these fields in South Holland is about 500,000,000 kg, which is 7% of the potato yield of the Netherlands (CBS, 2022a). The export value of the Dutch potato totals 860 million euros for all of the Netherlands, making it an important vegetable for the country. When the value is set against the amount of space needed, potatoes yield 52 million euros on 10,000 ha of cultivated land.

Corn
Corn is also an important vegetable for the Netherlands. The corn fields in the province of South Holland take up around 5.000 ha. The yield of these fields is about 220,000,000 kg, which is 3% of the corn yield of the Netherlands (CBS, 2022a).
The export value of corn is 230 million euros for the whole of the Netherlands. When the value is compared to the amount of space needed, corn requires about 5,000 hectares of cultivated land for an export yield of 6 million euros.

Wheat
Wheat has a smaller yield than potato and corn. The wheat fields in the province of South Holland are about 11,000 ha in size. The yield of these fields is around 95.000.000 kg, which represents 10% of the wheat yield of the Netherlands (CBS, 2022a). The yield is much smaller than that of potatoes and corn, while the space required is greater than that of potato fields.
The export value of wheat is 90 million euros for the whole of the Netherlands. When the value is compared to the amount of space needed, wheat needs about 11,000 hectares of cultivated land for an export value of 9 million euros.



Sugar beet
The sugar beet industry differs from the industry of other vegetables, as the Netherlands itself hardly exports or imports the vegetable. However, the country imports and exports the sugar obtained from sugar beet on a large scale. The sugar beet fields in the province of South Holland are around 5.000 ha large. The yield of these fields is about 420,000,000 kg, which is 6% of the sugar beet yield of the Netherlands (CBS, 2022a). The revenue 9s comparable to the revenue of potato, which means that the sugar beet is also an important vegetable for the Netherlands.
The export value is in this case about sugar instead of the sugar beet, since the vegetable itself is seldom exported. That is why the sugar beet is not included in the import and export maps. The export value of sugar is 720 million euros (OEC, n.d.) for the whole of the Netherlands. When this value is compared to the amount of space needed, sugar beets require about 5,000 ha of cultivated land for an export value (of sugar) of 42 million euros.

2020	cultivated area (ha)	harvested area (ha)	gross gains per ha (1000 kg)	total gross gains (1000 kg)
wheat	10.781	10.690	9,0	96.597
corn	4.961	4.954	44,7	221.305
potato	10.081	9.957	50,2	500.044
sugar beat	4.750	4.750	88,1	418.493

Amount of products of crops in the province of South Holland. Source (CBS, 2022a)

These four vegetables can be compared according to their value per hectare. These numbers are based on the proportion of fields in South Holland compared to the total area of fields in the Netherlands. This percentage is used to calculate the value in the province relative to the value in the Netherlands. The values are therefore based on the province of South Holland.

• Potato has a value of €5.200 per hectare
• Corn has a value of €1.200 per hectare
• Wheat has a value of €800 per hectare
• Sugar beet has a value of €8.400 per hectare (based on the export of sugar)

These values show that the sugar beet is a high-value product when exported as sugar. The potato also has a high value. Corn and wheat have a lower value, which means that there is more surface needed for less export value.
The export and import maps show the main countries to which the Netherlands imports and exports.
The export map shows that exports are mainly to nearby countries. Germany and Belgium are the most important export countries for all vegetables. Potato yields the most profit and wheat the least.

The import map shows that the most important import countries are within Europe. The Netherlands imports 1.1 billion euros worth of corn, mainly from Ukraine. With the current Russian invasion of Ukraine, corn imports will become a problem (Leiva, 2022).
The export value of the potato is 860 million euros and the import value is 310 million euros. So we can conclude the potato is an important export product for the Netherlands.
The export value of corn is 230 million euros and the import value 1.1 billion euros. The production of corn in the Netherlands is quite small-scale when compared to the demand which is shown by the high amount for which corn is imported.

The export value of wheat is 90 million euros and the import value is 900 million euros. Also with wheat, there is much more import than export. This is probably because a lot of space is needed for a relatively low wheat yield (table ?). The Netherlands is a small country does not have enough space to produce such a large amount of wheat.

Export of products for crops. Source: own map, based on data from (OEC, n.d.)

Import of products for crops. Source: own map, based on data from (OEC, n.d.)

2.4 Understanding Economic Value

2.4.1 Import and Export Values - *products of greenhouses*

Chosen products
The value of four commonly produced products in the Netherlands will be calculated. First, the value of tomatoes will be calculated, since this is the most grown crop in Dutch greenhouses. Next, the value of the flower industry will be calculated. The flower industry is large and polluting, and therefore plays a big role in the economy. In addition, the value of seeds will be calculated. Seeds are a high value product and have the potential to contribute to the transition to a biobased economy. Lastly, the value of plants with roots will be calculated. This industry is an addition to the cut flower industry, and also of great value to the Dutch economy.

Seeds
Growing seeds does not take up much space. The seeds included in this report are potato seeds, flower seeds and vegetable seeds.
It can be seen from Table ? that only 47% of the seeds produced in South Holland come from greenhouses. It can also be seen that the seeds grown in South Holland are 23% of the total production of seeds in the Netherlands.

The export value of seeds for the Netherlands is 2.0 billion Euros. If the value is set off against the amount of space needed, seeds need about 200 ha of land for an export value of 170 million euro.

Tomatoes
All Dutch tomatoes are grown in greenhouses. Growing tomatoes covers an area of 10,564,378 m2 in the province of South Holland and 18,461,911 m2 in the Netherlands (Table ?). This means that 57% of all tomatoes are produced in South Holland. The reason for this is the large number of greenhouses in this province.
The value of the total kilogram of tomatoes exported from the Netherlands is 1.7 billion euros. If the value is combined with the amount of space needed, about 1100 ha of land is needed to export 970 million euros worth of tomatoes.

Cut flowers
The cut flowers in the Netherlands usually grow in the open ground. These flower fields are important to the Dutch heritage; since the introduction of the tulip, tulips fields have been an integral part of the landscape. Also, when the fields are in bloom, they attract many tourists. The percentage of cut flowers grown in greenhouses is 72% in the province of South Holland, while on the scale of the Netherlands only 41% of cut flowers are grown in greenhouses. This is because most flower fields are in the province of North Holland. In South Holland there are many greenhouses and therefore the percentage of cut flowers in greenhouses is high.
The export value of cut flowers is 210 million euros. If the value is set off against the amount of space needed, cut flowers in greenhouses need about 1200 ha of land to create an export value of 50 million euros.

Plants with roots
The percentage of rooted plants growing in greenhouses in the province of South Holland is 26%. This is relatively high compared to the Dutch percentage of rooted plants growing in greenhouses, which is only 7%. This shows, as does the cut flower sector, that more flowers are grown in greenhouses in South Holland compared to the rest of the Netherlands than in the open ground.
The total export value of rooted plants is 200 million euros. If the value is combined with the amount of space needed to grow rooted plants, plants with roots in greenhouses require about 1200 ha of land for an export value of 8 million euros.

2021	Netherlands (m²)	South Holland (m²)
seeds, total	25.677.000	4.609.814
seeds in greenhouses	5.977.230	2.184.214
tomatoes	18.461.911	10.564.378
cut flowers, total	47.949.490	16.141.467
cut flowers, greenhouses	19.823.390	11.573.967
plants with roots, total	291.829.876	43.919.960
plants with roots, greenhouses	19.225.276	11.599.060

Surfaces of products of greenhouses in the Netherlands and in South Holland. Source (CBS, 2022b)

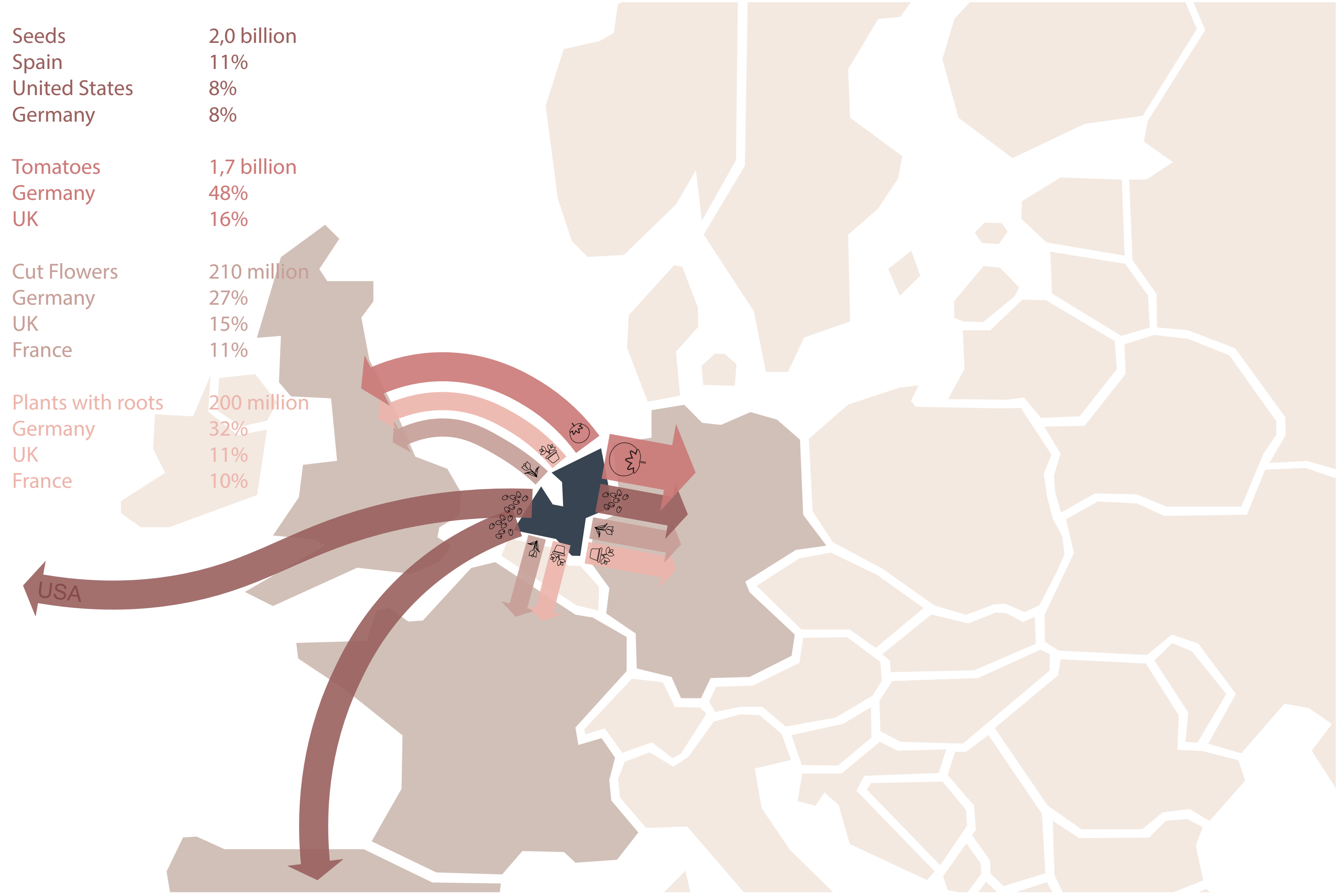
To calculate how much value is extracted from an acre, it is calculated how much is harvested per acre and how much it yields. This is calculated using the proportion grown in South Holland compared to the total yield in the Netherlands. The values in South Holland are based on that yield from its greenhouses.

- Seeds have a value of €850.000 per hectare
- Tomatoes have a value of €880.000 per hectare
- Cut flowers have a value of €40.000 per hectare
- Plants with roots have a value of €7.000 per hectare

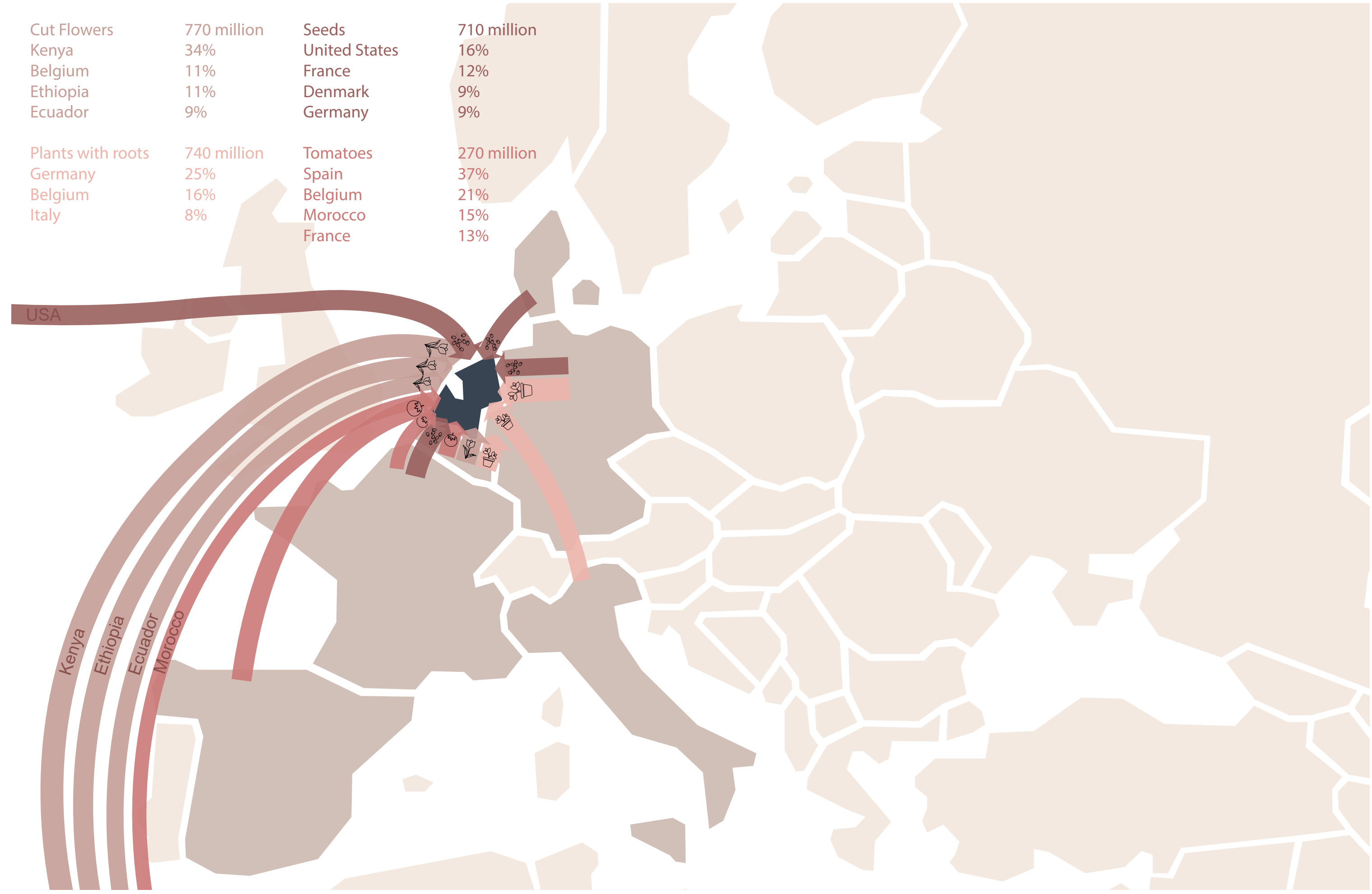
These numbers show that the seeds and tomatoes are high-value products. Within the flower industry, the cut flower has a higher value than the plants with roots.

The export and import maps show the most important countries where the Netherlands import and export to.

The export map shows that the main countries the Netherlands exports to are within Europe. An exception to this is the export of seeds to the United States. It is also noticeable that seeds and tomatoes have a higher value than cut flowers and plants with roots. The import map shows that proportionally more is imported from countries outside Europe. Especially cut flowers are imported from countries outside Europe. When we compare the import and export maps, it is striking that the export of tomatoes and seeds is much larger than the import. This means that the production of tomatoes and seeds in the Netherlands takes place on a large scale.



Export of products for greenhouses. Source: own map, based on data from (OEC, n.d.)



Import of products for greenhouses. Source: own map, based on data from (OEC, n.d.)

2.4 Understanding Economic Value

2.4.2 Stakeholders

The involved stakeholders of the design project can be divided in four different sectors.
The different sectors consist of society, the private sector, the public sector and innovators.
Society includes all kinds of people. Citizens, which includes consumers, workers, and farmers associations (LTO). Also the future generations are included, since the decisions of nowadays effect the future, but they can not give their opinions. Society does not have a lot of power, but especially farmers associations have a high interest. With a transition their jobs will change and therefore they want to be included in the decision making. For the society sector it is important to include the different workers and farmers and listen to their opinions with the transition.
The private sector includes all individual companies, like petroleum-based companies, flower industry companies, biobased companies, ProRail, but also different investors, like InnovationQuarter. Examples of the involved companies in the transition are Royal FloraHolland, Keukenhof, Greenport Aalsmeer, Eneco and Shell in the Netherlands. A transition towards a biobased economy would change the profits of these companies and therefore they need to be included.
The public sector consists of governmental organisations. These are organisations like the province of South Holland and the national government. The public sector will be important for the transition towards a biobased economy, since the sector has a lot of power. The public sector organisations need to have enough interest to provide subsidies.
The last sector are the innovators. This sector will help with the transition with their innovations to create biobased solutions. The sector includes start-ups and research centres. Examples are World Horti Centre, Biotech Campus Delft and the different universities in the Netherlands, like Wageningen. The innovators have a high interest, but not a lot of power. They will need money from the public sector (subsidy) or investors to achieve some change.

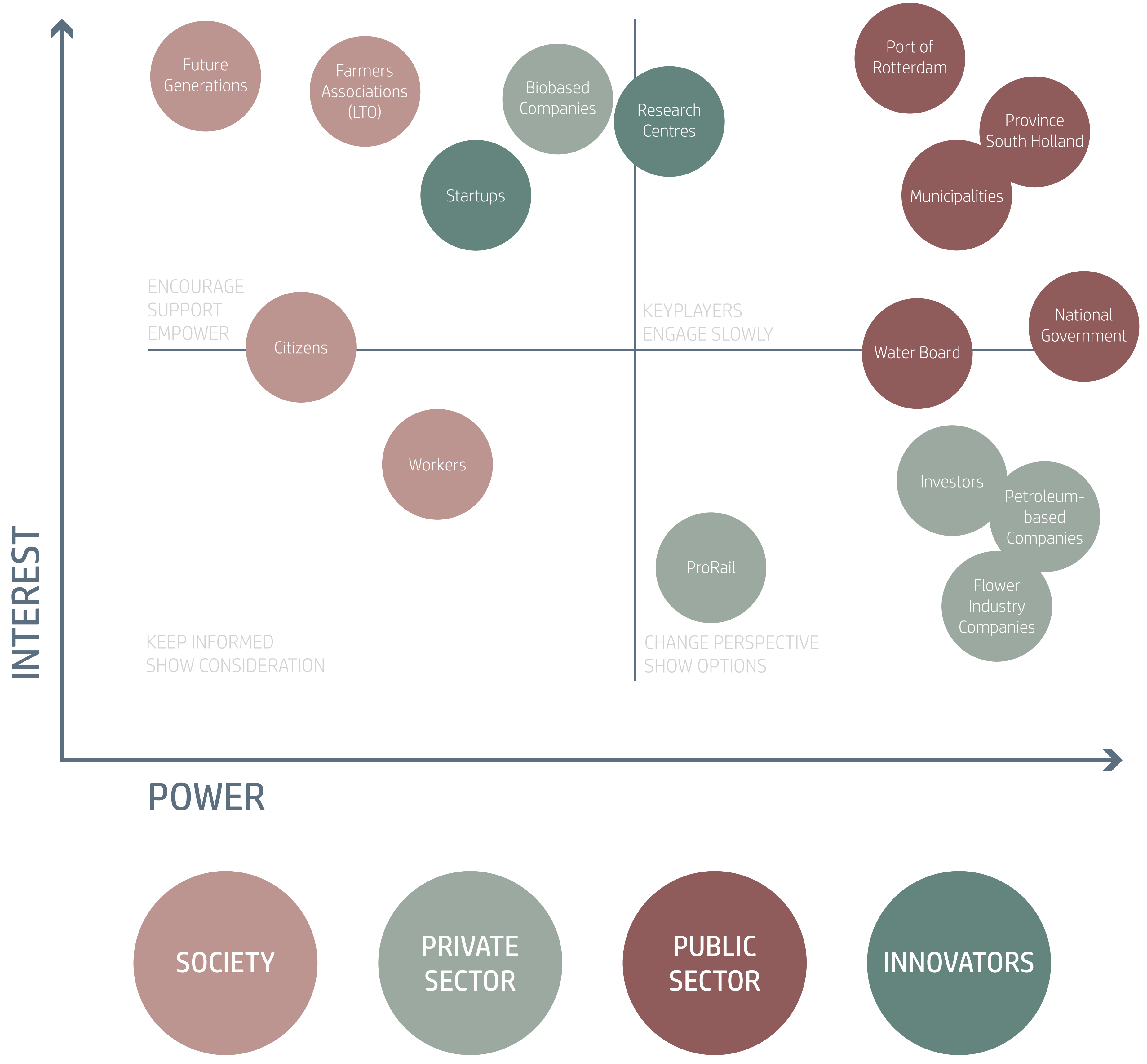
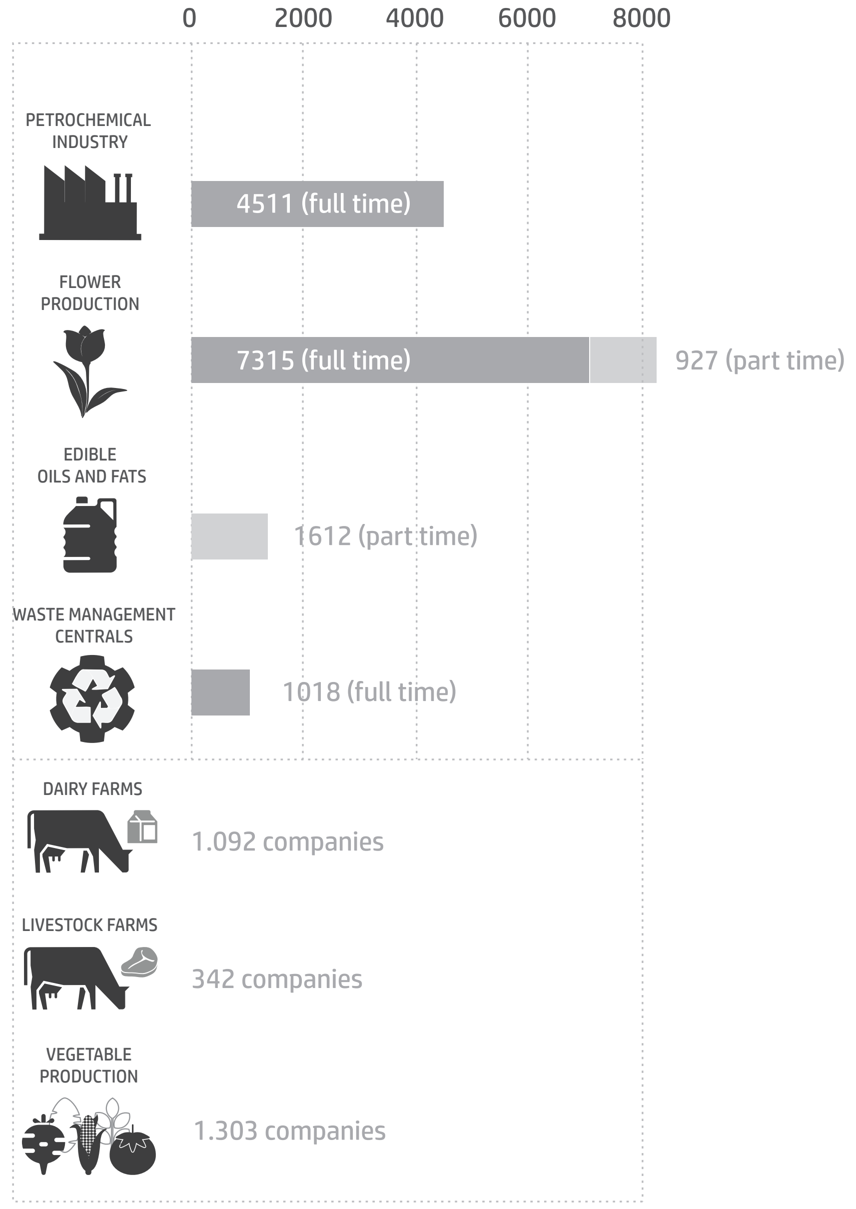


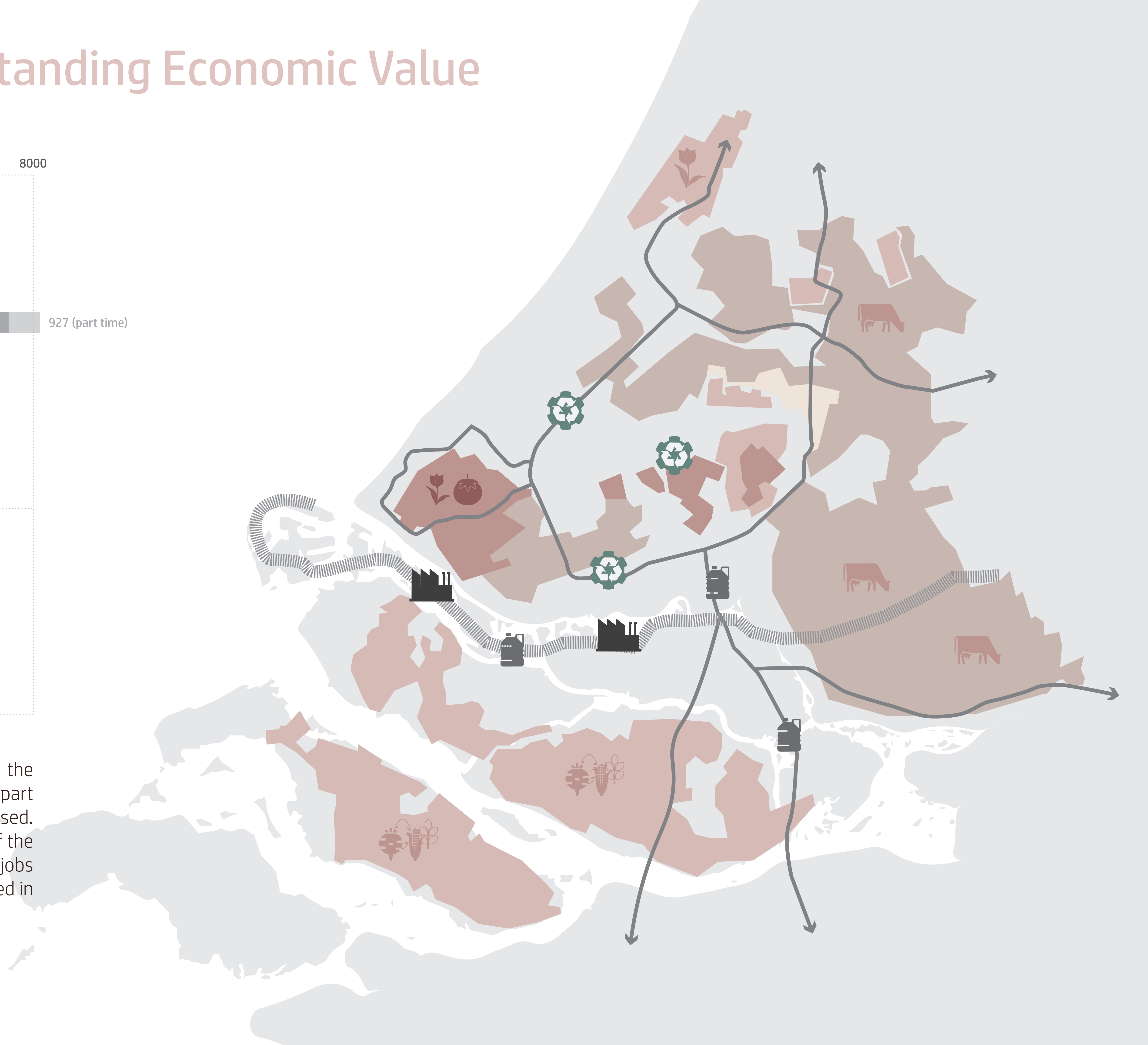
Image ? A power and interest diagram with the involved stakeholders

2.4 Understanding Economic Value

2.4.3 Jobs



This report advises changes to the current system on which a big part of our national economy is based. To understand the importance of the existing structure the amount of jobs in every sector has been displayed in the graphic on this page.



2.5 Opportunities

2.5.1 From SWOT to TOW

TOWS Strategies

Within chapter 1 a SWOT analysis of the area was shown and discussed. The next step is to convert the different elements of the SWOT analysis into TOWS strategies. This can be done by for example using the opportunities to overcome weaknesses within the analysed area.

So, While a SWOT can be done to understand the current situation, TOWS strategies can help a designer to identify strategic objectives.

Both tools are examples of using research for design. (Dabrowski, 2022)

SWOT

Strengths	Weaknesses
• Economic value of the port of Rotterdam, the flower industry and the cattle and calves industry • The Green Heart	• Conflict of space between urban areas, agriculture and nature
Opportunities	**Threats**
• Waste management • Innovations by research centres	• Climate change • CO_2 emissions • Flooding risks • Growing population

1. Aim	2. Asses	3. Activate	4. Apply
Improve the situation	Understand the situation	Identify strategic objectives	Take action
Define aims of new strategy	SWOT analysis	TOWS strategies	Develop policy / designs to implement the strategy

SWOT analysis and TOWS strategies in the design process. Source (Dabrowski, 2022)

- Strengths and Opportunities (SO) – How can you use your strengths to take advantage of these opportunities?
- Strengths and Threats (ST) – how can you take advantage of your strengths to avoid real and potential threats?
- Weaknesses and Opportunities (WO) – how can you use your opportunities to overcome the weaknesses you are experiencing?
- Weaknesses and Threats (WT) – how can you minimize your weaknesses and avoid threats?

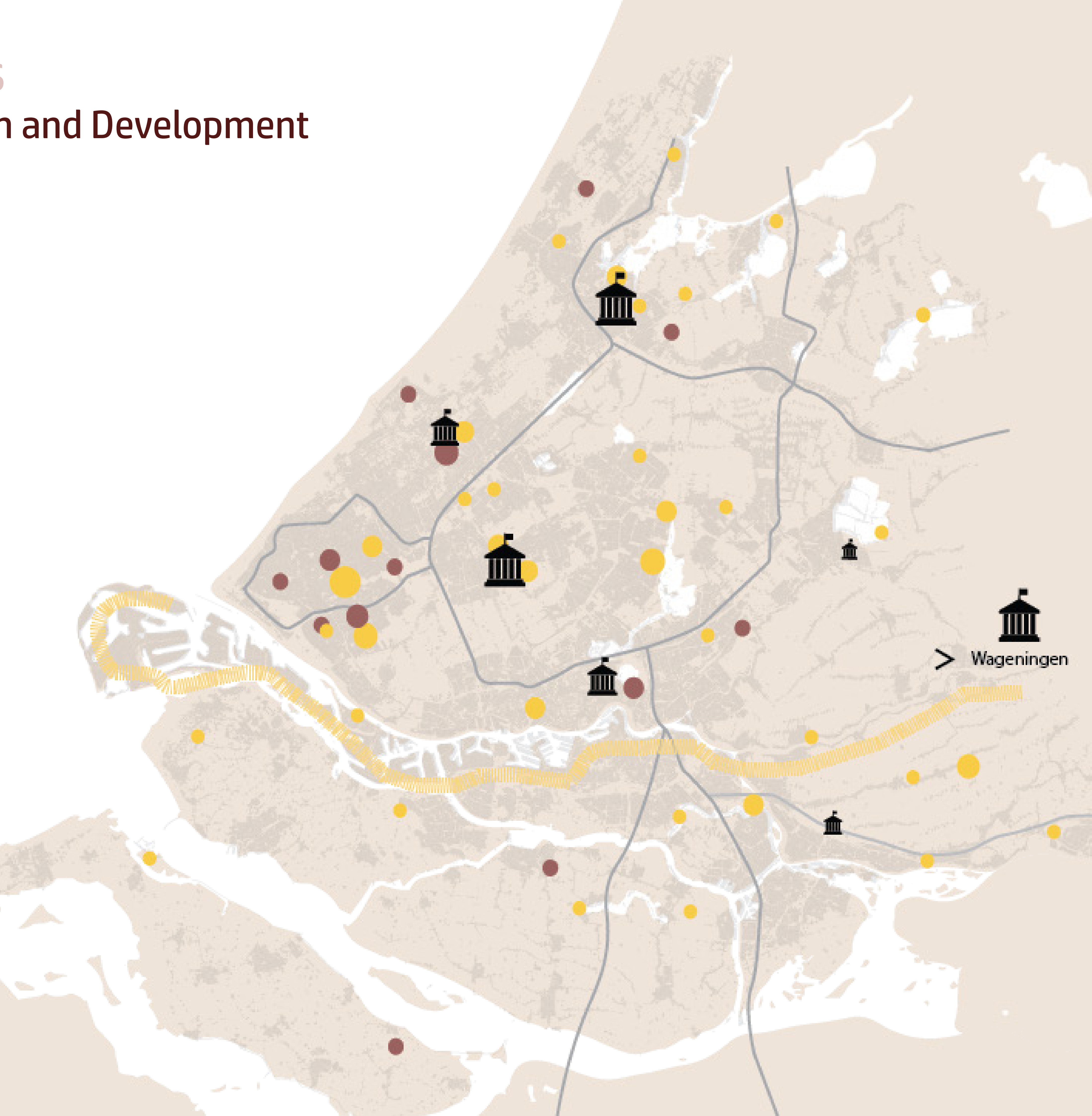
Within the next paragraphs some of the strategies concluded from this TOWS Strategy will be discussed.

2.5 Opportunities

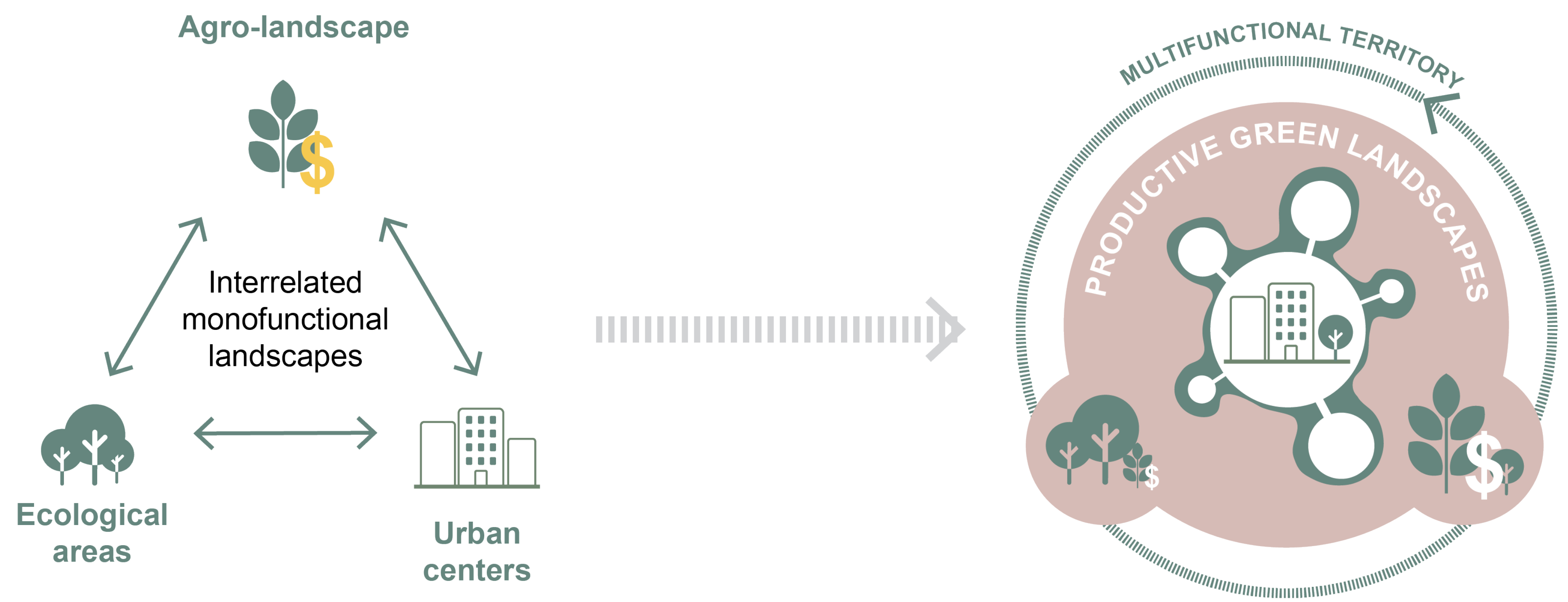
2.5.2 Universities, Research and Development

The high amount of universities, research centres and (bio)tech-companies in the province can be considered an opportunity. These scientific stakeholders can help us to strive for innovation and the development of new industries. This can support the shift that needs to be made to overcome some of the provinces/national weaknesses.

The Netherlands still uses many fossil fuels, and also houses many companies which handle fossil fuels. When looking at alternatives innovation is still very much needed. Not only the petrochemical industries need to reform, but also the agricultural sector urges to be reformed. Development of technologies is needed, to keep this thriving business active without the environmental impact.



2.5.3 Balancing Nature, Urban and Agriculture



Source: own elaboration

2.5.4 Multifunctional territory

To achieve a balanced land use, it is essential to decompose South Holland in its main structures: Agro, Ecological and Urban. Currently, each of one of this structures performing interrelated functions, being respectively the support of the province agro-economic activities (crops, greenhouses and cattle), enable water defence and green areas (dunes, forests and wetlands), and support a dense population.

However, to achieve a higher efficiency in the use of the scarce land, the bio-transition must integrate all this structures to mitigate any possible land-use conflict, indicated by many recent studies one of the dangers of bio-economy models (Lago et al. 2019), since uncoordinated actions can create conflicts between food production, feedstock supply, environmental projects and urban expansion.

To spatialize it is proposed to understand the agro-structures and the ecological areas as a base of a productive agro ecological landscape, envisioning both environmental recovery and production, also guiding urban development.

In that sense, establishing a guideline for regional design strategies and local applications. However to implement this envisioning it is crucial to create strategies, programs and policies able to connect a multiple range of stakeholders, and balance top-down actions with bottom-up initiatives as part of a multilevel governance. Then sharing as equal as possible burdens, responsibilities and potential gains of this transition between its participants without perpetuating injustices and conflicts.

2.5.5 Actions for Social and Environmental transitions

INTEGRATE AGRO I AND POST-PETROCHEMICAL INFRASTRUCTURE

Objective: integrate productive green landscapes with the robust industrial infrastructure in the Port of Rotterdam to unify both as a multifunctional and interdependent major structure of high economic value in a post-petrochemical scenario to gradually achieve a sustainable bio-economy model.

CONSOLIDATE AGROECOLOGICAL ACTIVITIES AS ECONOMIC GENERATOR

Objective: promote the economic intensification and efficiency of the agro landscape concomitant with the protection of natural environments. Then achieving a productive and bio-diverse landscape, generator of economic prosperity and environmental protection, climate resilience and recreational activities.

EXPAND FUTURE CLIMATE RESILIENT AGROECOLOGICAL AND URBAN DEVELOPMENT

Objective: prepare the territory of South Holland to be an adaptable structure capable of face future environmental scenarios, as flooding and salinisation problems, without losing its productivity. Also, to fulfil new urban demands for housing and infrastructure, understanding the landscape as the binding and key element of the territory that guides development.

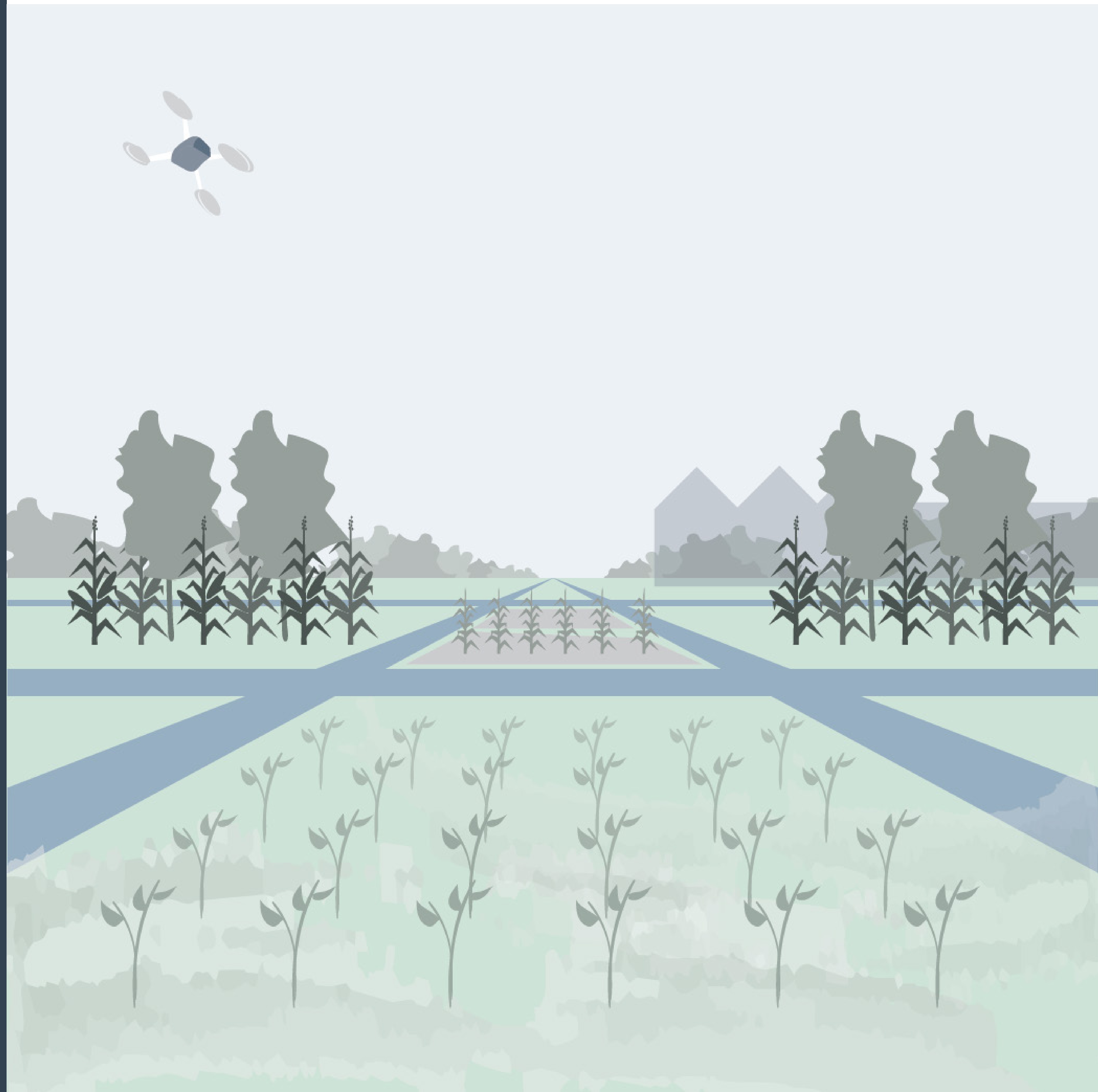
3 Biobased Economy

In the third chapter the biobased economy will be discussed to understand what is needed for a transition of the current economy.

The first part will be the explanation of what the biobased economy is and then the potentials to take over petrochemical industries.

The chapter ends with the envisioning of a new system as an introduction of the vision.

CONTENT



3.1 What is a biobased economy?

Concept and potentials

Definition

Bio-based economy, also known as bio-economy, has changed its definition in the past years. In 2012 it was defined by the European Commission as an economical model where food, feedstock, bio-products, and bio-energy are produced efficiently in a sustainable system from renewable resources in land and water environments (European Comission, 2012). Later in 2014, this concept was modified to include sustainable production and processing that links consumer demand with industrial infrastructure, which at the same time responds to environmental challenges (van de Pas, 2015).

In that sense, bio-economy is strongly based on optimal uses of biomass, both in terms of bio-based raw materials, organic residues, and agro-industrial production chains. Can include the sectors of agriculture, forestry, fisheries, food, pulp, and paper production, and also might engage chemical industries, biotechnological, and bio-refineries capable of producing raw materials for the biochemical, biomedicine, bio-plastics, and energy sectors.

To coordinate and optimize the connections between emerging bio-industries is essential to promote a framework that includes cascade uses - a concept that describes the efficient utilization of resources by "using residues and recycled materials (...) to extend total biomass availability within a given system" (Vis et al., 2016). Then, integrating bio-refineries that also support innovation toward bio-materials, biochemicals, and bio-products (Lago et al. 2019). Therefore, reaching sustainability in the use of biomass is one of the crucial aspects of bio-economy models (Scatlat et al., 2015).

