PETRO-FREE MOBILITY

A REGIONAL STRATEGY TO FACILITATE THE MOBILITY TRANSITION IN THE PROVINCE OF SOUTH-HOLLAND

provincie ZUID HOLLAND

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PREFACE

Hereby we present you or strategy towards a society with petro-free mobility. With the five of us living in the province in South-Holland, we experience the inevitable side effects of the petrochemical industry in our daily lives. Especially in times like this, in which COVID-restrictions are taking place and our dependency on fossil fuels is at stake. Although these restrictions withheld us from working together on site, we nevertheless developed the common goal of questioning the fossil dependency within our own environment, the province of South Holland.

We would like to express our gratitude to our supervisors Remon Rooij, Nikos Katsikis, Daniele Cannatella, Roberto Rocco Perreira and Marcin Dąbrowski for helping to guide this report from start to finish. our guest lecturers Carola Hein and Verena Balz who provided us with insightful details about the topic we delved into. It was an incredible learning experience with sometimes struggles, but mostly excitement. An experience we will carry with us throughout our personal and professional life.

We hope this report can provide new insights and benefits to the reader.

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Human driven pollution is causing irreversible damage to the habitability of our planet. Due to these environmental concerns, it has become imperative to move away from petrochemical dependency as this industry contributes significant greenhouse gases causing air, soil and water pollution. About 85% of the petrochemical industry that travels through the port of Rotterdam goes towards fuels for mobility, this is a critical bottleneck that requires careful consideration.

To ensure a sustainable province in terms of both a liveable province as well as economic prosperity policy is set up by means of communicative rationality between all actors (commercial stakeholders, residents, consumers, etc.).

In 2060 all our vehicles will run on electricity from sustainable production sources, such as solar and wind. We will travel less and more efficiently in part by improving spatial proximity to (social) functions. To aid this mobility transition, biofuel potentials will be optimized to phase out the existing infrastructural dependencies by 2040. After which a complete build down from all polluting mobility fuels will be put into action. This phase allows different actors to cultivate and experiment with sustainable waste–to–value connections between stakeholders by optimizing biofuel potentials from regional waste.

To make this transition succeed, the mobility and fuel transition is brought on through the three pillars: 1. sustainable connections, 2. waste to value and 3. consumer patterns. Allowing for an integrative transition in line with the global move towards a circular economy and a more healthy and liveable environment.

As a result of this transition the petroleum–industry leaves waste spaces that require transformation. By creating a toolkit to assess different typological waste spaces, petrol stations, terminals and refineries will be transformed into residential, office, cultural, green and other functions after the soil is properly remediated.

KEY WORDS: circular mobility, petrochemical industry, fuel transition, wastescape transformation, South Holland

ABSTRACT

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INTRODUCTION 01

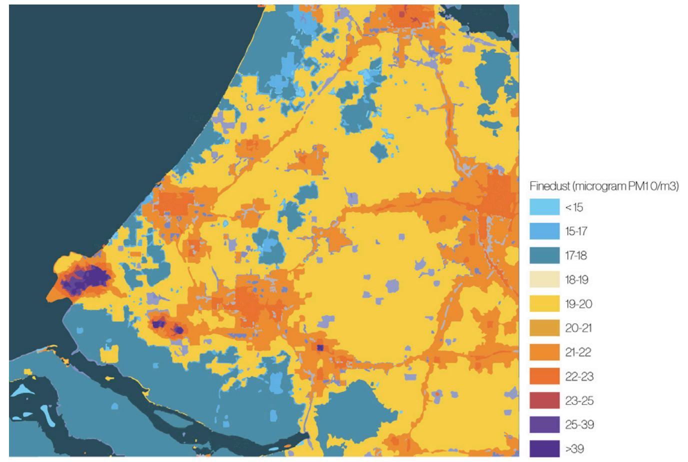
01 INTRODUCTION

01.1 THE EMERGENCE OF THE PETROLEUMSCAPE IN SOUTH HOLLAND

This report focuses on the Province of South Holland, The Netherlands. This region is the most populous of the country, and the second biggest economic powerhouse of The Netherlands. Early settlements in the Rhine-Meuse-Scheldt Delta developed the region as we know it today, and made sure the region got connected to the rest of the world. With efficient infrastructures, a global port, the seat of the government and prominent research institutes, the Province of SouthHolland has an anchor in the global economy. The location of the port in Rotterdam is highly compatible with these economic, infrastructural and organisational conditions. The Port of Rotterdam is the biggest port of Europe, due to its location and connection to the hinterland (Port of Rotterdam, 2021). However, this web of infrastructures and interconnectedness also causes problems, since the province is the biggest polluter of the country (Provincie Zuid-Holland, 2020a), as portrayed in figures 1,2 and 3, and also in the rest of Europe, with its petrochemical industry being the biggest contributor (Atlasleefomgeving, 2019; Provincie Zuid-Holland, 2020a).

The Port of Rotterdam and its petrochemical landscapes are a dominant industry in the country and the province (Hein, 2018). The petrochemical industry is deeply rooted in the landscape and the history of the country. Looking at the history of the Port of Rotterdam and the relationship with the oil industry and the national government, the petrochemical industry has not only decidedly shaped the port, but also the entire province (Hein, 2018). Buildings, retail, institutions, actors, infrastructure and citizens all are connected to the port and determine the urban landscape of the province, and are intertwined with society as we know it. The sometimes rapid and structured expansion of the petrochemical industry has turned petrochemical companies into dominant players with financial and political power in the spatial layers of the province and the country (Hein, 2018). The petrochemical industry is unavoidably immersed throughout the urban life in the region.

Fossil fuels have intensified the concentration of CO2-emissions in our atmosphere. This has led to an increase of human-induced climate change (IPCC, 2018). Current CO2-emissions cause health risks and negatively influence livability. The urban climate in these areas are in critical condition in several areas of the Province. This exemplifies the seriousness of the urgency. These threats not only pose a risk for current generations, but also for generations to come. Simultaneously, fossil fuels are depleting, which makes the quest for alternative sources pressing. Therefore, a transition to biofuels and renewable sources have become urgent and the search for a good alternative to fossil fuels, which can foster mitigation of climate change, can boost economic development.



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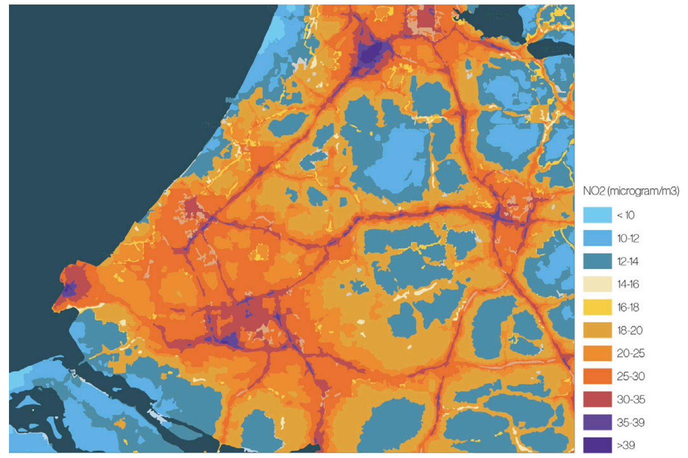

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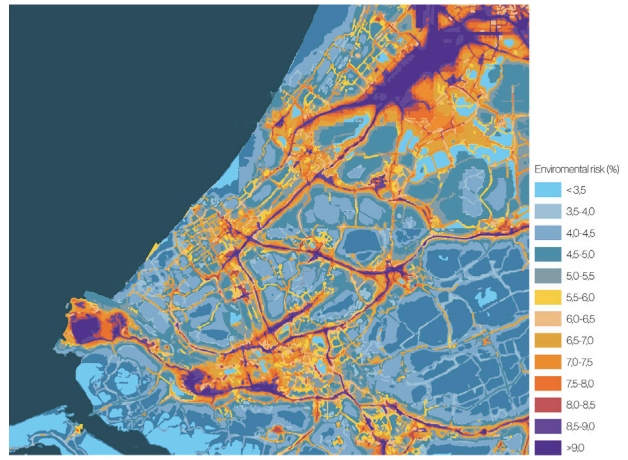


Figure 3: MER, own work based on leefatlas.nl


All figures are shot by our own

01.2 PROBLEM STATEMENT

Keeping this in mind, the following problem statement has been addressed:

'THE REGION OF SOUTH HOLLAND, WITH THE PORT AS A CENTRAL HUB FOR TRADE, STORAGE, AND PROCESSING IN PETROCHEMICALS, IS IN A CRITICAL POSITION AS THE ENVIRONMENTAL CONSEQUENCES AND THE LIVING QUALITY IN THE PROVINCE ARE DIRE.'