Bio-energy and Innovation

The adoption of cascade uses is a necessary step to address the potential of bio-economy models for the production of bio-energy. Usually, energy production is the last destination for biomass after being used for bio-materials or biochemicals, differing cascade flow frameworks into single cascade flows, where biomass is processed into products to later be transformed into bio-energy, or multi staged flows, where biomass is processed into products that are used again as materials before being recovered as energy (Vis et al., 2016).

Then, biotech innovation is a key long-term aspect to ensure the success of the chain promoting new uses of biomass, for example expanding the potential of biodiesels to contribute to a reduction of dependency on fossil energy in transportation systems (Moeltner & Schallhart, 2020), and use of waste of vegetable oils (WEO) as one of the main sources for biodiesel feedstock (Lee et al., 2008) due to its abundant availability without impacting the food economy. Also, recent studies suggest the adoption of a hierarchical sequence in cascade uses, giving priority respectively to high-value uses, recycled products, and finally, energy uses (Lago et al. 2019).

To improve the cascade flows, integrating existing and new infrastructure for logistics and production is essential. Extensive handling and transportation infrastructure can be leveraged to increase and impulse the competitiveness of the bio-energy industry. In a combination with an increased scale of transportation resulting from growing demands, it is possible to reduce transportation costs and increase the economic viability of new integrated bio-economy logistic systems (Searcy et al. 2016).

3.2 Potential to take over Petrochemical Industries

3.2.1 Petrochemical Products

Petroleum products

This report looks at the transition from petrochemical products to bio-based products. Petrochemical products derived from petroleum or natural gas.

In 2018, approximately 93,000 million kg of petroleum products were produced in the Netherlands. The share produced by the petrochemical industry is about 4,000 million kg, i.e. 4% of all petroleum products.

The total weight of imported petroleum products is about 90,000 million kg. The import and export map shows that the total import value is 99.8 billion euros. This means that the import value per kilogram is about 1.10 euros. We can conclude that the petroleum products are low-value products.

The total weight of petroleum products exported is about 110,000 million kg. The import and export map shows that the total export value is 58.3 billion euros. This means that the export value is 0.50 euros per kilogram.

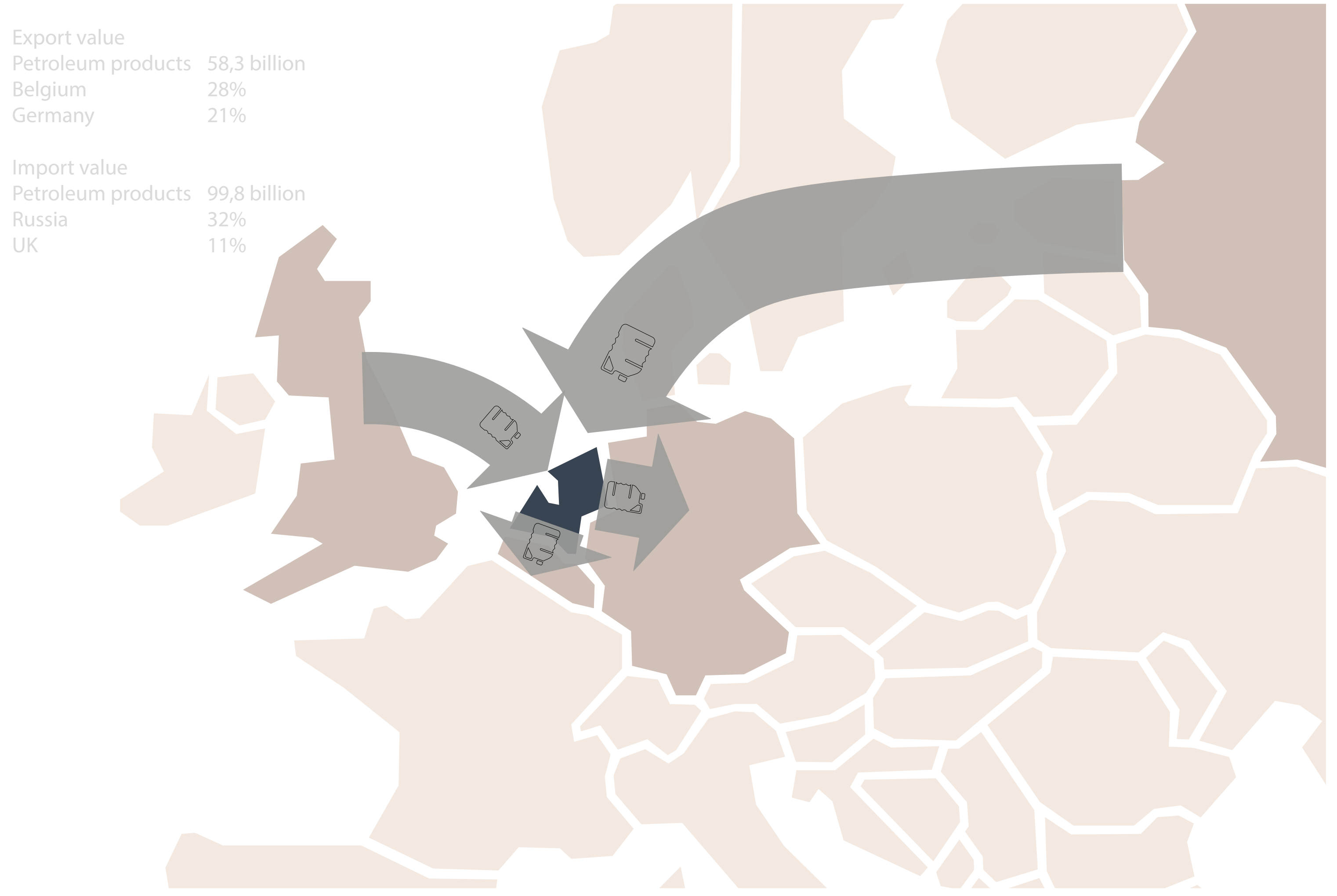
This means that the export value is lower than the import value. The import and export map shows the main trading countries, which are all within Europe.

Russia currently stands out in the map, due to its high import value. With the current Russian invasion of Ukraine, imports of Russian products will most likely decline sharply. Consequently, there will be changes in the amount of gas and oil that countries will purchase to offer. This will also lead to an increase in the prices of gas and fuels.

2018

total production of petroleum (x 1 million kg)	production of petrochemical (x 1 million kg)	total import (x 1 million kg)	total export (x 1 million kg)
92.743	3.716	87.817	109.511

Weight of petroleum products in the Netherlands. Source (CBS, 2021)



Import and export of petroleum products. Source: own map, based on data from (OEC, n.d.)

3.2.2 Biobased Products

Biomass

Definition:
Biomass is renewable organic material that comes from plants and animals. Biomass has a lot of potential regarding circularity. The materials that form biomass used to thrown in a heap in order to make compost. This form of reusing the materials turned out not to be very sustainable – a lot of gasses are emitted when doing so. Through innovation and research other methods have been developed to make better use of the materials and ensure they do not harm the environment.

Biomass can now be converted to biogas, electricity, cattle feed and compost. Because biomass is a product which you can find in large amounts anywhere across the globe, it has the potential to take over large parts of the fossil fuel industry. All applications of biomass can be done locally, which also contributes to the sustainability of the sector.

Biomass is currently already used as an energy source in the Netherlands. However, the biomass is not produced locally, but mostly imported from countries in South America (Studio Gear Up, 2021). The biomass mostly comes from corn, wheat and sugar beet. These crops are manufactured from food and feed crops, which leads to a scarcity in land to produce food and feed crops for consumption. Unsustainable land-use also leads to deforestation. In 2021 the Dutch government has decided that it will not continue to use biomass if it is imported from South America, where it leads to indirect land-use change (ILUC). To call a halt to this unsustainable way of obtaining energy, this vision will seek sustainable, local ways of producing biomass. For example in optimizing cascade flows from existing agricultural systems.

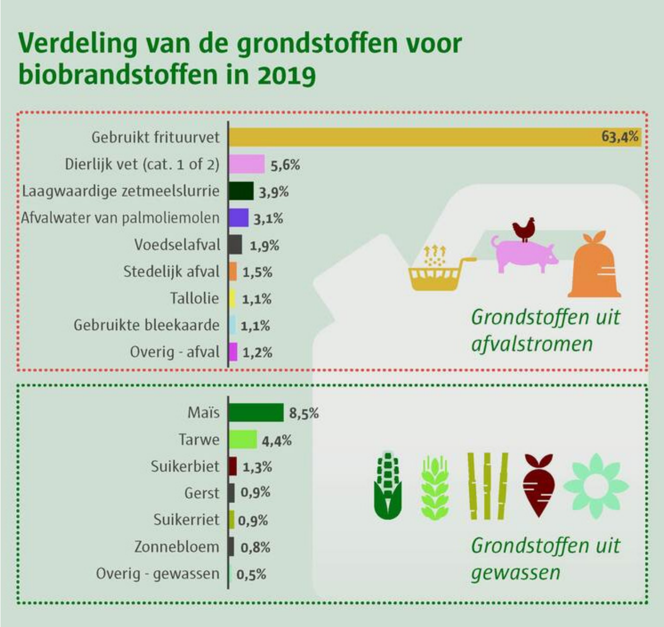
Biofuels

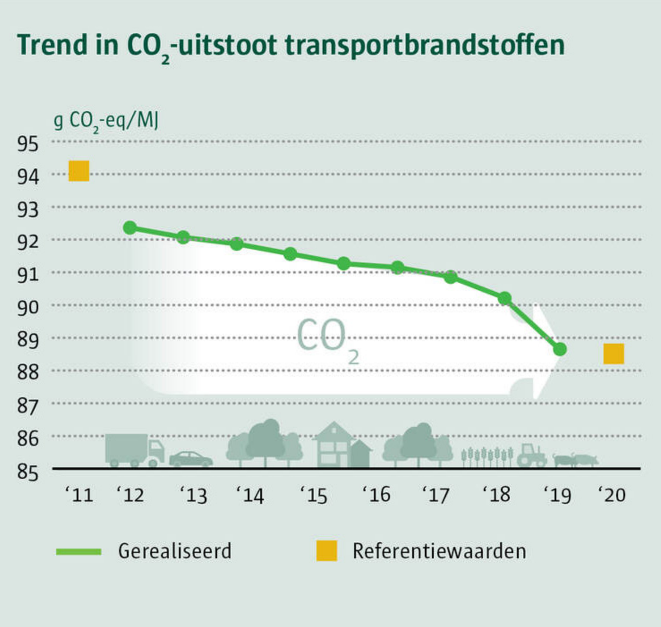
From biomass we can create bio-energy, like biofuels and biogasses. These biofuels can be made out of different bio-materials. Depending on the source the product is more or less sustainable. In the Netherlands 80% of biofuels is already made out of waste products, which is the more sustainable variant of making biofuels. The waste product used the most within these fuels is used frying fat from urban and industrial waste flows. Biofuels made from used frying fats emits only 11% of CO2 in comparison to normal Diesel. (NEA, 2020)

Due to the introduction of these biofuels in the Dutch transport sector currently more than 2,5 Mton CO2 has already been spared within the fuel chain. This reduction is comparable to the amount of CO2 emissions from one coal-fired power station in the Netherlands in 2019. (NEA, 2020)

Previously biofuels where mostly made out of crops, but biofuels made out of crops have been proved to be less efficient in reducing CO2 emissions then the use of waste products. Crops can be better fitted in the food chain and come back to the biofuel chain after they have become organic waste. This makes the cycle more sustainable. (ETIP, 2022)

In this strategy we want to optimize cascade flows of the agro&food industries in such a way that all organic waste, such as cooking waste oil, is reused and brought back in the bio-energy industry. Products that cannot be used for biofuels, can be used for the production of other bio-energy resources. For example manure from the cattle industries can be used for the production of biogas.

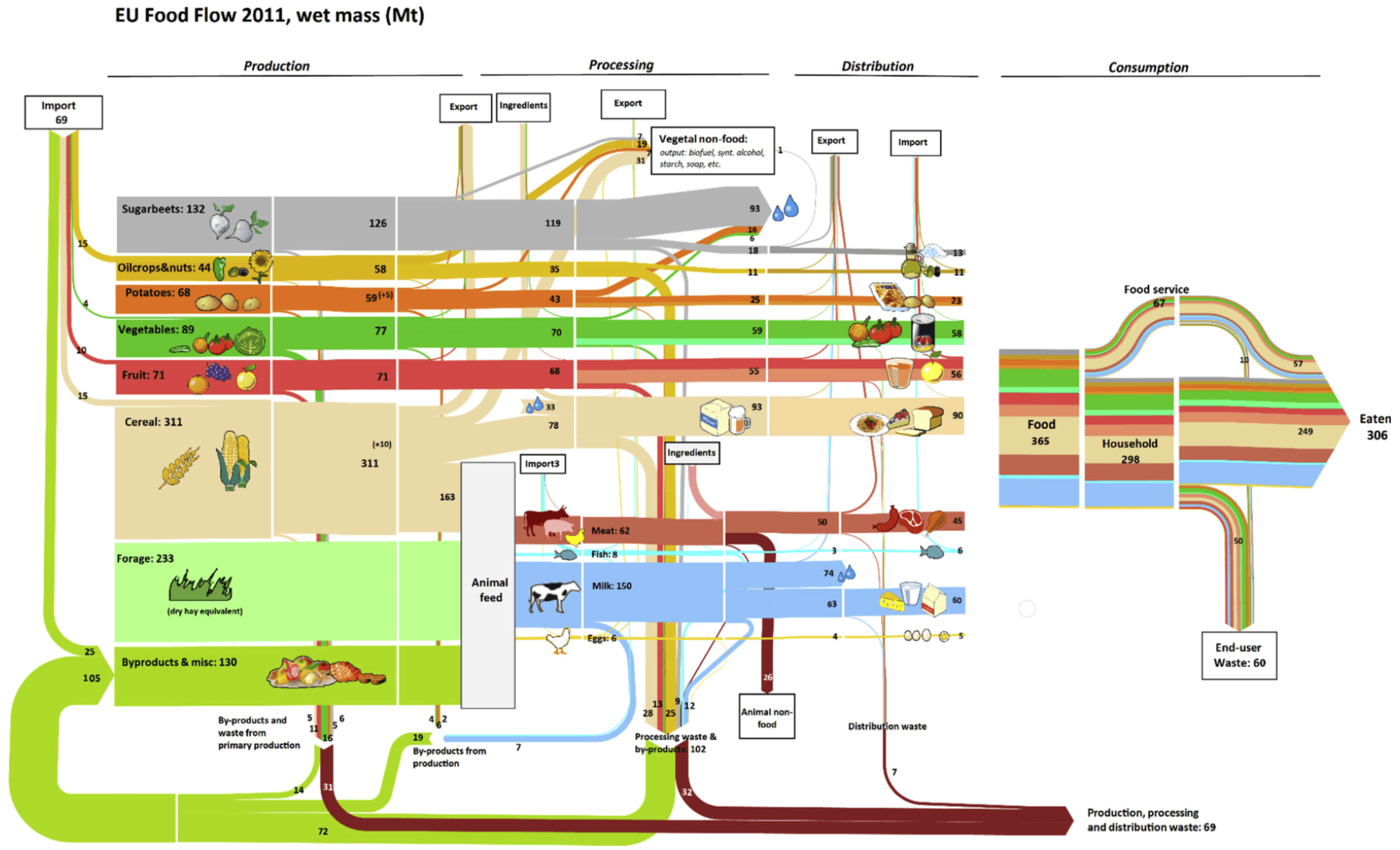




source: NEA (2020)

3.2 Potential to take over Petrochemical Industries

3.2.3 Agriculture as a Generator

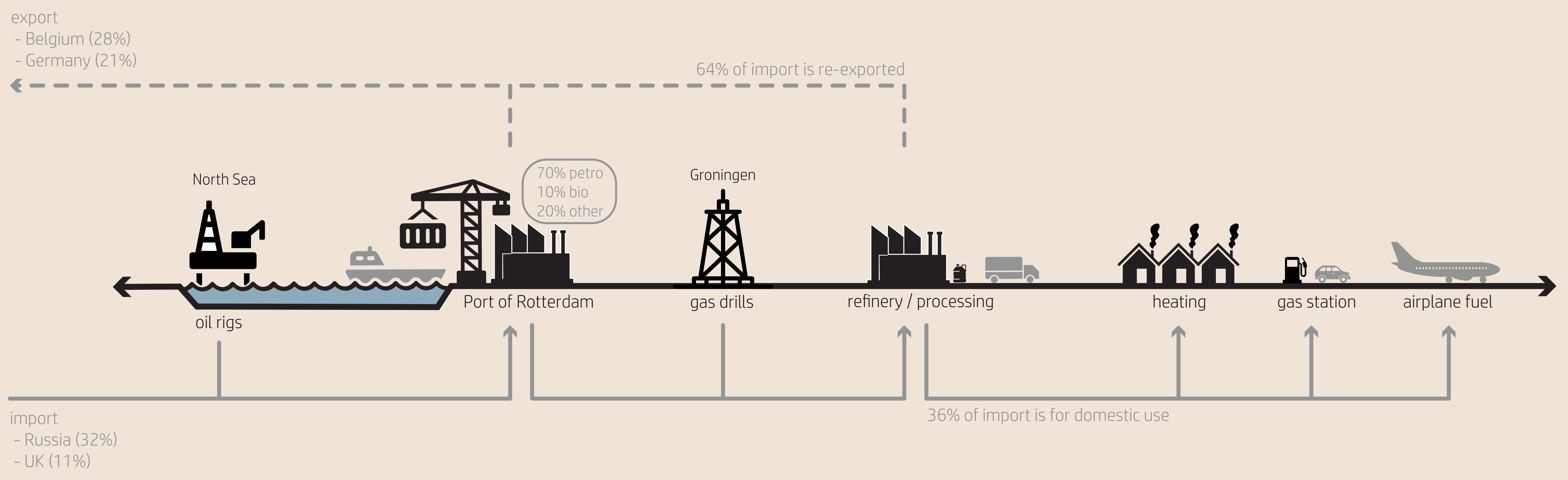


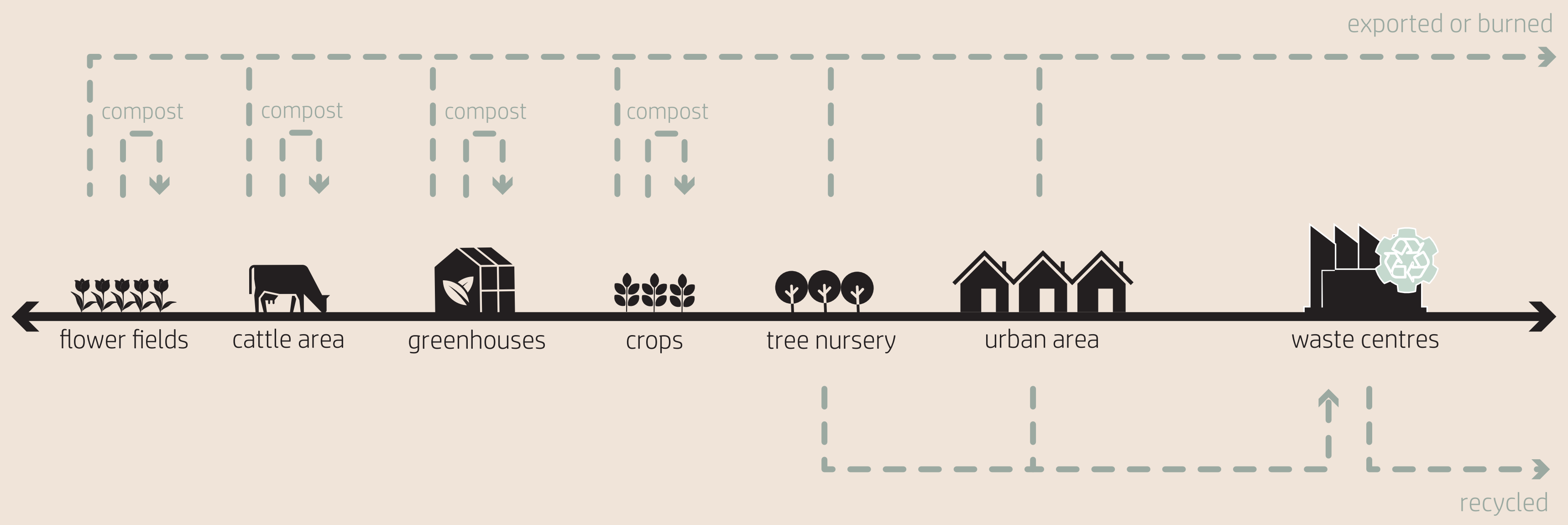
Source: (Caldeira, 2019).

There are many residual streams in the food stream. For example, offal, fruit and vegetable stems and other products are considered waste. Currently, these residual streams often end up in landfills. Even though some of these residual streams would become compost, it is still unsustainable. Organic matter releases a lot of methane when decomposing, which contributes to the greenhouse effect which harms the earth (Mathur, n.d.). However, new technologies make it possible to make better and more sustainable use of the residual streams. These residual streams can be used as biomass, which produces energy, such as biogas, biofuels and electricity generated from combustion heat. Biofuels, like discussed in paragraph 3.2.2, produced from waste flows are way more efficient in reducing emissions and reaching sustainability goals then direct use of f.e. Food crops for biofuel production. When we are reusing the waste flows from our agro and food industries they can become the generator of a new era, replacing extensive use of fossil fuels.

3.3 Envisioning a New System

3.3.1 Old System

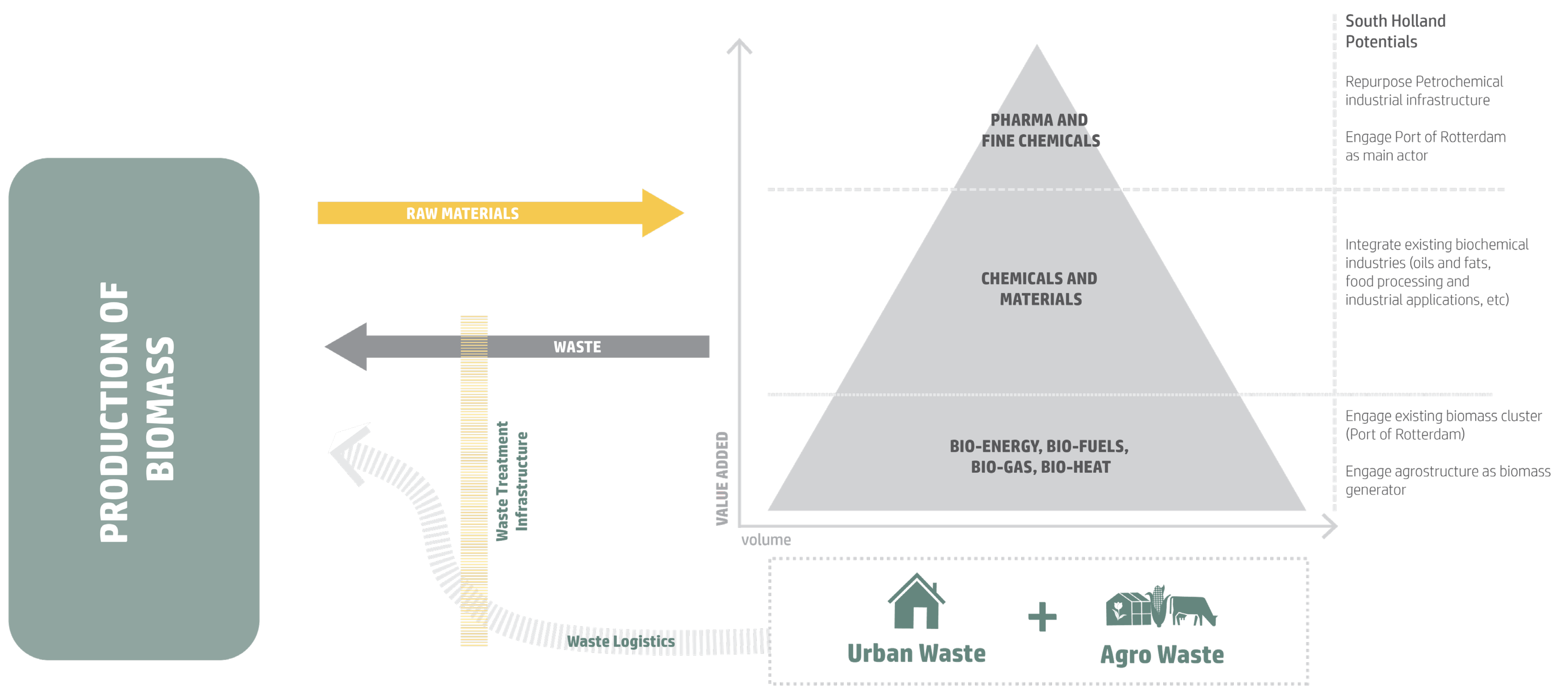




Within the current system agriculture and petrochemical industries are two different sectors. Both Sectors are polluting and have dysfunctional waste flows. Nonetheless they are part of the countries most valuable assets when it comes to economic value. This means that the transition needs to be aware and deal with retaining this economic value. Not only when it comes to money, but also when it comes to jobs.

3.3 Envisioning a New System

3.3.2 Introducing a New System



Bio-economy systems must be integrated with regional planning and policies to mitigate possible conflicts of land for the agro sector, urban expansion, and ecological purposes (Lago et al. 2019). Coordinating logistic and infrastructure operations, identifying local sources of biomass and potential industrial synergies are necessary steps to connect the existing infrastructure within the agro-sector with the Port of Rotterdam in optimal bio-economy cascade flows.

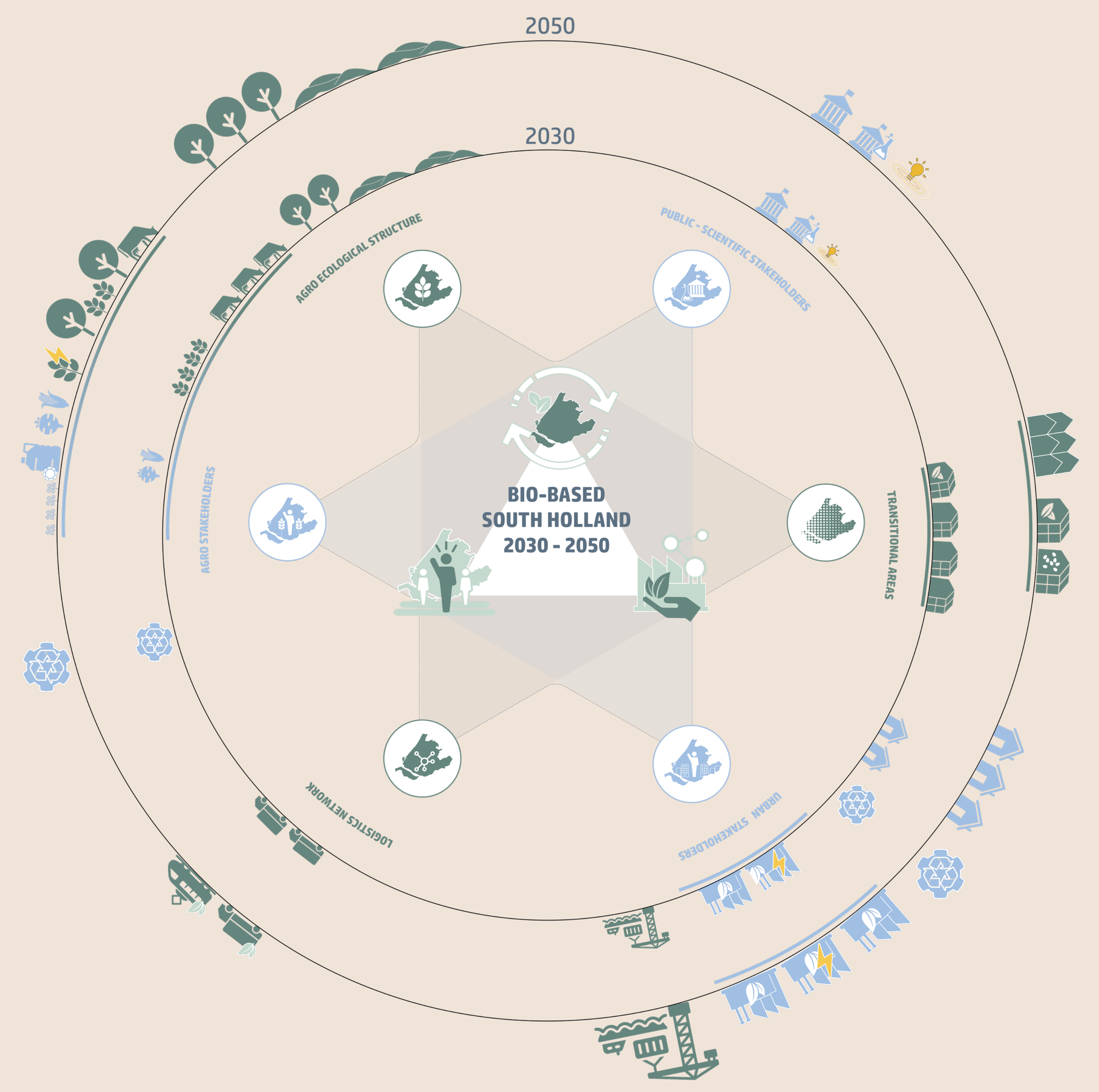
As a guideline to integrate flows and volumes, the different values of products were organized in a pyramidal framework (diagram above) adapted from Hintjens et al. (2015) that also reveals the necessity of waste treatment infrastructure and its potential sources and related industries in South Holland in order to make a transitions towards a integrated systems of industrial and agro-ecological to retain the economic importance of the Port of Rotterdam and the Province.

4 Vision - Strategy

Within the fourth chapter the concept of a biobased economy is used together with the main values and goals to create a vision for the region of South Holland.

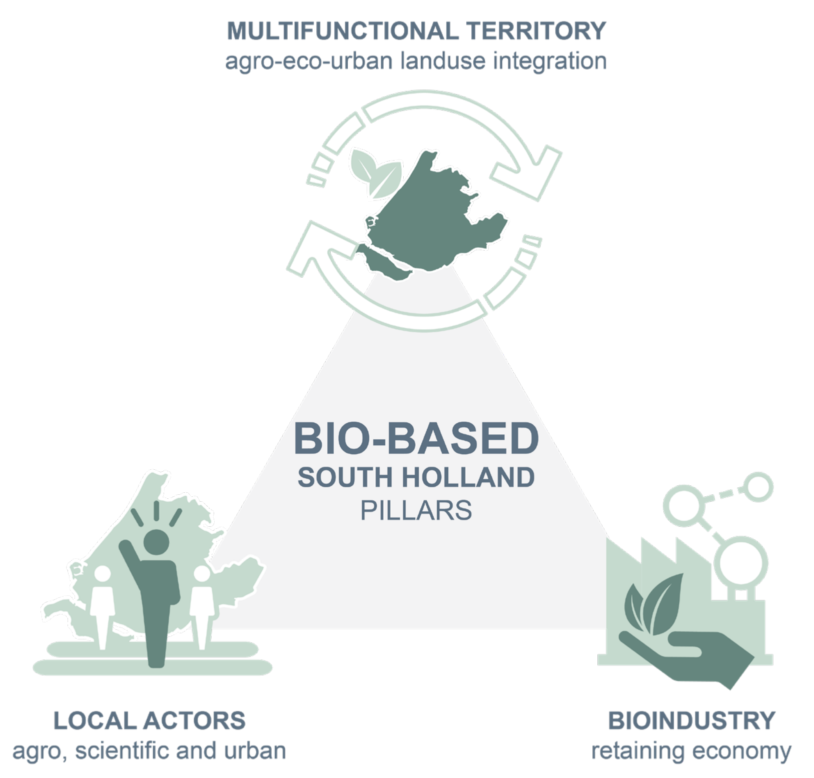
Next to explaining the vision of the BIOCYLE this chapter will take this vision to a strategy for transformative design.

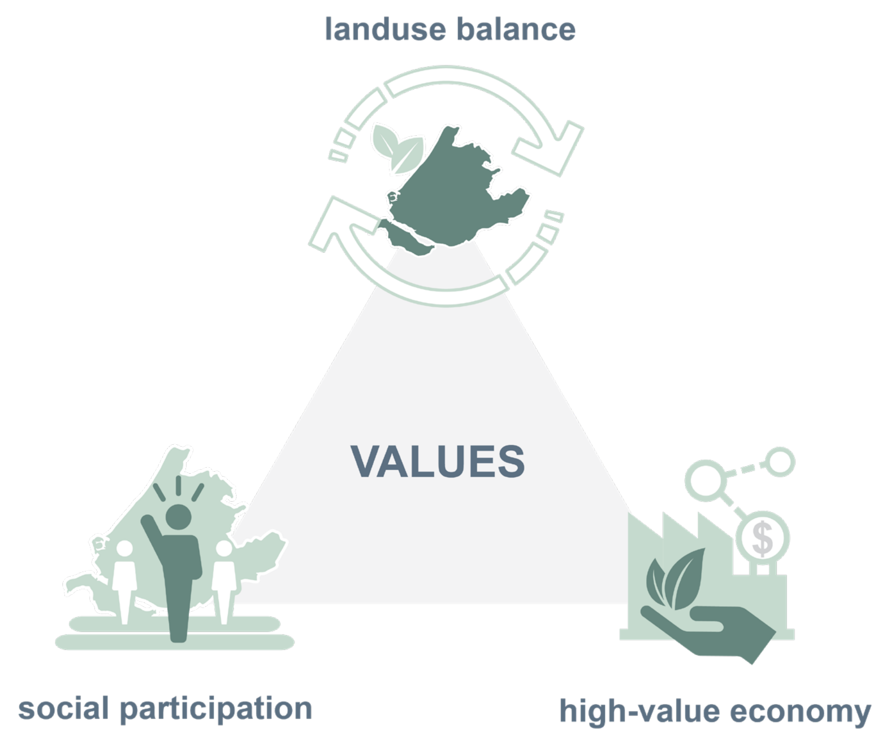
CONTENT

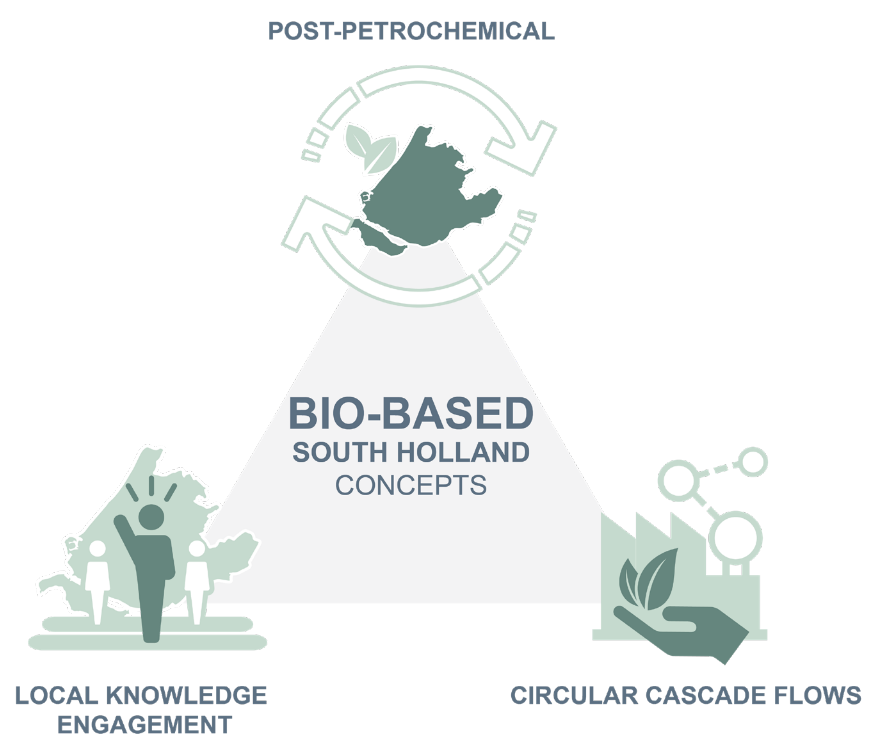


4.1 Envisioning the Future Biobased Economy

4.1.1 Guiding Goals and Values







The guiding pillars for the bio-based transition in South Holland are; retaining the economy of current industries, shaping a multifunctional landscape within the province and satisfying needs of local actors within the agro, scientific and urban sectors. To perform a multi layered and gradual transition it is necessary to promote socio-economic synergies allowing mutual benefits and prosperity.

The next step was to determine three main values to accompany the implementation of the guiding pillars. It is of equal importance to; keep a balanced composition of land-use and minimize conflict due to scarcity of land, promote social participation to establish qualitative relationships with stakeholders and create a high-value economic model which maintains the importance of the Port of Rotterdam, both locally and globally. Meanwhile, making sure the bio-economy doesn't create a conflict with for example food production when the need for biomass rises.

The scheme was converted into main concepts to utilize it for creating a strategy and a local design. The concepts will also suppport the indentification of the needed spatial structures and social actors that need to be activated. In that sense, the integration of a post-petrochemical infrastructure is proposed as a leverage for the bio-transition with a new logistic concept creating circular cascade flows. Made possible by integrating knowledge of local actors towards innovation.

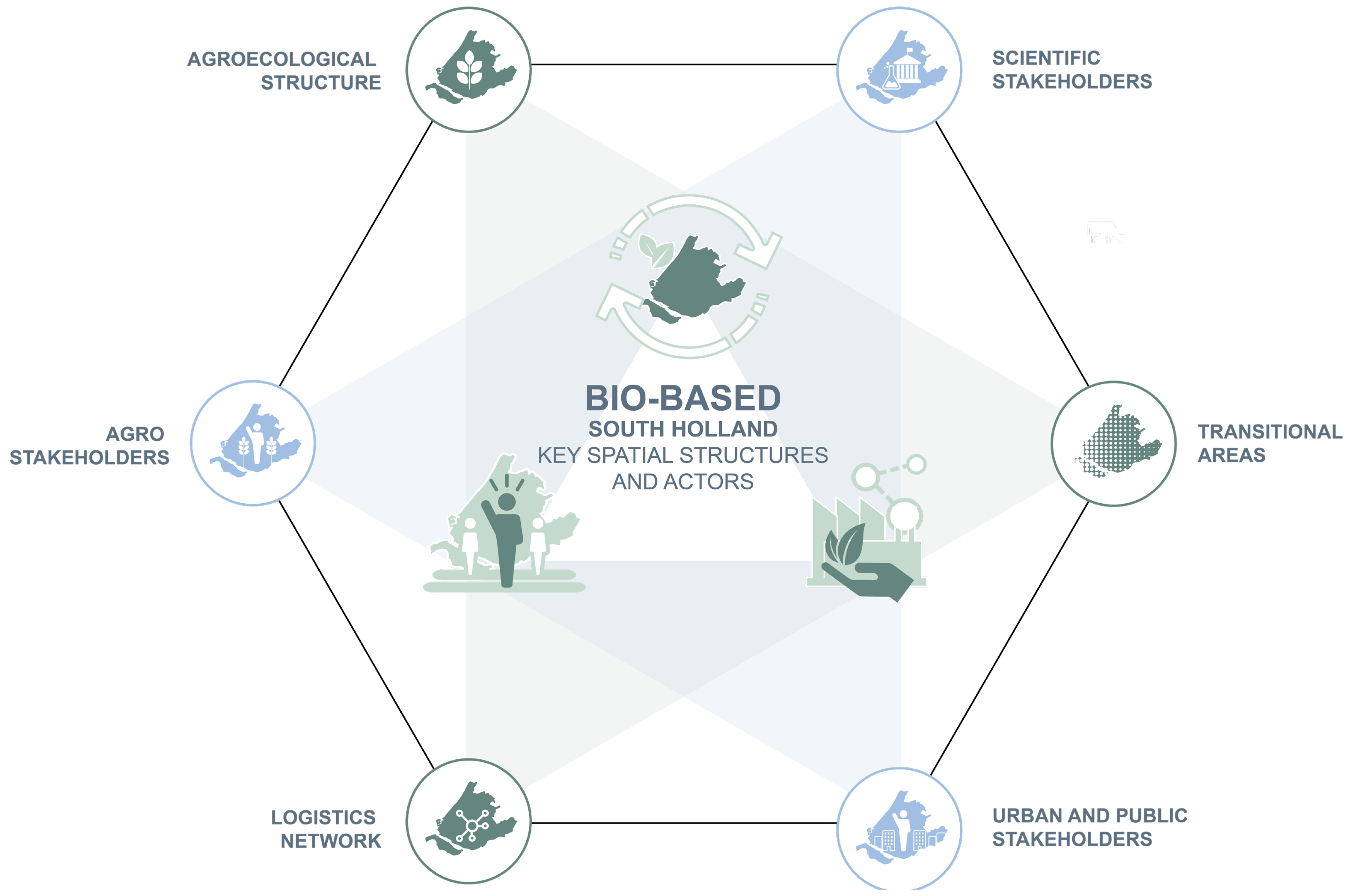
4.1 Envisioning the Future Biobased Economy

4.1.2 Key structures and Actors

By integrating all the Pillars, Values and Concepts into a holistic territorial reading, it was possible to identify the crucial elements to be taken into consideration:

The Spatial Structures:
- Transitional Areas: areas that have potential to be transformed within a post-petrochemical scenario, meanwhile meeting regional and global environmental goals.
- Logistics Network: existing transport infrastructures that can be incorporated to promote efficient flows of raw materials, products and energy.
- Agro-ecological Structure: Combinations of ecological and agricultural landscapes that will be engaged as economic and environmental generators. And connected in a system for the production of bio-energy.

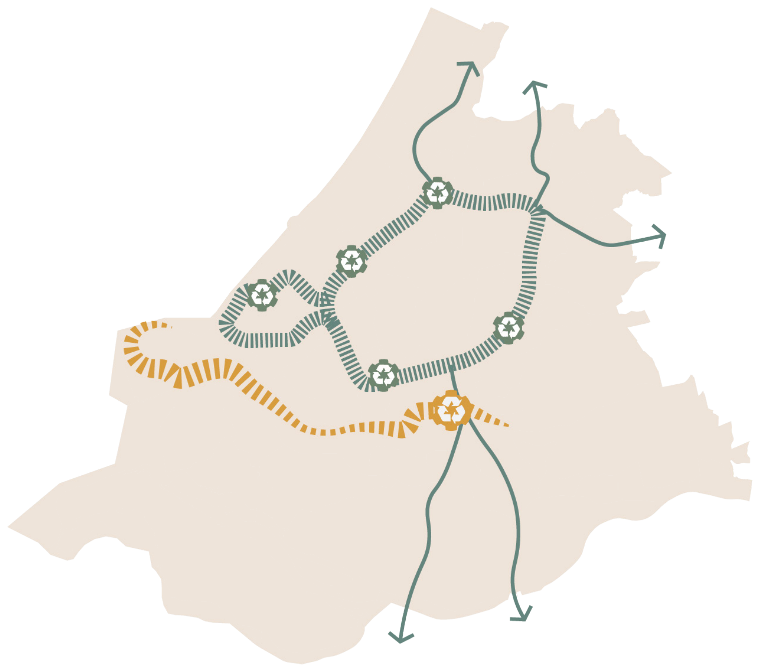
The Actors:
- Scientific Stakeholders: research institutes, universities and (private) technology centres are engaged to accompany within this strategy to promote long-term innovation towards efficient and competitive bio-economy systems.
- Urban and Public Stakeholders: integration of urban centres as biowaste sources, and governmental support by policy making to allow bio-transition.
- Agro Stakeholders: farmers of a broad spectrum of agricultural businesses are activated as partners for the production of feedstock for a diverse range of bio-industries/bio-energy production plants. Next to enaging in the transformational actions towards a sustainable landscape.

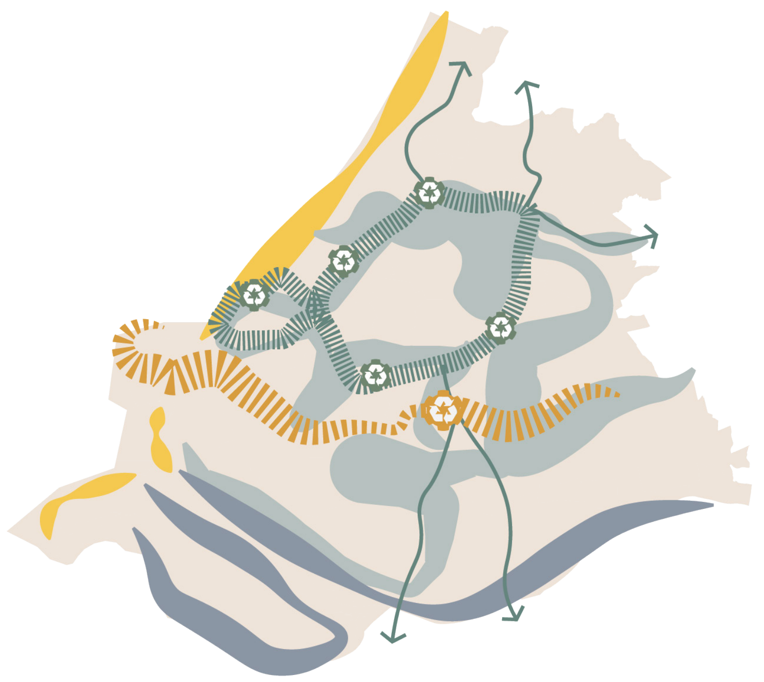


A conceptual framework for creating a functioning strategy:

4.1 Envisioning the Future Biobased Economy

4.1.3 A Strategy in Three Acts





Logistics Ring for Bioindustries

Engage industrial stakeholders in the Port of Rotterdam and Province. To plan a coordinated action to offer infrastructure and logistics of bio raw materials to existing and future bio-industries and bio-energy clusters. Gradually changing existing logistics as a starting point to integrate agro-ecological structures with the production of bio-energy and to induce future economic growth.

Agro-ecological interfaces

Consolidate agro-ecological interfaces to promote a balanced territory without losing the economic capacity as a productive landscape. Meanwhile, promoting water defence systems, expansion of a network of green corridors, and multi-purpose buffer zones - allowing transitions of landscape structures and guidelines for future developments.

Multipurpose Agro-urban landscapes

Expand green ecological structures to integrate and intensify the Green Heart connections and vitality. Also, supporting a flexible and intense use of land. To overcome future environmental, social and economic challenges by adopting local and global innovation and technologies, empowering local actors. Whilst allowing bio-industrial intensification.

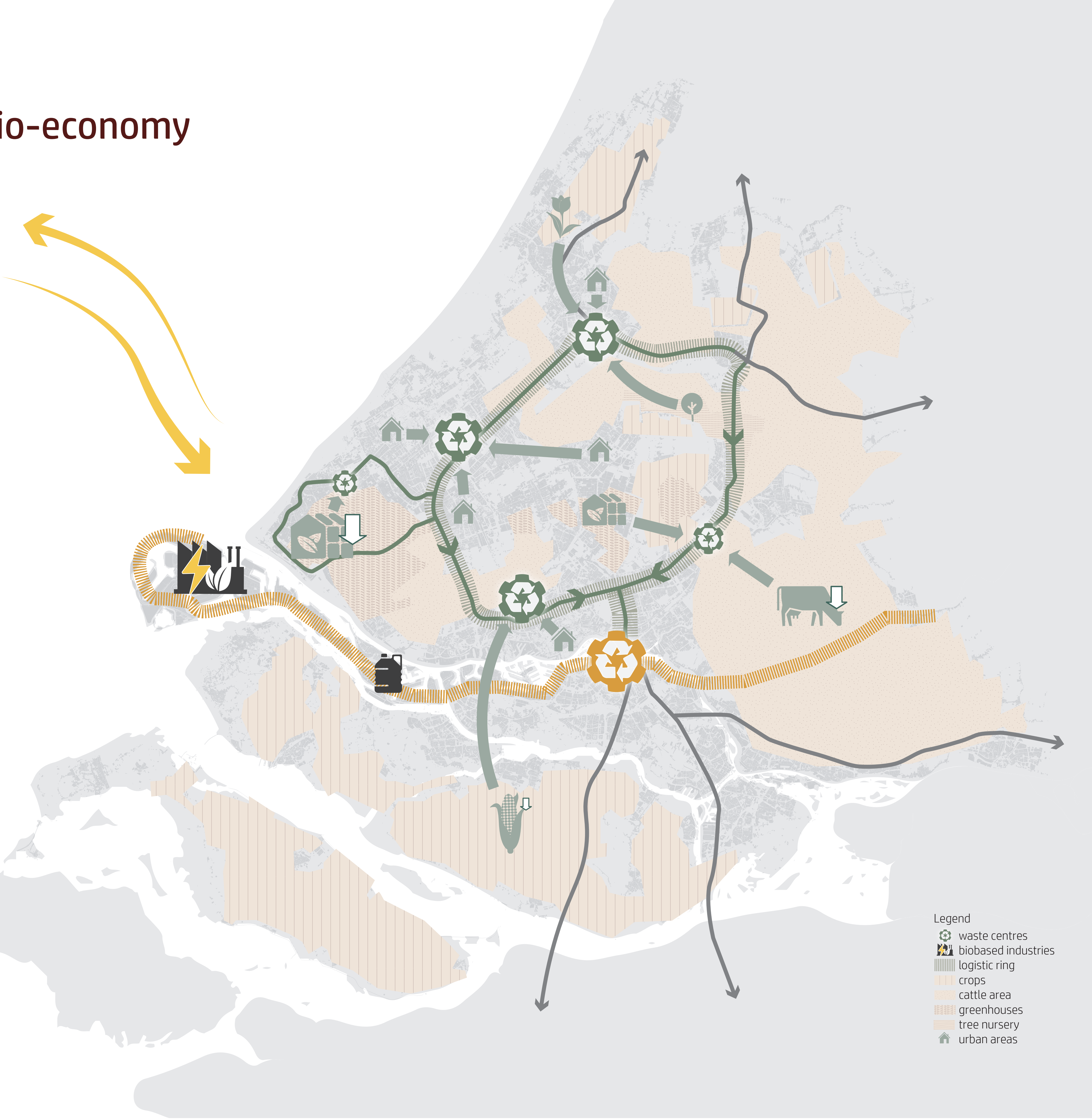
4.2 Integrate

1st Act - Logistic Ring for Bio-economy

The starting point of the regional strategy is the integration of the existing logistics infrastructure into a network based on a central logistics ring. Regionally, the logistics ring is composed of existing highways and railways that will perform logistic support for the cascade flows of biowaste from urban areas and agricultural properties, operated by new and existing logistics companies coordinated by public-private partnerships.

In the first stage, the biowaste will be directed to bio-waste treatment centres, initially placed in existing waste management centres along the ring. There, the organic waste will be processed and separated into bio raw materials. In the second stage, the materials will be transported to bio-industries and bio-energy clusters in the Port of Rotterdam through the logistics ring. Then, the biomass is transformed into biobased products and biochemicals for exportation, local demand consumption, and bio-energy regional supply.

The first act of the strategy is envisioned as a starting point to enable and empower existing and new businesses. These businesses will be the pioneers of an intensified biobased market that benefits from the new infrastructure potential. In that sense, creating new industries and services based on re-use of biowaste or biomass can activate a transition of the current petrochemical industries into bio-industries and bio-refineries. The feasibility of this stage is reached through the mediation of top-down policy regulations, public incentives, and subsidizing programs for entrepreneurship stimulation.



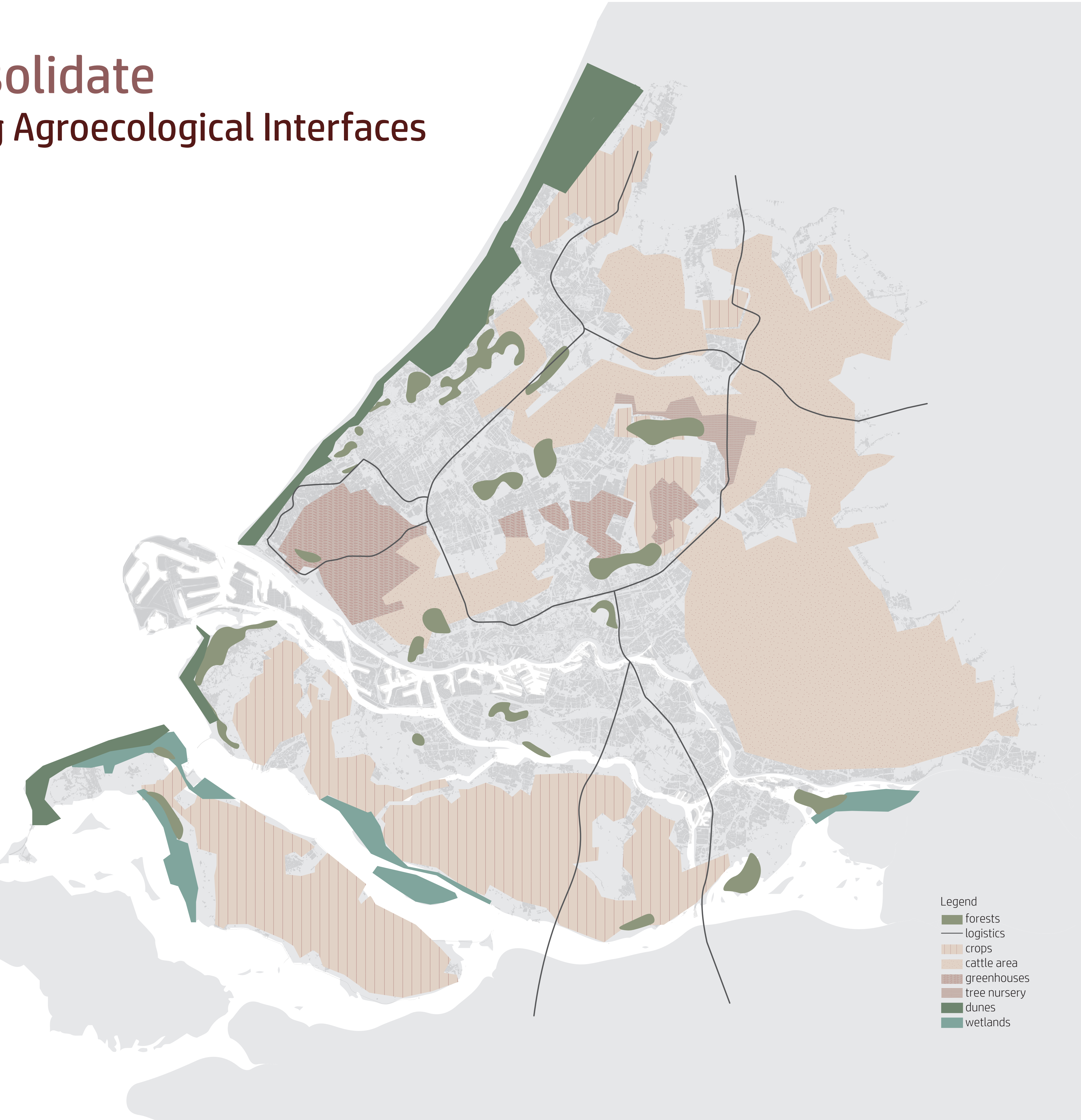
4.3 Integrate & Consolidate

1st and 2nd Act - Promoting Agroecological Interfaces

The second act of the strategy is the gradual inclusion of the agricultural sector by implementing Knowledge Hubs that will connect research institutes with a diverse range of farmers and agricultural business owners. Then the agricultural structure as an economic generator will be incorporated, since this will be a vital source of biomass and feedstock for the emerging bio-industry in the Port of Rotterdam consolidating the BIOCYCLE.

Concomitant with the bio-economy promotion, this stage will be the starting point for the landscape transformations to achieve a balanced and sustainable land-use. Incentives, top-down policies and bottom-up trigger programs such as the Knowledge Hub will enable a long-term transition. These initiatives will enable the implementation of a new type of agricultural activities integrated with ecological functions, water defence, and recreational purposes.

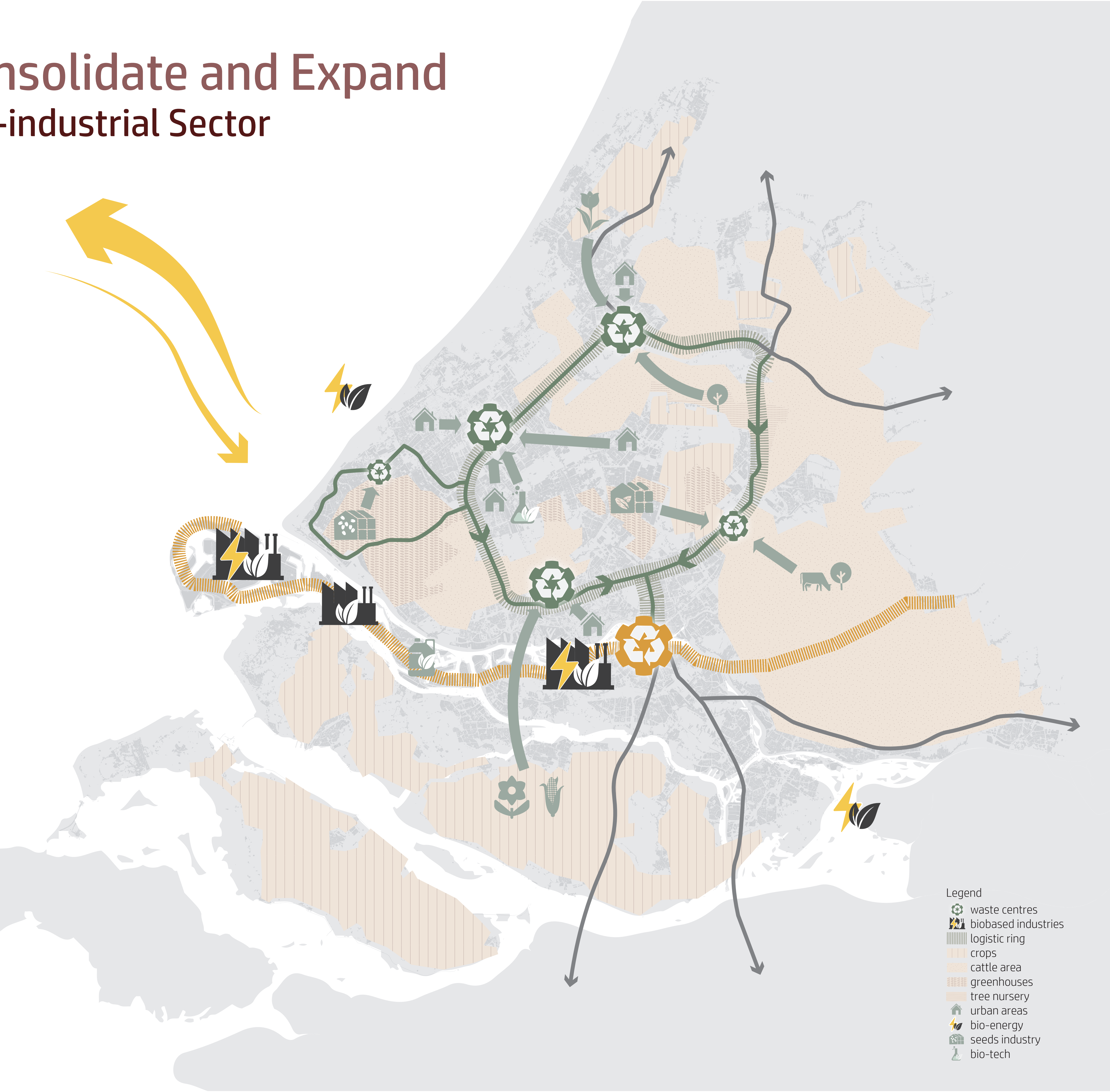
This is also the starting point to integrate ecologically sensible areas by implementing green corridors. These corridors will enable the gradual consolidation of the Green Heart area as a network of connected natural environments interfacing productive green landscapes.



4.4 Integrate, Consolidate and Expand

4.4.1 Expanding the Bio-industrial Sector

The final stage for the implementation of the logistics is a gradual and intense process of engaging bio-industrial stakeholders who will benefit from new biotech and biochemical innovations. These innovations are intermediated by the Knowledge Hubs, policies supporting entrepreneurship, and governmental incentives. Then the expansion of high-value business will be enabled to increase the competitiveness of the Port of Rotterdam. This includes special incentives for bio-pharma industries, biochemical industries and seeding industries as high-value products for exportation. This will also embrace new possibilities for biofuel refineries, by adopting seaweed and waste of vegetable oils as raw materials, structured by a reinvented intensive and highly technological agricultural sector.

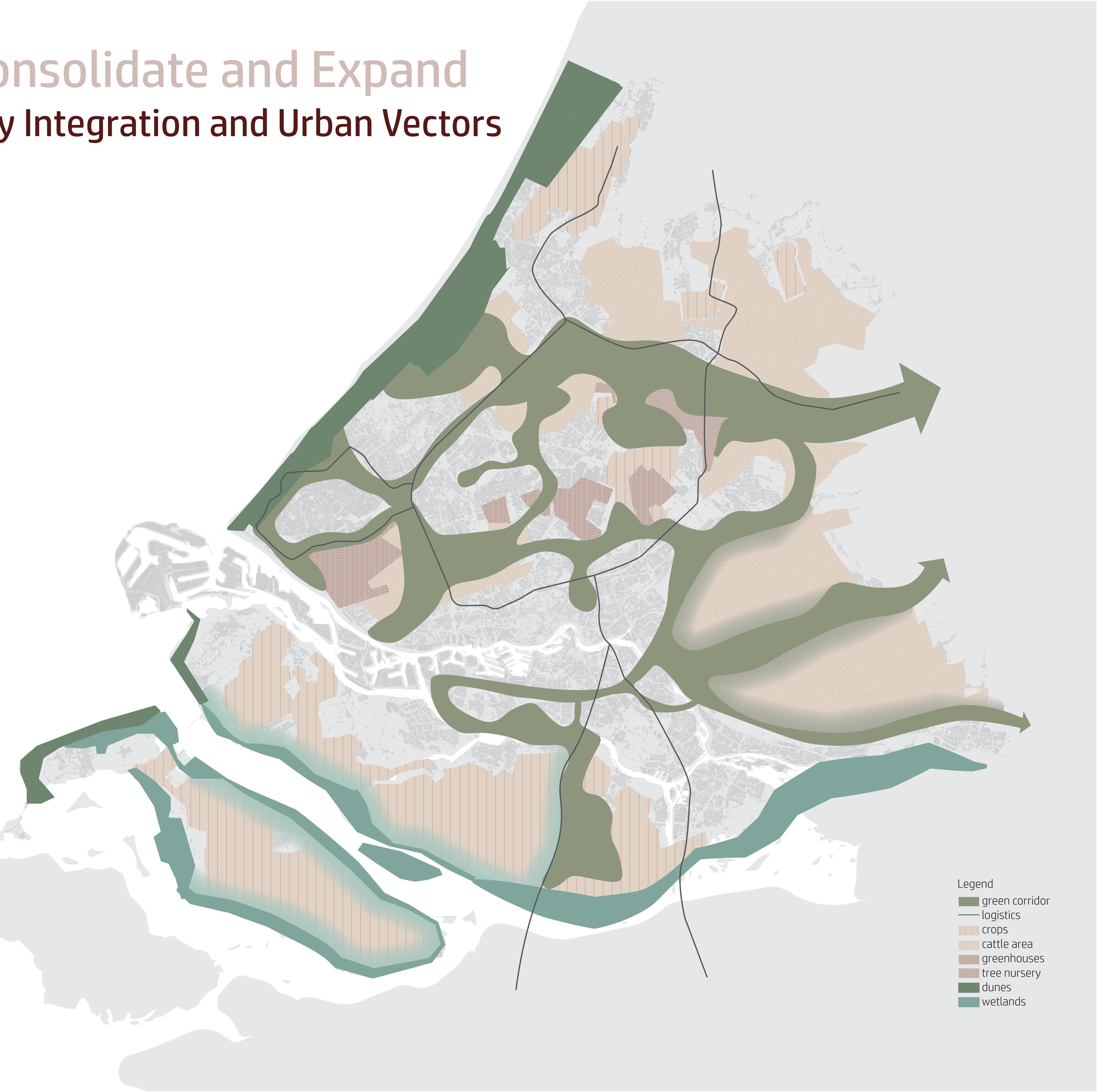


4.4 Integrate, Consolidate and Expand

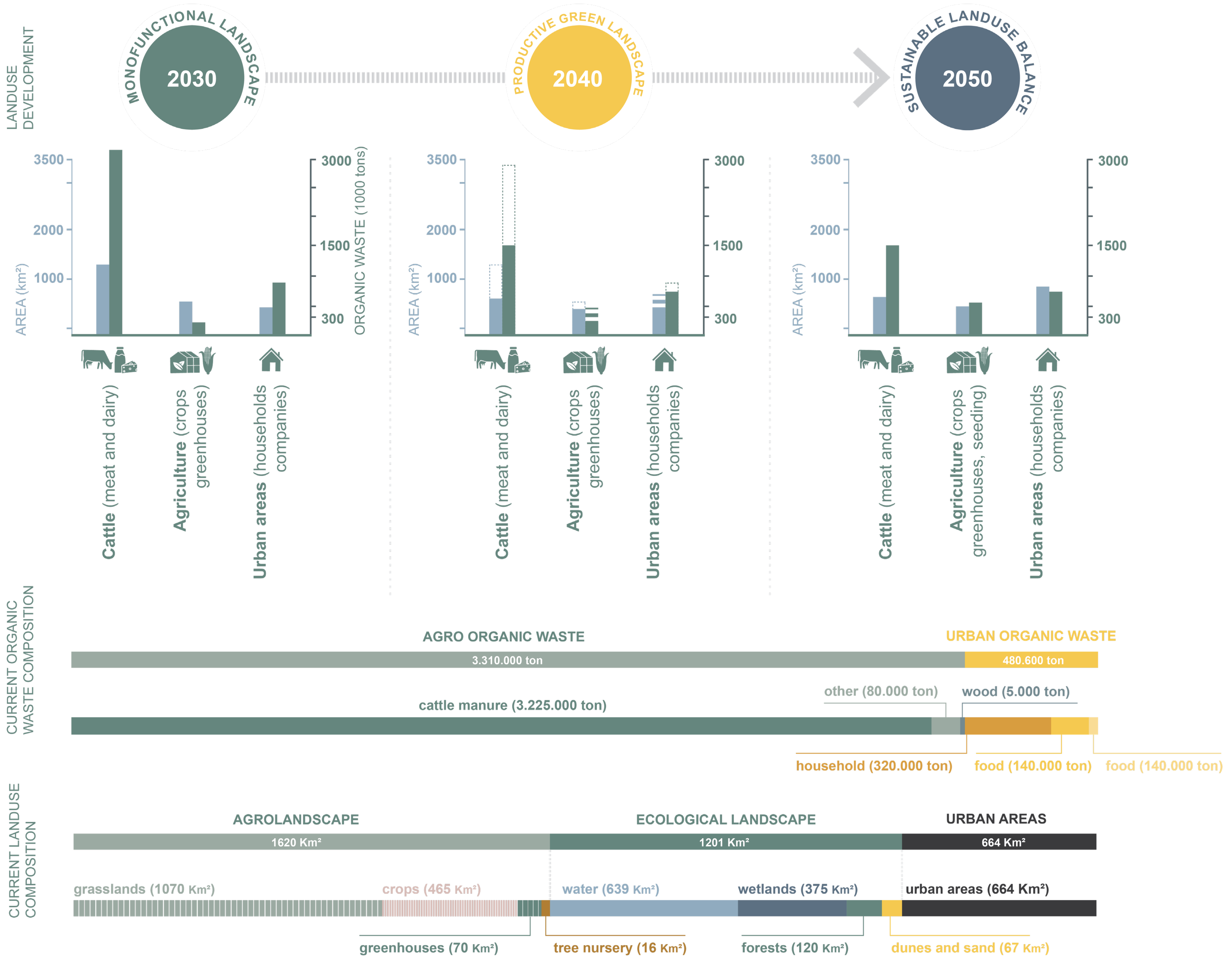
4.4.2 Expand Agroecology Integration and Urban Vectors

The final stage for the land-use structure envisions a future agricultural sector transformed by technological innovation, economic support and technical support, provided by the Knowledge Hub program and supporting policies. In this respect, the agricultural sector functions as an integrated agro-ecological productive landscape, highly productive and intense economically. Next to that, it also guarantees vital ecological buffers and connections with the wetlands, forest fragments, composing an extended Green Heart that interfaces mixed-agriculture systems and urbanization areas that will be explored with more detail in the zoom-ins located in the following chapters.

In this stage, the new agricultural system is characterized by its multi-functionality and resilience, being capable of adapting to environmental changes, flooding, and the salinisation process. To achieve it, a strong connection between technical support, entrepreneurship orientations and subsidy to agricultural stakeholders plays a key role to ensure South Holland's bio-economy vitality. Then, ensuring future unfoldings, while keeping and propelling the role of agro-ecological business.

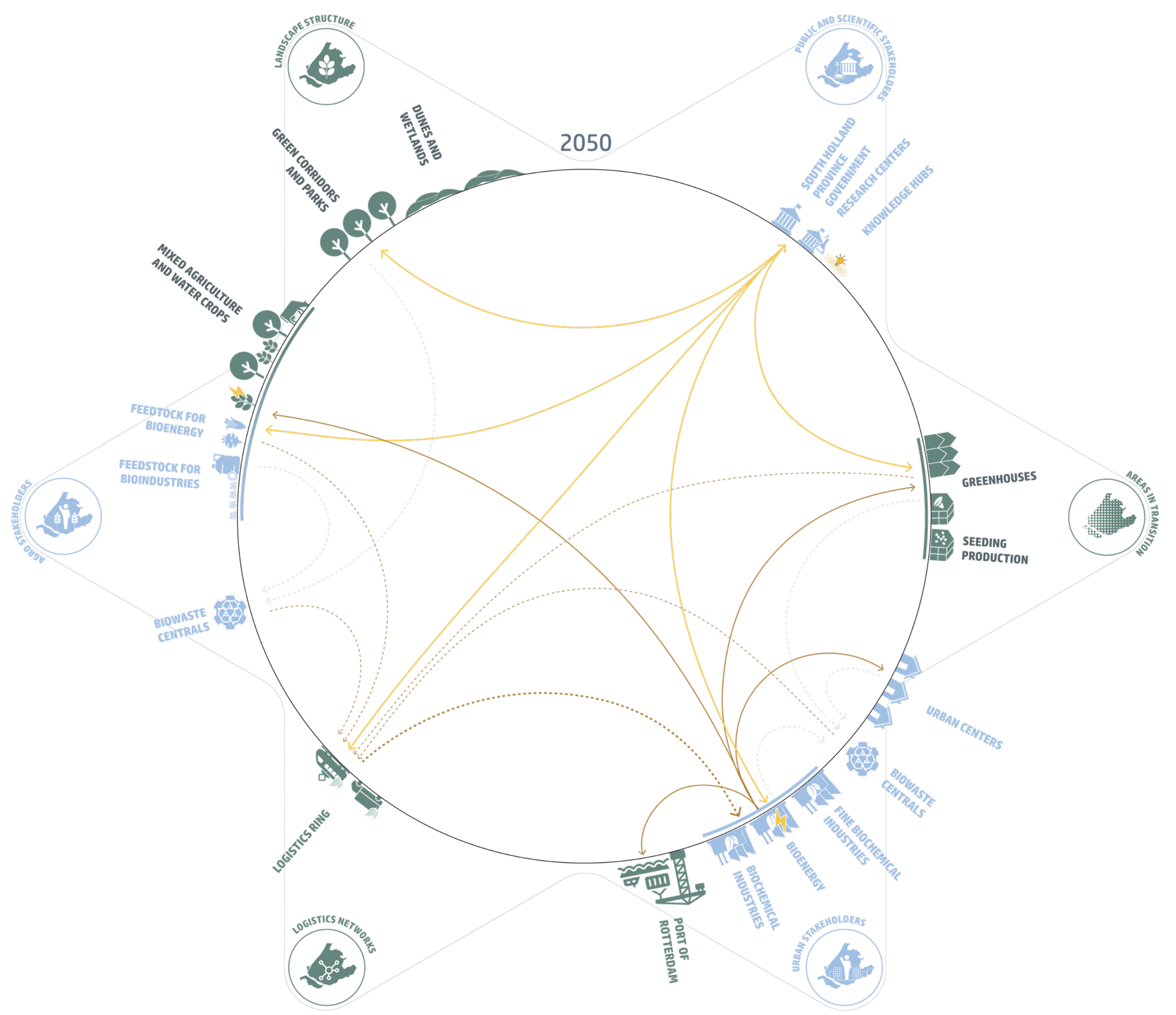


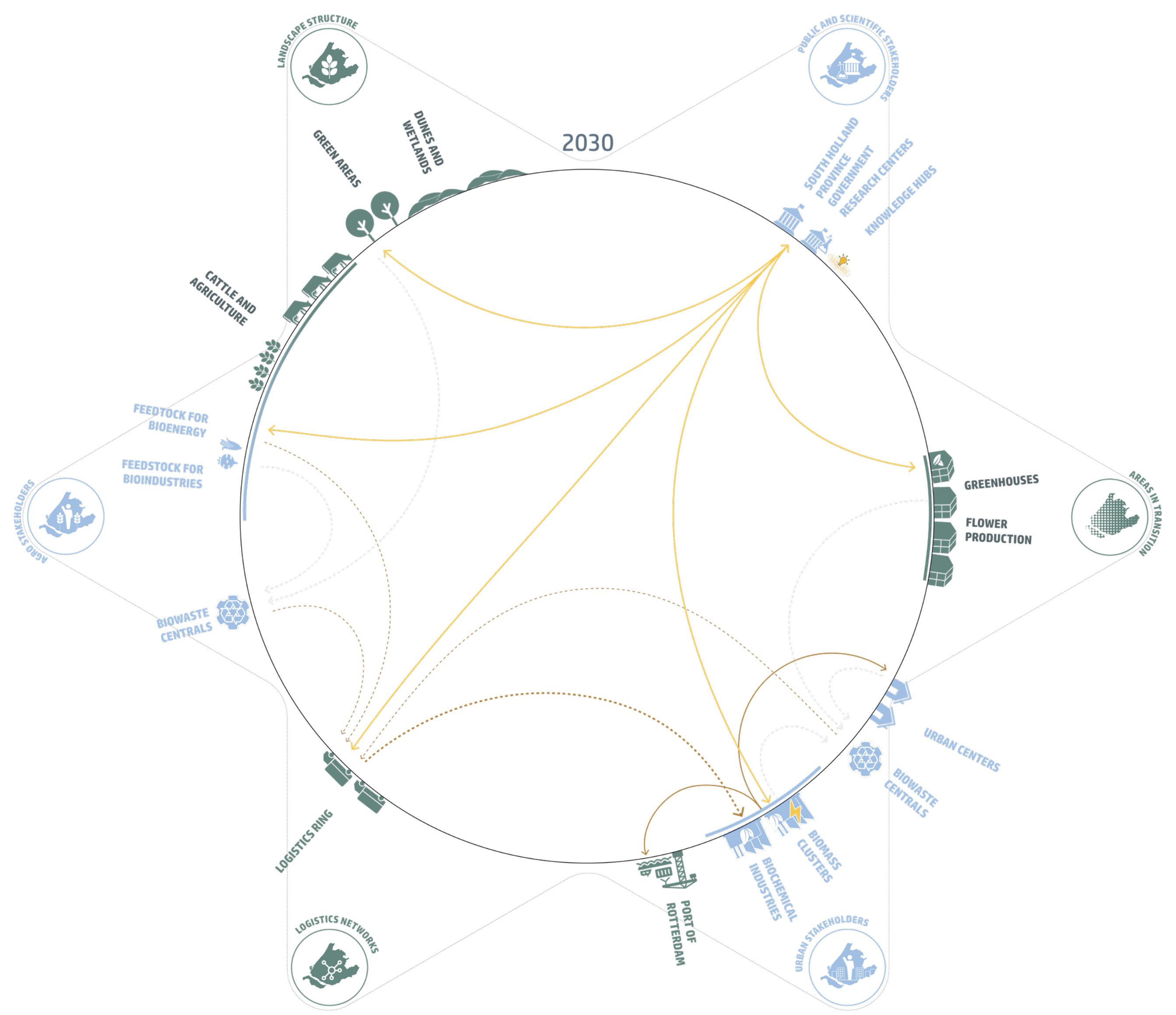
4.5 Spatial Balance



4.6 Logistics Strategy

4.6.1 BIOCYCLE - optimizing cascade flows





Within this paragraph the logistics strategy is explained in flow diagrams and maps. The first step is to optimize the cascade flows through two acts. In sub-paragraph 4.6.2 the complete flows of the suggested BIOCYCLE are configured in one map. The materials going in and out of locations are transported via the renewed infrastructure. Transport methods are transport by; freight train, trucks on biofuels and shipment with for example roboats. Moved through the new BIOCYCLE infrastructure. Waste flows will be organised within the waste centres and after this they are transported to the port industries. One example of a process within the new bio-port is the refining of biomass into bio-energy. Other examples of new industries in the port are highlighted in paragraph 6.3. In the last part of this paragraph (4.6.3) the flows are connected to show the potential of the circularity of this new biobased system.

4.6 Logistics Strategy

4.6.2 BIOCYCLE - optimized cascade flows

urban

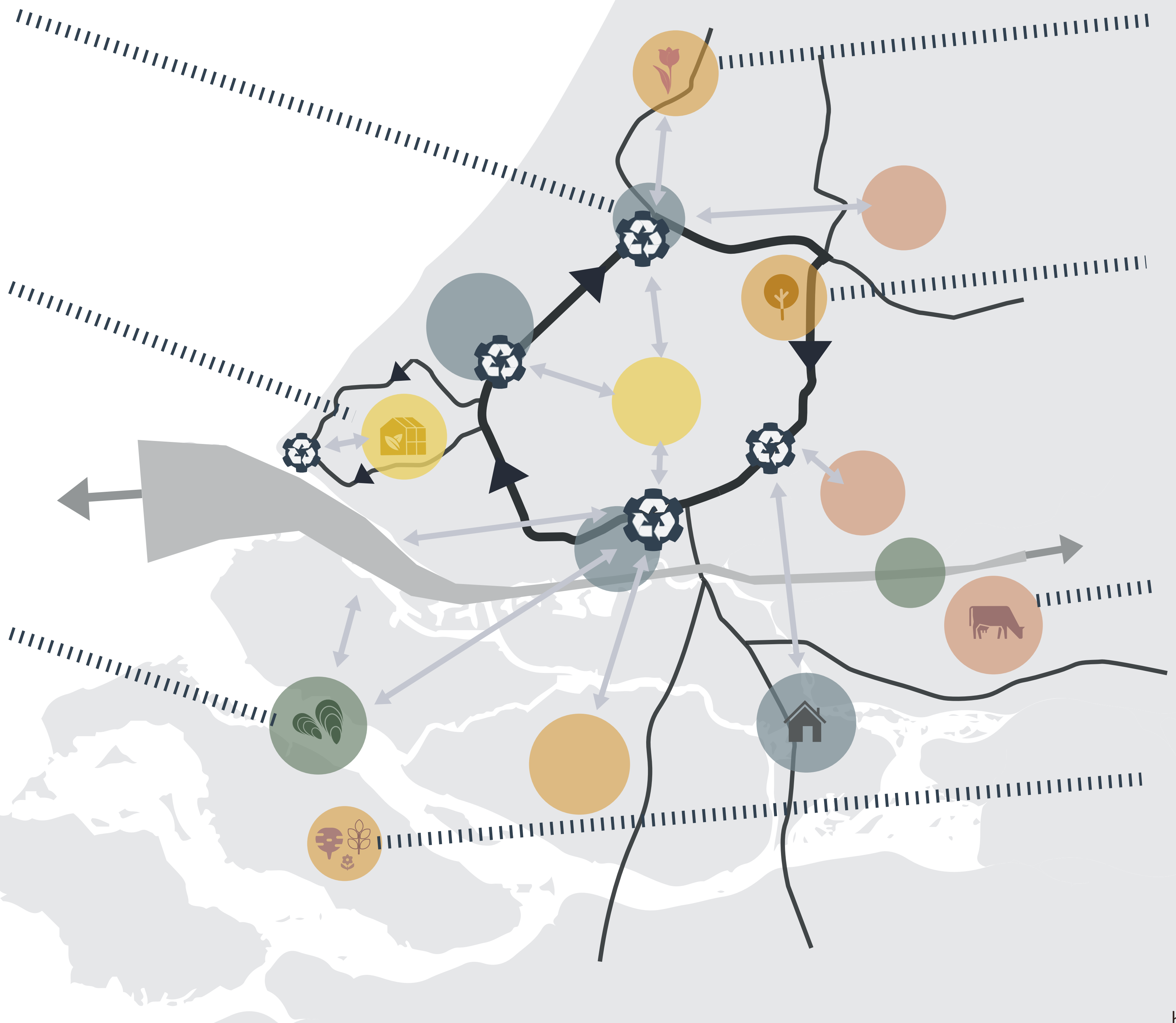
in	out
food	biowaste
bio-insulation	oil waste
bio-energy	solar energy
edible oil	
other materials	other waste

greenhouses

in	out
co2	organic waste
seeding	seeding
water	food
bio-energy	

water crops

in	out
nitrogen & phosphorous	food
	biomass



port

in	out
biomass	bio-energy
wood pellets	bio-insulation
energy crop	feed
	edible oil

waste centre

in	out
biowaste	biomass
wood waste	wood pellets
oil waste	bio fertilizer
manure	

flowers

in	out
seeding	potted plants
water	organic waste
	seeding

tree nursery

in	out
seeding	trees
water	wood waste
	biowaste

cattle

in	out
feed	food
water	manure
	organic waste

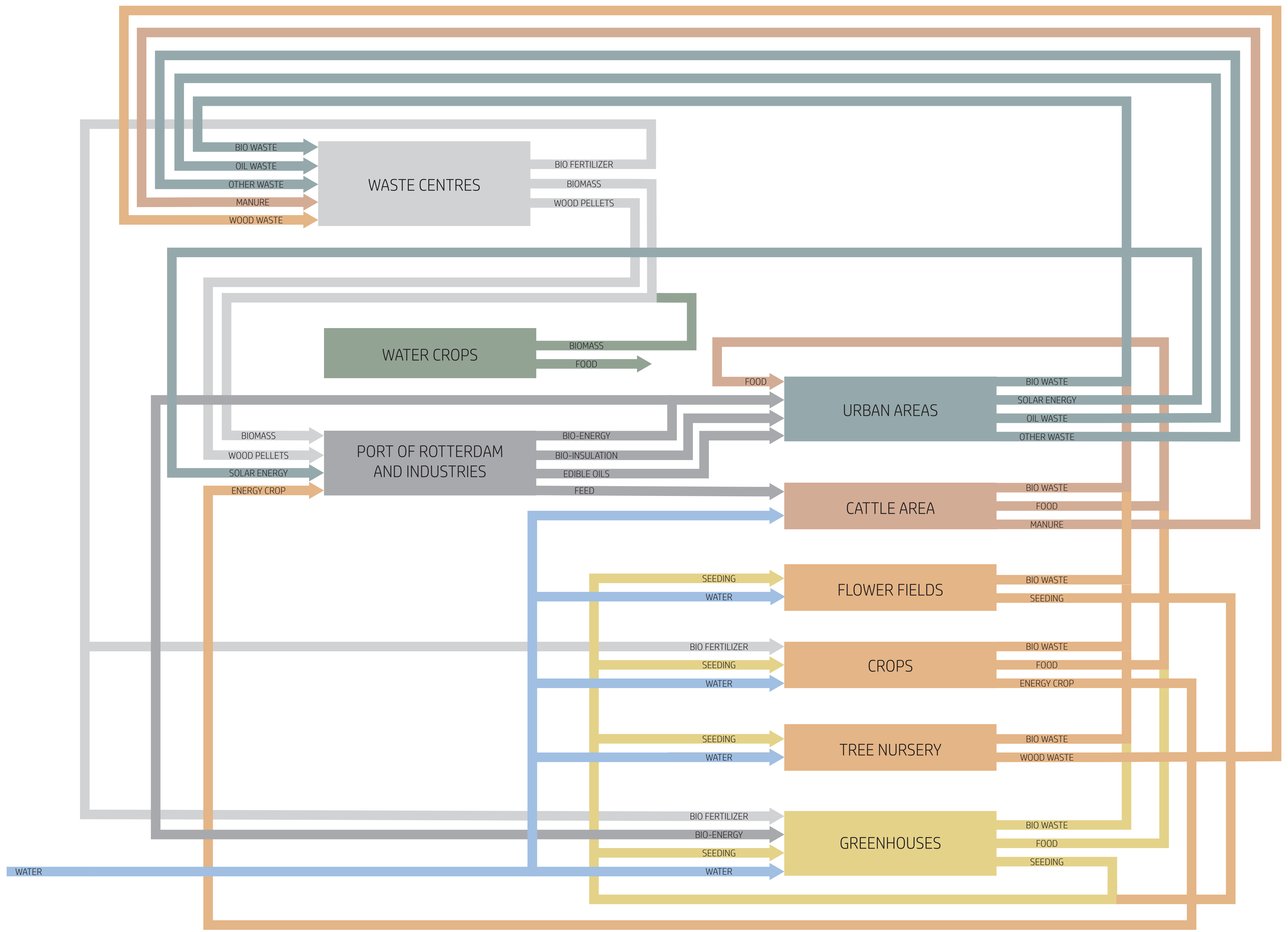
crops

in	out
seeding	food
fertilizer	bio waste
water	energy crop

bio-energy = biofuels, biogasses etcetera

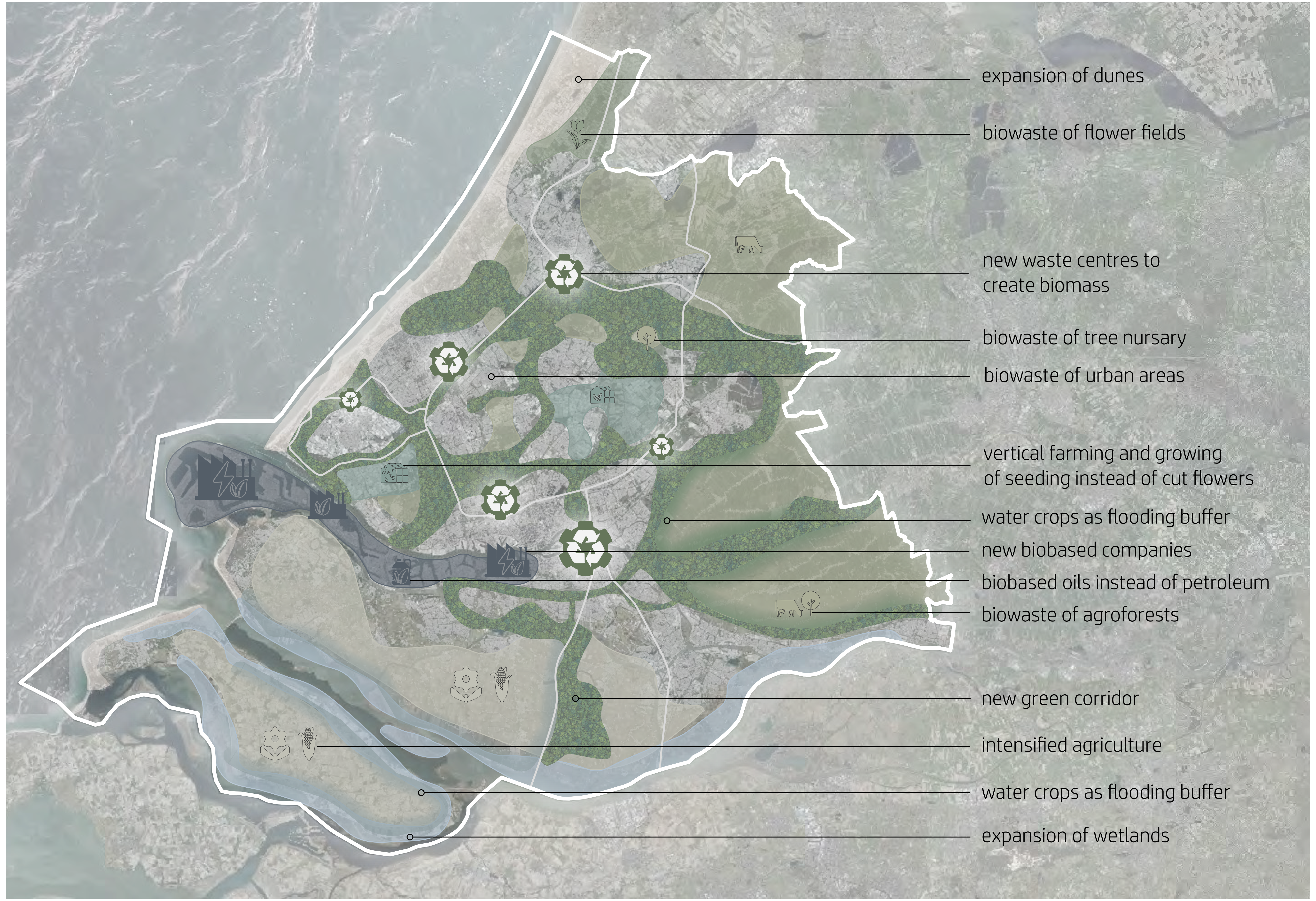
4.6 Logistics Strategy

4.6.3 BIOCYCLE - Flow Diagram



4.7 Complete Strategy

2050 - Final Vision



4.8 Sustainable Agriculture

The agricultural landscape in the province of South-Holland needs to densify. New technologies such as vertical farming and algae production have created possibilities to make better, more efficient use of space, resources and energy (WUR, n.d.).