In 2015, member states of the United Nations signed the Paris Agreement. The diligence of climate action and safeguarding the most vulnerable undergoing climate change effects was underlined in this agreement (Rosenzweig et al., 2018). With the goals of the Paris Agreement in mind, it is necessary for urban and regional areas to take their vulnerable citizens into account in their regional and urban planning designs for spatial justice (Rosenzweig et al., 2018). Governments and big entities need to adhere to these climate agreements, but they are falling short. Therefore, there is an urgency to change. Consequently, a transition from petrochemical fuels towards a cleaner energy source is receiving much attention from scholars and governments.

Figure 4: Problem statement

01.3 GOALS & OBJECTIVES

The goal is thus to comprehend how the petrochemical industry has been written into spatial practice and representations, and how to transform these leftover spaces from the petrochemical industries into spaces that serve the mobility sector in a less polluting manner. To achieve the climate goals that are set in the Paris Agreement in 2015, it is also important to maintain economic stability in the region and improve the spatial quality to preserve the quality of life, in accordance to the United Nations' sustainable development goals (United Nations, 2021):

good health and well-being can be achieved by diminishing the CO2-emission and other polluting agencies. Residential areas become healthier and more liveable, influencing the air we breathe and by proxy the water we drink and other consumables;

affordable and clean energy can be achieved by making the trains more accessible and electric cars more affordable the transition away from the petrochemical industry to a completely green energy source for mobility becomes more attainable;

decent work and economic growth can be achieved by introducing alternatives to the petrochemical industry and connecting all stakeholders;

industry, innovation and infrastructure can be achieved by prioritising dense transportation methods, such as train traffic and working on a well connected multipurpose network. More areas will be reachable both for residents as well as business networks;

combating climate change and peace, justice and strong institutions through partnerships. This goal can strengthen the means of implementation and revitalise the global partnership for sustainable development via multi-stakeholder partnerships and voluntary commitments.

RESEARCH- & SUB QUESTIONS 01.4

The following research question were formulated in accordance with the problem statement and research goals:

How can a regional design strategy facilitate the transition away from petrochemical dependency towards a circular Province of South Holland?

In order to answer this research question a set of sub questions are addressed:

What are the current (petrochemical) systems in the province? (chapter 02);

How can we replace them in a more sustainable and circular way? (chapter 03);

How can the petrochemical dominance be diminished? And which strategies are needed to fulfill this transition and how will those new systems look like? (chapter 04).

To be able to answer the research questions a conceptual framework was designed. This conceptual framework, with the theoretical framework, will be discussed in chapter 01.5. The conceptual framework guided the selection of the methods used in our report. A brief explanation of the methods used in this report can be found in chapter 01.7. Analysis of current systems of the petrochemical industry will be introduced in chapter 02. Subsequently, the vision statement will be presented in chapter 03.1 and the strategy will be outlined in chapter 04. The final conclusions and recommendations will be drawn in chapter 05.

01.5 THEORETICAL & CONCEPTUAL FRAMEWORK

In our vision and strategy we react to two current trends to support the need for a circulary, in the province of South Holland.

1. The environmental necessity to diminish the use of petrochemicals (downward trend);

2. The international commitment to a sustainable, circular mobility (upward trend).

The transition to a circular mobility is supported by three strategies each driving the complex system from different angles towards a sustainable new model. These strategies are entitled:

sustainable connections;

consumer patterns;

waste to value.

With those three strategies, all concepts of sustainable development are covered: people (consumer patterns), planet (waste to value) and prosperity (waste to value). Together they direct us pragmatically towards new spatial shapes and functions. This is further elaborated upon in the chapter 'Strategies'.

Transition Management

By connecting the downward trend of the petrochemical industry with the upward trend of circular mobility, different phases of the transition become apparent. By adapting the x-curve of Loorbach et al. (2017), the conceptual framework pinpoints the disruptive phase as a crucial period which the three strategies will help to bridge.

The Netherlands is currently at the beginning of this transition, only dipping its toes into the institutionalisation of new mobility and the breakdown of the petroleum based mobility sector (Loorbach et al, 2017). There are signs of destabilisation of this incumbent regime present today. The urgency of the problem are increasingly visible with worldwide resistance from demoralised citizens and escalating incidents such as pollution and drought as a result of global warming. In addition, increasing competition from renewable energy sources and the emergence of new technologies puts pressure on the petrochemical system. The future of the energy sector is facing a fundamental shift.

Building new structures, formed by a small group of agents that diverges from the current regime, also known as niches, in combination with breaking down old habits of the current deep structure, also known as 'incumbent regime', ensures the establishment of a new societal (sub)model (Rotmans & Loorbach, 2009).

Transition Management: a multiple stakeholder approach

The emergence of new opportunities is also causing a change in the role and attitude of various stakeholders, such as governments, market parties and citizens. This change has a slow character within the transition dynamics, and is part of the constant influence and interaction of economic, cultural, technological, ecological and institutional developments all together at different scale levels (Rotmans & Loorbach, 2009).

Understanding management transitions within society used to be a more simplistic approach of seeing it either top-down or bottom-up (Geels, 2011). However, with multiple stakeholders playing in the field of decision-making such an approach is not applicable anymore. To locally enhance societal and policy sustainability challenges, multiple actors and local governments need to be studied to clarify the dynamics. Transition management evaluates how "systemic change occurs across scales, sites and temporal manifestation within economies, institutions, technologies, cultures and beliefs" (Geels, 2011; Campbell-Johnston et al., 2019, p.1233; Rotmans et al., 2001). It covers:

the pre-development stage (the status-quo);

the preparation stage, where change is started;

the shifting stage, where systematic change appears; and;

the circular stage, where a new status-quo is attained (Rotmans et al., 2001).

Rather than being part of a hierarchical structure, these levels co-exist and interact with each other. Their distinction is based on the internal differences between the executed activities and involved actors (Loorbach, 2007). This multi-level governance approach is based on the assumption that there exists an actor-governance system, a complex societal system, and that these two systems co-evolve. The systems comprise dominant trends, structures, and cultures (Loorbach, 2007). However, the realization of transitions is complicated by lock-in mechanisms and path dependencies present at the regime level, that usually result in incremental innovation on foreseen directions (Geels, 2010).

Transition Management: a policy approach

At the tactical level, activities with a 'steering' rationale are identified. These activities are interest driven and relate to the dominant regime in a societal system. Actions, such as negotiations, planning, and programming, are involved as well as institutions, such as rules and regulations, organizations and networks, routines and infrastructures (Kemp et al., 2007). The operational governance level is short-term oriented and focuses on the implementation of actions and experiments with innovative potential. Issues of scaling-up and routinizing are addressed to change dominant regime structures (Loorbach, 2007).

A transition can be governed by regulatory procedures and normative expectations, knowledge sharing, infrastructure development, measures and financial aid (de Haan & Rotmans, 2011). How to successfully manage transitions, either planned or spontaneous, is policy related. The complicated nature of transitions indicate that it cannot be managed (Geels, 2011), but, although this would be difficult, the transition's direction can be altered with integrating long-term ideas and short-term policies and joining multiple stakeholders and multi-level features (Kemp & Loorbach, 2003; Rotmans et al., 2001). Primary procedures should be flexible, experimental and need to limit undesirable lock-in and allowing innovations (Rotmans et al., 2001).

A more sustainable and adaptable climate transition demands a change in systems thinking (Urbinati et al., 2017). There are hard (instrumental, technological and financial) and soft (institutional, relational and cultural) barriers in transitions (Kirchherr et al., 2018). In general the hard barriers are less complicated to overcome. However, these hard and soft barriers can obstruct households and other actors from engaging in transition management (van Doren et al., 2016). Consequently, to unveil the barriers within the city level it is important that the multi-level features are integrated and coordinated (Campbell-Johnston et al., 2019). Van Doren et al. (2016) outline four categories in the environmental context of transition management:

the socio-cultural context (e.g. awareness, attitudes and capacities of actors);

the market context (e.g. skills, costs, information and credit availability);

the policy context (e.g. policy leadership and instruments);

the built and geographical context (e.g. characteristics of the environment).

Spatial justice and equality from the perspective of mobility

The broad concept of justice is often linked to which (re)action is the correct and righteous one. Low & Gleeson (1998) see it as a fair distribution of advantages and costs. Others associate it with a person's right to a natural environment that provides for his or her well-being (Hayward, 2005). Literature on spatial justice in urban areas raises concerns about principles addressing fair distributions of rights and responsibilities, and it specifies procedural requirements for citizens to take part in decision-making (Bulkeley et al., 2014). Scholars of justice research argue that some groups are more affected by processes and planning than others. This is caused by the disadvantaged position of these groups within the decision-making and policy-making process (Sarokin, & Schulkin, 1994). Social and spatial justice research looks at principles such as equality, merits (who causes injustice and who profits from it), the importance of the greatest good, solidarity and basic rights (Paavola, & Adger, 2006).

Looking at the concept of spatial justice in relation to mobility, one thinks of equality, which in the case of mobility means access to opportunities. Equality is taking vulnerable citizens into account and "meeting the needs of citizens of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p.). Equality in transport resonates with a sustainable and circular mobility: it is an "access to goods and services in an efficient way for all citizens of the urban area" (Johnsson in Bertolini, 2012, p.). Carter et al.'s (2014) definition for equality in transport demonstrates an emphasis more on quality of sharing and partnerships within mobility:

1. Equitable access to quality, affordable mobility alternatives, services, amenities, employment and destinations;

2. Shared distribution of the benefits and burdens of mobility systems and investments, e.g. pollution and access to jobs, and;

3. Partnerships in the procedural planning that results in shared decision-making and more equitable results for vulnerable communities, and simultaneously reinforcing the region.

Obtaining equality in sustainable mobility demands transformative change to current systems. Sustainable progressive policies are, even though favourable, often politically unfavourable as they go against the electorate or they strike against public finances. Therefore, the mobility transition needs to be controlled strategically from examining the provincial's dynamics, to setting an agenda and connecting stakeholders (Roorda et al., 2014). The challenge lies in bringing stakeholders back into the equation of planning, equilibrating the physical spaces with the social (Bakker et al., 2014).

Circular Mobility: the Commons and the role of governments

In the search for other options some residents and government bodies are looking into collective and shared spaces. Next to an alternative to owning vehicles, sharing a space and attributes is a response to increasing transportation costs and diminishing pollution (Tummers & MacGregor, 2019). The idea of shared-riding is to be inclusive and equitable, which is in line with the concept of the commons (Pokharel, 2020). The commons is conceived as a triarchy and consists of: resources, institutions to regulate the resources and the community that construct the institutions (Dellenbaugh et al., 2015).

According to Pokharel (2020) and Mansbridge (2014) governments have a crucial role in steering the commons. Firstly, by enforcing a solution if local institutions can not find consensus. Secondly, governments have to supply neutral information since some institutions can not supply this themselves. The third role of the state must be one of mediation where "low-cost, enforceable agreements can be reached" (Ostrom, 1990, p. 146). The last role is one to assist with required activities of performance after agreement to pursue execution. With interference of the state the urban commons becomes polycentric. This suggests that the commons is neither a top-down nor a bottom-up approach, but it is a division of work by all levels: the state, associations, private institutions and individuals. This polycentric approach grasps a blend of institutions by diversity and dependency (Mansbridge, 2014).

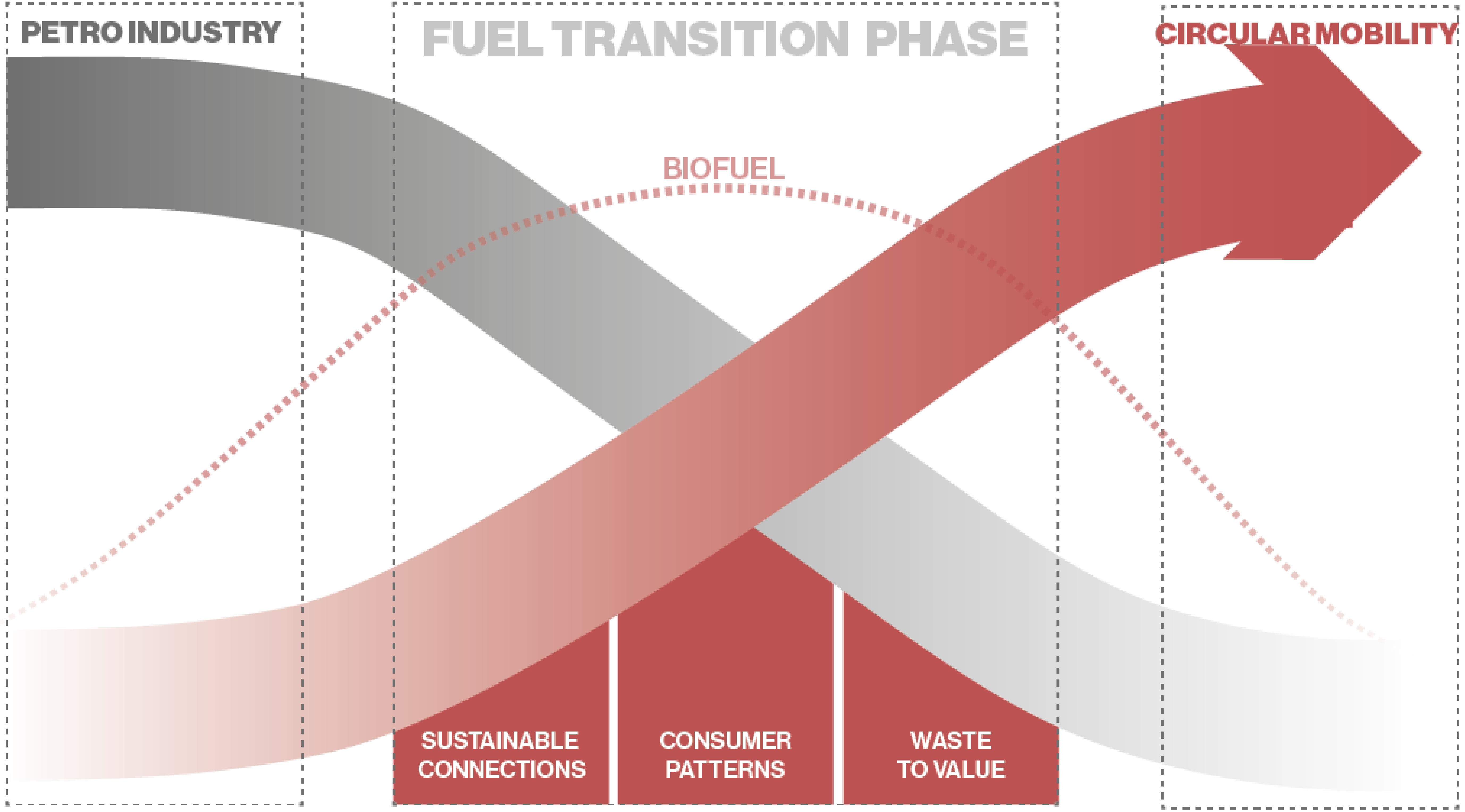


Figure 5: conceptual framework

01.6 METHODS

Figure 6 depicts all different kinds of methods we have used during our design and decision making process. In this overview we distinguished several kinds of tools we have applied: literature, visual, and textual tools. Next to that, we defined one overarching method: discussion. This method consists of all (online) communication tools and platforms to allow group meetings, and to support, and favour our team work.