SECTOR			
SOLUTION	There is a high demand for food in the Netherlands. To optimise the agricultural industry, crop production needs to be intensified. Cultivation of vegetables should be as efficient as possible to create a spatial balance between agriculture and nature.	In the future the amount of cattle and calves needs to be reduced to decrease nitrogen emissions. To reach this goal, the total area of cattle fields should decrease. This will most probably lead to less dairy products on the market. The solution lies within innovations towards plantbased substitutes and cultivated dairy products.	The amount of cattle needs to be reduced for sustainable reasons. The consequences are decreases of meat production. The solutions lies with innovations of plant based/ cultured meat products and changing consumer behaviour. Already there is a rapid trend towards decreasing demands.
RISK	The risk of intensifying agriculture is the balance within land-use. Agricultureal landscapes should be in balance with our natural lands, whilst living up to the industries demands for food production. Another risk is that intensification will increase the demand for water, nutrients and other products for these agricultural businesses, which might lead to sustainability problems	A risk with these innovations is that we need to scale-up the industry of cultivated and plantbased substitutes while this market is currently lead by a lot of small scale businesses which could be a risk when the demand rises. Next to that, the behaviour of the consumer needs to change. It might be a problem to some consumers to make the step towards these new products.	A risk with these innovations is up scaling the now smaller start-ups and companies to produce enough meat for the high demand. Next to this, behaviour of consumers can be hard to influence. By this, the switch to non-meat could be a problem.

4.8 Sustainable Agriculture

SECTOR			
SOLUTION	The land-use of the greenhouses needs to be reduced. Mosty because the permeability in this area drastically needs to improve to stop subsidence. A solution to this will be the innovation towards vertical farming. Research shows that this innovation results in ten to twenty times less land-use (WUR, n.d). Which will also leave us with more space for natural areas.	The greenhouses need to reduce in land-use. The solution will be to get rid of cut flowers in greenhouses and to invest in seeding. The plants with roots will remain, since these are more sustainable. Seeding is a high-value product and therefore needs less space than cut flowers to reach the same economic demand.	The flower fields are important heritage for the Netherlands. The fields are a hotspot for tourists and a lot of people are proud of the identy that comes with these productive industries. Therefore the flower fields should be retained, whilst looking for more sustainable ways of producing.
RISK	Some of the risks that come with transitioning towards vertical farming are ;the high investment costs, higher energy demands and demand for new knowledge and innovative production methods. (Groen Kennisnet, 2019). Especially the high energy demand could be a problem, since vertical farming should be a sustainable solution.	Possible risks of this new land-use of the greenhouses can be the change of the behaviour of the consumer that is needed, since there will be less cut flowers in the future. Another risk could be the knowledge that is needed for the production of seeding.	Next to the cultural value of the flower fields near Lisse, the flower industry has a high economic value. That would also make it difficult to change the industry. In the future the value of this industrie might be reconsidered.

5 How to Support the Transition

The fifth chapter will explain how to support the transition to a biobased economy using our strategy. The three acts will need to be accompanied by a top-down and bottom-up strategy. This will make relations to current local visions and governmental policies to support the transitions that are needed.

CONTENT

5.1 Top-Down Strategy

5.1.1 Policies

To create an environment in which this vision can flourish, it must be supported by public policy. Both the national government, the province and the municipalities will implement policies that will result in a more sustainable province. An advice to the Ministry of Infrastructure and Water Management by the policy table on flooding and high water recommends thinking about how the living environment can be designed as safely as possible, taking into account a changing climate (Rijksoverheid, 2022). This policy was created in response to that call.

Climate crisis & landownership in coastal areas
The climate crisis is a direct threat to the safety of the inhabitants of the Netherlands. Due to the greenhouse effect, the world is warming up, as a result the ice caps at the North and South Pole are melting, resulting in rising sea levels. Since the 'Watersnoodsramp' in 1953 stricter safety standards were made for primary water defences (Rijkswaterstaat, n.d.). However, these safety standards will not suffice when the sea level continues to rise; Wageningen University and Research has developed a vision of what the Netherlands will look like in 2120 when sea level rise continues (2019). In this vision, large parts of the Netherlands have flooded, becoming lakes, seas or rivers.

The central government will continually review risk management to identify areas at risk of flooding. To accommodate landowners, the government offers to buy up land at risk of flooding. To do so, three levels of risk have been identified: immediate, high and medium. These three levels connect to three different options:

Immediate threat: the government will buy the land for €150 per square meter.
High threat: the government will buy the land for €250 per square meter
Medium threat: the government financially encourages the landowners to move to a low-risk area.

In addition to financial compensation, the ultimate goal is for landowners to eventually resettle in the areas they left, albeit under different conditions. There have been made resettlement plans for two specific groups: residents and agricultural farmers. Additional legislation for these two groups can be found in the next paragraph on the future of flooded areas.

In the future scenario flooded areas will not become "lost lands," quite the contrary. These areas, depending on their exact location, will transform into floating residential areas or production areas for water crops. Residents or businesses that have left the area due to the government's risk strategies will be given priority to work or live in these areas again.

Knowledge hubs
The agricultural landscape in the province of South-Holland needs to densify. New technologies such as vertical farming and aquaponics have created possibilities to make better, more efficient use of space, resources and energy (WUR, n.d.).

With financial support from provinces in the form of subsidies, agricultural companies are encouraged to transform their business into vertical farms or the cultivation of water crops.

In addition to financial incentives, provinces would also like to support farmers with knowledge. Therefore, in cooperation with the many universities that the province of South Holland counts, the province will create 'Knowledge hubs', which will become centres of agricultural knowledge. In these centres, scientists and academia will provide farmers with the needed information on how to transform their businesses. The centres are set up in such a way that farmers not only learn from the academia, but also from each other's experiences.

The knowledge hubs are also designed for people who want to start their business in water crop production in flooded areas. The hubs will offer retraining courses so that farmers can continue to work in the agricultural sector, however with other types of crops.

Soil quality
New legislation forbids the quality of soil to degrade below a certain level. When the nutritional values of the soil drop to a dangerous level, landowners are obliged to transform their land to agro-forests. Said landowners have to bear the costs of the transformation themselves.

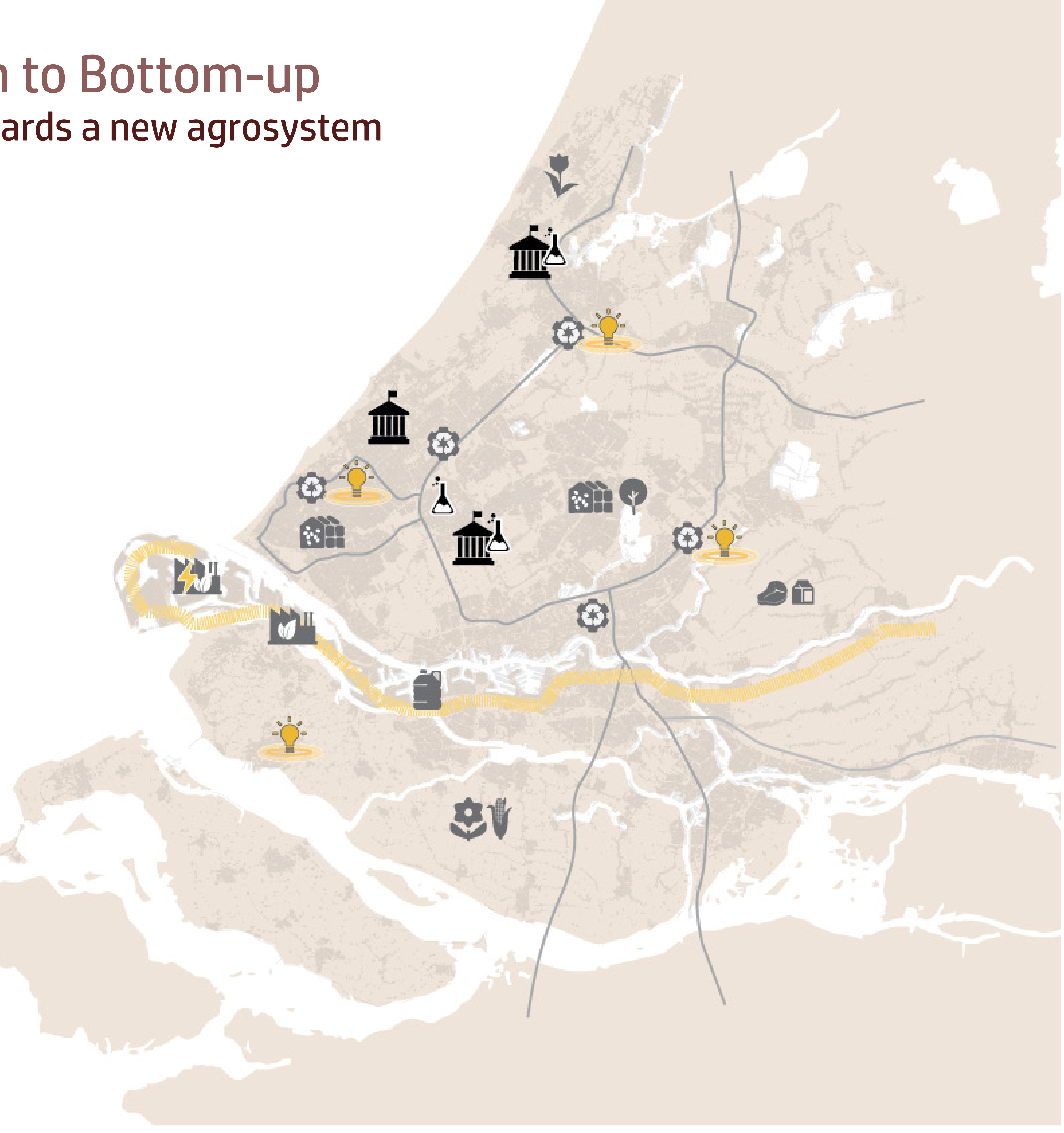
5.2 From Top-Down to Bottom-up

Stakeholder engagement towards a new agrosystem

To allow the foreseen bio-economy development, identifying and engaging local actors is a crucial steps towards a just and feasible transition.

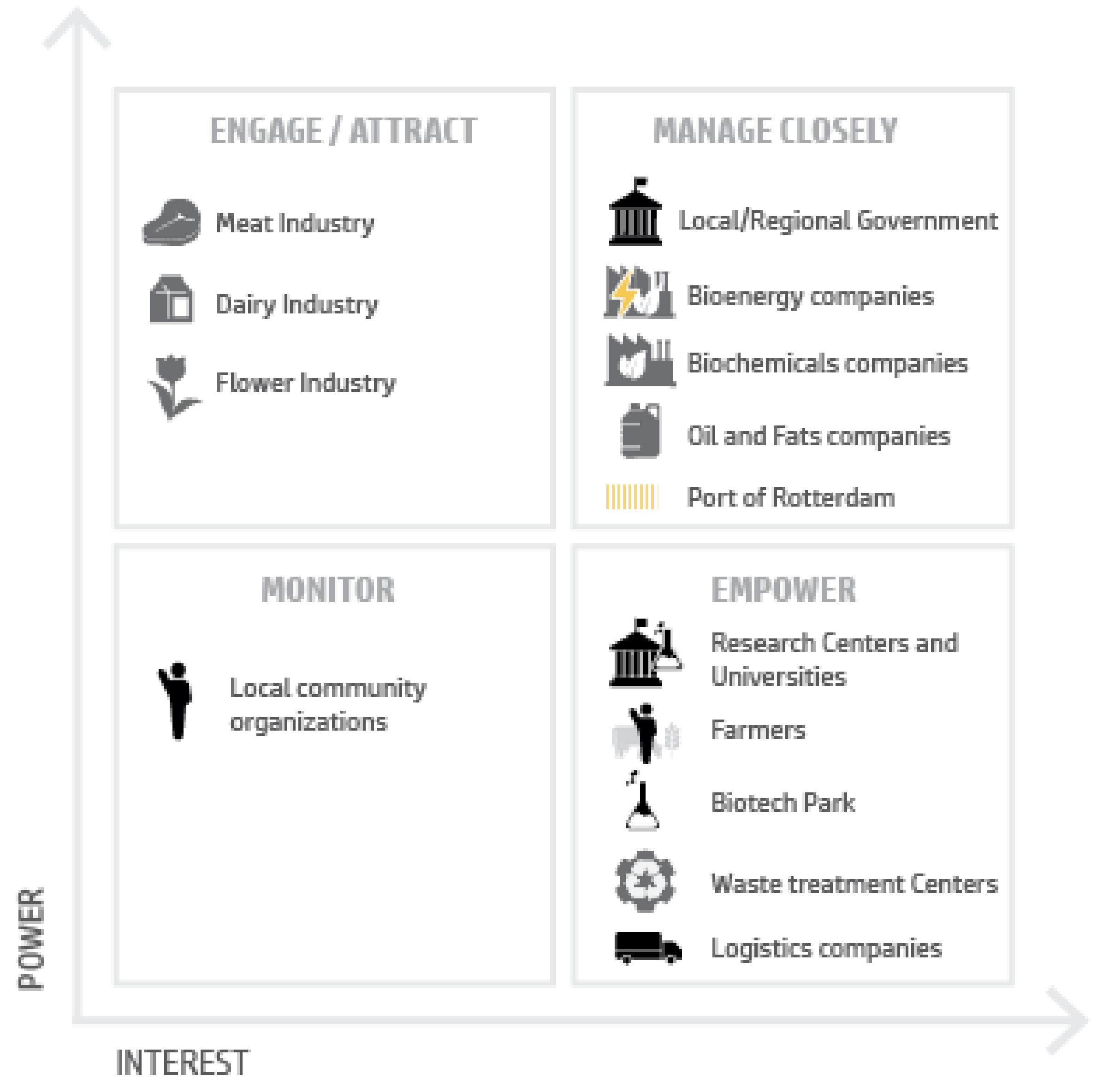
In a first moment, incorporate and expand biowaste centres to promote cascade flows integrated with a logistics network is the starting point to create a favourable economic environment to support new and current bio-industries and bio-energy production. That being possible with the support of top-down policies and public-private agreements.

Subsequently, for a long-term resilient transition, the scientific stakeholders need to be linked with local actors to promote knowledge flows, allowing fluid innovation systems to promote technologies in biosystems, logistics, biofuels, spatial planning, landscape transformations and agro products, equipments and biological products. Therefore, this innovation atmosphere will be closely followed by land use transformations possible with environmental and climate change mitigation policies, local agreements, economic incentives, public and private subsides and entrepreneurship promotion.

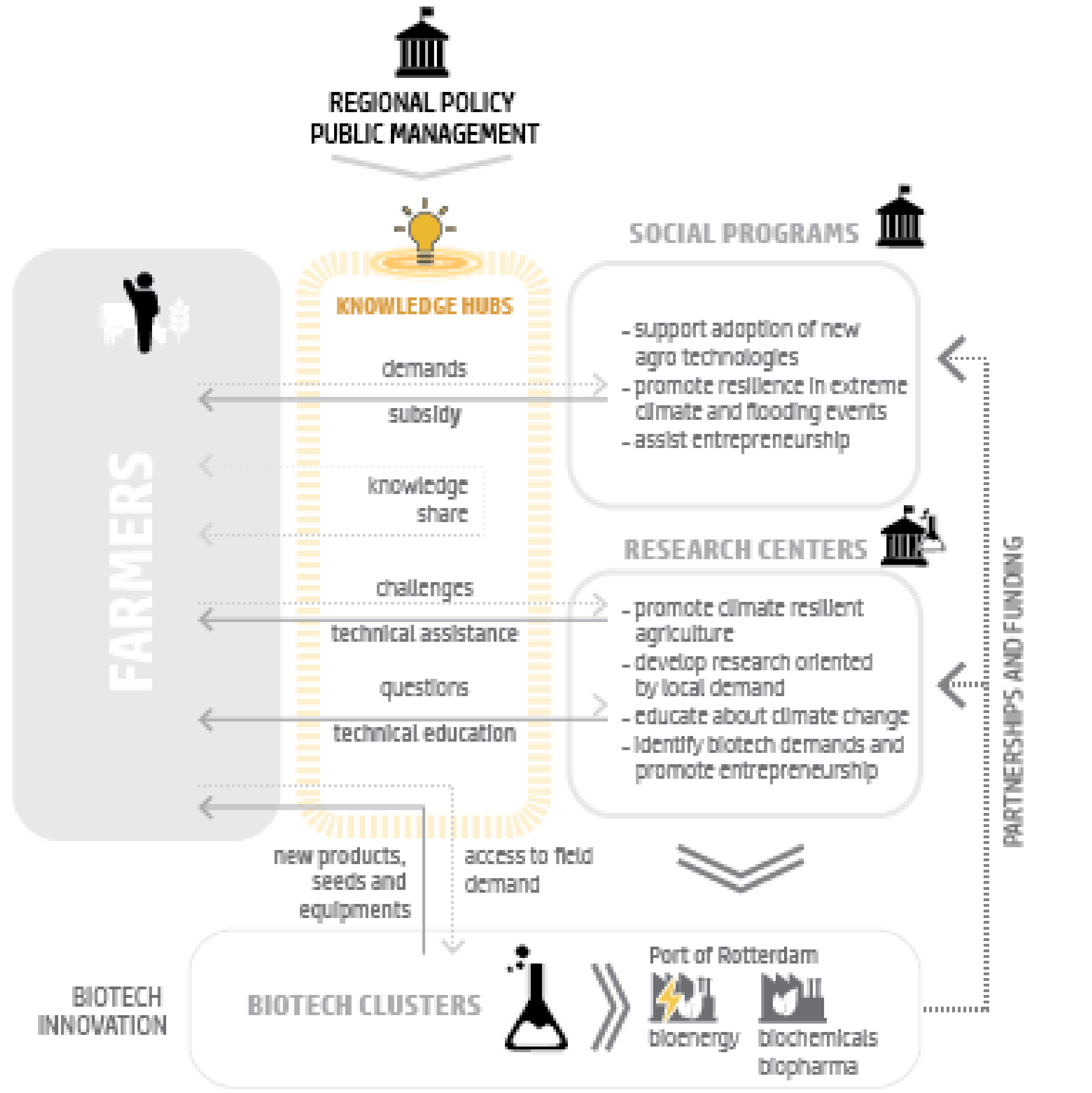


5.3 Bottom-Up Strategy

5.3.1 Stakeholder Support



By initially understanding the different stakeholder powers and interests, it was the necessity for an integrating program to empower actors was detected. The transition of top-down policy and structural changes in the territory will be complemented by a public program that will be able to connect stakeholders and integrate bottom-up initiatives. The envisioned Knowledge Hubs will fill the current gap by creating bridges between local agricultural actors with research institutes, which wil provide technical support and overlook future research demands.



Also, the program links the diverse types of farms and agro-actors with new business opportunities, providing direct contact with retailers and possible feedstock buyers. Within this new social structure the Port of Rotterdam will function as an industrial and economic backbone for a development. Then, also allowing direct research linkages between bio-industrial demands in technology and social innovation to place the agro actors as the foundation of the Province bio-economy model.

5.3 Bottom-Up Strategy

5.3.2 Knowledge Hubs

Within this strategy the engagement of local stakeholders is very important. The changes that need to be made for the transformation to a biobased economy influence a lot of people and their jobs. To make sure these local stakeholders, like farmers, can join the revolution we need to support them within a bottom-up strategy. To do this the province will have to create 'knowledge hubs'. Within these hubs, technology and innovation will come together with the actual workers/users within the field. This bottom-up strategy is connected to the already present vision on stakeholder participation within the province of South Holland mentioned in the 'groeiagenda'. (2020)

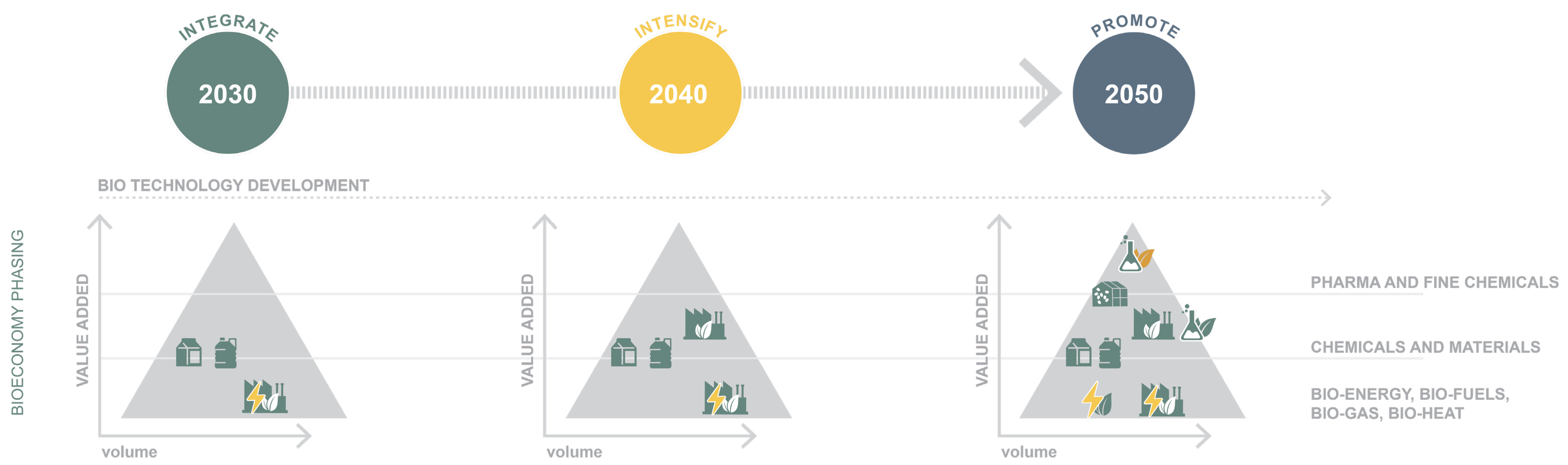
These 'knowledge hubs' will become the centres of for example agricultural knowledge and innovation techniques. In collaboration with scientists and academia they will provide local actors with the needed information to transform their businesses in an economically justified manner. The centres are set up in way that actors, like farmers, will not only learn from specialists, but also from each other's experiences. Discussion sessions and workshops can be organized, to share new innovations and talk about the applicability in the work-field. By this, for example farmers, will be heard in their concerns and can ask questions on how to use these new technologies and the affordability of the changes they need to make. To accompany farmers in the journey to sustainability retraining courses are offered and subsidised by the government.

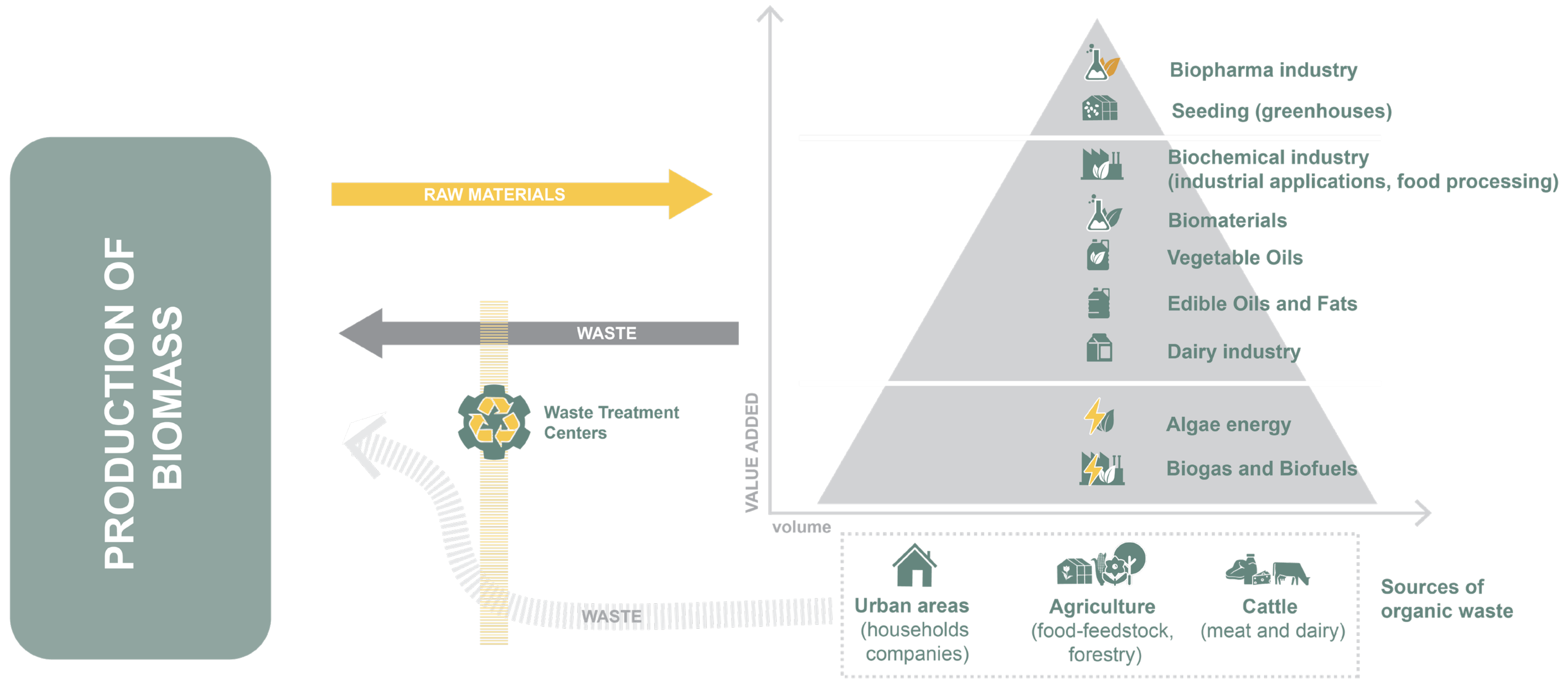
The hubs will not only house educational and conversational events, but they will also house research laboratories where new innovations can be tested and shown.

Policies:
In addition to the knowledge support of those hubs, the province would also need to support the local stakeholders financially. With this financial support , in the form of subsidies, agricultural companies are encouraged to make the decision for sustainable applications, like transforming their business into vertical farms or the cultivation of water crops.

In the appendix a map is located where the flows to the knowledge hubs have been visualized.

5.4 Towards a high value bio-based economy

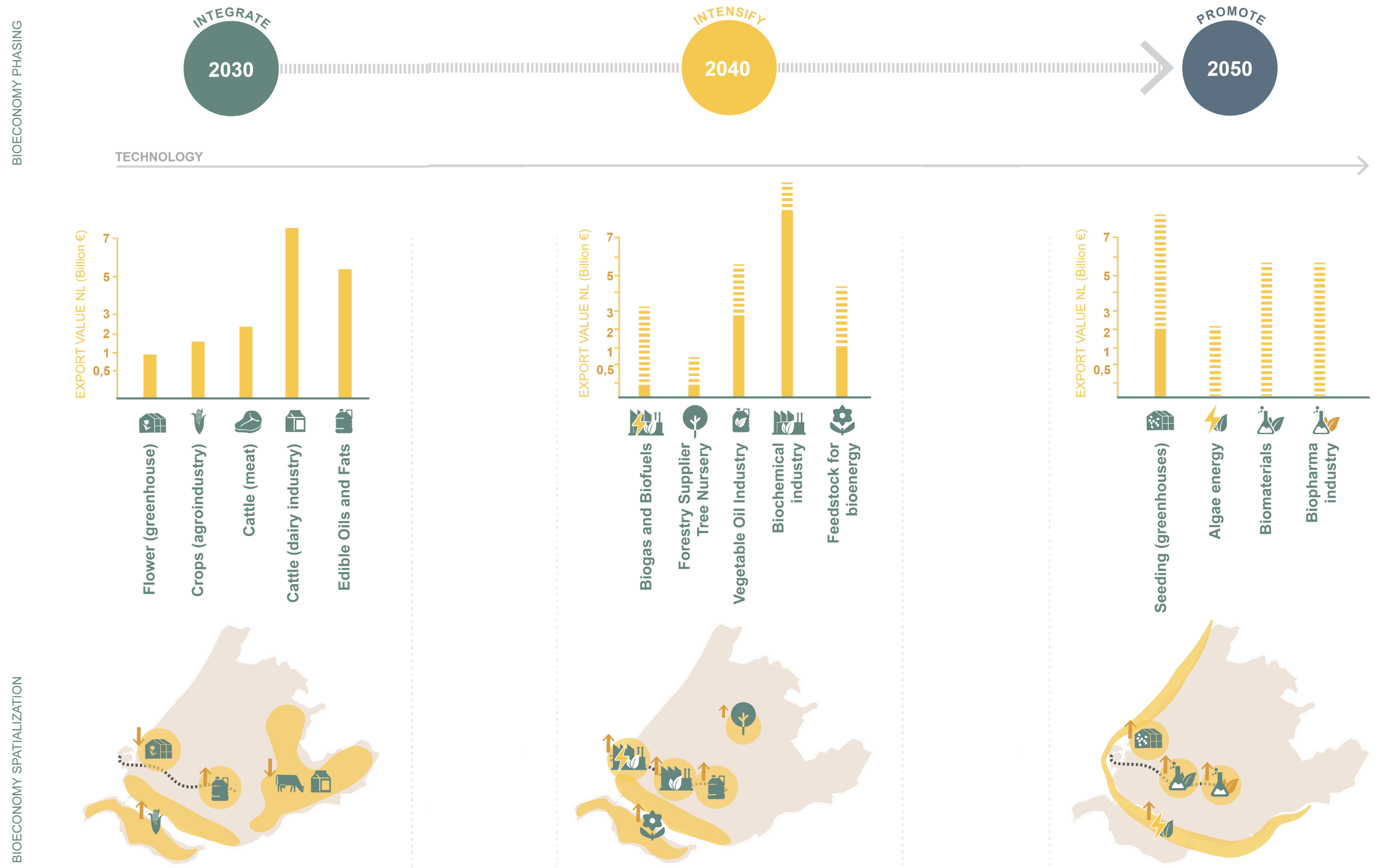




By adapting the pyramidal framework that reveals the relation between economical values and flows of raw material from Hintjens et al. (2015), the future of the bio-economy for South Holland was divided into three phases of increasing economic value.

Integration of the existing bio-industries and gradually shifting the current system towards industrial infrastructures for high value products will aim to increase the province's competitiveness in the bio-industries. Among others; biochemical, bio-pharma and bio-energy industries will advance in providing for both exportation and local demands.

5.4 Towards a high value bio-based economy



6 Regional Design

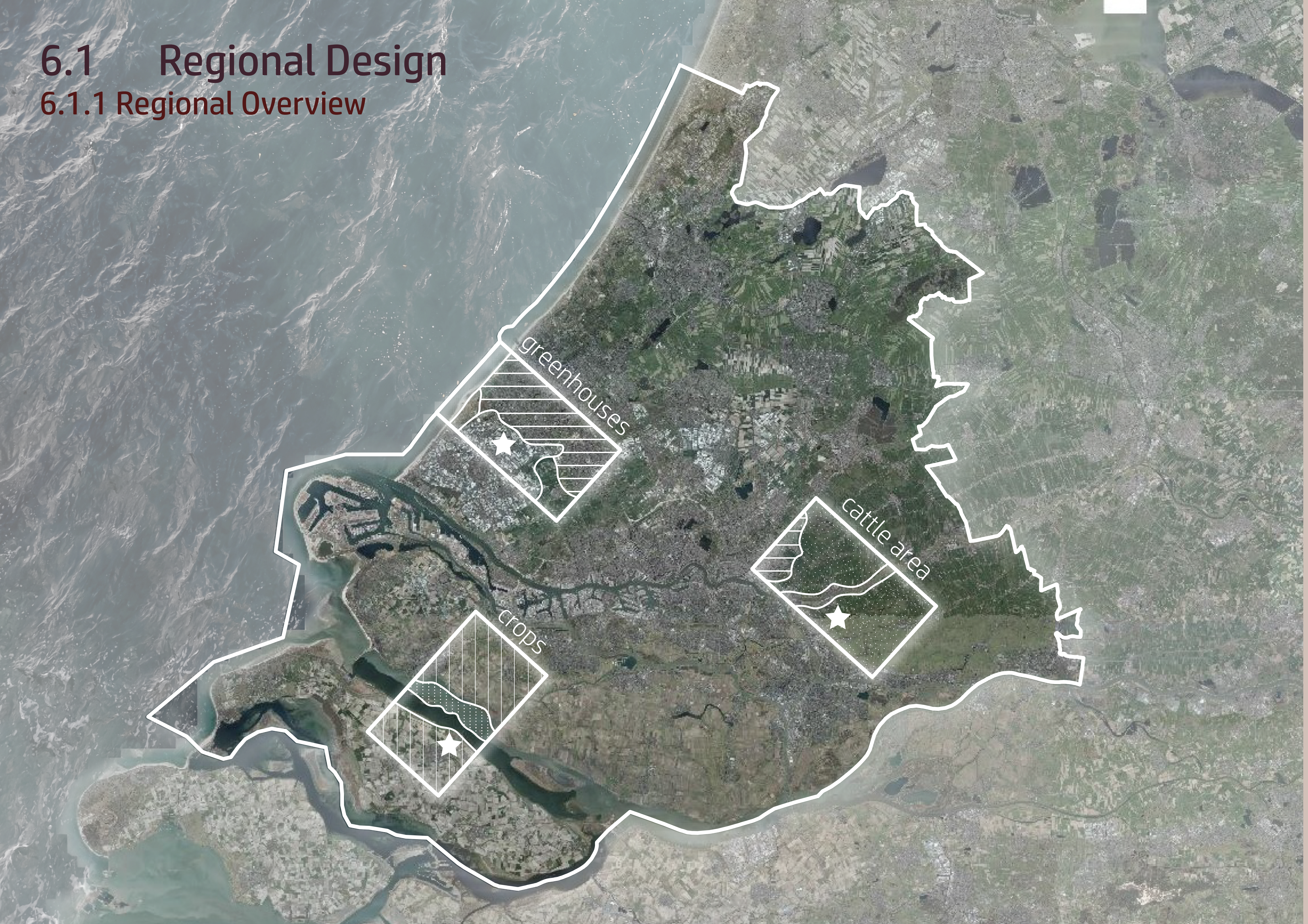
The sixth chapter is about the regional design. In this chapter the vision and strategy are translated into a design.

The chapter begins with the regional. After that, the design will be explained on a smaller scale.
Then the new purpose of the port will be discussed and the chapter ends with the economic value.

CONTENT

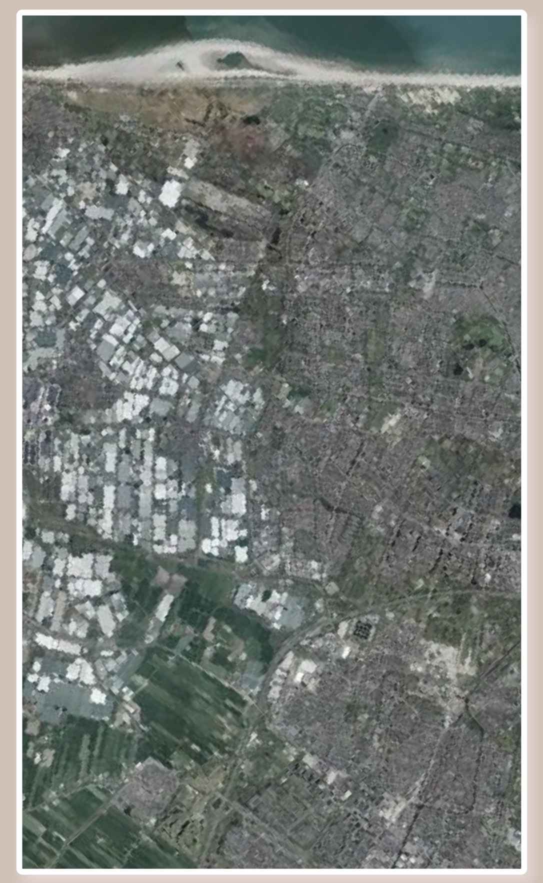
6.1 Regional Design

6.1.1 Regional Overview



6.1 Regional Design

6.1.2 Pattern One



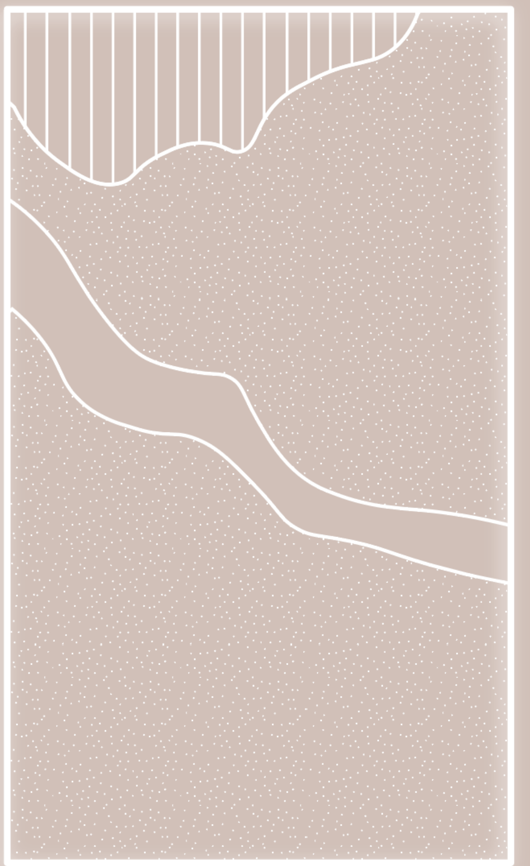
source: Google Earth (n.d.)

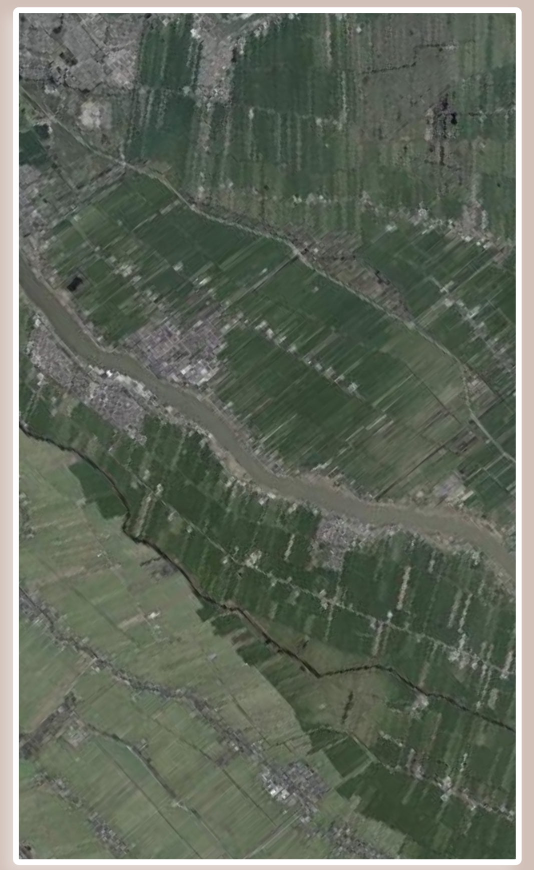
Area	urban area, The Hague
Area	greenhouses
Area	cattle area
Area	dunes - nature

Challenges	Design Opportunities
Because of population growth the challenge of the urban area is the immense housing demand. The current cities have to densify with the risk of creating low permeability and heat stress in urban area's.	Transformations in the urban areas need to occur mostly within the borders of the current cities. Densification with an eye on resilience and a sustainable urban climate is the goal. In this specific area there will be some expansions outside the city scope. This will be possible because of the vertical densification of the greenhouse area. The planning strategy will strive for a balance of natural elements, housing and agriculture.
The biggest challenge of the greenhouses is the huge amount of pollution. The consequences of emissions from these industries are huge. For example the light pollution lowers biodiversity in these areas. Next to this subsidence is caused by the low permeability of the area, where most of the soil is covered by horticulture industry.	The incentive of the design for this area is to reduce the land-use of the greenhouse area to improve for permeability and to reduce numbers of emissions. The advice is to start a transition to vertical farming. Research shows that this innovation results in ten to twenty times less land-use (WUR, n.d).
The cattle area creates a huge share of nitrogen emissions. Nitrogen causes soil acidification, which leads to decrease of biodiversity. For a lot of purposes the soil in these areas has become unsuitable.	To stop the decrease of biodiversity, the cattle areas need to become more sustainable. This also has an economic relevance. When the current trend in the decrease of demand for meat and dairy products continues the amount of cattle in the area will be forced to shrink. Right now the soil is unsuitable for any other productive landscape, so the first step of this design strategy is to promote a transition to agro-forests, which will induce soil quality to make it suitable for other purposes in the future.
The importance at the shore of the province is with the protection of our natural water defence line. In former times urban expansions have taken over part of the dunes because of the high value in beach apartments. This is a huge risk for water-management now that the sea-levels are rising.	To protect us from the rising sea levels we need to reinforce our natural borders. The dunes need to be extended and a buffer needs to be created as a buffer and to improve the biodiversity in this area. A protected natural buffer will also help to stop urban sprawl toward our natural areas.

6.1 Regional Design

6.1.3 Pattern Two





source: Google Earth (n.d.)

Area cattle area

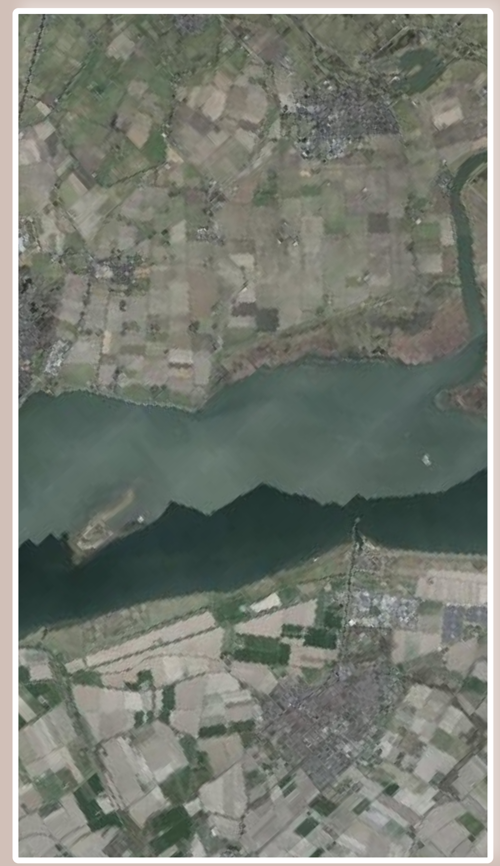
Area urban area

Area river

Challenges	Design Opportunities
The cattle area creates a huge share of nitrogen emissions. Nitrogen causes soil acidification, which leads to decrease of biodiversity. For a lot of purposes the soil in these areas has become unsuitable.	On page 79, the first step is introduced; creating agro-forests to induce soil quality and biodiversity. In this specific area the possibility of flooding and the max. water depth is really high. This creates an importance for a water sensitive strategy. In between the agricultural productive lands and the river a buffer needs to be created. One option is the introduction of natural wetlands. This also gives the opportunity of creating a productive water landscape with crops like: algae, seaweed, mussels etcetera (water crops). Vertical mussel farms can contribute to inducing water qualities because of the organisms capacity to filter fine particles from the sea. (Shaunak, 2020)
Because of population growth the challenge of the urban area is the immense housing demand. The current cities have to densify with the risk of creating low permeability and heat stress in urban area's.	Urbanization needs to be well organized, because of the current scarcity of land. In this vision document we consider the flooding threat as a reality where the amount of land left to use shrinks even more. To create new urban typologies realising live on and with water, would hand a solution to this situation. A knowledge hub will be created for an urban laboratory creating water sensitive living environments. In the future productive landscapes will return to these areas in the from of f.e. mussel farms. The farmers will be accompanied in this transformation by the knowledge hubs.
The challenge of the river area lays within the flood risks. Climate change causes the water levels to rise, which increases the flooding risks in the Netherlands.	Where the main reason to alter this area is to be more resilient to flooding scenarios in the future. A border needs to be created and living areas in this location need to be designed in a different manner. A start can be the broadening of the polder structure to guide the water in different directions. In a later phase the water sensitive urban laboratory can be created. The river bedding will not only be utilized for producing water crops like algae, they will also start to serve recreational purposes through the shape of wetlands . Which will very probably create a higher biodiversity.

6.1 Regional Design

6.1.4 Pattern Three



source: Google Earth (n.d.)