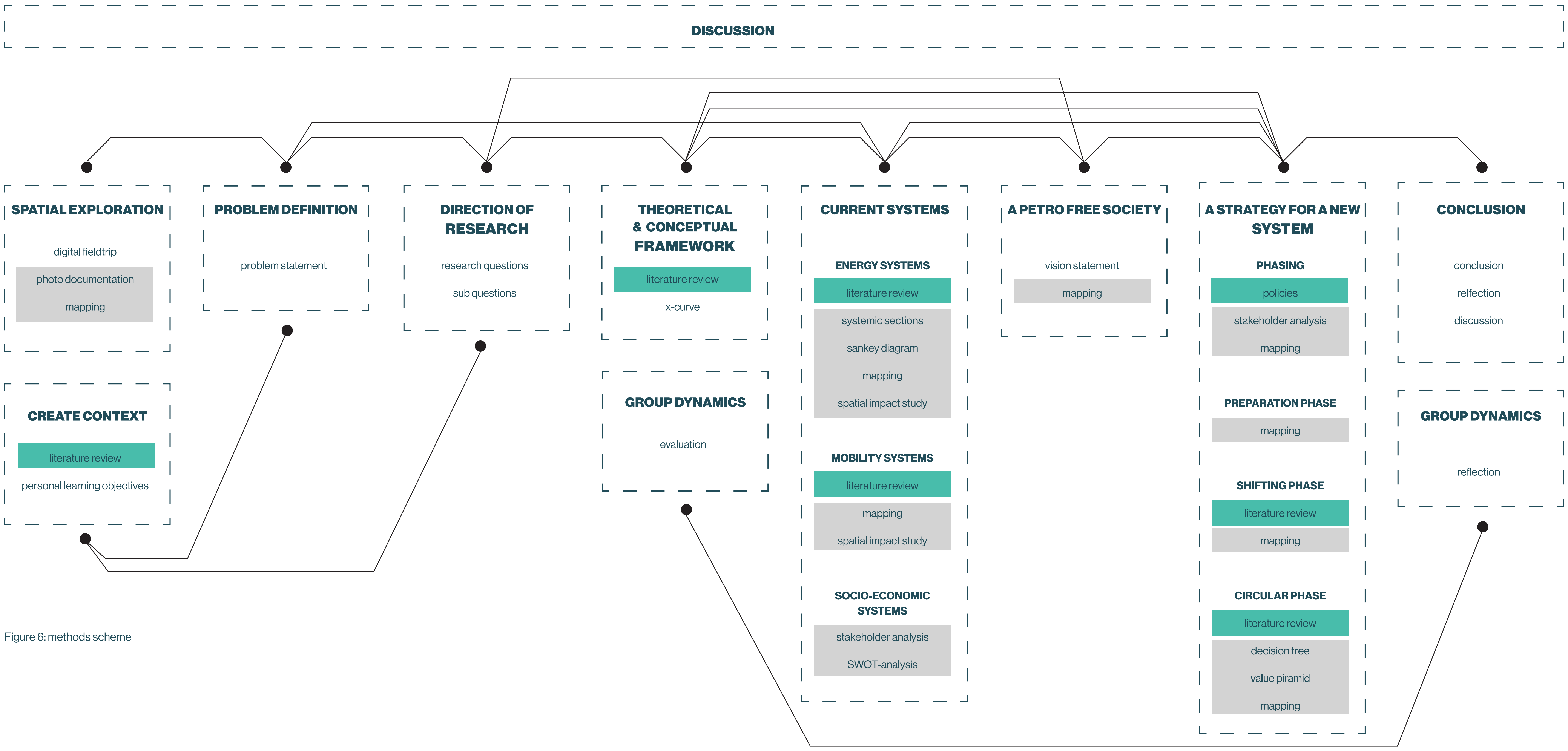


Figure 6: methods scheme

literature tools

visual tools

textual tools

connections

themes

CURRENT SYSTEMS 02

02 CURRENT SYSTEMS

02.1 INTRODUCTION

In this chapter we will discuss three different systems, being: Energy system, Mobility system and the Socio-economic system. The first system ,the energy system, is used to get a grip on what is present in the province. It functions as a evaluation of the current energy systems. This evaluation includes an introduction to the petro port, to the energy flows, the underground network supporting this system. Furthermore this includes the potentials of biofuels and renewable energy.

The second system evaluated is the mobility system. This is split up between first a small site analysis, this concretisizes the occupied spaces by mobility. The second parts handles from the infrastructure.

The third system evaluated is the socio-economic system. In order to develop a new strategy it is crucial to know which stakeholders are present. Also the weaknesses, strengths, oppurtunities and threats within the region are assesed.

LAND USE

In the province there are many different soil uses to be found. In figure 8 are all the different types of land-use in the province shown, except from the residential areas. It is remarkable that only a very small part of the province include rare natural habitats and sites, as shown in figure 7. These areas belong to a European network of protected natural areas, called Natura 2000. It is the largest coordinated network of protected natural areas in the world and cover over 18% of the European's land (Natura 2000, 2015) (European Commission, 2008). Over 25% of the province is urban area, the rest is mainly agricultural or grassland, almost 50% (CBS, 2019).

LAND USE

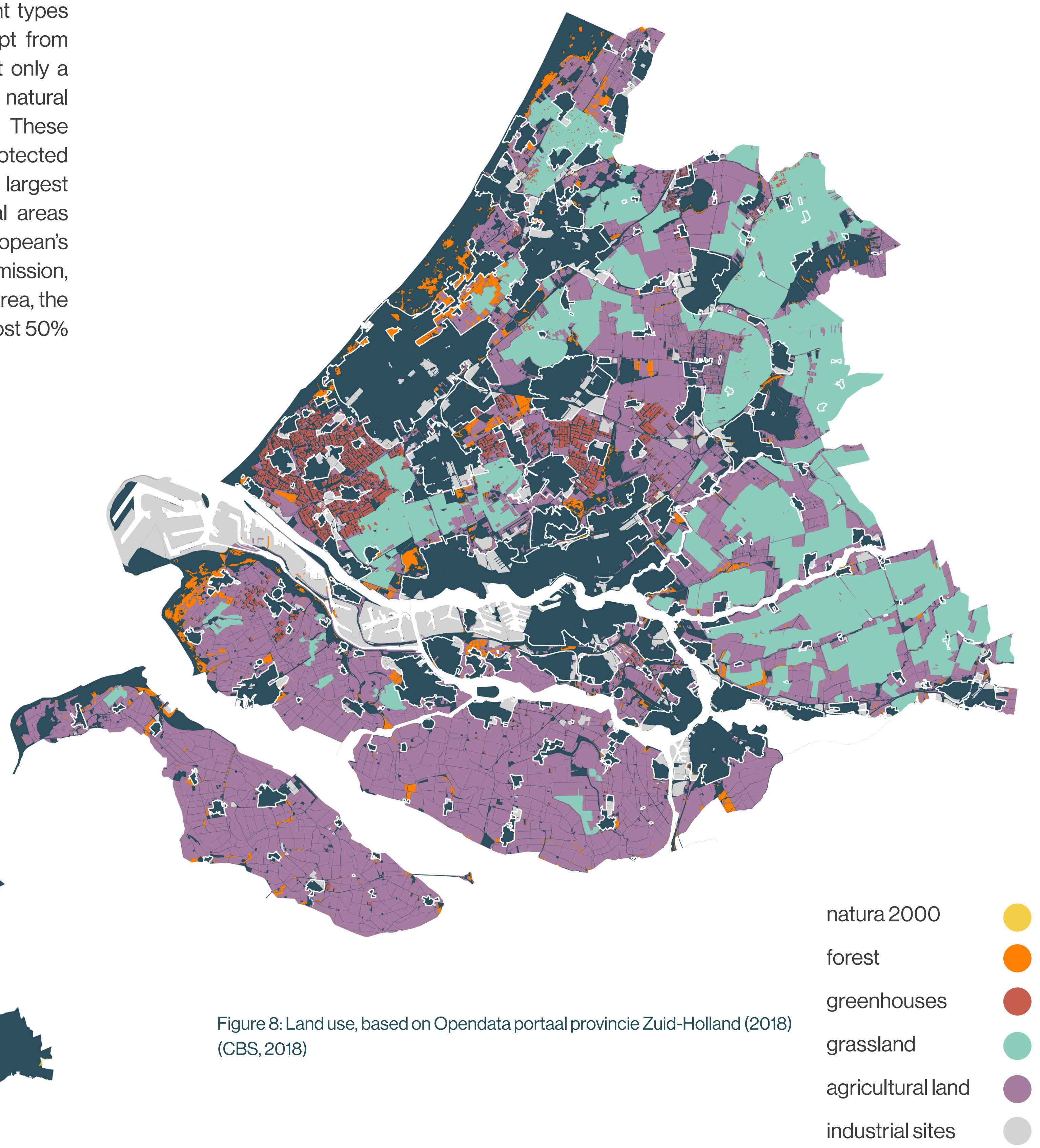


Figure 8: Land use, based on Opendata portaal provincie Zuid-Holland (2018) (CBS, 2018)

NATURA 20000

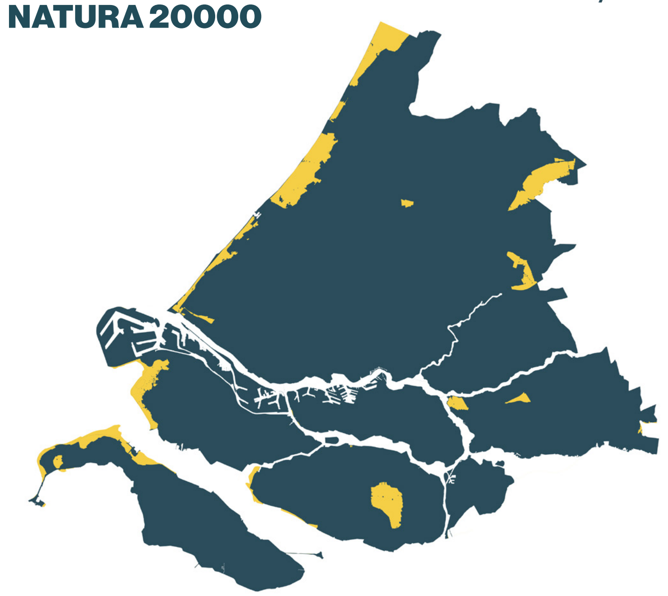


Figure 7: Natura 2000, based on Opendata portaal provincie Zuid-Holland (2018)

02.2 ENERGY SYSTEMS - THE PETRO PORT

Petroleum, under which crude oil is classified, is a fossil fuel created through millions of years of compression and heating of organic matter (EIE, 2021). Extracted from underground reservoirs the crude oil is refined to produce a large range of products ranging from plastics, aromatics, and fuels. However, by far the largest percentage of petroleum products end up as a type of fuel including about 85% of the crude oil imported to the port of Rotterdam (Port of Rotterdam, 2021).