Area crops

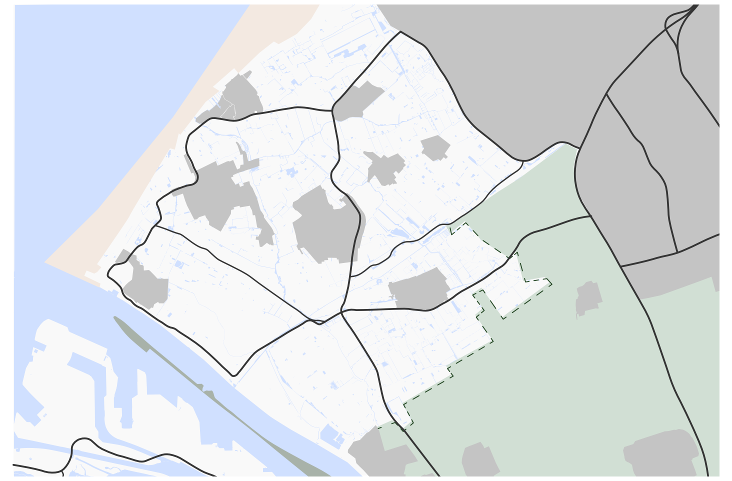
Area wetlands

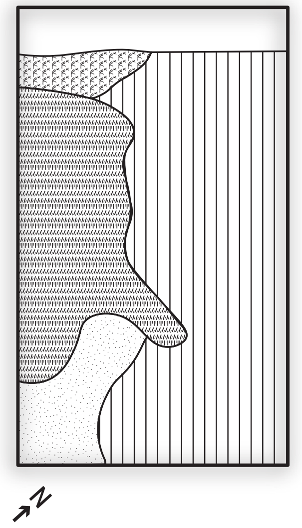
Area river

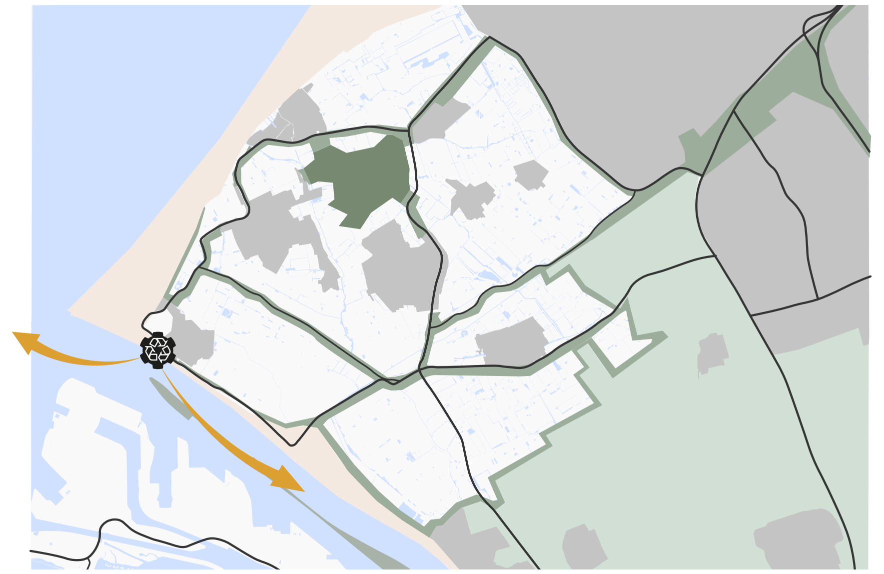
Challenges	Design Opportunities
In the future the crops produced on these lands will form an even more important source of food and feed, due to growing population. The challenge here is to keep a balance between productive agriculture and nature.	The task we need to full-fill in this area is increasing productiveness for increasing demands. Agriculture needs to be densified, since there will be no expansions of the crop areas to protect nature. Next to this crop rotation with energy-crops like rapeseed have a lot of potential to add to the value of agricultural lands. (Boerenbond, 2014) From these crops oils can be made for the use in biofuels. This area will also be the main generator for waste flows used in the bio-energy field.
The wetlands function as a water protection area. The importance of this function needs to be strengthened and areas like this should be considered protected natural areas. It is important to consider that current buffer created by the wetlands might not be enough when the water levels rise.	Expansion of these wetlands will be proposed to increase the water-management areas. Next to this, the wetlands can partly function as a recreational area for people to enjoy the beautiful surroundings.
The challenge of the river lies with the flood risks. Climate change makes the water rise, which increases the flood risk in the future.	The design incentive of the river will be to deal with flooding in the future, instead of trying to prevent the flooding. A laboratory in combination with the knowledge hub will accompany this change.

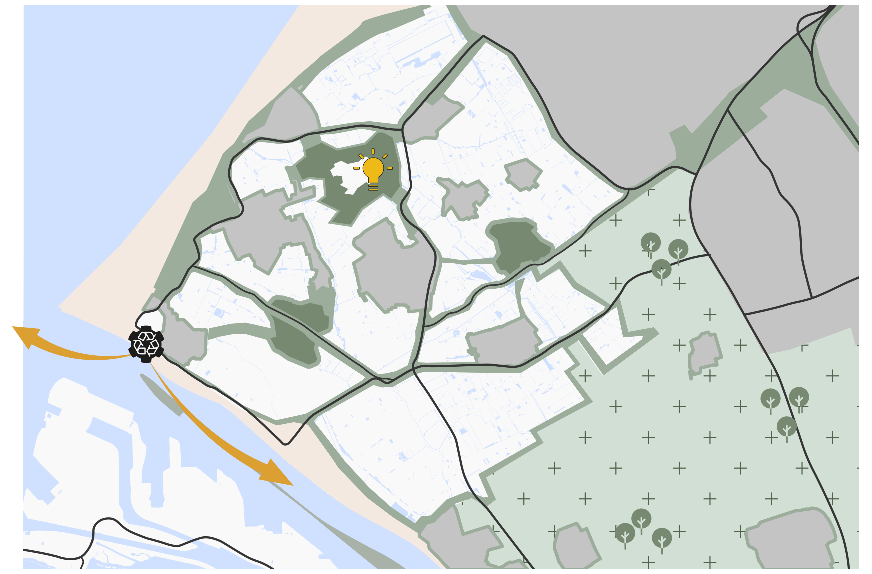
6.2 Area Design

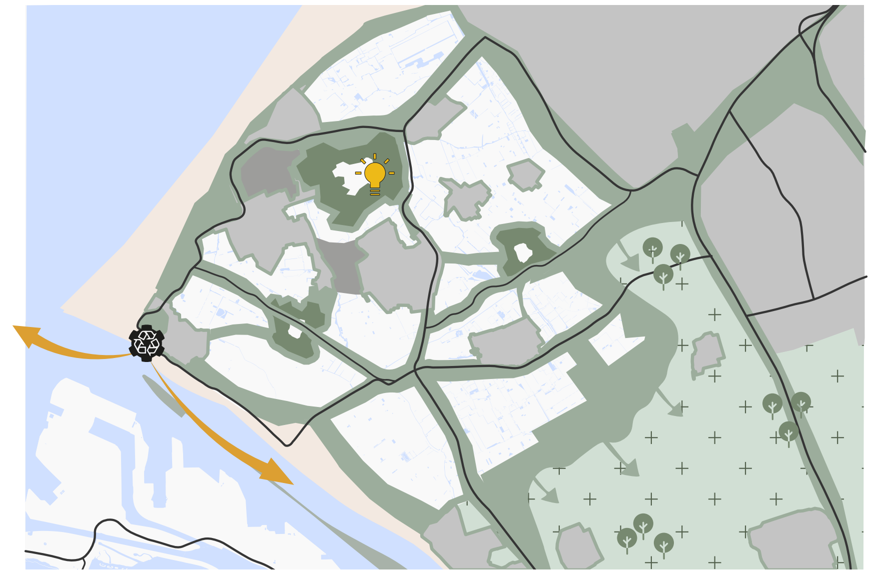
6.2.1 Westland - *Phasing*











2030

Initial definition of areas of interest to promote vertical mixed-use glasshouse typologies (in green). The areas were defined by their proximity to logistics and surrounding villages. In this stage, the port of Hoek van Holland is incorporated into the cascade flow logistics as a vital connection with the Port of Rotterdam and nearby glasshouses.

2040

The vertical mixed-use typologies are implemented through land policies and entrepreneurship incentives towards a new seeding industry and intensive high-value agro-products. Surrounding areas of forests and parks create a network of recreational green connections between villages, preparing for the expansion of these typologies.

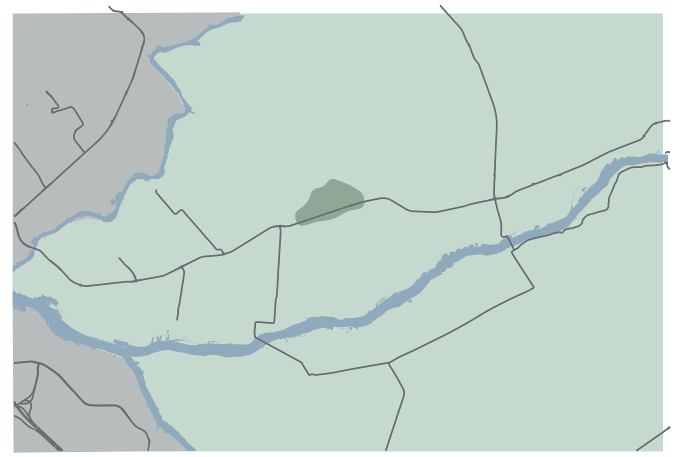
2050

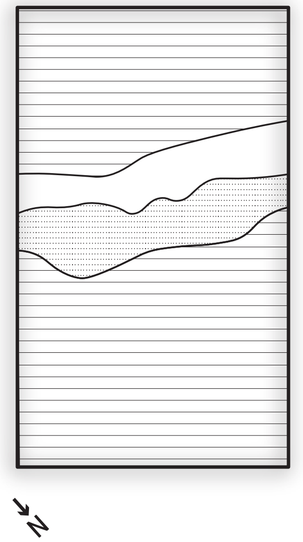
The final step is the enlargement of areas with high-intensive vertical greenhouses with multifunctional purposes. Surrounded by green recreational areas and ecological buffers, allowing water infiltration, new public spaces, and improvement of air quality. Meanwhile, providing high-value products to expand the agro-ecological sector with optimal cascade flows towards the Port of Rotterdam and the new bio-energy sector.

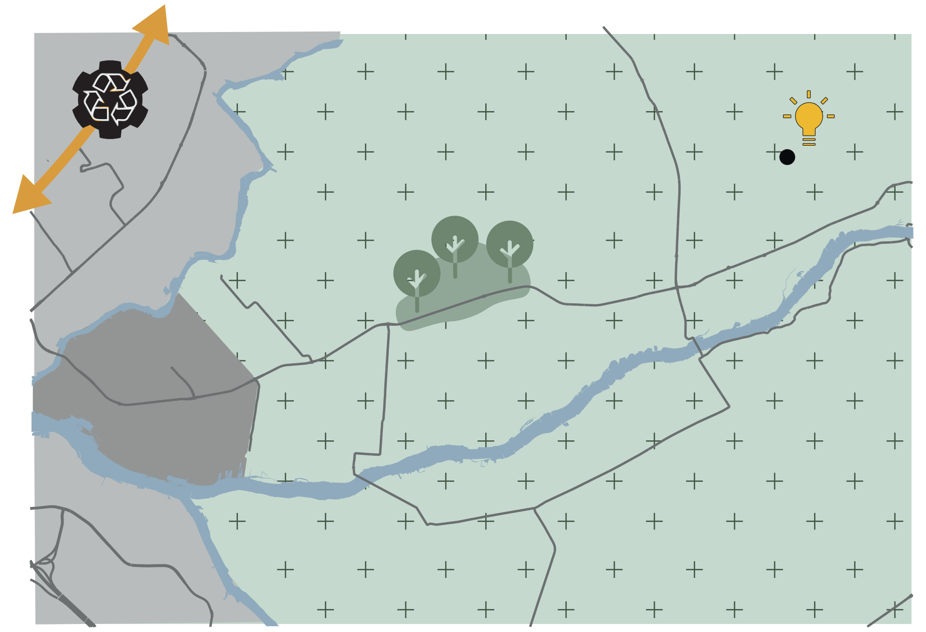
6.2 Area Design

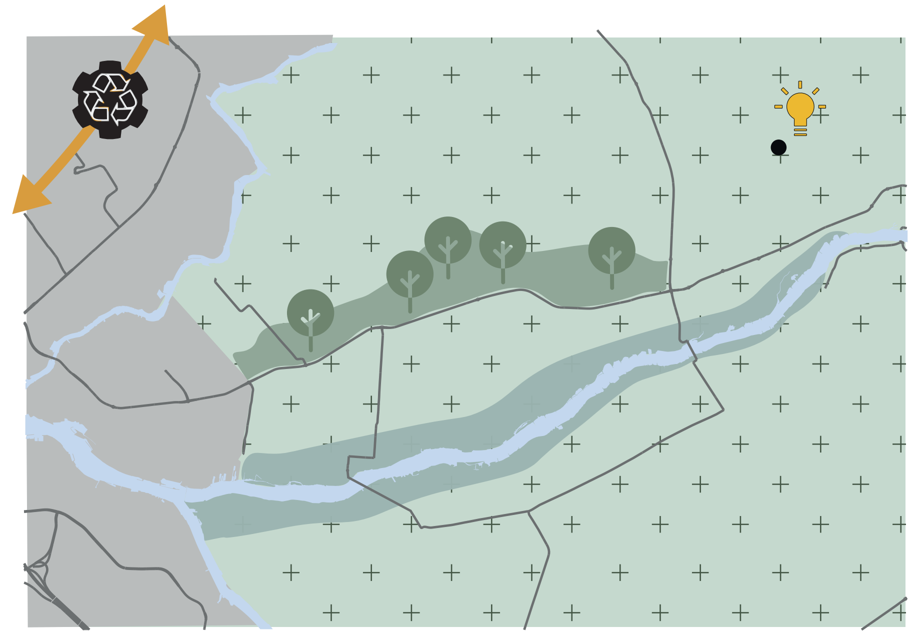
6.2.1 Westland - *Visualising the future scenario*

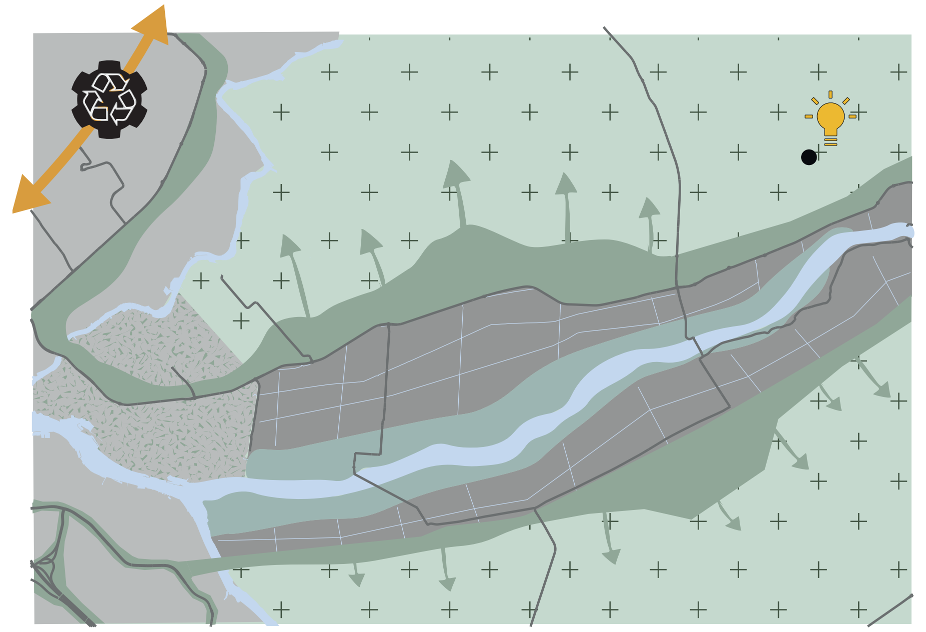
6.2.2 Krimpenerwaard - *Phasing*











2030

Initial implementation of agro-forestry systems through active participation of the Knowledge Hubs, local agro stakeholders, and subsidizing incentives. The agroforest systems integrate existing cattle activities with ecological environments, which provides soil quality improvement and mitigation of degradation processes.

2040

The consolidation of agro-forestry areas along the highway creates a vector of urban and agro landscape structure. It connects forests that integrate and consolidate the Green Heart with new buffer areas of recreational wetlands. This phase is a middle step towards the creation of the urban laboratory that will be defined and expropriated between the highway and wetlands. These laboratories will explore the participatory proces to define the future of flooded habitats.

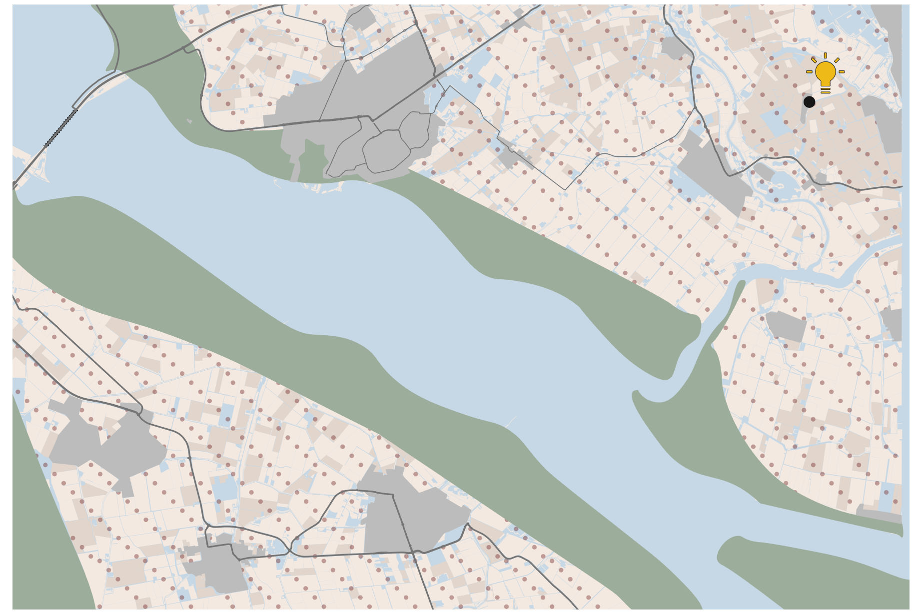
2050

The final expansion of the agroforestry systems and wetlands allows the construction of a more finalized urban laboratory in the area between these two systems. Within this step of the strategy flooding will be allowed within the borders of this area. The urban laboratory will then in its turn explore urban typologies structured by an enlarged network of polders and other water infrastructures. Next to this productive landscapes within the flooded areas will be explored. For example algae and mussel farms.

6.2.2 Krimpenerwaard - *Visualising the future scenario*

6.2 Area Design

6.2.3 Goeree Overflakkee - *Phasing*



2030

Initial expropriation of crop areas to integrate coastal wetlands buffers as a water defence strategy, with possibilities to create recreational landscapes. This phase, introduces the rotation of crops, implementing rapeseed and energy feedstock in gradually value/area intensification through the Knowledge Hubs program.

2040

This phase is characterized by the consolidation of green connections of the wetlands and new agro forest systems integrated strategically into the crop areas to improve their resilience to flooding, meanwhile recovering the soil for long-term degradation. Water crops, such as seaweed and mussels are introduced as alternatives. Not only will there be an increase of green environments, but also green infrastructures will be realised as continuous habitats which will hopefully lead to the increase of biodiversity.

2050

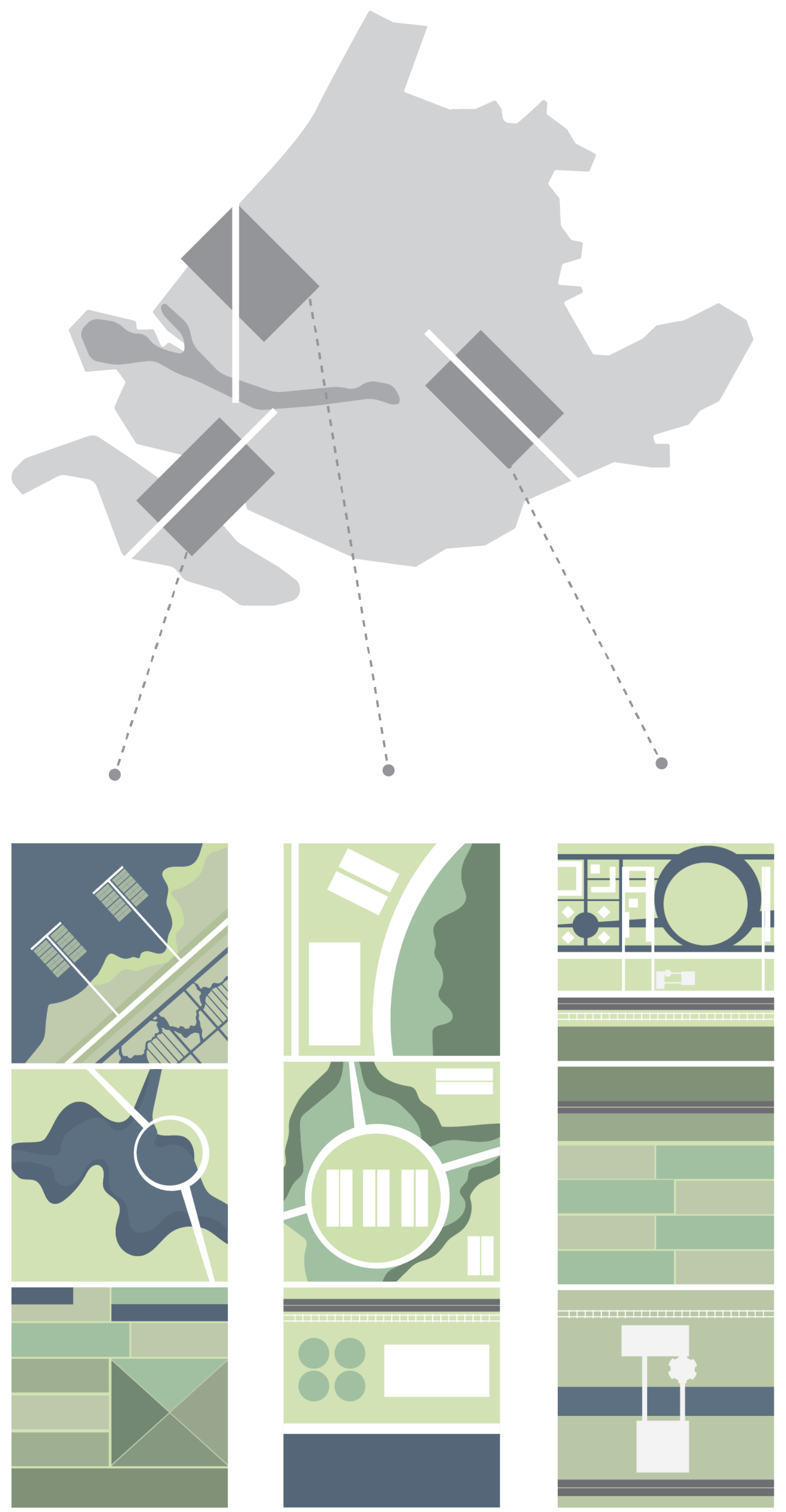
The final stage integrates the wetlands with green corridors and agro forest systems. New crops are introduced by the adoption of advanced technologies from the seeding industry, in order to resist salinisation processes. New models of water crops are explored as articulated actions between local stakeholders and Knowledge Hubs.

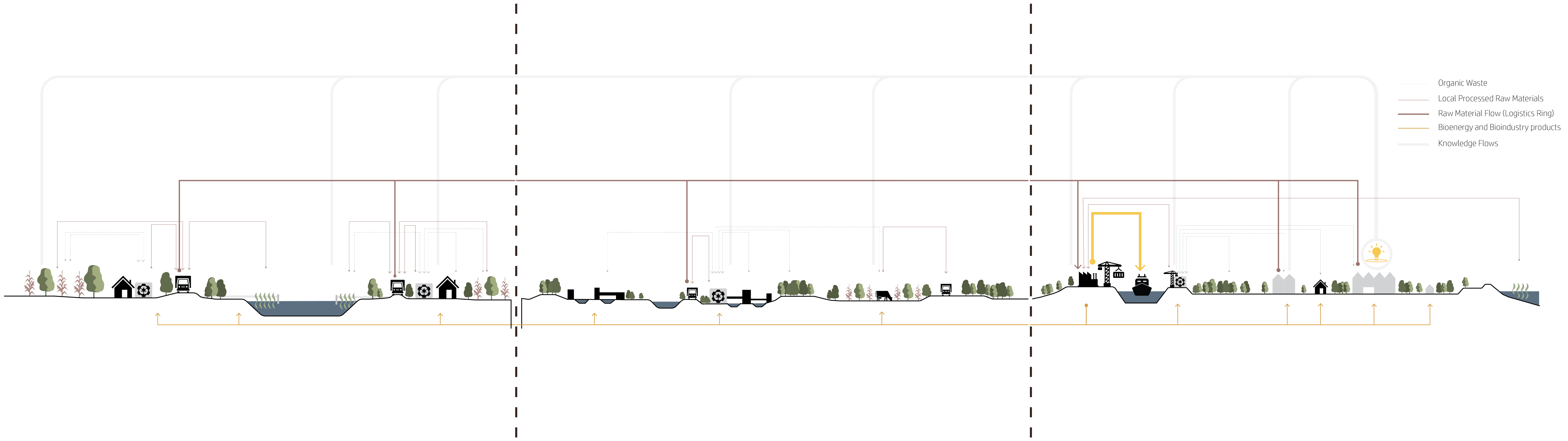
6.2 Area Design

6.2.3 Goeree Overflakkee - *Visualising the future scenario*

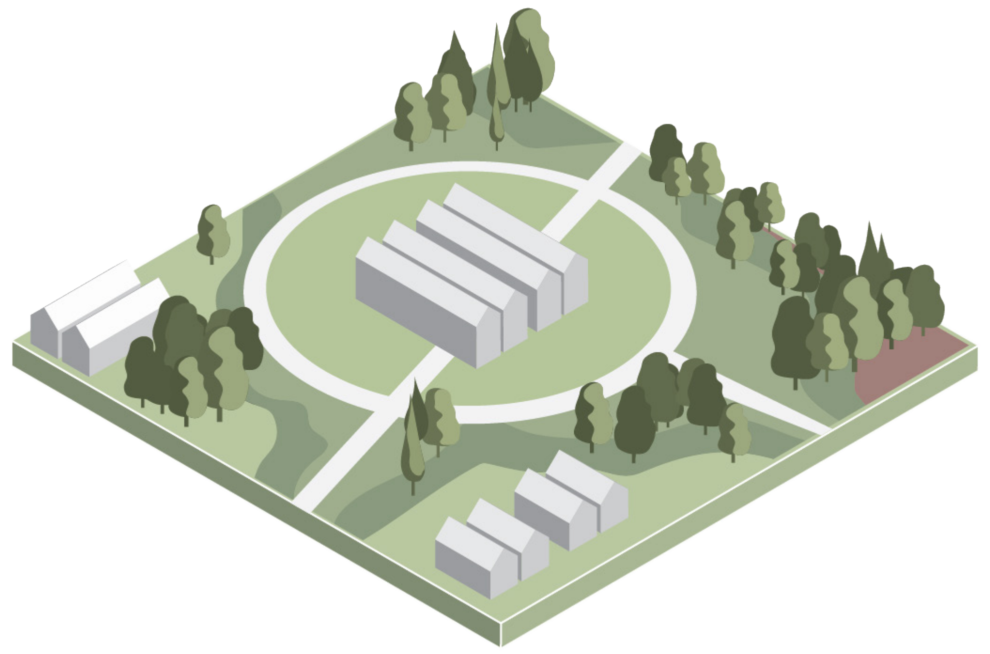
6.2.4 Sections

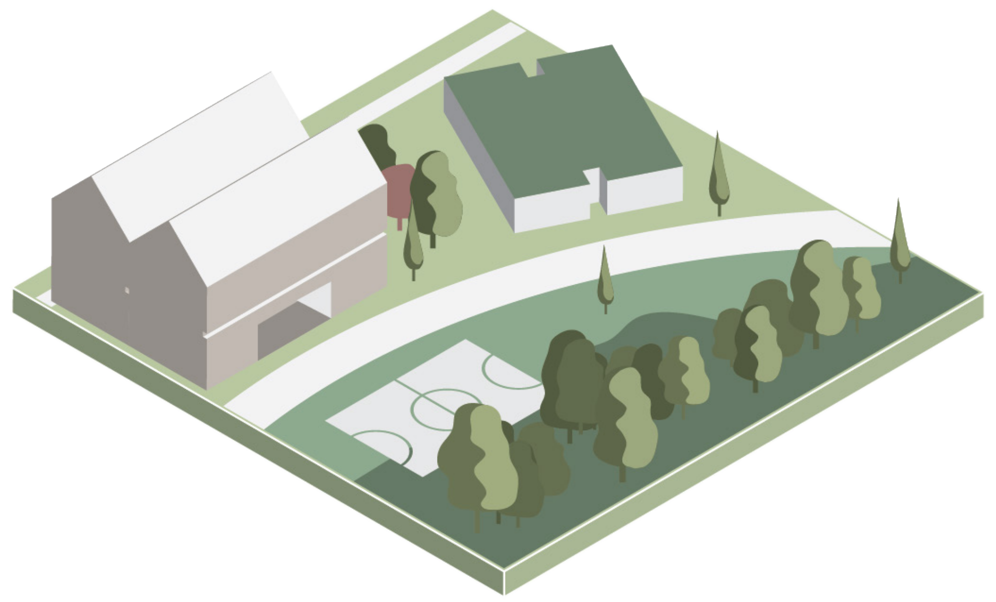
6.2 Area Design

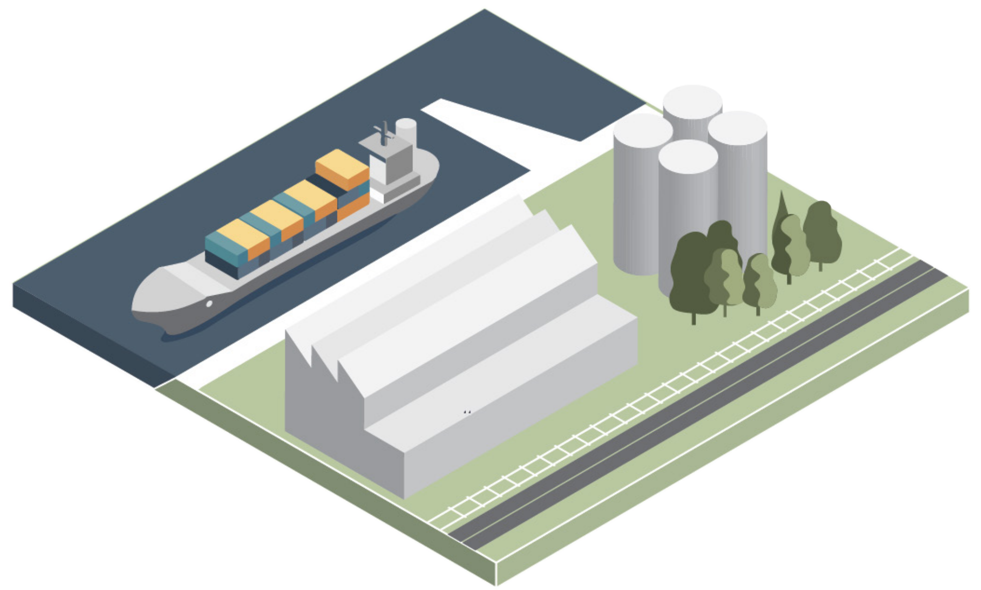




6.2.5 Design Elements - *Westland*





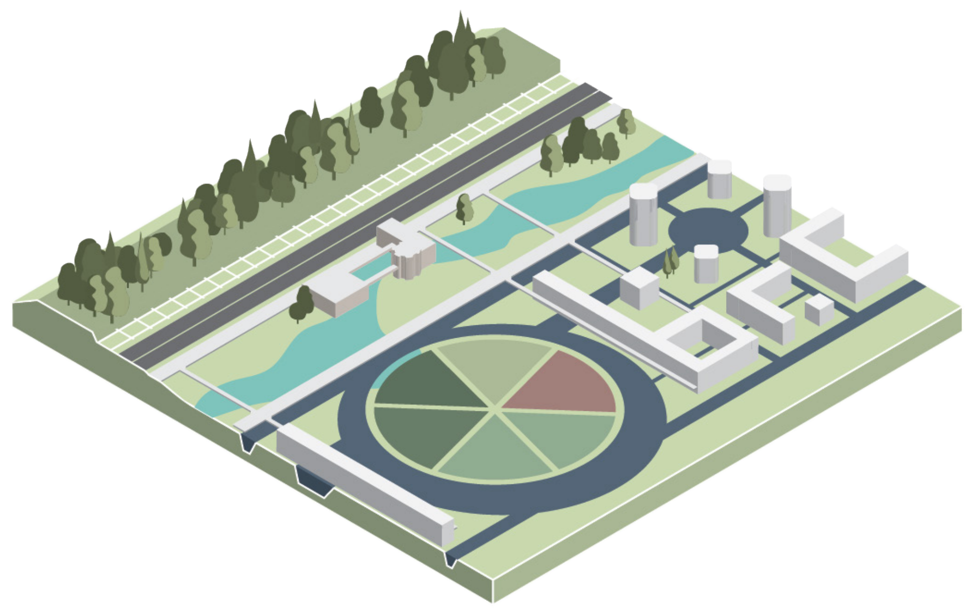


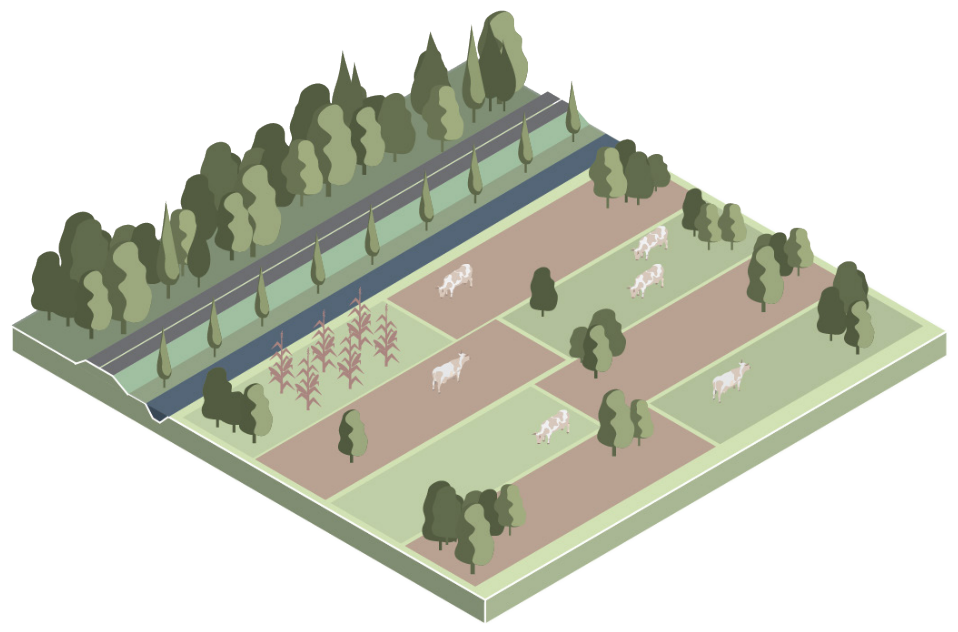
Buffer areas surrounding the mixed-use glasshouses that promote recreational and ecological interfaces between villages, glasshouses, dunes, and logistic infrastructures. Is composed of a network of parks and green corridors.

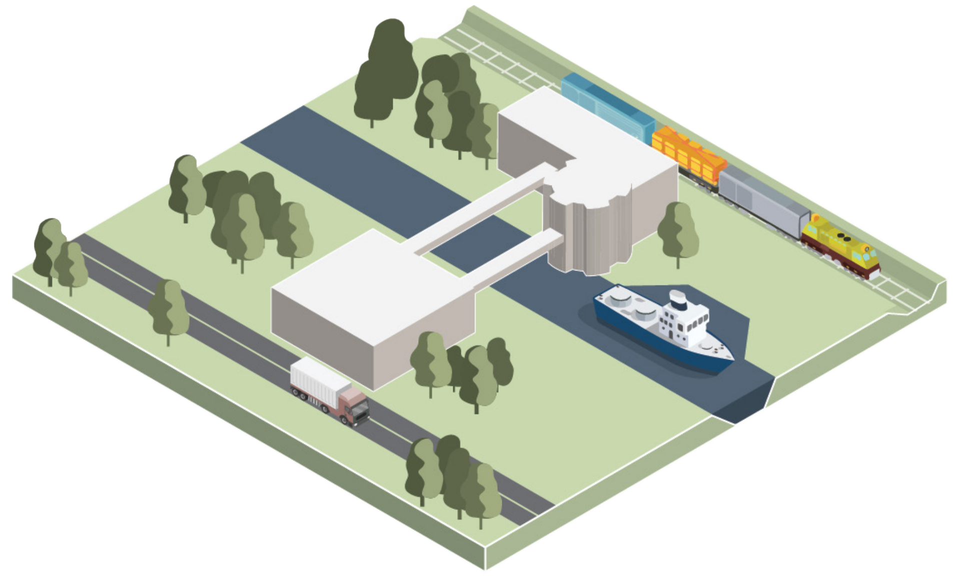
Highly intensive production in vertical greenhouses. With a renewed interrelation to the seeding industry and bio-energy feedstock. Combined with social functions as the knowledge hubs, open markets, and other activities.

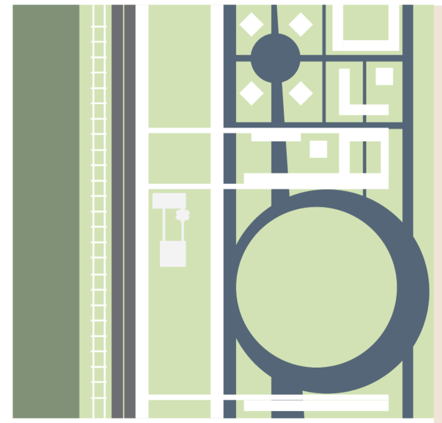
Industrial infrastructure was given a new purpose during the bio-based transition. The retrofit of industrial spaces to produce biochemicals and bio-energy is intermediated by top-down policies feasible by subsidies and incentives

6.2.5 Design Elements - *Krimpenerwaard*

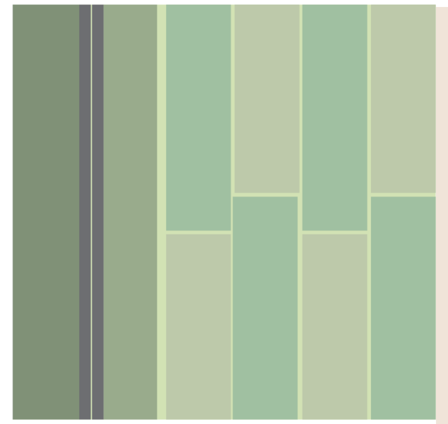




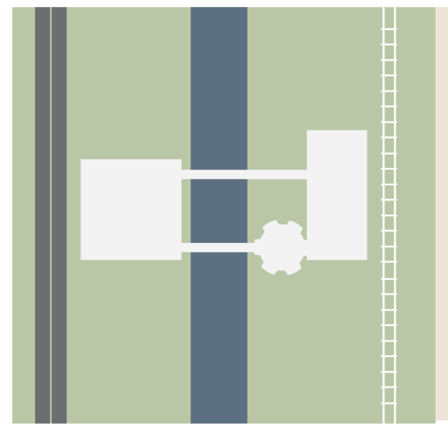




An urban laboratory surrounded by agro-ecological lands. It explores how water, urban environments, nature and agriculture can coexist, through an intensive articulation between governments, knowledge hubs, and local and private stakeholders.



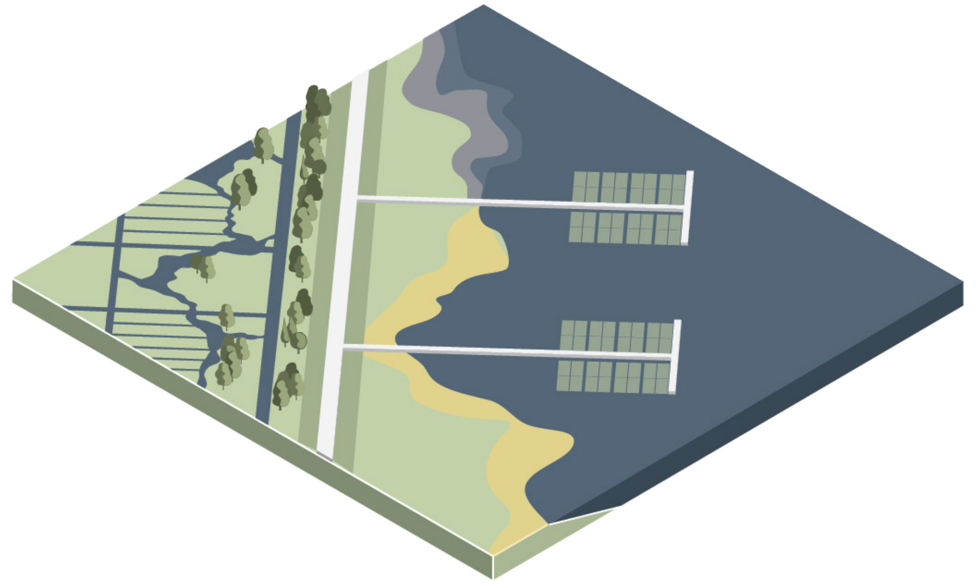
Integrated agro-forests to combine diverse agriculture and small-scale cattle activities. It allows diversified incomes to local farmers whilst adopting new technologies in seeding to promote soil recovery and ecological connections.

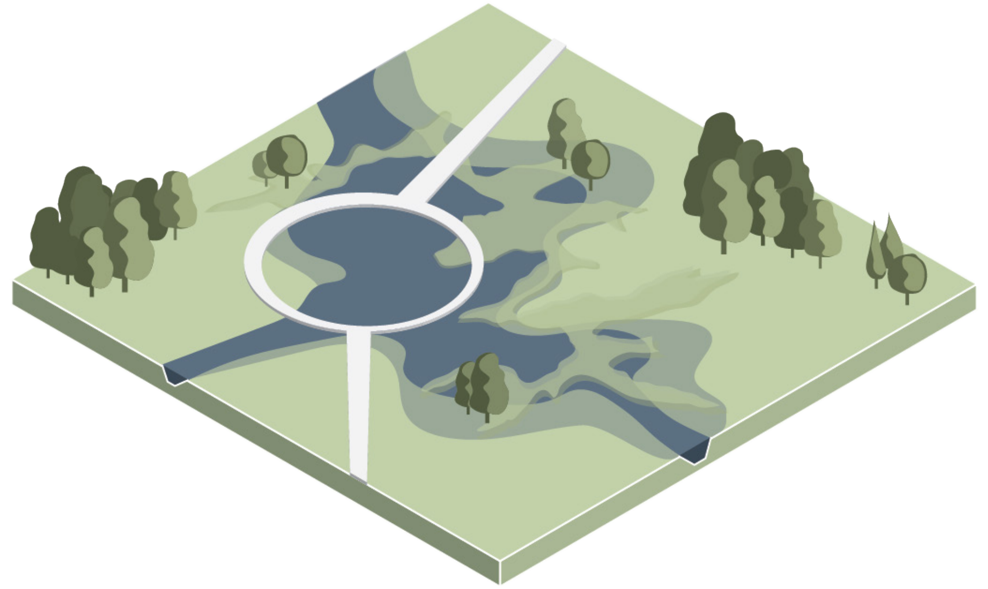


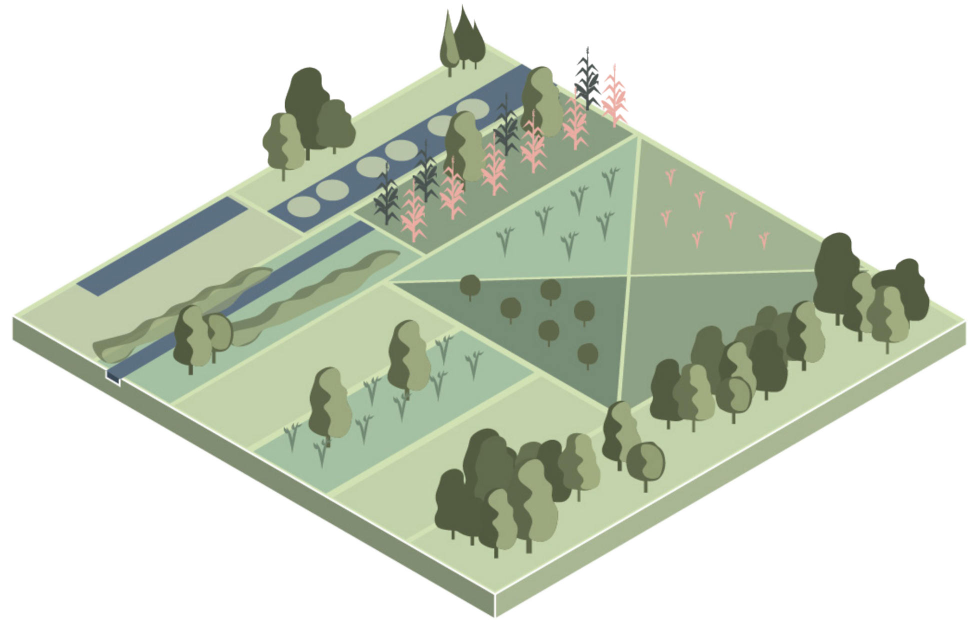
Strategic waste management centres can be accessed by the logistics ring/network composed of highways and railways or by water through automated boats that transport low volumes of organic waste.