The port of Rotterdam plays a key role in the Petrochemical industry, both as an infrastructural node in the transport of petroleum products as well as the processing thereof.

Due to the decreased demand for fuel products as a consequence of the Covid-19 Pandemic the import of crude oil has diminished in 2020 by over 10% from 103,3 to 92,5 million tons (Port of Rotterdam, 2021).

90 % of cargo is transported over seas. As the largest bunkering Port in Europe (Port of Rotterdam, 2021), The Port of Rotterdam plays an important role in supplying fuels to the shipping industry. In combination with the high accessibility of the location, the port becomes an important facilitating node in the international transport industry.

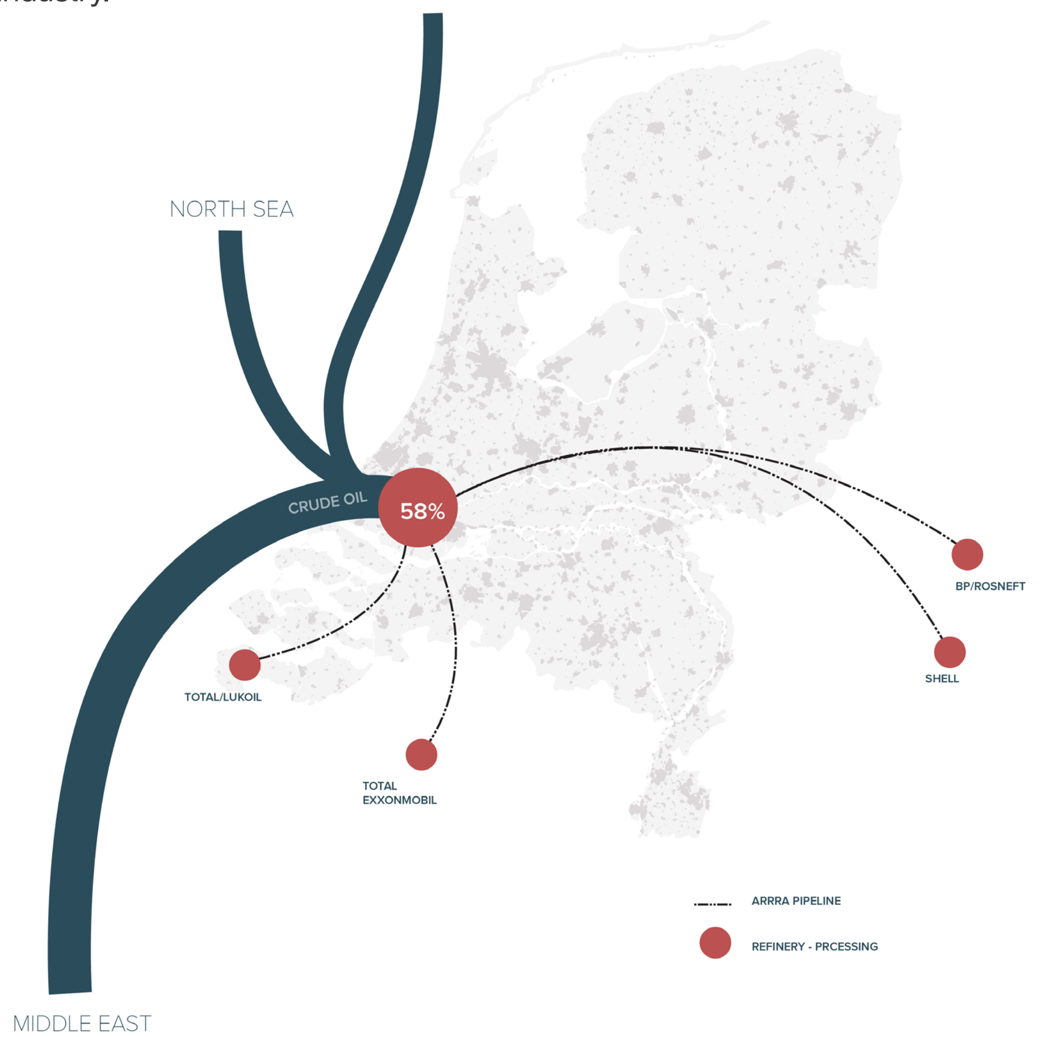


Figure 9: Pipeline network transporting petrochemicals, own image based on data from Port of Rotterdam (2020)

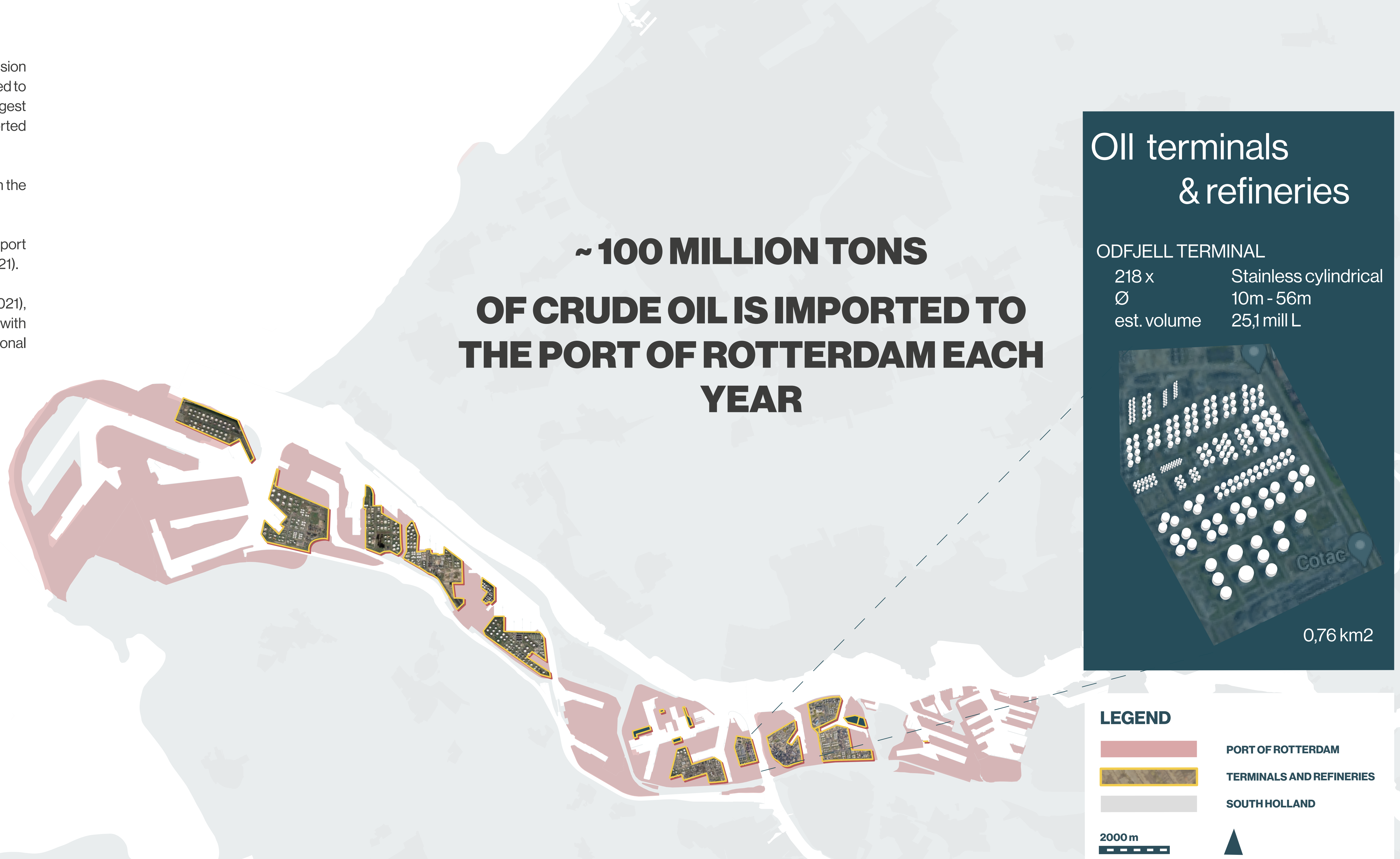


Figure 10: Locations of Refineries and Terminals in the Port of Rotterdam, own image based on Port of Rotterdam (2020)

ENERGY SYSTEMS - FLOWS

After importing the crude oil into the port 58% is refined in one of the five refineries at the port, the other 42% is sent out to the hinterland by truck, train or pipeline (Port of Rotterdam, 2021).