6.2 Area Design

6.2.5 Design Elements - *Goeree Overflakee*







Water crops such as seaweed (bio-energy) and mussels (food consumption). Considering the large percentage of water in the province and flooding risks, this productive activity will be explored as a future promise for the bio-economy.

Wetland buffers that function as water defence mechanisms, as a flooding damage mitigation green infrastructure protect close urban and agro areas meanwhile providing ecological and recreational landscapes.

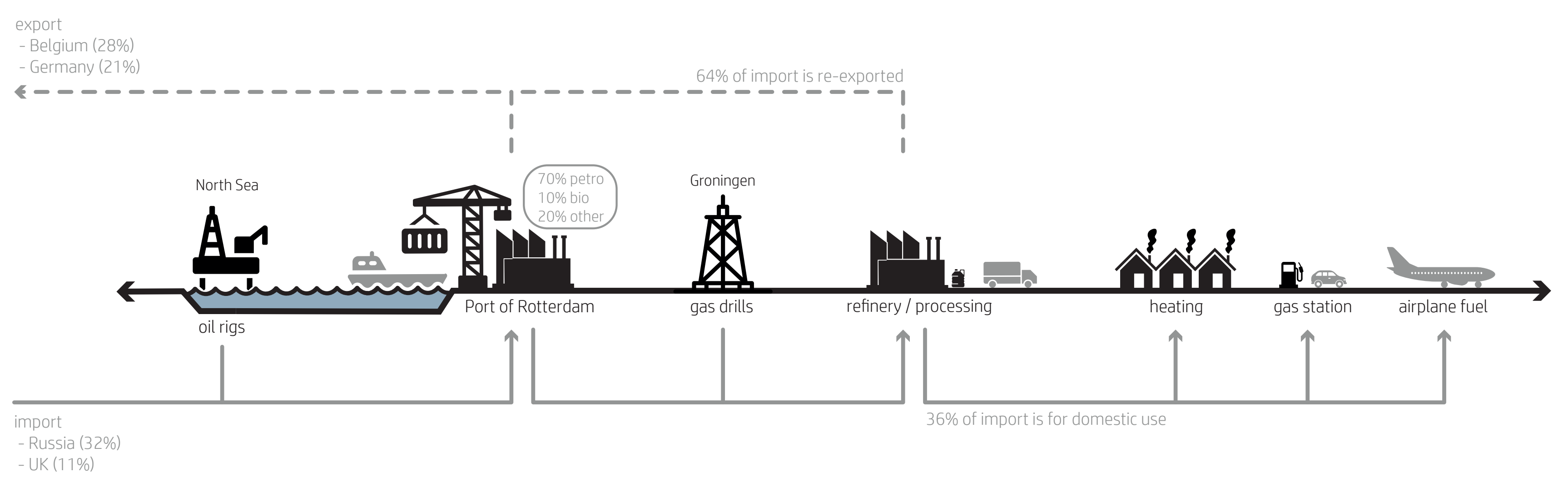
Integrated agro-forests with a focus on feedstock for bio-energy and high-value bio industries. The land use is highly optimized by the adoption of hi-tech local seeding supplies resilient to environmental changes and salinisation.

6.2 Area Design

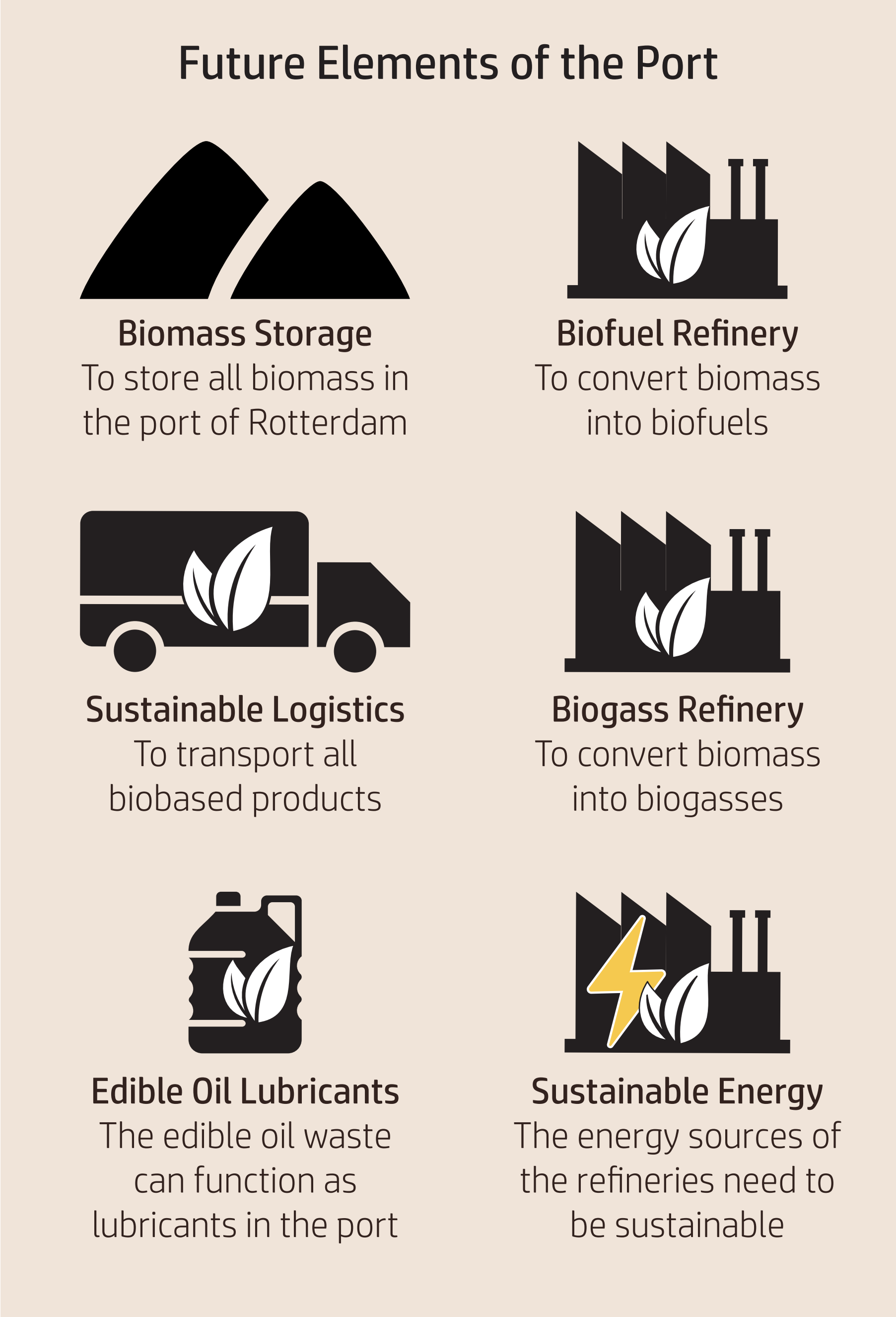
6.2.6 References

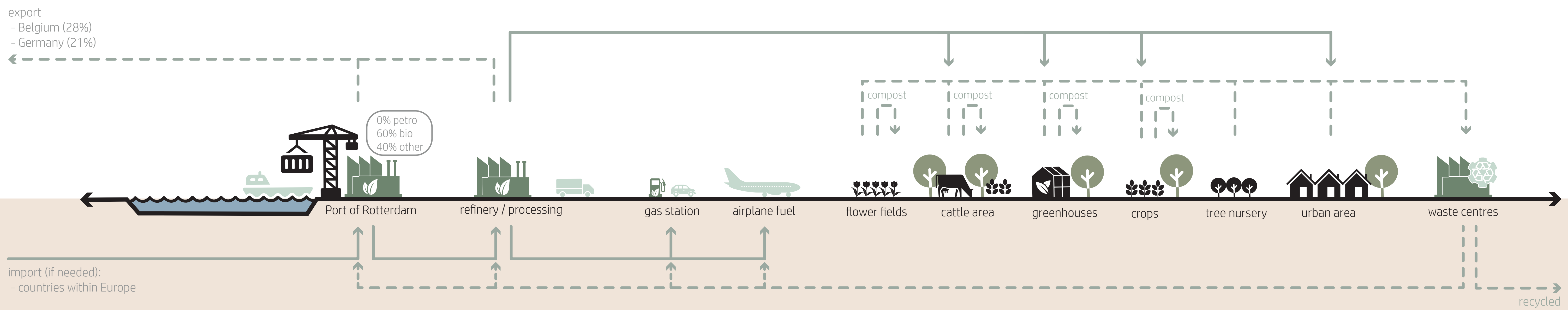
Sources for reference pictures from top to bottom: Zearz (2022), Shaunak (2020), Romero (2019), Waijerink (2021) and Kubus (n.d.)

6.3 The New Purpose of The Port



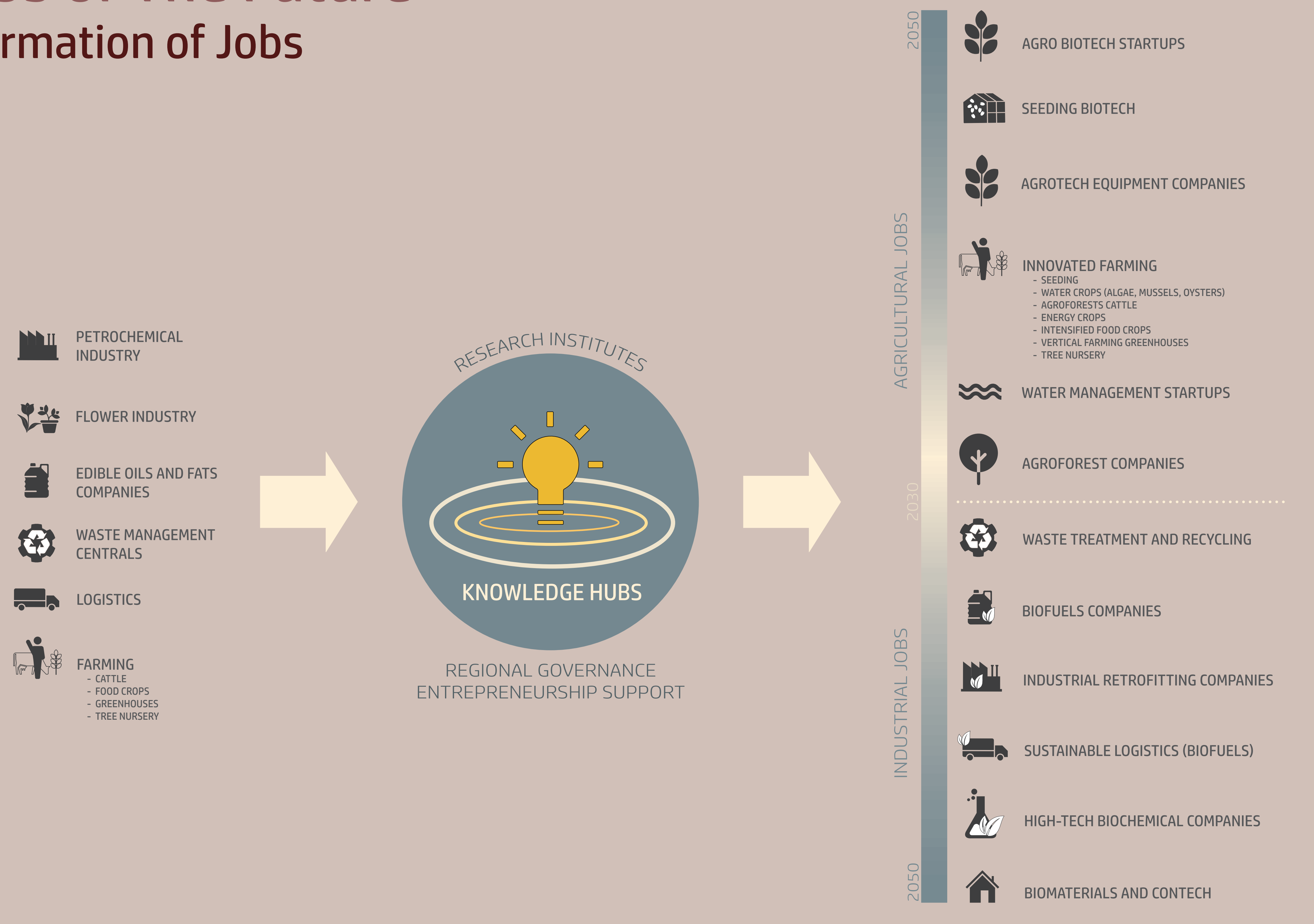
The current situation of the port of Rotterdam was already discussed before. The section above was also already explained, but the difference with the future situation will become more clear with the current situation next to it.
The future situation of the port will include all kinds of new sectors, because biomass will be an important element of the port. These new sectors will provide biowaste, which can be converted into biomass. The biowaste comes from flower fields, the cattle areas, greenhouses, crops, tree nurseries and urban areas. This waste will be transported towards the multiple waste centres in the region and will be either convert into biomass or recycled, like for example wood pellets for insulation.
The biomass will be transported towards the port of Rotterdam, where in the future will be a biobased industry instead of a petroleum-based industry. New innovations and companies in the port will convert the biomass into biofuels and biogasses, which will replace the current petroleum-based fuels and gasses. Therefore oil rigs and gas drills in the Netherlands are not needed anymore in the future.
The port of Rotterdam will also use sustainable energy sources in the future, for example wind energy that comes from wind turbines or heat that comes from greenhouses.





6.4 Jobs of The Future

6.4.1 Tranformation of Jobs

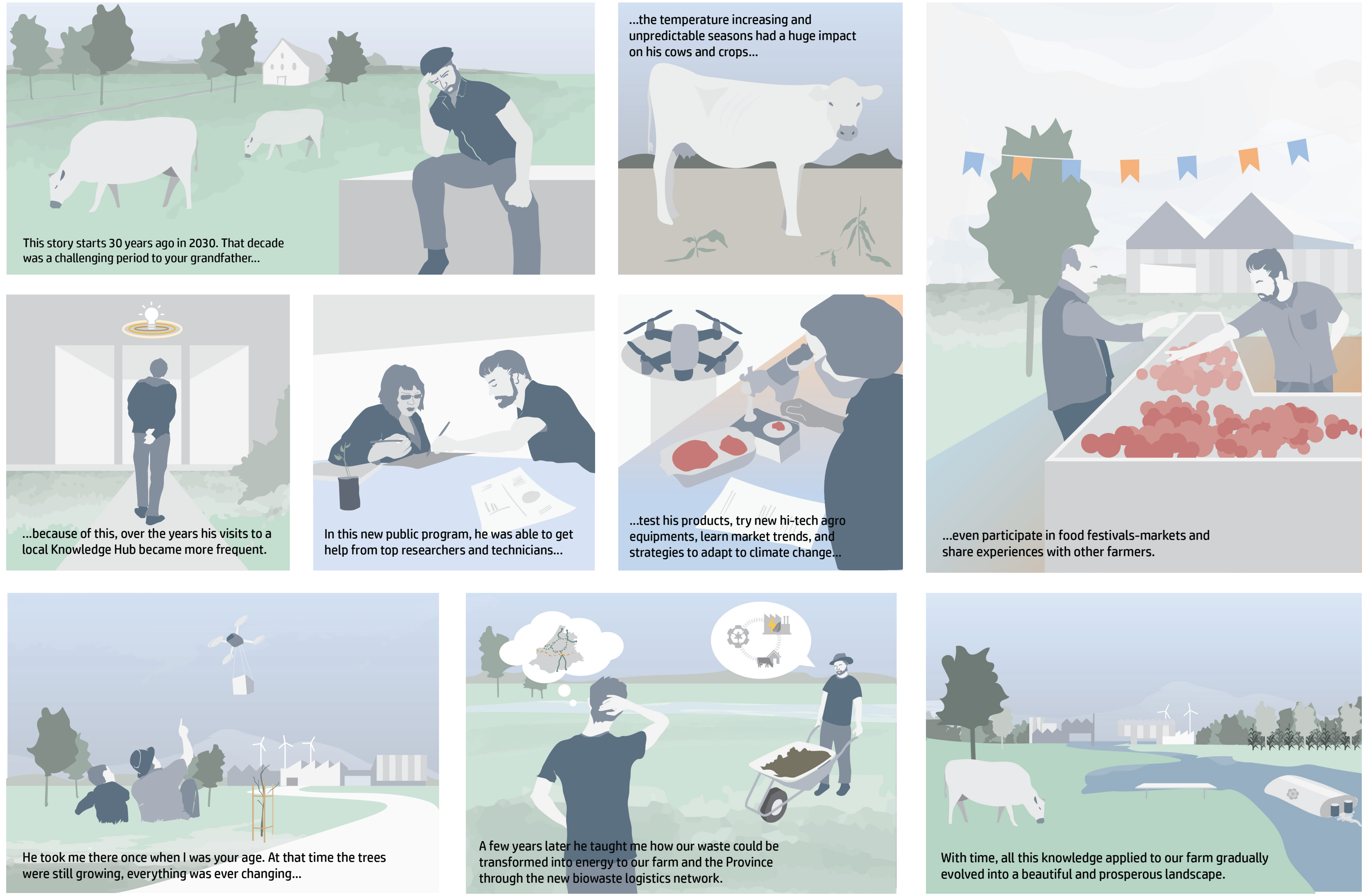


By supporting a bridge between local actors needs, bio-industry demands and technology innovations, the Knowledge Hubs also must enable and structure potential new economical activities and jobs of the future. Thus, gradually empowering technically social actors to be incorporated into the transition to mitigate possible disruptions in job structures.

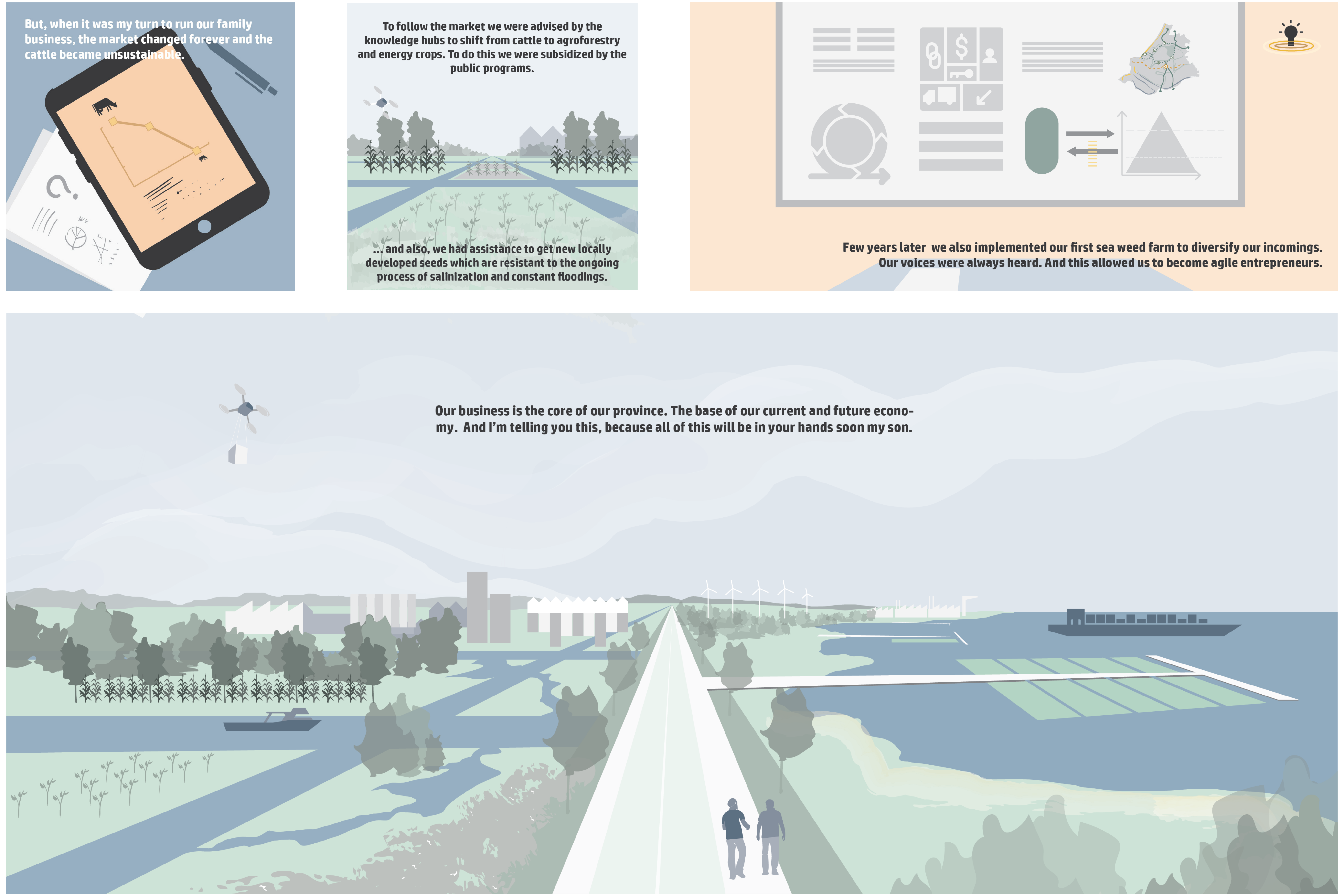
To promote new possible jobs and valuable activities, the Knowledge Hubs work closely aligned with entrepreneurship support initiatives, as incubators and business creation centres, allowing local farmers/entrepreneurs to implement new technologies into the bio-economy model providing a diverse range of jobs adapted to changing market demands.

6.4 Jobs of The Future

6.4.2 Story Board of a Future Province



6.4 Jobs of The Future



7 Acchieved Goals

Chapter 7 is about the achieved goals. It includes the evaluation, discussion and conclusion.

The chapter will explain what goals are achieved with the regional design. Next to that it will explain the limitations of the research.

CONTENT

7.1 Discussion

The ¨BioCycle¨ vision incorporates ideas and theories on reusing and obtaining biomass currently applied on smaller scales. To promote a bio transition by scaling up these strategies to a regional or national scale, new local and focused studies are necessary to determine possible negative side effects in terms of social, environmental, and economic sustainability. Also, the incorporation of new agricultural practices and innovative ways to transform water and land environments into ecological productive landscapes must be followed with caution by an iterative process of assessment. In that sense, it is essential to promote sustainability regulations and parameters for new agro-business models, such as seaweed and mussel farms. Which are also providing alternatives and instruments to facilitate transitions to more sustainable practices in the long term. Guaranteeing the longevity of the project's values and goals.

Also, reusing and adapting the current petrochemical infrastructure towards new bio-energy infrastructures reliant on biomass has possible risks. If for any reason Dutch biomass production suffers disruptions because of climate factors, disasters, etc., the bio industries and bio-refineries will probably need to import biomass to sustain bio-energy activities. This scenario can lead to geopolitical struggles, for example, because of the government's statement of not importing biomass from South America, which currently leads to indirect land-use changes (ILUC) (Studio Gear Up, 2021). However, in that case, import from different countries could be the country's only option in case there is no possibility to collect local biomass in the Netherlands itself. Therefore, this might impose difficulties to assess the overall sustainability of the bio-chain, due to the different political domains over the biomass supplies.

The project also carries a dimension of unpredictable complexity since it heavily relies on innovation and technology capacities to overcome environmental challenges. The future climate predictions, or other types of environmental disasters, can impose impossible conditions to keep the agro sector alive. Therefore, even when the highest technological innovations, achieve the proposed strategy for a sustainable ¨BioCycle¨ might not be possible. To consider this option another future scenario needs to be reviewed. When innovations do not reach the demand for a large-scale bio-economy, the result can be a massive attempt to safeguard the remaining social and economic assets to avoid a total collapse of the regional economy. This could result in disastrous decisions regarding sustainability as governments might reintroduce petrochemical industries to attend to economical demands.

To face the aforementioned challenges, a coordinated implementation of the project must engage spatial planning research in close contact with an interdisciplinary team of scientists and technicians. Then creating a looped revision of the strategy to be constantly updated to attend to future scenarios like: the newest environmental predictions/realities, geopolitical scenarios, market changes, and social conditions. In that sense, the urbanized water laboratories envisioned could perform a crucial role to test radical solutions and new forms of coexisting with future hostile climate environments. Thus, opening the possibility to a more local bio-economy.

Another limitation of the proposal might be if the proposed agro-sector is proven to be unsustainable. Then the urban laboratory in close cooperation with the Knowledge Hubs could be an experimental stage to apply technologies to collect biowaste inherent in human settlements, such as reusing sewage waste, body recycling as alternatives to burial and cremation, or even radical man-made environments, by building artificially controlled environments to avoid the necessity of biomass importation. Or even, use the Knowledge Hubs structure as ¨think thanks¨ to envision new strategies if the current way of realizing the ¨BioCycle¨ is proven to be impossible to be implemented.

Besides radical futures challenges, minor complexities can be tackled and addressed during an ongoing implementation of the strategy. In terms of logistics transitions, the right balance of transportation models can be designed with the help of big data technologies. This will be needed to incorporate accurate logistics demand-offer in real-time to avoid risks of economic loss. Also, shifting the transportation systems to incorporate biofuels also implies the engaging of manufacturing industries to adapt to the current vehicles or even new bio-mechanical industries that can emerge from this demand. This however must be regulated by policies and specialists to avoid the generation of massive amounts of obsolete infrastructural waste that was not incorporated into the circular systems. Regarding this issue, we strongly advise to coordinate the ¨BioCycle¨ implementation concomitant with visions to promote manufacturing circularity and diversified energy transition systems.

On another note, within this strategy, some of the implemented regional initiatives are currently only tested on a small scale. Changing the scale of these initiatives to a regional or national scale could have yet undiscovered effects on sustainability. Therefore these strategies must be applied slowly and carefully and always have a feedback loop.

Limitations of Research

The project lacks a bit in the policy department. The connection to current policies could have been stronger, if the amount of time for this project would have allowed this. When there would have been more time the connection to other sectors could have been stronger as well. The story of a complete biocycle might then include for example the use of bio-plastics.

Another department which could have been further developed is the financial feasibility of the project. The transformations this strategy suggests will eventually cost of lot of money. The assumption in this report is that the urge for transformation of the system is of the highest importance and by this the costs are a necessity.

Assumptions made to create this strategy

Governments will subsidize the transition towards a circular economy, because of the necessity of this transition. Next to this Dutch polices will state that climate change is not up for discussion, but a fact. This will make it nothing less of a threats than the COVID pandemic.

The report made multiple assumptions to create a spatial vision and a development strategy. One of these assumptions is regarding the trend of decreasing demands for meat and dairy production, based partly on; plant based substitutes, consumer behaviour and advances in cultivating dairy and meat products.

The effect of climate change on the sea level will rise even more, which leads to the assumption that the current water protection of the Netherlands will not be enough to prevent flooding. Therefore flooding scenarios are taken as a fact in this strategy.

7.2 Conclusion

By adopting an iterative process of designing and research, the ¨BioCycle¨ strategy comprises all the key aspects to achieve social, industrial, environmental, and agro sustainability, by integrating the spatial structures of South Holland with its main actors. Therefore, allowing a responsible transition towards a bio-economy model that reinforces the current economic competitiveness of the region by incorporating the full potential of the agro sector as an economic generator by empowering local actors.

The regional strategy provides a platform for the integration of existing infrastructures as a leverage action to promote the bio-transition. This first act establishes a platform for agro-ecological unfolding mediated by top-down policies and bottom-up initiatives, placing biotechnological, social, and spatial planning innovation at its core.

The project ¨BioCycle¨ answers the research question "How can the biobased transition in the province of South Holland be ignited through the linkage of its agro-urban structure with new potential bio-industries while promoting optimizing cascade flows and preserving sustainable land-use?" By indicating that to achieve this transition it is essential to integrate and re-purpose existing infrastructures. Also, that is crucial to change land-use paradigms to achieve a balanced and multi-purposed agro-ecological structure, and integrate local stakeholders in the core of the transition to promote a socially just future for South Holland.

Regarding the sub research questions the strategy conclusions are:

How can biomass play a role in reducing the use of petrochemicals in line with the biobased transition of the province of South Holland?
By providing a territorial structure to allow high-value bio-industries that are related to global and regional demands, then ensuring the Port of Rotterdam's vitality towards a sustainable future.

How can sustainable land-use contribute to the biobased transition?
By structuring a multi-purpose landscape that generates economic prosperity, ecological restoration, and urban expansion vectors.

How can we optimize cascade flows to help the biobased transition of the province of south Holland?
By placing multi-actor governance systems integrated with defined and clear logistics to process biowaste of diverse sources and transport raw materials towards the industrial backbone in the Port of Rotterdam. Also, by placing social and technological innovation as crucial elements to ensure the future expansion of the ¨BioCycle¨.

ENDNOTE

BIOCYCLE is a vision which ignites the biobased transition in the province of South Holland through the linkage of its agro-urban structure with new potential bio-industries, while promoting optimizing cascade flows and preserving sustainable land-use. It is the product of the collaboration between Fabio A. Alzate Martinez, Margot Schouls, Chaniek Mellink and Julie Noorman. Over a period of two months, this interdisciplinary team developed a plan based on shared values. With inclusive and sustainability always in mind, the vision of BIOCYCLE was created during the 2021-2022 MSc2 Urbanism courses AR2U086 R&D studio Spatial Strategies for the Global Metropolis and AR2U088 Research and Design Methodology for Urbanism at Delft University of Technology.

We as a team would like to thank our main tutors Diego Sepulveda Carmona and Robert-Jan van der Veen. Also, we would like to give a special thanks to Roberto Rocco and Karel van den Berghe, who have also been of great value to our vision.

References

Arun, Gopinath, K. P., Sivaramakrishnan, R., SundarRajan, P., Malolan, R., & Pugazhendhi, A. (2021). Technical insights into the production of green fuel from CO2 sequestered algal biomass: A conceptual review on green energy. *The Science of the Total Environment*, 755, 142636–.

Atlas Leefomgeving (2021, May 28). *Kaarten*. Retrieved from https://www.atlasleefomgeving.nl/kaarten visited on 12-03-2022

Boerenbond (2014). *Valt er met koolzaad iets te verdienen?* Management & Techniek 6, 16-18.

Cargill Netherlands (n.d.). *Cargill at a Glance*. Retrieved from https://www.cargill.nl/en/cargill-at-a-glance?language=en visited on 22-02-2022

CBS (2018) Sustainable Development Goals [image] Retrieved from https://www.cbs.nl/nl-nl/nieuws/2018/10/duurzame-ontwikkelingsdoelen--sdg-s---dichterbij-gekomen visited on 12-03-2022

CBS (2021, July 1). *Aardolieproductenbalans; aanbod, verbruik en voorraad, 1946-april 2021*. CBS StatLine. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83403NED/table?ts=1648147620092 visited on 24-03-2022

CBS (2022a). *Akkerbouwgewassen; productie naar regio*. CBS Statline. Retrieved from https://opendata.cbs.nl/#/CBS/nl/dataset/7100oogs/table visited on 20-03-2022

CBS (2022b). *Landbouw; gewassen, dieren en grondgebruik (SBI 2008)*. CBS StatLine. Retrieved from https://opendata.cbs.nl/#/CBS/nl/dataset/84756NED/table visited on 24-03-2022

CBS (2022c). *Vleesproductie; aantal slachtingen en geslacht gewicht per diersoort*. CBS StatLine. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/7123slac/table?fromstatweb visited on 24-03-2022

CBS (2022d). *Internationale handel en doorvoer; waarde, gewicht, goederen, vervoerwijze*. CBS StatLine. Retrieved from https://opendata.cbs.nl/#/CBS/nl/dataset/84668NED/table?searchKeywords=aardolie%20statline visited on 25-03-2022

CBS (2022e). *Melkaanvoer en zuivelproductie door zuivelfabrieken*. CBS StatLine. Retrieved from https://opendata.cbs.nl/statline/#/CBS/nl/dataset/7425ZUIV/table?fromstatweb visited on 24-03-2022

Dabrowski, M. M. (2022, March 3). *SWOT Analysis* [Slides] Brightspace https://brightspace.tudelft.nl/d2l/le/content/398766/viewContent/2616477/View visited on 10-03-2022

Dillard, J. F., Dujon, V., & King, M. C. (2009). *Understanding the social dimension of sustainability* (Ser. Routledge studies in development and society, 17). Routledge.

Donati, F., & Tukker, A. (2020). *Milieudruk Nederlandse landbouwimport groter dan die van de -export*. ESB. Retrieved from https://esb.nu/esb/20061398/milieudruk-nederlandse-landbouwimport-groter-dan-die-van-de-export visited on 24-03-2022

ESA (2020) Dutch tulip fields come into bloom [image] Retrieved from https://www.esa.int/ESA_Multimedia/Images/2020/04/Dutch_tulip_fields_come_into_bloom visited on 05-04-2022

Esso (n.d.). *Business divisions*. ExxonMobil. Retrieved from https://corporate.exxonmobil.com/About-us/Business-divisions visited on 04-04-2022

ETIP (2022) *Biofuels and Sustainability Isues.* Retrieved from www.etipbioenergy.eu/sustainability/sustainability-overview visited on 03-03-22

European Commission (2012). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Bioeconomy for Europe, COM, 60. *European Commission*

European Commission (2019a). *Insights into the European market of bio-based chemicals. Analysis based on ten key product categories,* EUR 29581 EN, Publications Office of the European Union, Luxembourg.

European Commission (2019b) The European Green Deal [image] Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52019DC0640&from=ET visited on 27-03-2022

European Commission (n.d.). *Farm to Fork Strategy*. Retrieved from https://ec.europa.eu/food/horizontal-topics/farm-fork-strategy_en visited on 24-03-2022

European Commission (n.d.) *What is the bio-economy* Retrieved from https://ec.europa.eu/research/bioeconomy/policy/bioeconomy_en.htm visited on 20-03-22

Fózer, Volanti, M., Passarini, F., Varbanov, P. S., Klemeš, J. J., & Mizsey, P. (2020). Bioenergy with carbon emissions capture and utilisation towards GHG neutrality: Power-to-Gas storage via hydrothermal gasification. *Applied Energy*, *280.*

Gemeente Rotterdam (n.d.). *Inheemse planten*. Retrieved from https://www.rotterdam.nl/wonen-leven/inheemse-planten/ visited on 05-04-2022

Google Earth (n.d.) Province of South Holland (several scales) [online] Retrieved from https://www.google.nl/maps visited on 06-03-2022

Groen Kennisnet (2019), Vertical Farming. Retrieved from https://wiki.groenkennisnet.nl/display/VF/Vertical+Farming visited on 30-03-2022

Gui, N.M.M., Lee, K.T., Bhatia, S. (2008). Feasibility of edible oil vs. Non-edible oil vs. Waste edible oil as biodiesel feedstock. Energy. 33. 1646-1653. 10.

Havenbedrijf Rotterdam (2021). *Feiten & Cijfers. Een schat aan informatie. Make It Happen.* Retrieved from https://www.portofrotterdam.com/nl/online-beleven/feiten-en-cijfers visited on 27-03-2022

Healey, P. (1996) The Communicative Turn in Planning Theory and its Implications for Spatial Strategy Formation. *Environment and Planning. B, Planning & Design.*, *23*(2), 217–234.

Hintjens, J., Vanelslander, T., van der Horst, M., Kuipers, B. (2015). Towards a bio-based economy in ports: The case of the Flemish-Dutch delta. International Journal of Transport Economics. 42. 229-247.

J.W. van Aalst (2021). *GeoData OpenTopo*. Retrieved from www.opentopo.nl visited on 18-03-2022

Jhariya, M. K., Meena, R. S., & Banerjee, A. (2021). *Ecological Intensification of Natural Resources for Sustainable Agriculture* (1st ed.). Springer Nature Singapore Pte Ltd. https://doi.org/10.1007/978-981-33-4203-3

Lago, C., Herrera, I., Caldés, N., Lechon, Y. (2019). Nexus Bioenergy–Bioeconomy. In: Cîrstea, Ş. D., Cîrstea, A., Popa, I. E., & Radu, G. (2019). The role of bioenergy in transition to a sustainable bioeconomy – study on eu countries. *Amfiteatru Economic*, 21(50), 75–89. https://doi.org/10.24818/EA/2019/50/75

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

Kubus, J. (n.d.) Luchtfoto van uitgebreide groene levende graszodendaken met vegetatie [photograph] Retrieved from www.shutterstock.com/nl/image-photo/aerial-view-extensive-green-living-sod-1151258369 visited 20-03-2022

Lehman, C. (n.d.) *biofuel*. Retrieved from www.britannica.com/technology/biofuel Visited on 25-03-2022

Leiva, M. (2022, March 18). *Which countries are most exposed to interruption in Ukraine food exports?* Investment Monitor. Retrieved from https://www.investmentmonitor.ai/special-focus/ukraine-crisis/countries-exposed-ukrainian-food-exports visited on 24-03-2022

Mathur, S. (n.d.) *Unsustainable Composting.* Unsustainable Magazine. Retrieved from https://www.unsustainablemagazine.com/urban-composting-is-an-idea-whose-time-has-come/ visited on 05-04-2022

Moeltner, L., & Schallhart, V. (2020). Potential of Biomass to Liquid-, Hydrotreated Vegetable Oils-, and Fatty Acid Methyl Esters-Blends for Diesel Engines in Passenger Cars. Frontiers in Mechanical Engineering, 6. https://doi.org/10.3389/fmech.2020.576155

NEA. (2020). *Biobrandstof zorgt voor grote daling co2 uitstoot.* Retrieved from https://www.emissieautoriteit.nl/actueel/nieuws/2020/04/24/biobrandstof-zorgt-voor-grote-daling-co2-uitstoot visited on 27-02-22

NGR (n.d.) *Biomassa Zuid Holland*. Nationaal Georegister. Retrieved from https://www.nationaalgeoregister.nl/geonetwork/srv/search?any=biomassa+zuid+holland&fast=index visited on 24-03-2022

NOS (2022) Consument wil wel veranderen maar wacht op politiek en bedrijven. *NOS,* 04-04-2022

Obbink, H. (2021) Wie nog geen huis bezit, is wellicht voorgoed te laat: 'We zijn een fuik in gezwommen'. *Trouw*, April 14, 2021.

OEC (n.d.). *Netherlands (NLD) Exports, Imports, and Trade Partners* | OEC. The Observatory of Economic Complexity.

Ostrom, E. (2010). Beyond Markets and States: Polycentric Governance of Complex Economic Systems. *The American Economic Review*, *100*(3), 641–672. http://www.jstor.org/stable/27871226

PBL (2016). *Dalende bodems, stijgende kosten: mogelijke maatregelen tegen veenbodemdaling in het landelijk en stedelijk gebied: beleidsstudie.* (PBL-publicatie; No. 1064). Den Haag: Planbureau voor de Leefomgeving.

PBL (2012). *Nederland Verbeeld; Een andere blik op vraagstukken rond de leefomgeving.* Den Haag: Planbureau voor de Leefomgeving.

Port of Rotterdam (2022) *15 percent of the transhipment in Rotterdam is Russia-related.* Retrieved from https://www.portofrotterdam.com/en/news-and-press-releases/15- percent-of-the-transhipment-in-rotterdam-is-russia-related visited on 15-03-2022

Port of Rotterdam (2016). *Over 120 industrial companies.One Powerful Cluster.* Retrieved from www.portofrotterdam.com/sites/default/files/2021-06/facts-figures-energy-port-and-petrochemical-cluster.pdf visited on 04-04-22

Port of Rotterdam, Gemeente Rotterdam, Rijksoverheid, Provincie Zuid-Holland, Deltalinqs (2019) *Havenvisie Rotterdam.* Rotterdam: Port of Rotterdam; Gemeente Rotterdam; Rijksoverheid; Provincie Zuid-Holland; Deltalinqs.

Prorail (2021). *Duurzaamheid.* Retrieved from https://www.prorail.nl/toekomst/duurzaamheid visited on 05-03-2022

Provincie Zuid-Holland (2018). *Voedselverspilling? Op koers naar 'zero waste' in Zuid-Holland.* Den Haag: Provincie Zuid-Holland.

Provincie Zuid-Holland (2019) *CIRCULAIR ZUID-HOLLAND. Samen versnellen.* Den Haag: Provincie Zuid-Holland.

Provincie Zuid-Holland (2020) *Groeiagenda Zuid-Holland.* Den Haag: Provincie Zuid-Holland.

Rijksoverheid (2022) *Publiekssamenvatting 1e advies Beleidstafel wateroverlast en hoogwater.* Den Haag: Rijksoverheid.

Rijksoverheid (n.d., a) *Sustainable Development Goals: Werelddoelen voor duurzame ontwikkeling.* Den Haag: Rijksoverheid.

Rijksoverheid (n.d., b) *Goederenvervoer over het spoor.* Retrieved from https://www.rijksoverheid.nl/onderwerpen/goederenvervoer/goederenvervoer-over-het-spoor Den Haag: Rijksoverheid. Visited on 05-04-2022

Rijkswaterstaat (n.d.) *Bescherming tegen het water.* Retrieved from https://www.rijkswaterstaat.nl/water/waterbeheer/bescherming-tegen-het-water/watersnoodramp-1953 visited on 05-04-2022

Romero, R., (2019) How cattle can save the Amazon [photograph] Retrieved from www.renature.co/articles/how-cattle-can-save-the-amazon/ visited on 29-03-2022

Rubis Terminal. (n.d.). *Our story.* Retrieved from https://www.rubis-terminal.nl/company/our-story visited on 17-02-2022

Scatlat, N., Dallemand, J.-F., Monforti-Ferrario, F., Nita, V. (2015). The role of biomass and bioenergy in a future bioeconomy: policies and facts. Environ. Dev. 15, 334.

Searcy, E., Lamers, P., Deutmeyer, M., Ranta, T., Hektor, B., Heinimö, J., Trømborg, E., Wild, M. (2016). Commodity-Scale Biomass Trade and Integration with Other Supply Chains. 10.1016/B978-0-12-805165-8.00006-9.

Shaunak, A. (2020) *Cleaning the seas with oyster and mussel farms.* Retrieved from foodunfolded.com/article/cleaning-the-seas-with-mussel-and-oyster-farms visited on 24-02-22

Shell. (n.d.). *Shell in Nederland.* Retrieved from https://www.shell.nl/over-ons/netherlands visited on 04-04-2022

Solaroilsystems (2013) *Herintroductie van koolzaad in Nederland.* Retrieved from https://www.solaroilsystems.nl/wp-content/uploads/2015/10/2013-05-02-Food-Valley-Herintroductie-van-koolzaad-in-Nederland.pdf visisted on 08-03-22

Stichting LISA (2021). *LISA data.* Via brightspace.nl. Visited on 24-02-22

Svensson. (n.d.). *Controlling Greenhouse Light Pollution.* Retrieved from https://www.ludvigsvensson.com/en/climate-screens/news/posts/2020/april/2020/may/keeping-it-lit-controlling-greenhouse-light-pollution/ visited on 03-03-2022

U.S. Energy Information Administration (2021) *Biomass explained.* Retrieved from https://www.eia.gov/energyexplained/biomass/ visited on 25-02-2022.

USDA (2012) *What is agroforestry?* U.S. Department of Agriculture

Pas, van de, J. (2015). The bio-economy: definitions and measurement. http://edepot.wur.nl/338454.

Velden, van der, N. J. A. (2017). Energiemonitor Glastuinbouw. *Wageningen University & Research.*

Velzen, van, J. (2021) Boeren maken zich op voor een nieuw stikstofprotest in Den Haag. *Trouw*, July 7, 2021.

Vis M., Mantau U., Allen B. (2016). Study on the Optimised Cascading Use of Wood. No 394/PP/RCH/14/7689. Final Report. Brussels, Germany. 337 pages.

Voermans, T. (2022) Een miljoen woningen in tien jaar. Hoe gaan we dat doen? *Het Parool*, March 14, 2022.