The Port of Rotterdam has close network in the (international) fuel industry forming clusters with other petrochemical locations. One such cluster is the Antwerp-Rotterdam-Rhine-Ruhr Area or so called ARRRA cluster responsible for over 40% of the total (Petro)chemical production in the EU (Port of Roterdam, 2021)

PIPELINES

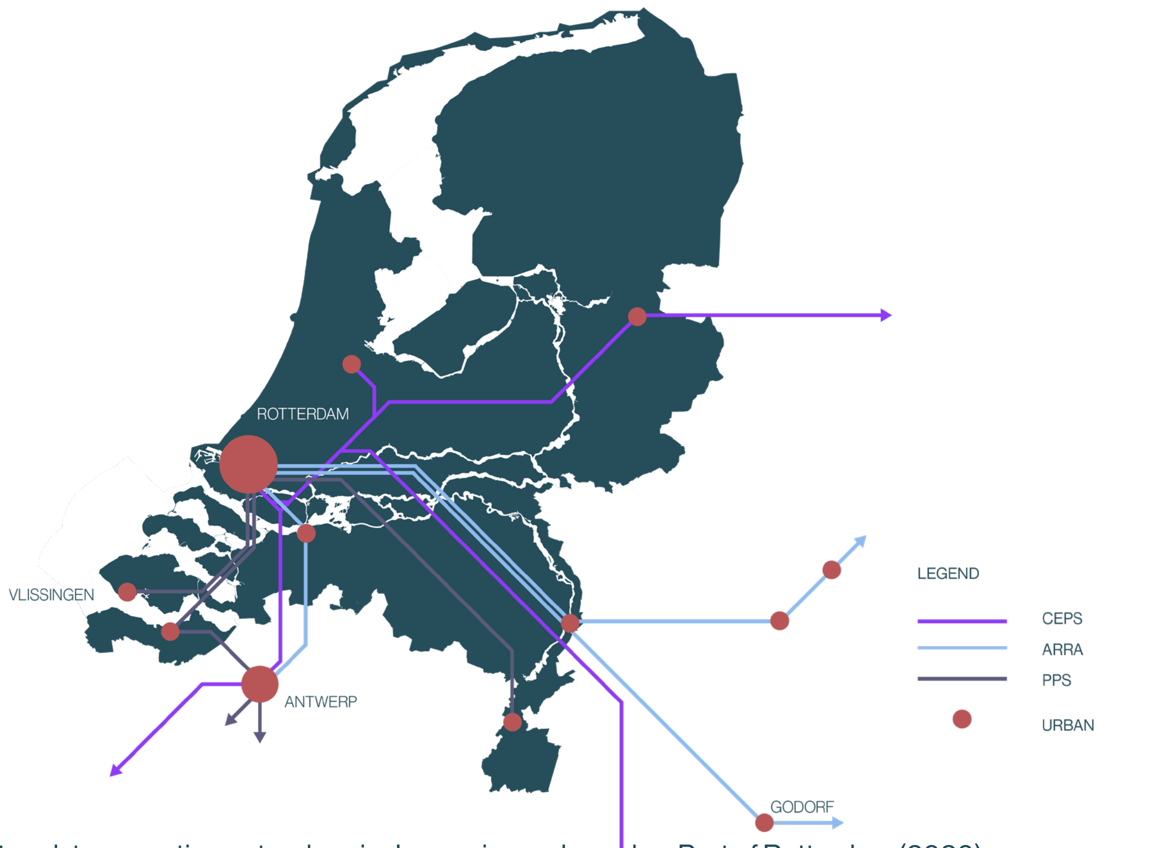


Figure 11: Pipeline network transporting petrochemicals, own image based on Port of Rotterdam (2020)

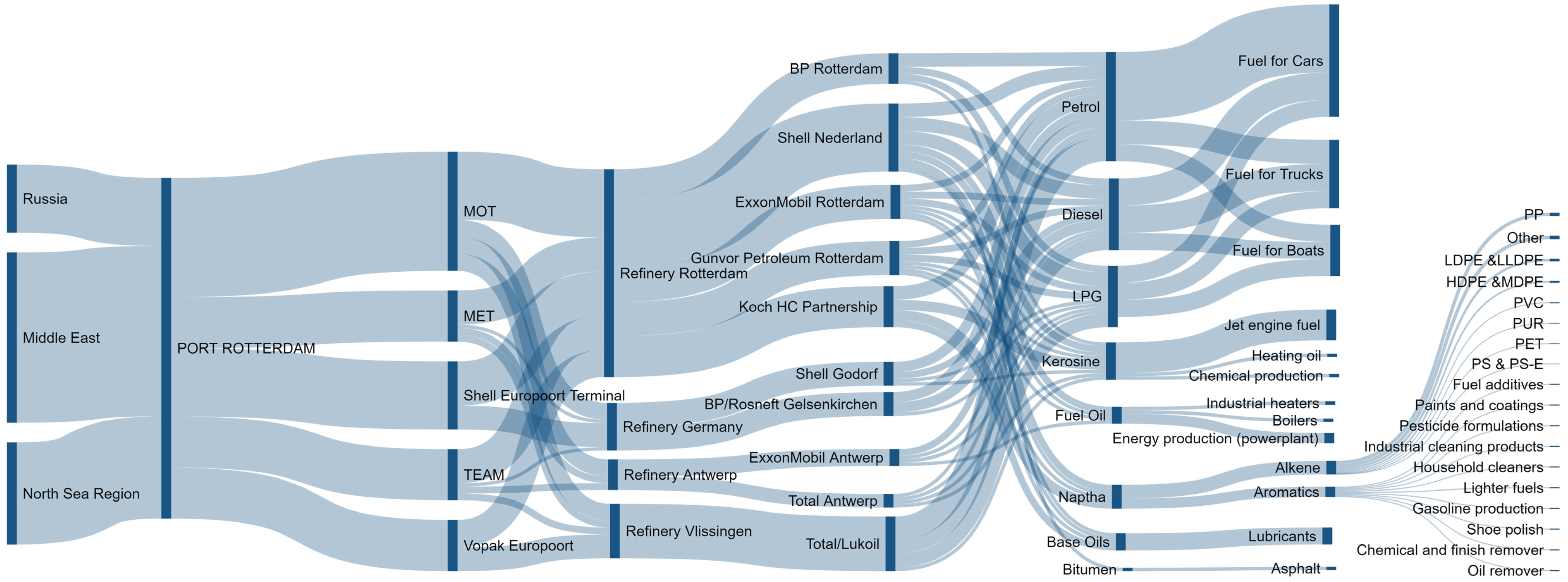


Figure 13: Sankey flow of crude oil, based on data from Port of Rotterdam (2021),

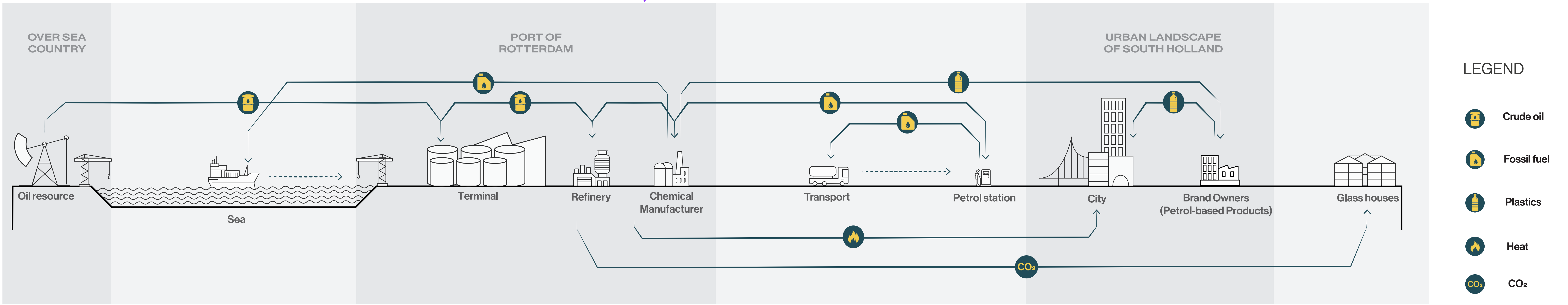


Figure 12: Systemic section of petrochemical industry, based on Port of Rotterdam (2021)

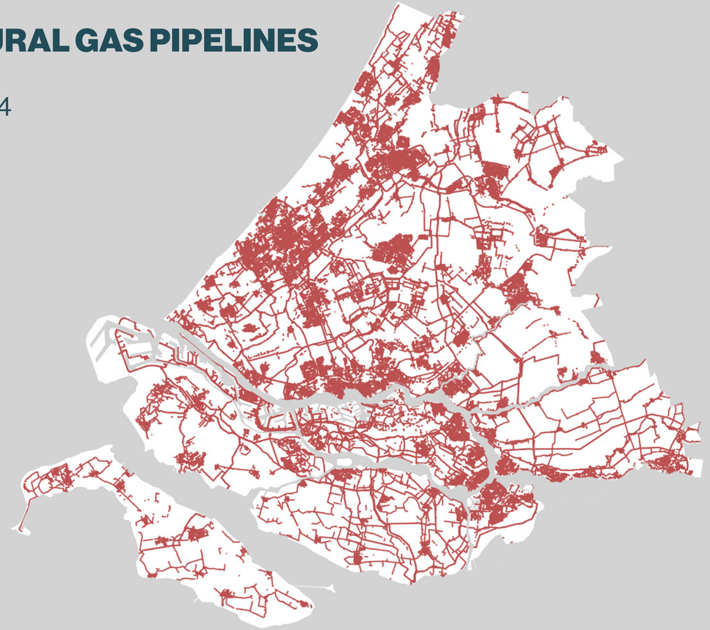
ENERGY SYSTEMS - UNDERGROUND NETWORK

In 2050 the province wants to get rid of fossil fuels, so also natural gas. On average, a household uses 1.239 cubic meters of gas per year (Milieu Centraal, 2020). About 95% of all households use natural gas to heat their houses (Essent, 2020). Therefore, the province has a huge underground gas network. In the future, it will no longer use these infrastructures for natural gas, but rather for more clean and sustainable generated substances, such as green gas and hydrogen (Stedin, 2009). That is why it is important that these networks should be well-maintained so that we could use them in a more sustainable way in the future. Because obviously, re-using existing infrastructure is much more sustainable than constructing a new underground network.

Another way to respond in a more sustainable way to our daily thermal energy demand is to make use of residual heat from (petrochemical) industries (Provincie Zuid-Holland, 2018). Besides, this could prevent the emission of huge amounts of CO_2. In figure 15 all heat distribution networks in the province are depicted by yellow strokes. The petrochemical industries are illustrated by blue dots. Many heat distribution networks are obviously located very closely to petrochemical industries and the greenhouses in Westland. However, compared with the natural gas network in the province, the heat distribution network covers only a very small part of the urban areas.

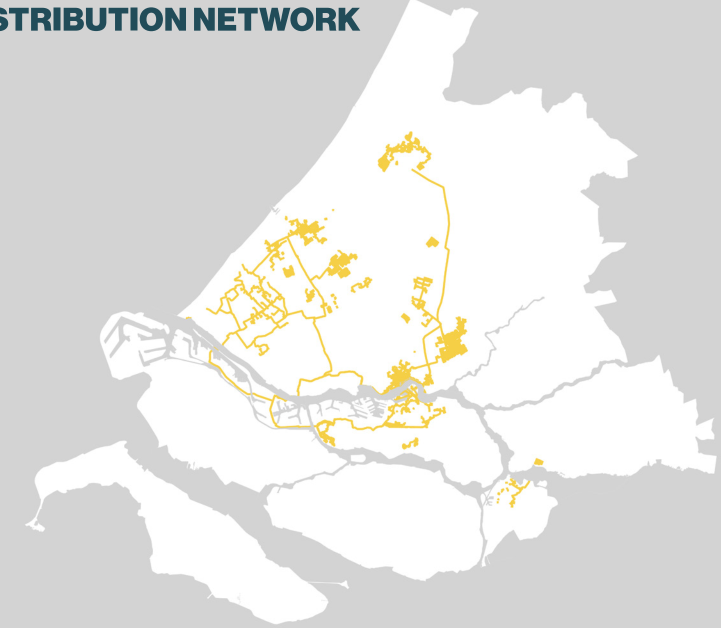
NATURAL GAS PIPELINES

Figure 14



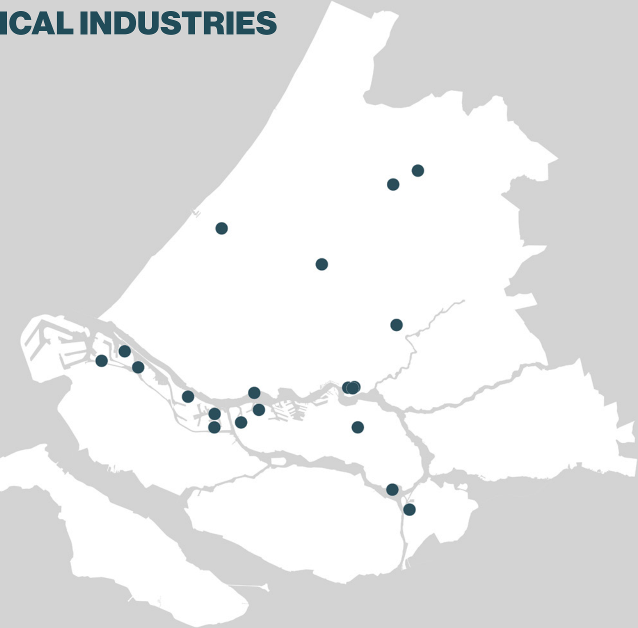
HEAT DISTRIBUTION NETWORK

Figure 15



PETROCHEMICAL INDUSTRIES

Figure 16



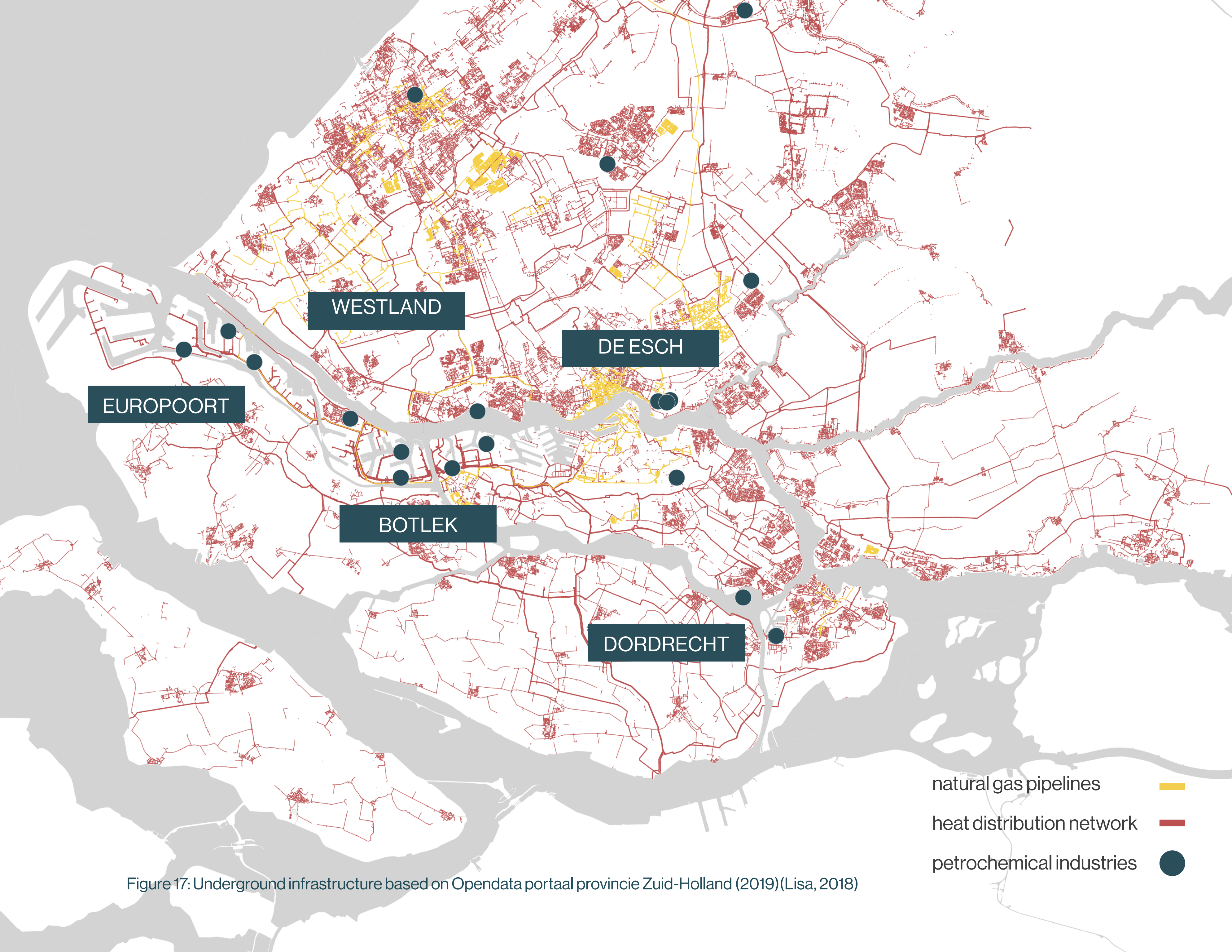


Figure 17: Underground infrastructure based on Opendata portaal provincie Zuid-Holland (2019)(Lisa, 2018)

ENERGY SYSTEMS - SITE ANALYSIS

To get a better picture of the spatial impact of all different sites that are related to the petrochemical industry in the province, field trips are very valuable. Due to the COVID-19 pandemic, we were not able to organise a real field trip. However, Google Street View still gives the possibility to get an idea of the size of buildings in relation to their environment, and the area it occupies.