Waijerink, H. (2021). Nationaal Park de Alde Feanen [photograph] Retrieved from https://www.google.com/maps/place/Nationaal+Park+de+Alde+Feanen/@53.129885,5.944981,3a,75y,90t/data=!3m8!1e2!3m6!1sAF1QipOJX2nbrnPDLNLRkFBWCNGKXFvxwhO1PNVKCNJW!2e10!3e12!6shttps:%2F%2Flh5.googleusercontent.com%2Fp%2FAF1QipOJX2nbrnPDLNLRkFBWCNGKXFvxwhO1PNVKCNJW%3Dw203-h360-k-no!7i2268!8i4032!4m5!3m4!1s0x47c85644bea2a3ef:0x17951990591737a6!8m2!3d53.129885!4d5.944981?hl=nl visited on 01-04-2022

WaysTUP (2020). *Survey report on regulatory obstacles and drivers for boosting a sustainable and circular urban biobased economy.* Retrieved from https://waystup.eu/survey-report-on-regulatory-obstacles-and-drivers-for-boosting-a-sustainable-and-circular-urban-biobased-economy/ visited on 08-02-2022

World Economic Forum (2021) *What you need to know about the European Green Deal - and what comes next.* Retrieved from https://www.weforum.org/agenda/2021/07/what-you-need-to-know-about-the-european-green-deal-and-what-comes-next/ visited on 01-04-2022

WUR (2019). *Dutch export of agricultural products exceeds 90 billion in 2018.* Retrieved from https://www.wur.nl/en/newsarticle/dutch-export-of-agricultural-products-exceeds-90-billion-in-2018.htm visited on 19-04-22

WUR (n.d.). *Vertical farming.* Wageningen University & Research. Retrieved from https://www.wur.nl/en/Dossiers/file/Vertical-farming.htm visited on 15-03-2022

Youmatter (2020) *Biogas Definition: What Is Biogas Production? What Are Its Stages?* Retrieved from https://youmatter.world/en/definition/definitions-biogas-definition-what-is-biogas/ visited on 24-03-2022

Zearz (2022) The eco-city [image] Retrieved from https://zearz.deviantart.com/art/Eco-city-395739541 visited on 06-04-2022

Indirect References for Figures

General

Basemaps from:

J.W. van Aalst (2021). GeoData OpenTopo. www.opentopo.nl

Gisdata from:

EZ (n.d.) Geoservices agrarisch areaal nederland (AAN)

Retrieved from https://www.pdok.nl/datasets/-/categories/1942245 using: Qgis [gisdata]

Kadaster (n.d.) GeoData basisregistratie topgrafie (BRT)

Retrieved from https://www.pdok.nl/introductie/-/article/basisregistratie-topografie- achtergrondkaarten-brt-a- Using: *Qgis* [GIS software].

Kadaster (n.d.) *GeoData basisregistratie kadaster.* (BRK)

Retrieved from https://www.pdok.nl/introductie/-/article/basisregistratie-kadaster-brk- using: Qgis [GIS software].

Ministerie van Economische Zaken, Rijksoverheid (n.d.). GeoData Basisregistratie gewaspercelen (BRP)

Retrieved from https://service.pdok.nl/rvo/brpgewaspercelen/wfs/v1_0?request=GetCapabilities&service=WFS using: Qgis [GIS software].

Stichting LISA (2021). *LISA data.* Retrieved from brightspace.nl. visited on 03-22

Biocycle

Foodunfolded (2020) *CLEANING THE SEAS WITH MUSSEL AND OYSTER FARMS.*

Retrieved from https://www.foodunfolded.com/article/cleaning-the-seas-with-mussel-and-oyster-farms visited on 20-02-2022

Caldeira, C., De Laurentiis, V., Corrado, S., van Holsteijn, F., & Sala, S. (2019).

Quantification of food waste per product group along the food supply chain in the European Union: A mass flow analysis. *Resources, Conservation and Recycling*, *149*, 479-488.

Goh, B. H. H., Chong, C. T., Ge, Y., Ong, H. C., Ng, J. H., Tian, B., ... & Józsa, V. (2020).

Progress in utilisation of waste cooking oil for sustainable biodiesel and biojet fuel production. *Energy Conversion and Management*, *223*, 113296

Landuse Battles

Gopal, K., Groenmeijer, L., van Leeuwen, G., Omtzigt, D., Stuart-Fox, M. (2021). *Rapportage*

Primos 2021. Retrieved from https://abfresearch.nl/publicaties/rapportage-primos-2021/ visited on 01-03-22

Import and Export Port of Rotterdam

World Economic Forum (2019) *These Dutch tomatoes can teach the world about sustainable agriculture.* Retrieved from https://www.weforum.org/agenda/2019/11/netherlands-dutch-farming-agriculture-sustainable/ visited on 03-04-2022

Lemmers, O., Streng, M., Bohn, T., Bouhuijs, I., Kuipers, B., Ramaekers, P., Walker, A. en

Wong, K.F. (2022). *Economische betekenis zeehavengebieden: Vestigingsplaatsfunctie, knooppuntfunctie en handelsstroomfunctie*. CBS en Erasmus UPT.

Design Goeree Overflakkee

Solaroilsystems (2013) *Herintroductie van koolzaad in Nederland.* Retrieved from https://www.solaroilsystems.nl/wp-content/uploads/2015/10/2013-05-02-Food-Valley-Herintroductie-van-koolzaad-in-Nederland.pdf visisted on 08-03-22

SWOT

Atlas Leefomgeving. (2021, May 28). *Kaarten*. Retrieved from https://www.atlasleefomgeving.nl/kaarten visited on 12-03-2022

Gopal, K., Groenmeijer, L., van Leeuwen, G., Omtzigt, D., Stuart-Fox, M. (2021). *Rapportage*

Primos 2021. Retrieved from https://abfresearch.nl/publicaties/rapportage-primos-2021/ visited on 01-03-22

Individual Reflections

Fabio

My experience in the Research and Design Studio: Spatial Strategies for the Global Metropolis provided me with a large set of knowledge in regional design, allowing me to understand its complexities. The initial moment of the course was intense, and I struggled to know which approaches to adopt to reduce the complexity of the systems, and overall understand where to start to face the challenge.

The initial group effort to understand the task and possible outcomes was important to face the regional scale, which was different from everything I did before as an architect and urban designer. Gradually, the process and interrelations made more sense, as they were made explicit into simple, but revealing diagrams. Based on this approach, our group work was divided into clear tasks and was able to provide a huge amount of research material.

Then, the group challenge was to link all of these parallel stories, research, and pieces of the puzzle that composes South Holland into a clear and narrowed narrative, that clarifies our intentions, values, and goals within our vision of the bio transition. In that sense, the overall experience was very enriching, with an intense learning curve that was combined with the Methodology Course and SDS lectures inputs and support throughout the quarter.

However, the second half of the quarter was defined by struggles with group dynamics, because of external factors. The impossibility to work together in the whole process created an unavoidable fragmentation of the understanding of the work among all the group members. This was felt in later phases of the work, where it was hard to coordinate group actions and produce the final materials.

Despite this problem, the overall educational experience exceeded my expectations in a good way, demanding an intense, but rewarding workload. In the end, I am able now to understand systems and their spatial implications in a systematic approach, without the initial blurriness of how to face this challenge. The course provided me with a valuable workflow to understand this scale for my future professional practices, and I am grateful to my group: Chaniek, Margot, and Julie, and to the tutors Diego, Robert Jan, and Karel for the teachings.

Besides the valuable inputs about the regional design profession, the course also provided me with useful workflows regarding GIS analysis, data mining, and visualization strategies. During the learning process, all the presentation strategies were explored to reduce complexity without losing information. In that sense, it was an interesting laboratory to explore forms to visualize urban strategies, public programs, stakeholder engagement, and diagrams to reveal critical aspects of the project. A training that will certainly be useful in my future path as an urban designer and urban planner.

Chaniek

Within the Research and Design Studio: Spatial Strategies for the Global Metropolis I started, not knowing what to expect. We did not have any regional scaled courses before and it always seemed very complex to me. During the course the bigger scale started to unravel to me and i began to find it more and more interesting. With the methodology course next to the design project it helped me find relations in this big complex thing that is regional planning.

Within the first weeks of the course we had to give a preference for a subject on which they would base the groups. My choice for the biobased transition is something I am still happy with. Because of the introduction of agricultural- and food-chains the actual province design was invited to the table. The port made things more complicated, but it did make the huge relevance of this project visible. In our strategy I do think we could have advanced a bit more on the new purpose of the port and the actual change that needs to happen here within the vision we propose.

In the end I think i learned the most about how a larger scale strategy can make a contribution to the sustainable transformation. The lectures and the tutoring sessions where inspiring and made me understand systems, flows and the effects of climate change a lot better. For example we learned how to do systemic sections and I think this can also be a relevant skill even on other scales. If I had more time to dive into the subject I would like to learn more about making a conceptual framework and how to let this guide your project. I think ours was pretty good, due to Fabio's personal experience, but I never made one myself.

The groupwork was sometimes hard due to working together under hybrid conditions. We had to manage through absence and communicate via zoom or whatsapp instead of in real life. I am very proud though of the results we made and the hard work we put in to come to this result, even though we were sometimes with a small number of people at the faculty.

When I started this master I always thought i would like the city scale the most, but i didn't have any experience in the regional scale before this course. In the end i think i must say that the regional scale surprised me in it's little details. And where i always thought of them as big complex structures i can now see the correlation between the scales a lot better. Even though i still like the creativity I can express within the smaller scale, i do now have a new found appreciation for the making of strategies and visions that come with regional planning.

Individual Reflections

Margot

The Research and Design Studio: Spatial Strategies for the Global Metropolis gave a lot of new insights. The regional scale of the course was a whole new view on urbanism. The course was, of course, a lot more strategic than the other courses of the master and also the groupwork was a new aspect of the course. After the first couple of lectures of Methodology and Capita Selecta, I realized that this is not the scale I prefer. The assignment is not really a design, but really a vision and strategy. This means that the process is more about analysis, scientific research and policies and less about the creative process of designing. With other words, this course made me realise that I prefer designing on a smaller scale.

In the first week of the course we were asked to write about your preferences as a basis for the group forming. I wrote about my vision on sustainability and my choices to for example use as much non-plastic products as possible. The group that was formed in the next week was the biobased group and they had similar thoughts on sustainability.

Both the Research and Design Studio and the Methodology course gave new insights to integrate in the vision and strategy. These insights were for examples sectors that were connected to the sectors that we were already researching or certain stakeholders that were important for the transition. The tutors also helped us to read certain scientific reports to make our research stronger. This information really helped us to create an as complete as possible vision and strategy on the biobased transition.

However we did had some issues with the group. I think the group dynamics were really nice. Everyone has their own qualities that we used to divide the different tasks and discussing was really nice in our group. The problem was the presence of everyone. We were really 'the unlucky group'. Chaniek, Fabio and I got Covid during the course. I also got sick because of the Norovirus (stomach flu) and Julie got a kidney infection. All this sickness and not being able to join the studio sessions lead to a difficult process. We were really struggling with presence and that might have lead to a less detailed research in the report, although we really tried our best to finish everything as complete as possible.

In the end I did learn a lot about how to contribute to a circular and biobased economy and that was really nice. I will always carry this new knowledge with me in future projects, but also in my own way of living. Although the courses also taught me that climate change is even worse than I thought and that we are not there yet at all. Sustainability will always be an interesting topic and the transition towards a circular economy is of high importance.

Julie

The courses R and D studio: Spatial Strategies for the Global Metropolis and Research and Design Methodology for Urbanism have been an enrichment to my academic career. After the courses I took during my undergraduate human geography and urban planning, these courses were very refreshing compared to the way my undergraduate classes were structured. The way in which there is encouragement from different scales to flows, processes and policies is, in my opinion, a good lesson in becoming a true urbanist.

Coming from a different master's program, these classes were really something else. Whereas I personally was used to explaining concepts mainly textually, these courses focus on explaining it as best as possible through images. I was not aware of the added value of conveying information through images. The simplification of concepts that some illustrations portray is something I had never understood. I hope to carry the knowledge I have gained about this over the past few months with me forever into my future career.

In this course I worked on a vision for a province that was relatively unknown to me. Through field trips, literature reviews, and inspiring lectures, the puzzle became a little clearer each day. For not only did discovering the province feel like a quest, but also finding our own vision. Our group consists of a mixture of different study backgrounds and nationalities. Initially, it was made clear to us during various lectures that differences could still cause problems in, for example, communication. Because we have been wary of this, we have been able to express our strengths and weaknesses to each other from the start, and to express our differences calmly. Partly due to this open communication, the four of us were able to form a clear vision. In our opinion, an area should not be planned 'permanently'. Areas are dynamic; for everyone and forever. This may sound very logical, but when implementing a regional vision, it is not that clear.

In our plan, we discussed different future scenarios related to climate and talked about different futures for South Holland society, ultimately arriving at a plan that seems appropriate to us. With sustainability and justice high on our agenda, we gave nature free rein in 2050, and did our best to virtually close waste cycles. In doing so, we hope to contribute to a future where less is consumed at first hand, and where people are mindful of their common future at all times.

In a group that was often unlucky with illness and quarantine rules, I am proud that despite all the setbacks we were able to work so well together and produce this fantastic final product. I admire the skills that my group mates have acquired in their previous academic careers, and am grateful to have been able to learn from them.

Terminology

Bio-economy
The Bio-economy encompasses the sustainable production of renewable resources from land, fisheries and aquaculture environments and their conversion into food, feed, fibre bio-based products and bio-energy as well as the related public goods. The Bio-economy includes primary production, such as agriculture, forestry, fisheries and aquaculture, and industries using / processing biological resources, such as the food and pulp and paper industries and parts of the chemical, biotechnological and energy industries (European Commission, n.d.)

Bio-gas
Biogas is a type of bio-energy naturally produced from the decomposition of organic matter. When this organic matter is exposed to an environment without oxygen they free a blend of gases (Youmatter, 2020).

Biofuel
Biofuel is any fuel that is derived from biomass - that is, plant or algae material or animal waste (Lehman, n.d.) There are different types of biofuels: they differ in the material they are made of (ETIP, 2022). The different biofuels all have a different impact on the environment. In general biofuels formed by waste products are the most sustainable kind.

Biomass
Biomass is renewable organic material that comes from plants and animals (U.S. Energy Information Administration, 2021). Biomass has a lot of potential regarding circularity. The materials that form biomass are thrown in a heap in order to make compost. This form of reusing the materials turned out not to be very sustainable – a lot of gasses are emitted when doing so. Through innovation and research other methods have been developed to make better use of the materials and ensure they do not harm the environment. Biomass can now be converted to biogas, electricity, cattle feed and compost. Because biomass is a product which you can find in large amounts anywhere across the globe, it has the potential to take over large parts of the fossil fuel industry. All applications of biomass can be done locally, which also contributes to the sustainability of the sector.

Energy crops
Energy crops are crops cultivated specifically to provide feedstock for energy industries (Fózer et al., 2020). The energy crop mostly suggested within this document is the production of rapeseed.

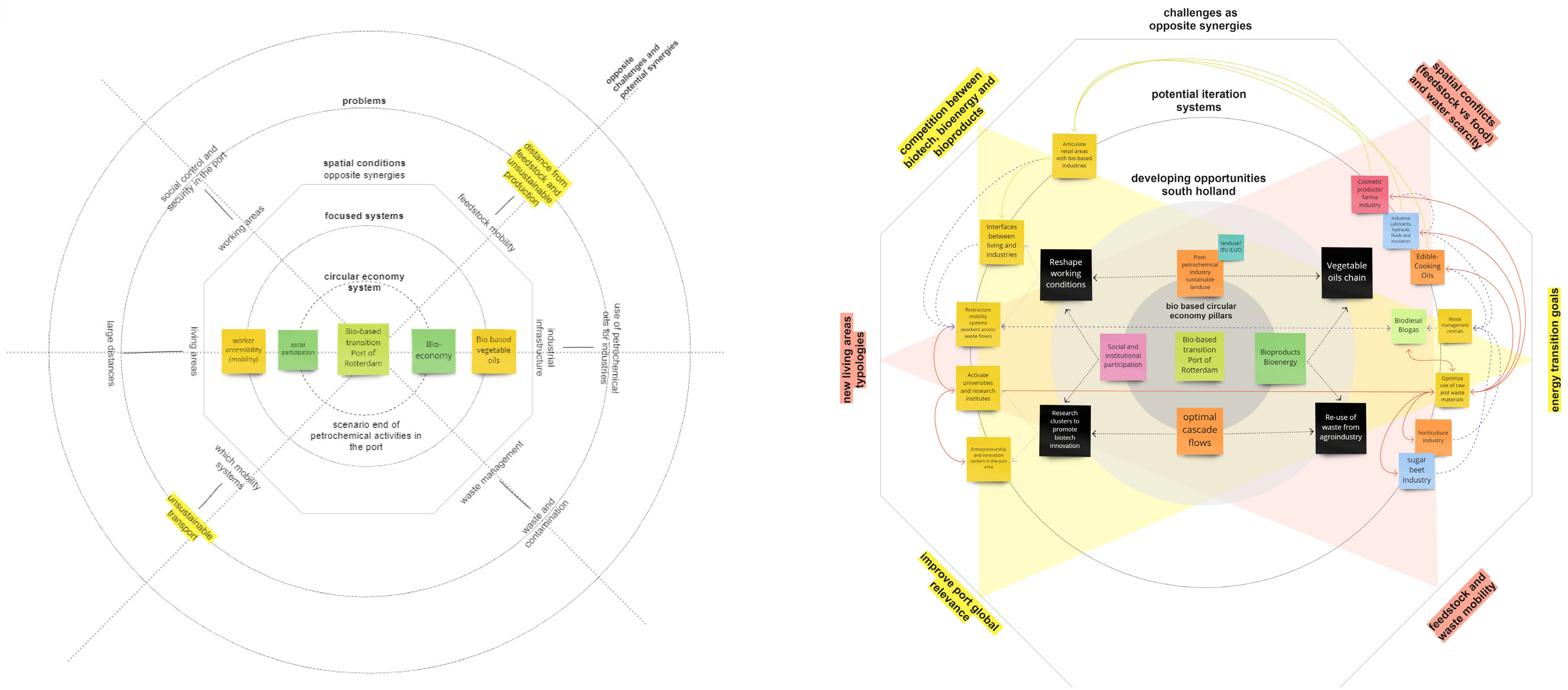
Vertical farming
Vertical farming is a form of agriculture that stacks production layers on top of each other to increase the productivity of an area (WUR, n.d.). The climate in vertical farms is very strictly controlled, to create the best environment for plants to grow.

Agro-forestry
Agro-forestry is the intentional mixing of trees and shrubs into crop and/or animal production systems to create environmental, economic and social benefits (USDA, 2012).

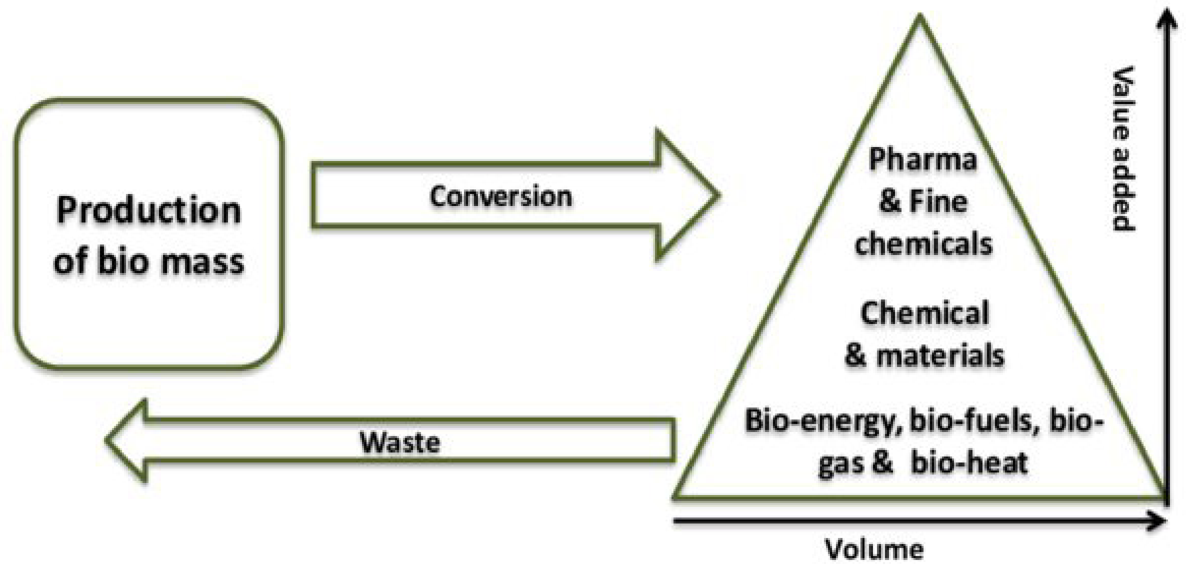
Conflict of space
This concept is used to illustrate how different futures for the same area can conflict with each other. An example of this is the urge to keep up with the current housing demand and create a bigger built environment. Which is in conflict with the ecological need to keep natural (protected) areas in tact.

Water crops
In this vision document the term water crops is used to describe the following crops and animals which can be harvested underwater: algae, oysters, mussels and seaweed.

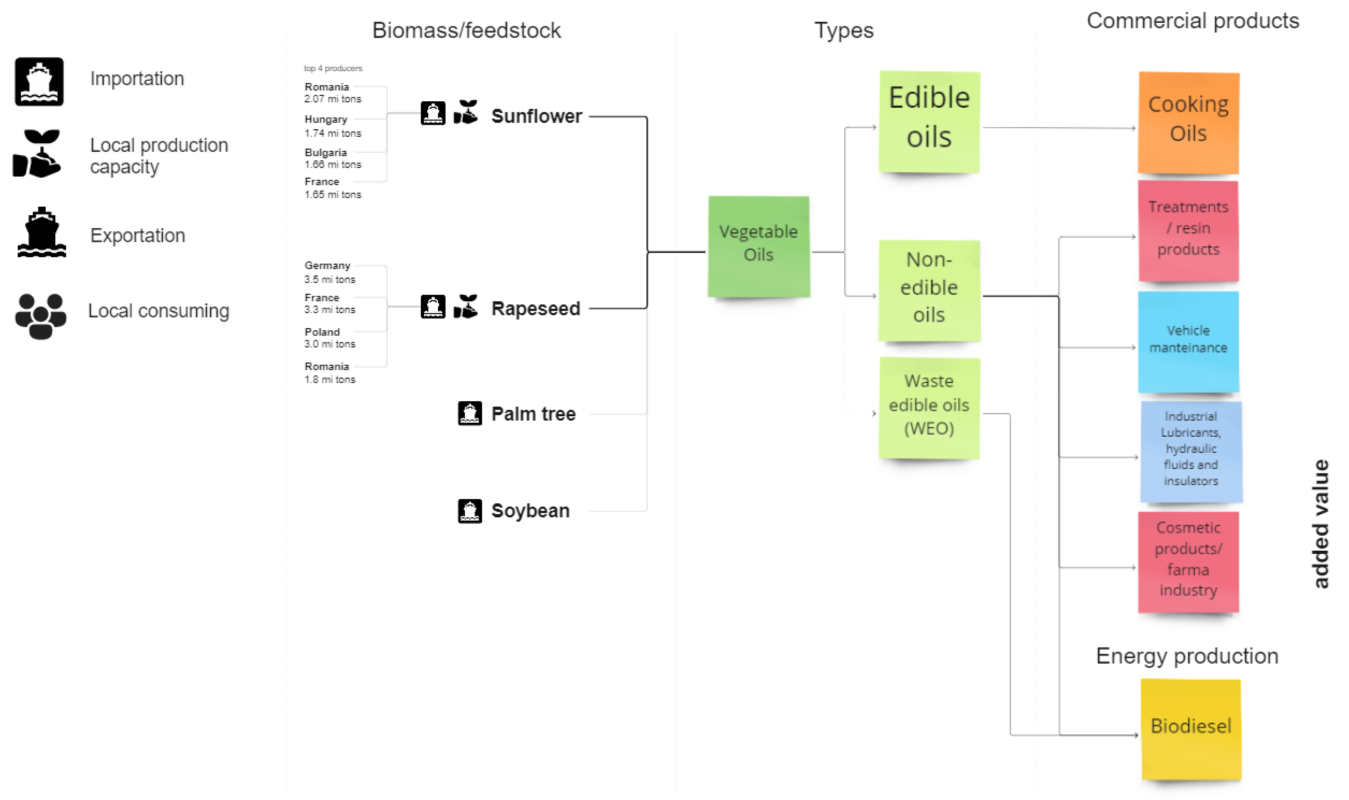
Appendix



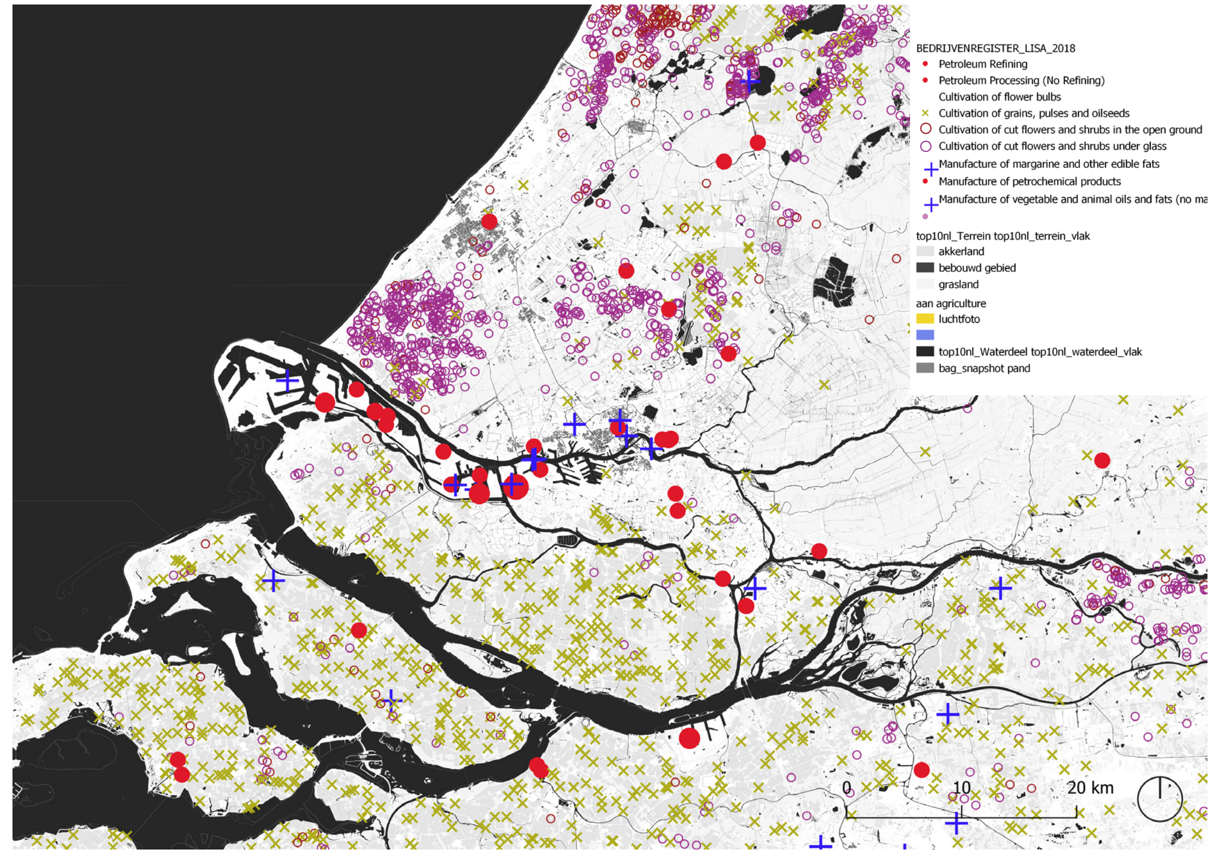
Previous versions conceptual framework. This was the first idea for the research. (made in Miro)



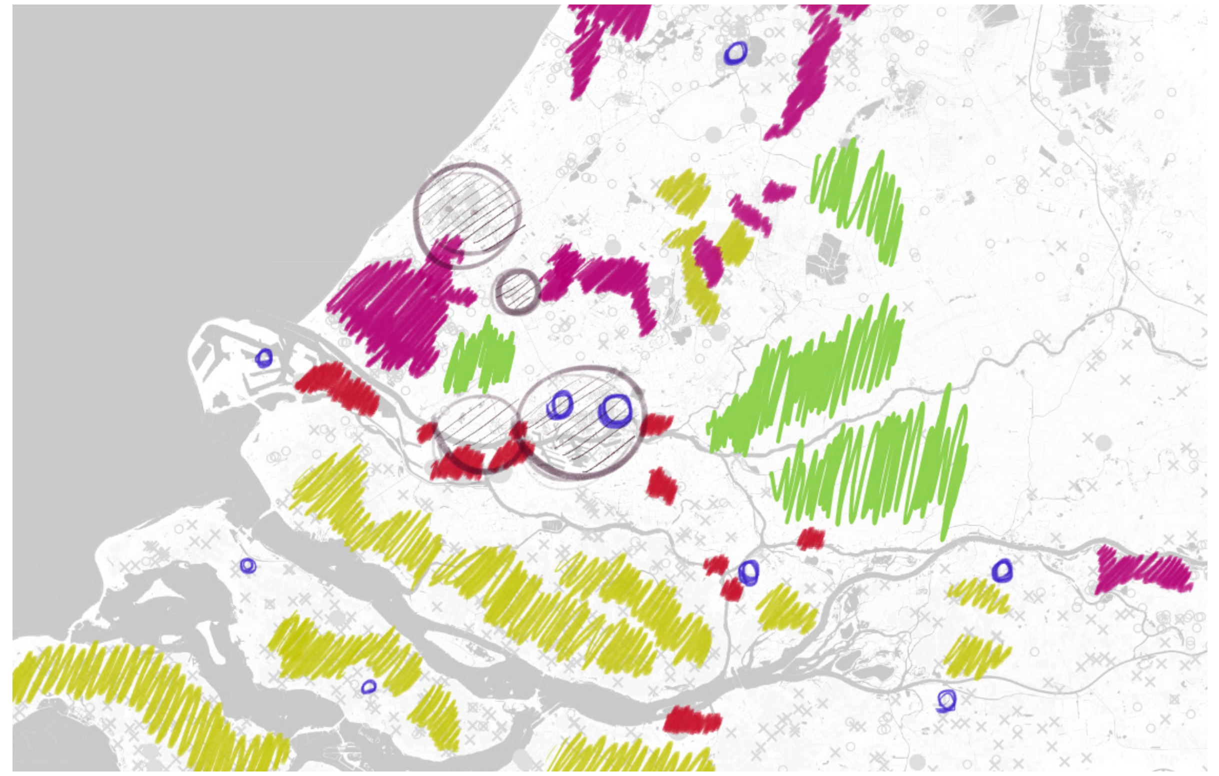
Value of products pyramid (Hintjens & Vanelslander & van der Horst & Kuipers, 2015)



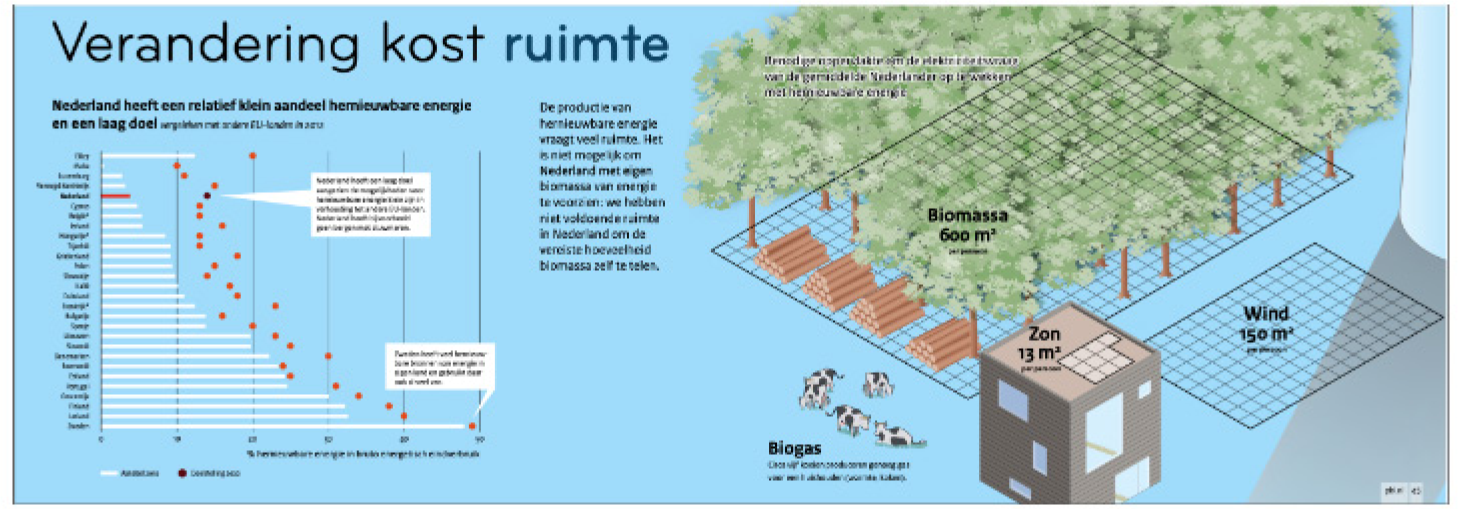
Information about vegetable oils. This was our starting point within the research. (made in Miro). Values source (OEC, n.d.)

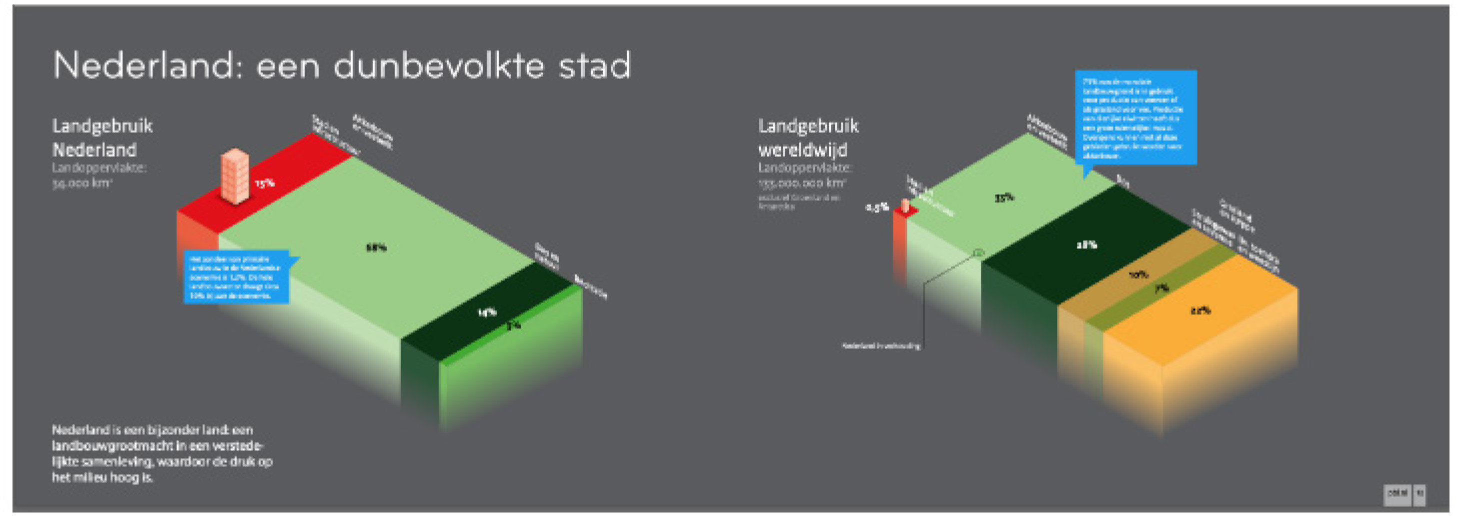


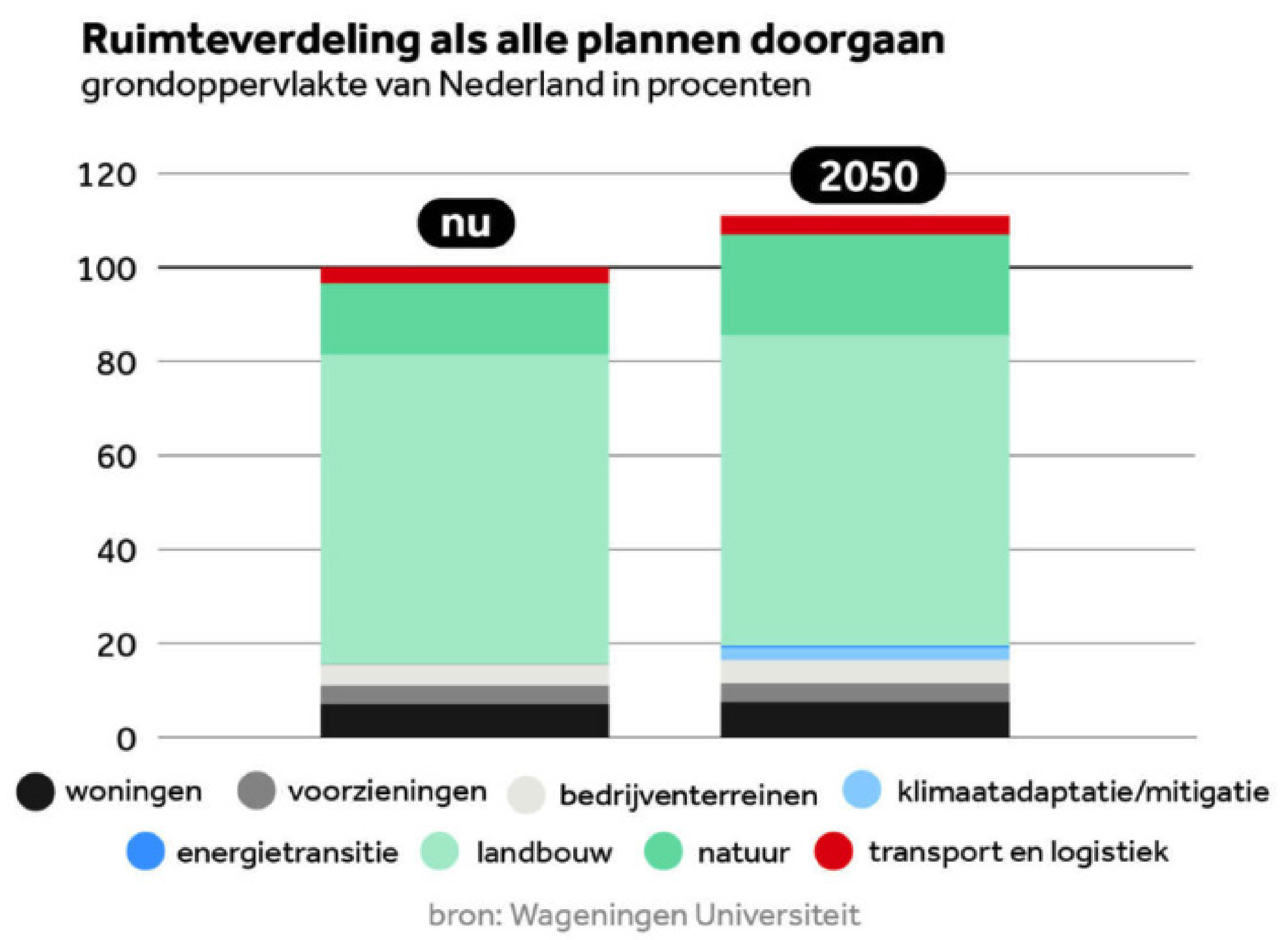
Types of industries within the province from the LISA data provided via brightspace (LISA ,2021)



Analysis of relevant locations for study

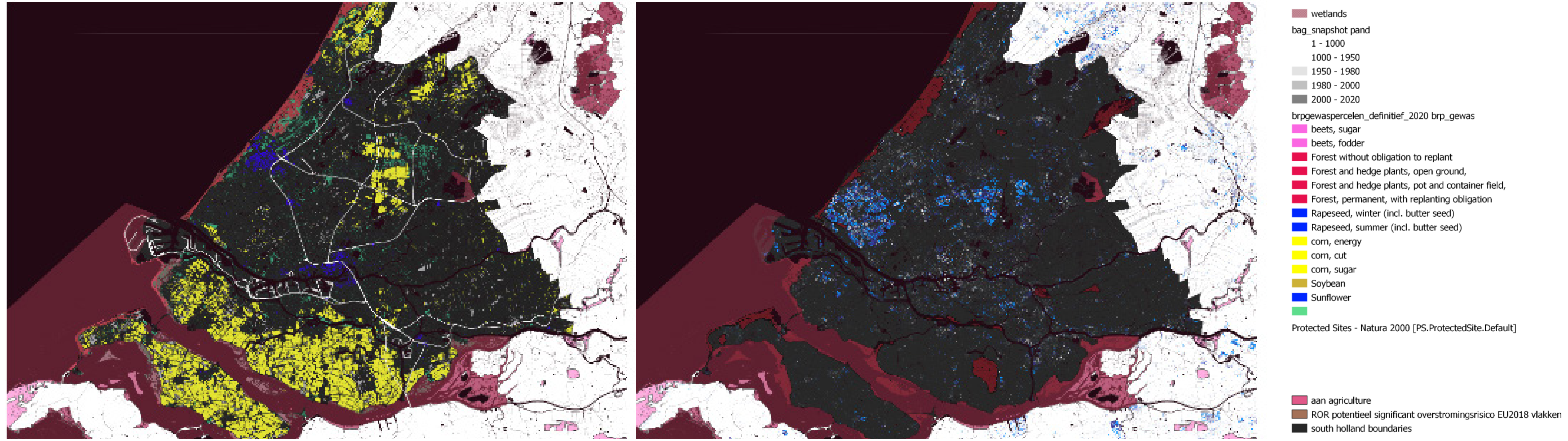






This page includes different images about land-use in the Netherlands. Source: (PBL, 2012)

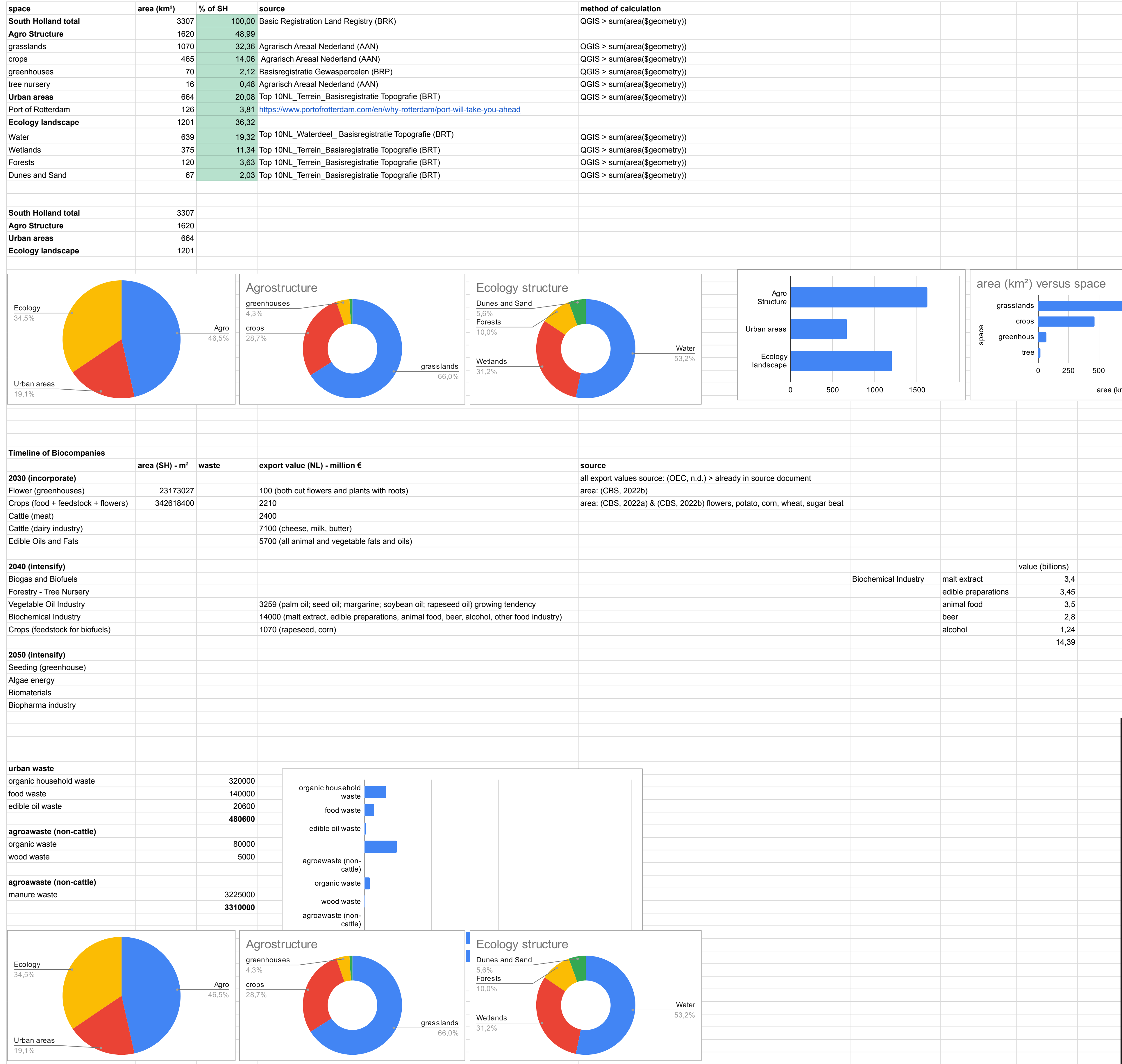
- **Urban and Agricultural clusters**
- **Greenhouses (+ industries) development**

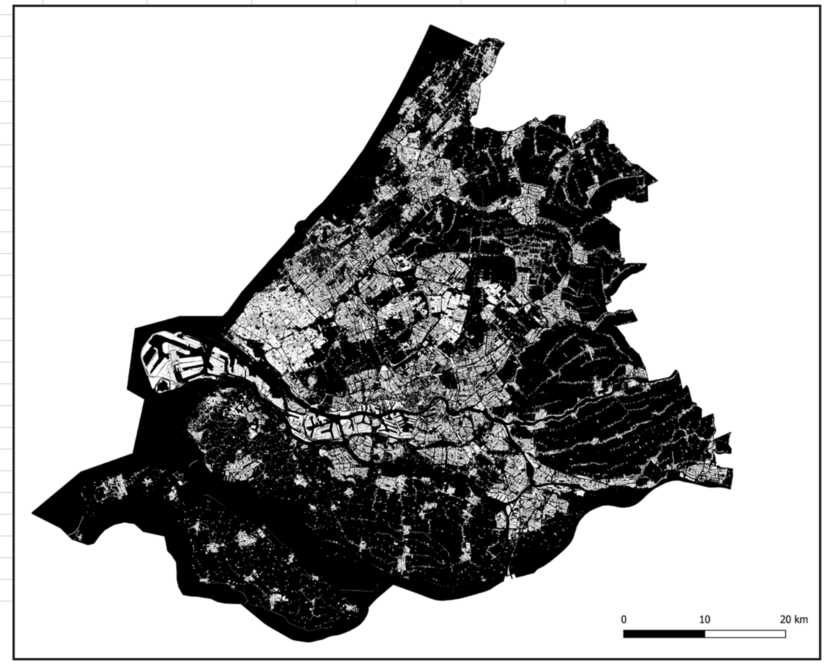


GIS maps about agriculture, urban areas and nature in the province. Sources are in the legend

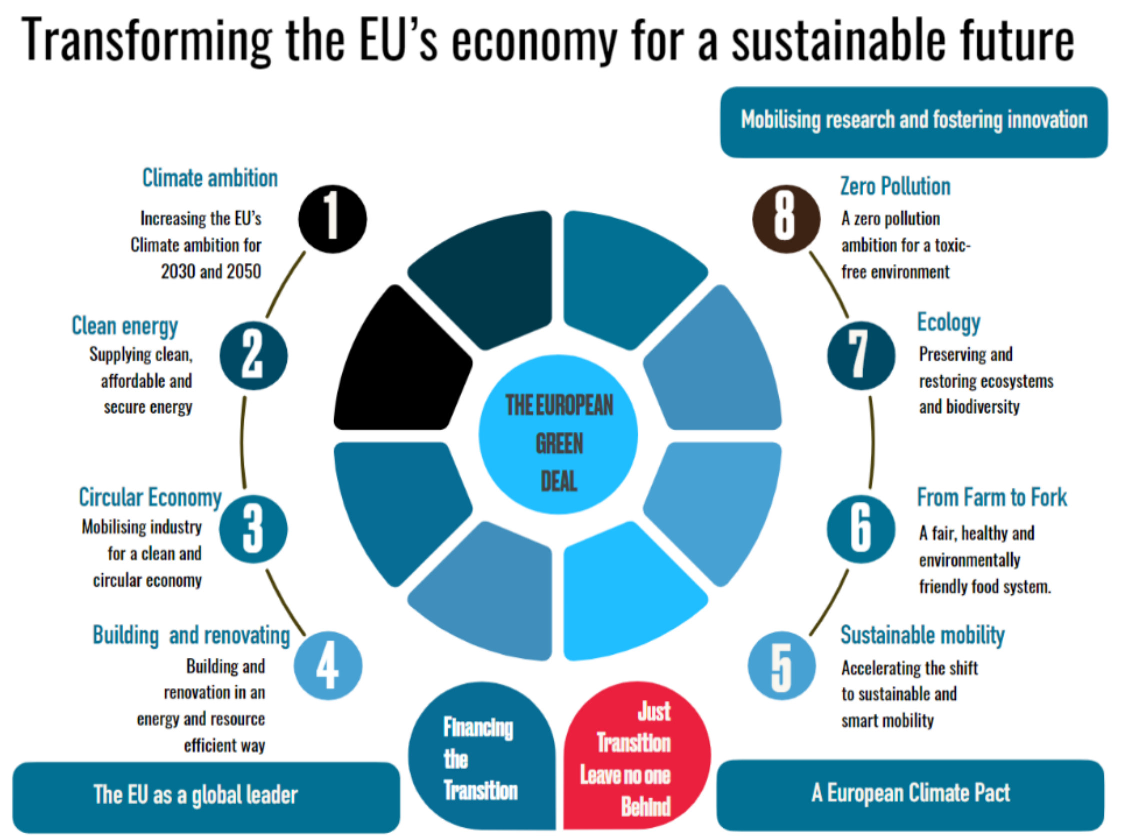
- **Housing development**
- Beets, corn, rapeseed and sunflowers

GIS maps about agriculture, urban areas and nature in the province. Sources are in the legend

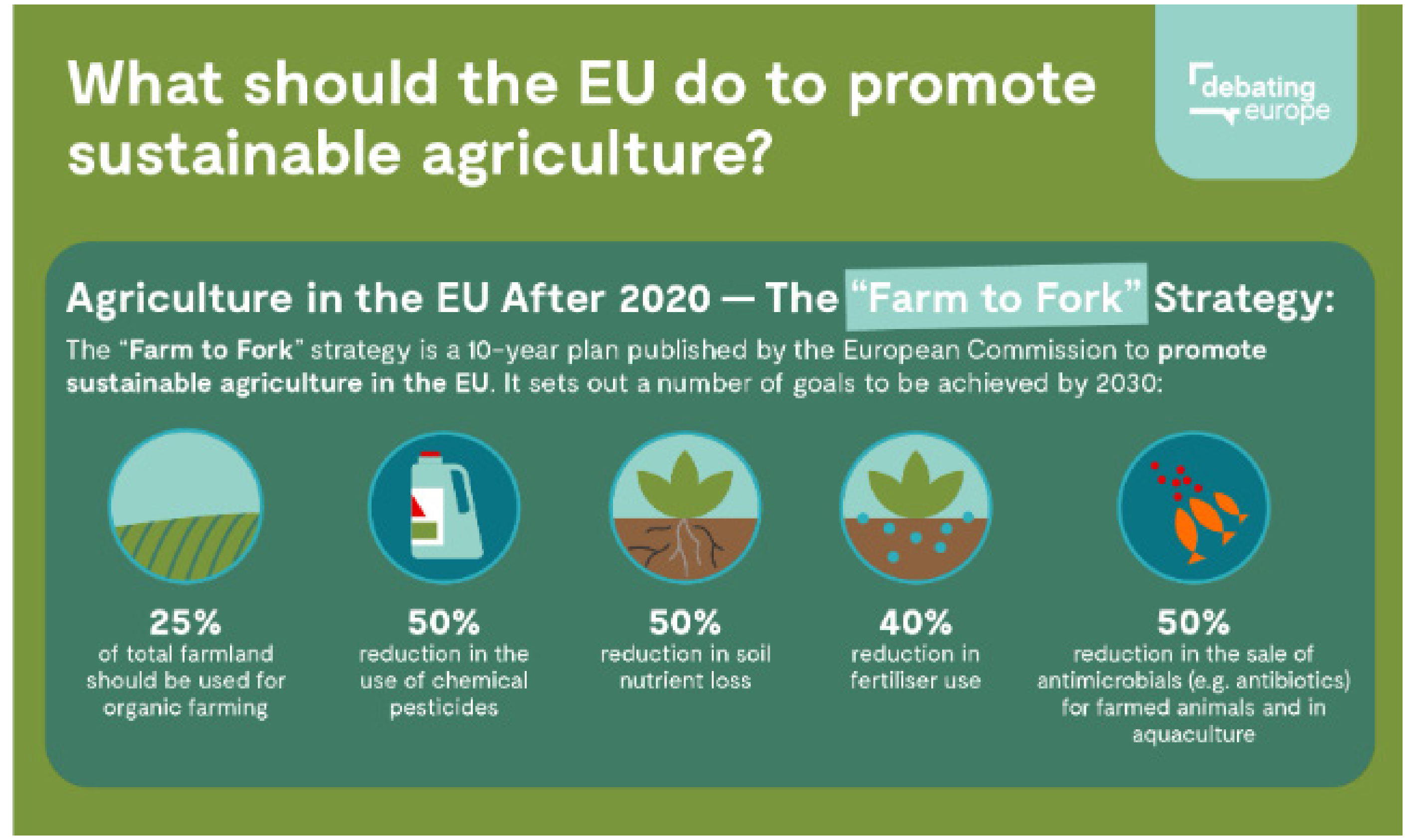




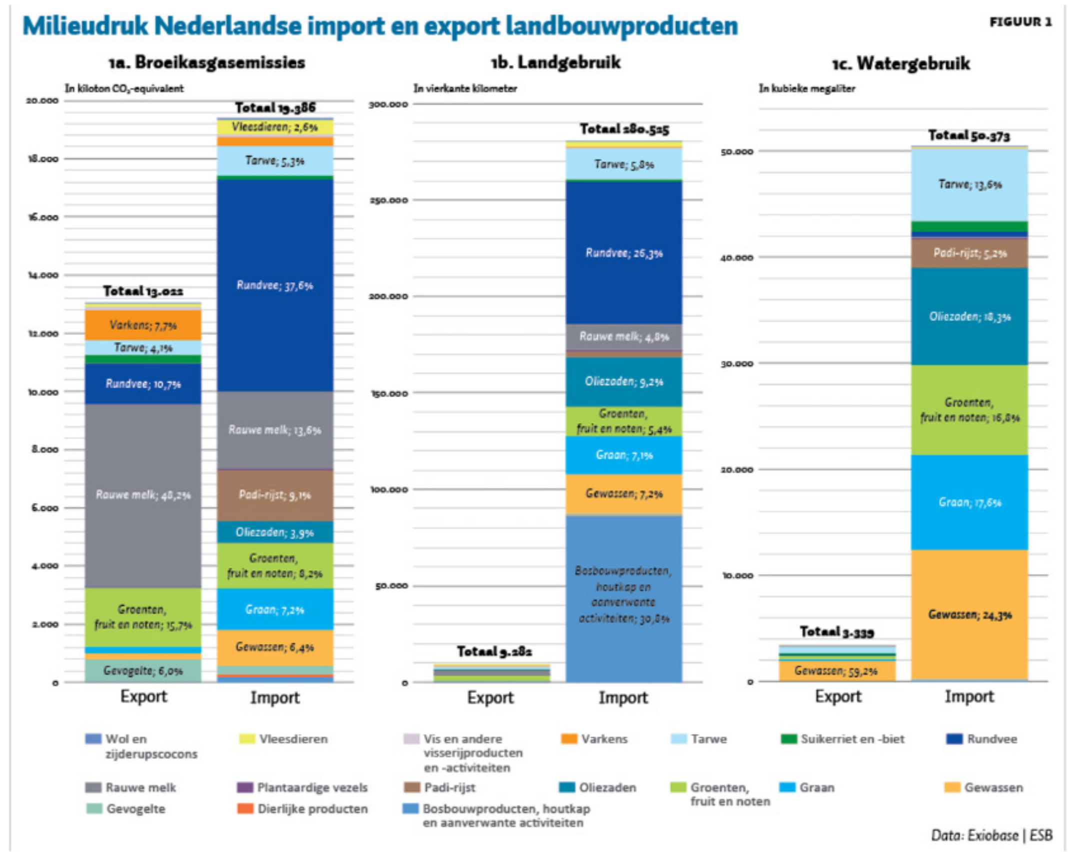
This Excel includes the different surfaces and values of products, based on GIS data. The GIS map is showed on the right.
Sources for different Gisdata show in sheet and in reference list for figures.



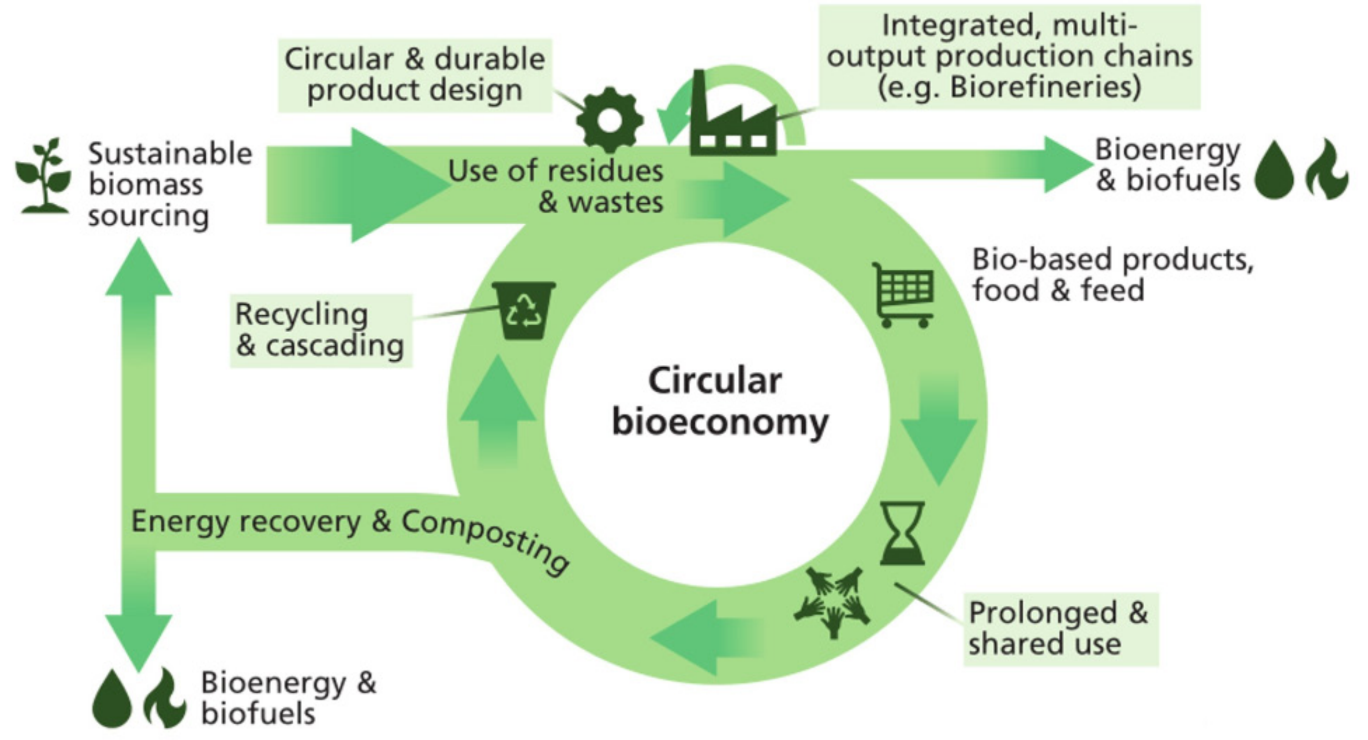
Source: (European Commission, 2019)



Source: (European Commission, n.d.)

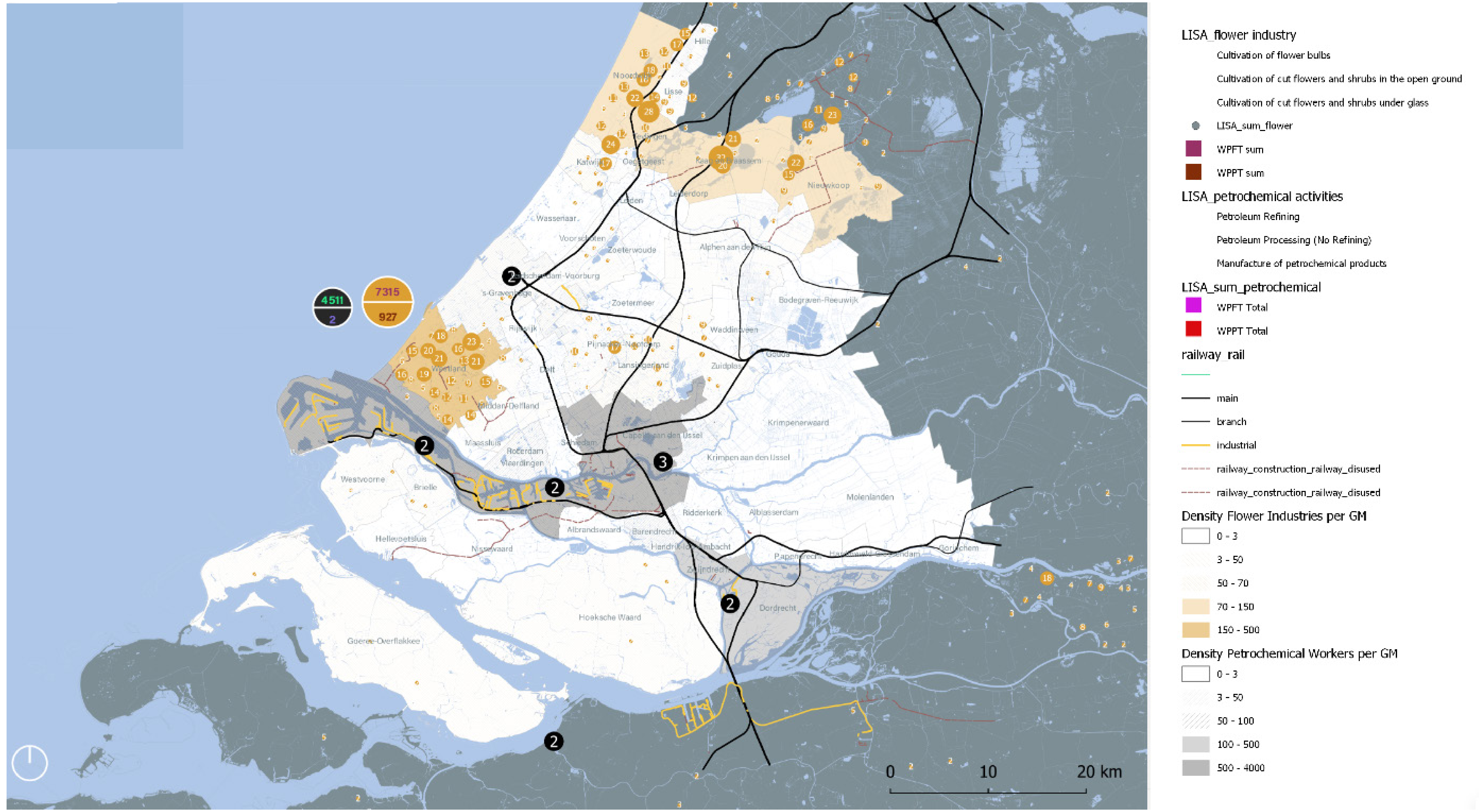


Source: (Donati & Tukker, 2020)

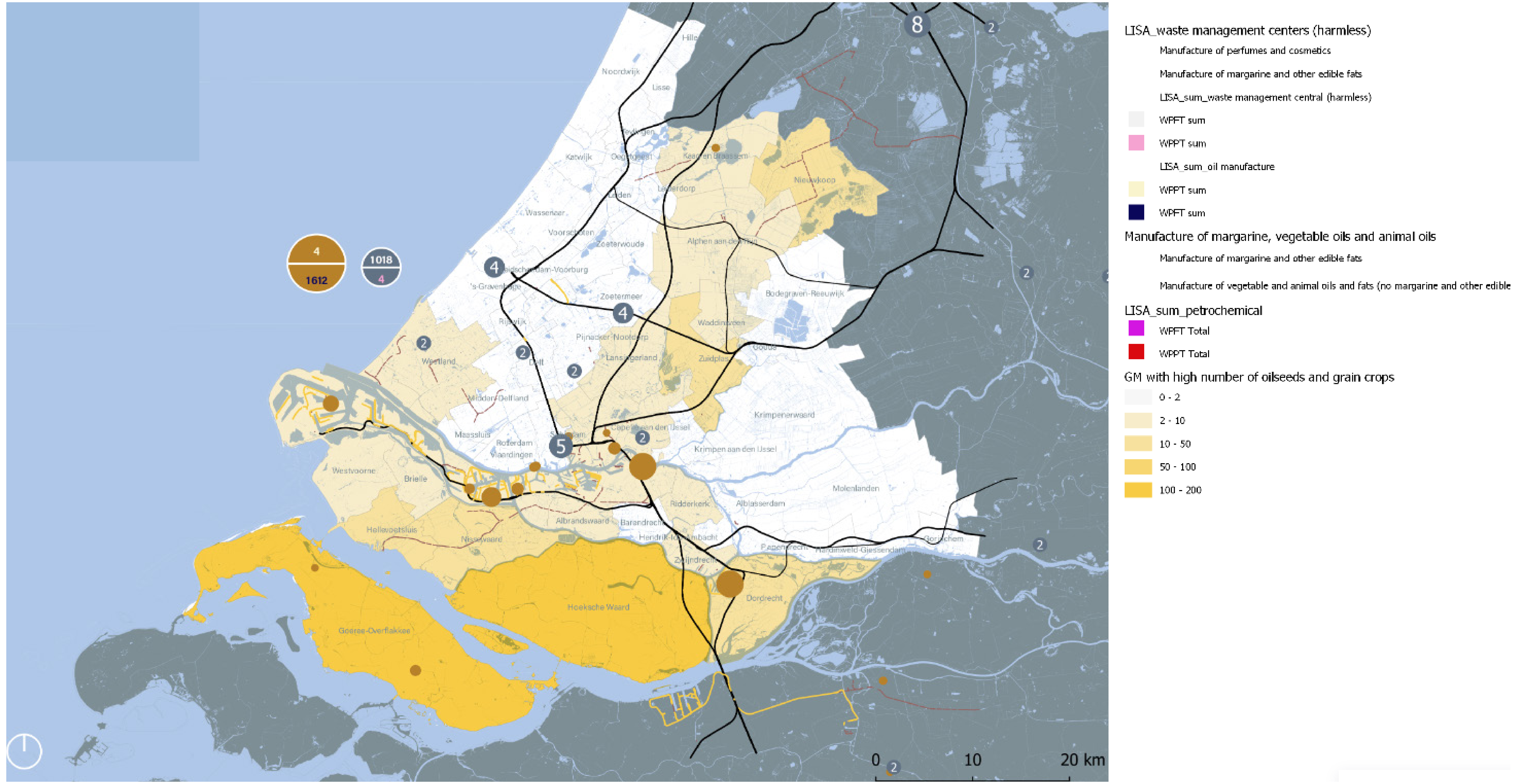


Source: (WaysTUP, 2020)

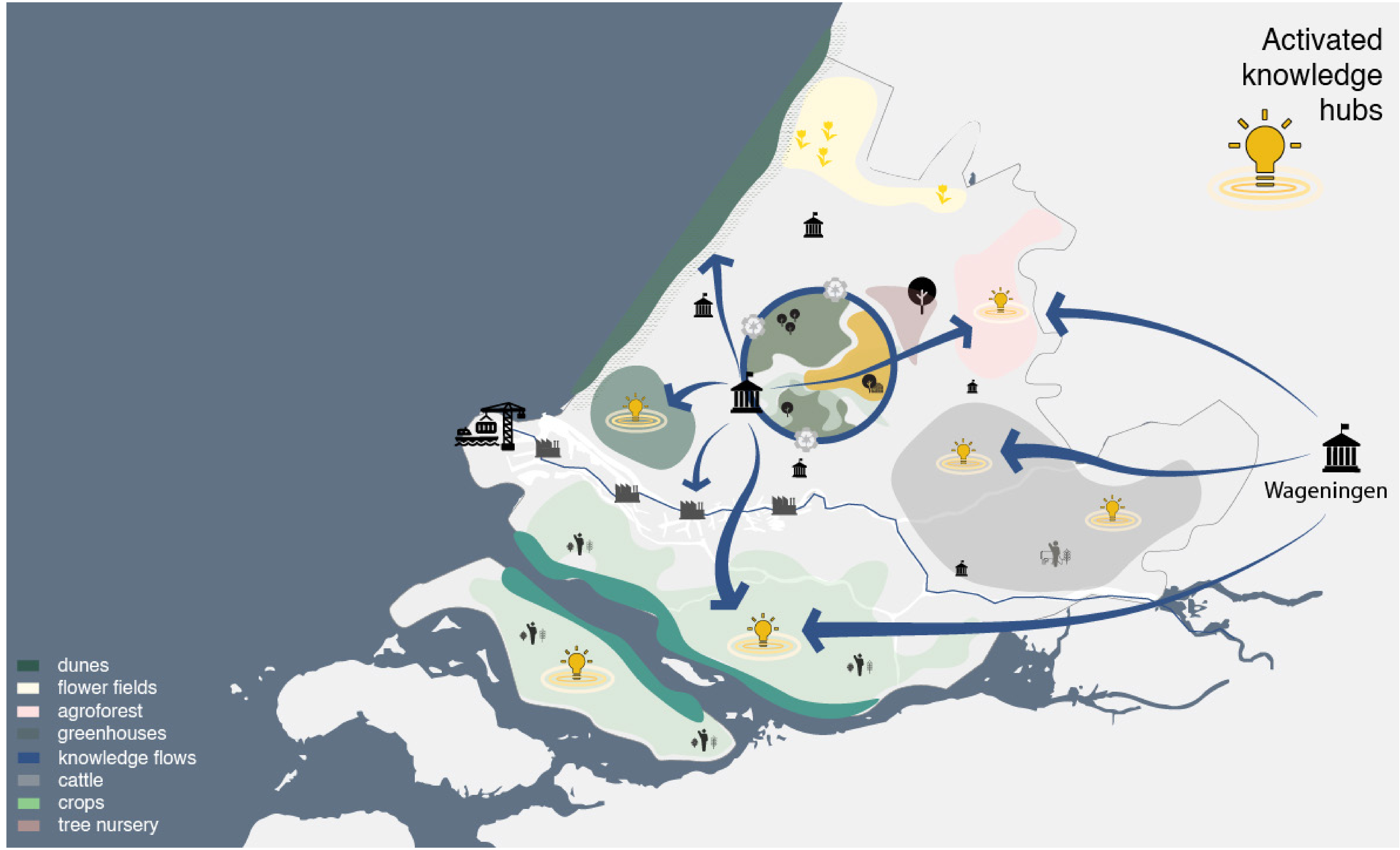
This page includes different sources we used as background information for the vision and the strategy.



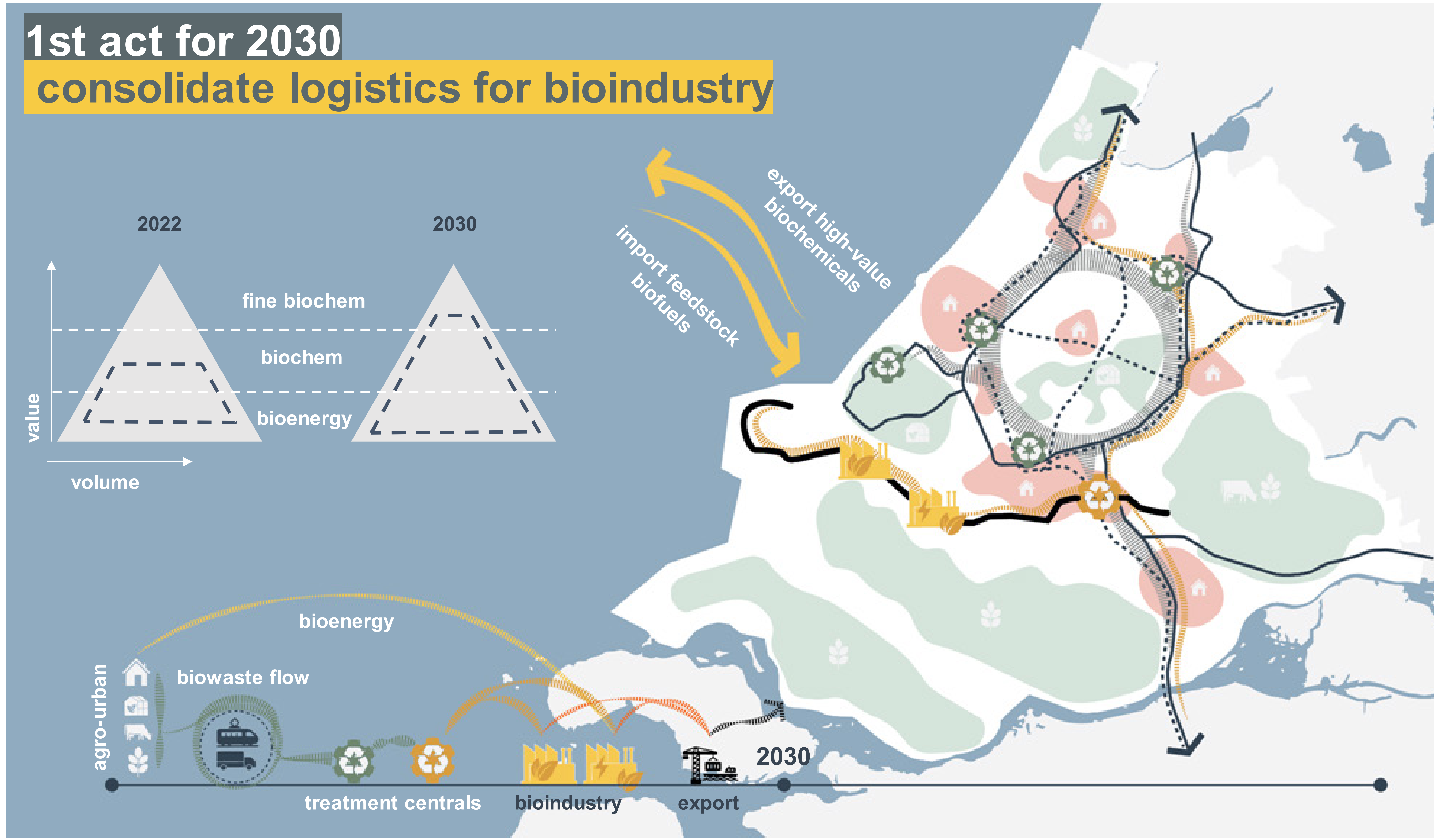
GIS map about the companies in the province. Source: (Stichting LISA, 2021)



GIS map about the companies in the province. Source: (Stichting LISA, 2021)



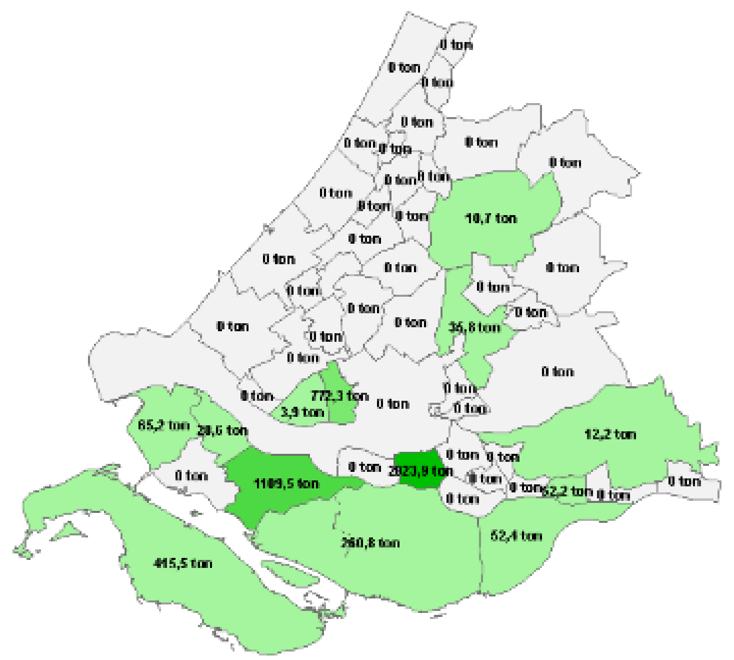
Within this map, the flows to and from knowledge hubs are shown with potential locations to initiate them.



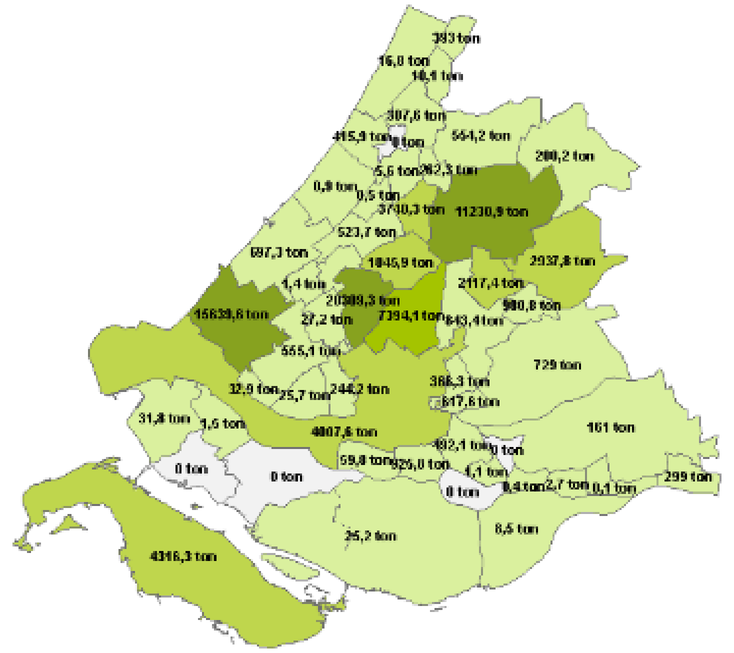
Vision for 2030 as it was in the midterm. In the end this advanced to our final vision.

	kg	kg	kg	kg	kg	kg	kg	kg	
Regio's	**Totaal huishoudelijk afval**	**GFT-afval**	**Oud papier en karton**	**Frituurvet en -olie**	**Grof tuinafval**	**Houtafval (A- en B)**	**Houtafval (C)**	**Kadavers**	
Alblasserdam	11236855,34	1452572,21	1084317,45	0.00	234449,88	485426,73	100896,61	0.00	
Albrandswaard	14361632,43	2375833,41	1760917,92	2591.30	902161,10	438793,47	40535,34	0.00	
Alphen aan den	59337109,89	7450265,42	6667844,75	0.00	1426688,96	3172191,11	299732,69	0.00	
Barendrecht	25539820,44	2453656,34	2724026,09	11125.49	1890984,90	928814,45	110733,35	0.00	
Brielle	10862439,47	1767713,16	839948,68	1775.00	291940,79	366276,47	93187,50	0.00	
Capelle aan den	37265995,50	2946516,28	2900932,33	2241.83	1371161,31	537079,21	56494,20	0.00	
Delft	47230853,36	4851333,20	5882352,00	0.00	475731,20	1372548,80	12536,16	0.00	
Dordrecht	64248782,68	6040979,52	6516892,00	0.00	930899,16	2392715,76	406558,40	0.00	
Goeree-	29013988,20	6087551,33	2993678,93	2552.70	2005784,03	848772,75	114871,50	0.00	
Gorinchem	22350297,45	3410107,35	1942154,18	3763.50	829475,40	1088780,55	279036,64	0.00	
Gouda	34479308,50	5188253,78	1334970,00	5562.38	578950,53	1693434,17	121754,21	0.00	
s-Gravenhage	255251432,10	6188014,05	11557595,50	0.00	599077,92	3611057,35	55299,50	0.00	
's-Gravenzande	10506872,13	2183035,40	984735,27	0.00	161634,20	460235,53	0,00	0.00	
Hardinxveld-	11393182,65	1705418,85	1208332,80	0.00	446646,30	456086,40	113836,50	0.00	
Hellevoetsluis	23935401,60	3195311,16	2158895,28	8119.20	719361,12	1453336,80	229367,40	0.00	
Hendrik-Ido-	19483400,00	1658729,43	1622844,00	0.00	464924,57	941857,43	188416,80	31720.00	
Hillegom	12953515,56	2029674,56	1260083,06	5297.91	927015,19	711986,95	103851,48	0.00	
Hoeksche Waard	49833070,10	13533155,00	5169221,50	8874.20	1433183,30	3727164,00	501392,30	8874.20	
Kaag en Braassem	15241438,86	3577961,10	1872392,67	2234.48	448292,55	748783,56	77009,76	0.00	
Katwijk	29378878,37	4983975,87	4512230,95	15694.24	371154,95	1261321,09	174170,64	6608.10	
Krimpen aan den	21295689,86	685335,00	1692427,92	6473.50	2370837,64	1396216,25	73072,08	490.43	
Krimpenerwaard	29036973,35	7083999,30	4190152,75	0.00	1778851,90	1688909,95	129916,15	2855.30	
Lansingerland	31038436,00	5632006,10	3013569,70	6412.90	1244743,89	1362494,60	97673,40	0.00	
Leiden	55685233,71	3624572,81	6137876,76	0.00	700239,83	1324793,88	215287,24	0.00	
Leiderdorp	13898300,45	1789989,17	1419837,82	3434.63	645984,27	468410,54	55984,39	0.00	
Leidschendam-	36963629,84	4427890,71	3604997,65	7664.20	648633,35	1038297,41	47378,69	0.00	
Lisse	11884826,31	2212236,84	437000,00	4271.43	437000,00	437000,00	299000,00	2300.00	
Maassluis	17949569,18	1766807,96	652232,00	6007.40	390435,83	499201,39	87068,29	0.00	
Midden-Delfland	9031989,00	2426369,50	1324307,00	0.00	67596,64	152285,00	3185,18	0.00	
Molenlanden	25672801,00	4374447,00	2871638,00	4466.00	870870,00	1757371,00	276892,00	0.00	
Nieuwkoop	16834495,66	3542007,30	2128866,51	2929.70	685403,32	848148,15	118443,59	0.00	
Nissewaard	45634086,00	5125744,80	2928175,20	0.00	1386424,80	2758467,60	762246,00	0.00	
Noordwijk	21306699,93	3034308,99	2892806,97	9426.08	575766,84	1034872,14	95739,35	554.48	
Oegstgeest	20552613,93	3753130,38	2834919,78	5069.49	795560,73	801992,64	97587,60	0.00	
Papendrecht	18198257,88	2096457,84	1782922,21	4289.87	432901,17	897976,34	93074,79	0.00	
Pijnacker-	26950250,91	5118359,12	3634673,05	4721.00	330914,33	857215,58	44806,58	0.00	
Ridderkerk	26997908,27	3999269,84	2633779,35	0.00	596755,68	1366000,42	222410,48	0.00	
Rijswijk (ZH.)	28600100,10	2366629,20	2381973,75	0.00	351140,40	863577,00	45105,84	0.00	
Rotterdam	313828078,00	12077880,50	16151951,00	65605.00	2686524,75	7695466,50	712282,86	39363.00	
Schiedam	38346180,70	1692587,63	2877997,05	7974.50	444977,10	1976479,83	90567,54	0.00	
Sliedrecht	14526337,80	1873023,87	1493726,49	3333.34	609001,74	772458,35	79629,86	1728.41	
Teylingen	20402772,75	3061567,69	2209250,23	7588.20	1784582,04	1158555,54	157017,37	1084.01	
Vlaardingen	37878979,14	1541283,81	2969537,67	7411.80	434825,60	1318559,22	85235,70	8338.28	
Voorschoten	12027507,19	2436583,65	1161735,04	0.00	491655,34	119662,92	15341,40	1704.61	
Waddinxveen	15217373,20	2637564,80	1697990,36	0.00	520018,20	771074,20	59102,77	0.00	
Wassenaar	16606174,31	3976320,85	1630806,54	2041.13	415761,46	489870,00	11430,30	0.00	
Westland	59693348,26	10507713,71	6790618,26	0.00	2474187,52	2869592,39	365816,75	0.00	
Westvoorne	10688256,94	2542767,19	960353,62	2240.85	403950,56	456469,44	78429,75	1493.90	
Zoetermeer	58905126,67	6794300,66	6319782,07	12586.70	749607,91	2151585,31	298484,60	0.00	
Zoeterwoude	3564266,70	589430,06	644788,02	2796.60	286045,57	127058,86	25369,16	0.00	
Zuidplas	21670788,00	4306406,59	2693014,59	10694.83	1255045,64	1207543,91	242925,50	0.00	
Zwijndrecht	24847524,46	2624263,02	2573827,71	0.00	600749,61	917597,24	147645,30	0.00	
ZUID HOLLAND	1889638850.12	202801313.26	161731900.41	257271.36	43976510.99	68281866.15	8213831.46	107114.71	KG
TOTAL	1889638.85	202801.31	161731.90	257.27	43976.51	68281.87	8213.83	107.11	TONNES
	Totaal huishoudelijk afval	**GFT-afval**	**Oud papier en karton**	**Frituurvet en -olie**	**Grof tuinafval**	**Houtafval (A- en B)**	**Houtafval (C)**	**Kadavers**	
	kg	kg	kg	kg	kg	kg	kg	kg	
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	

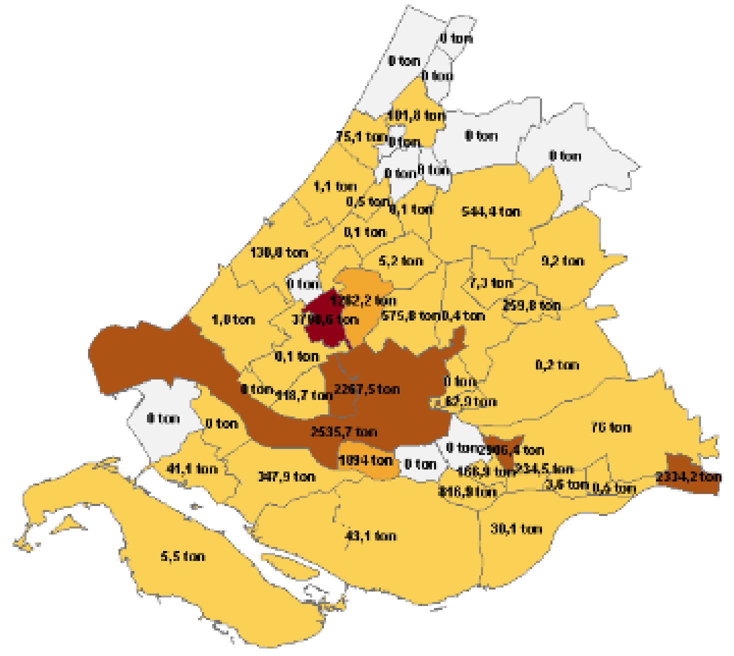
This Excel shows a calculation of waste flows per municpality within the province of South Holland. These waste flows can be reused in the BIOCYCLE. Source: (CBS Statline, 2022)



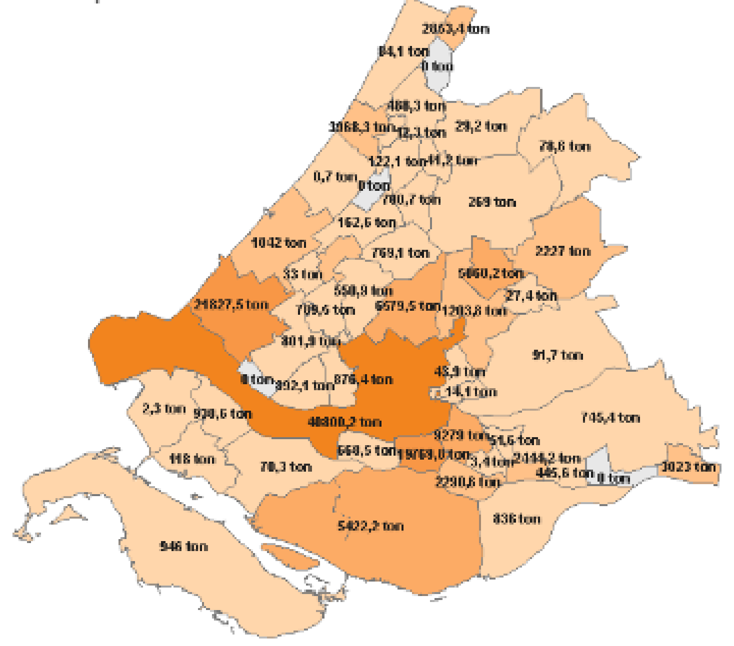
Biomass - bosbouw (forestry)
4.923,1 ton



Biomass - organic waste
80.526,6 ton
greenhouses: 43.343,0 ton
Boskoop: 11.230,9



Biomass - edible oils and fats
20.083,9 ton



Biomass - Foodwaste (f/e expired food)
140.392,2 ton

From the national georegister, this is a representation of the organic waste flows from industries/companies. Within the map they are visualised per municipality within province of South Holland. Underneath we calculated the total waste. Source: (NGR, n.d)