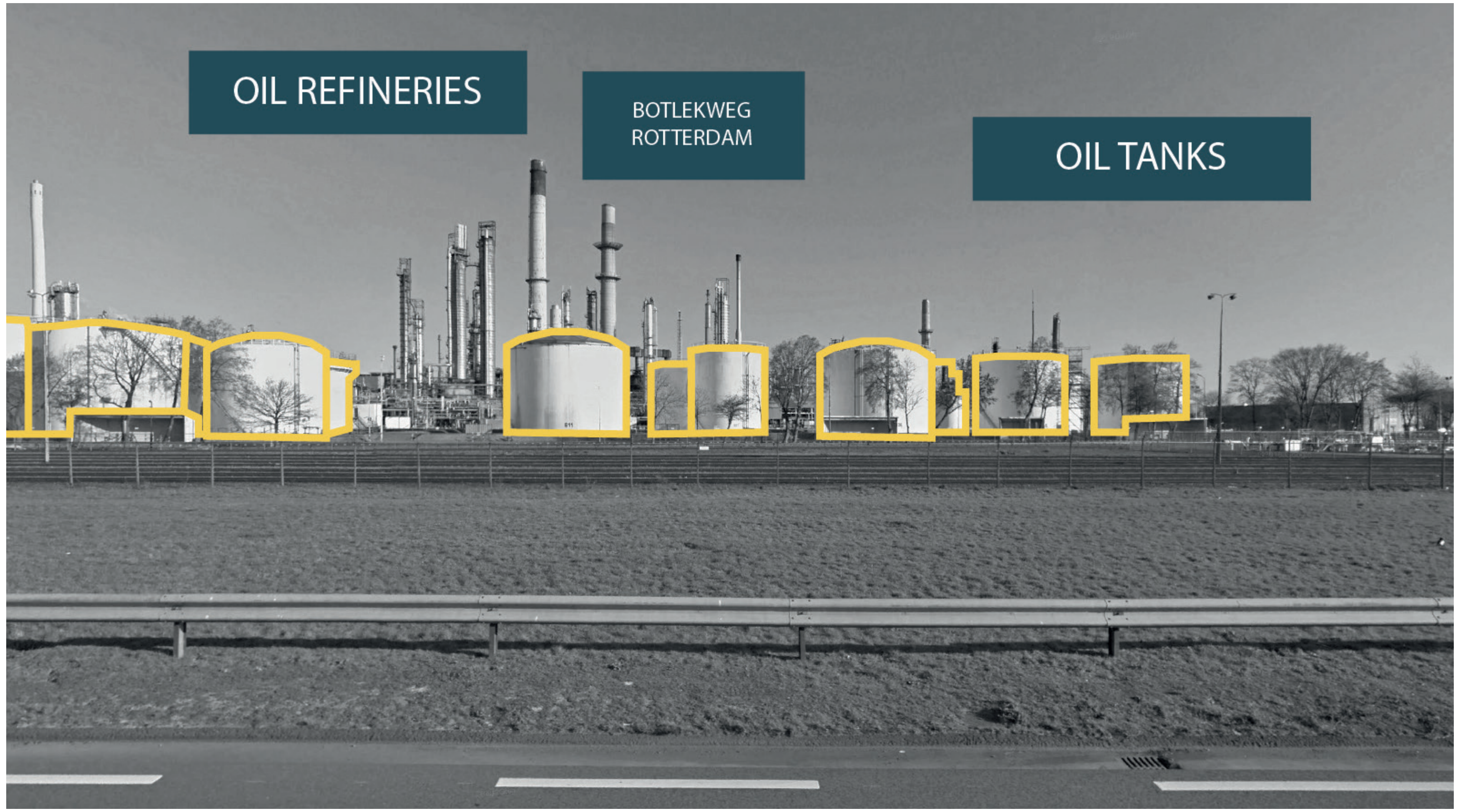


Figure 18: Oil refineries and tanks based on

Google Streetview (2020)

In this project, several elements of the petrochemical industry are addressed, such as the terminal, tanks, refineries, and petrol stations. Every picture on this page indicates the size and shape of a specific element of the petrochemical industry by a yellow stroke. The area it covers is visualised by a yellow filled surface.

As can be seen in figure 18 and figure 19, oil tanks, and refineries are mainly located in a desolate wasteland, far from residential areas. The only way they seem to be connected to their hinterland is by the railways. Besides, these areas are not accessible for unauthorized persons.

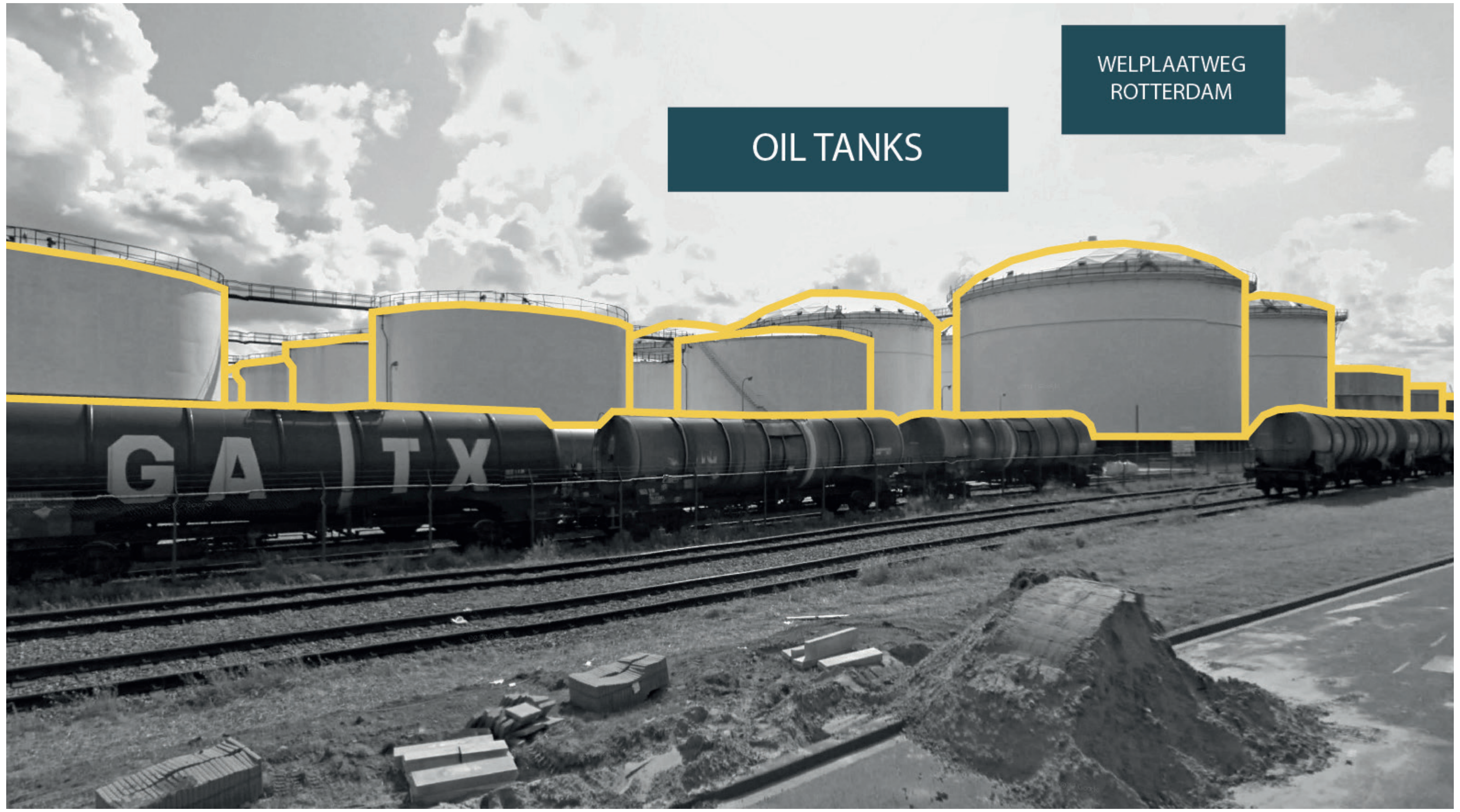


Figure 19: Oil refineries and tanks based on

Google Streetview (2020)

petrochemical buildings

occupied areas

ENERGY SYSTEMS - SITE ANALYSIS

While petrochemical industries are mainly located outside residential areas, petrol stations are found everywhere in the province. Some of them are directly put on buildings, see figure 20. This petrol station is as much as possible incorporated into the urban environment.

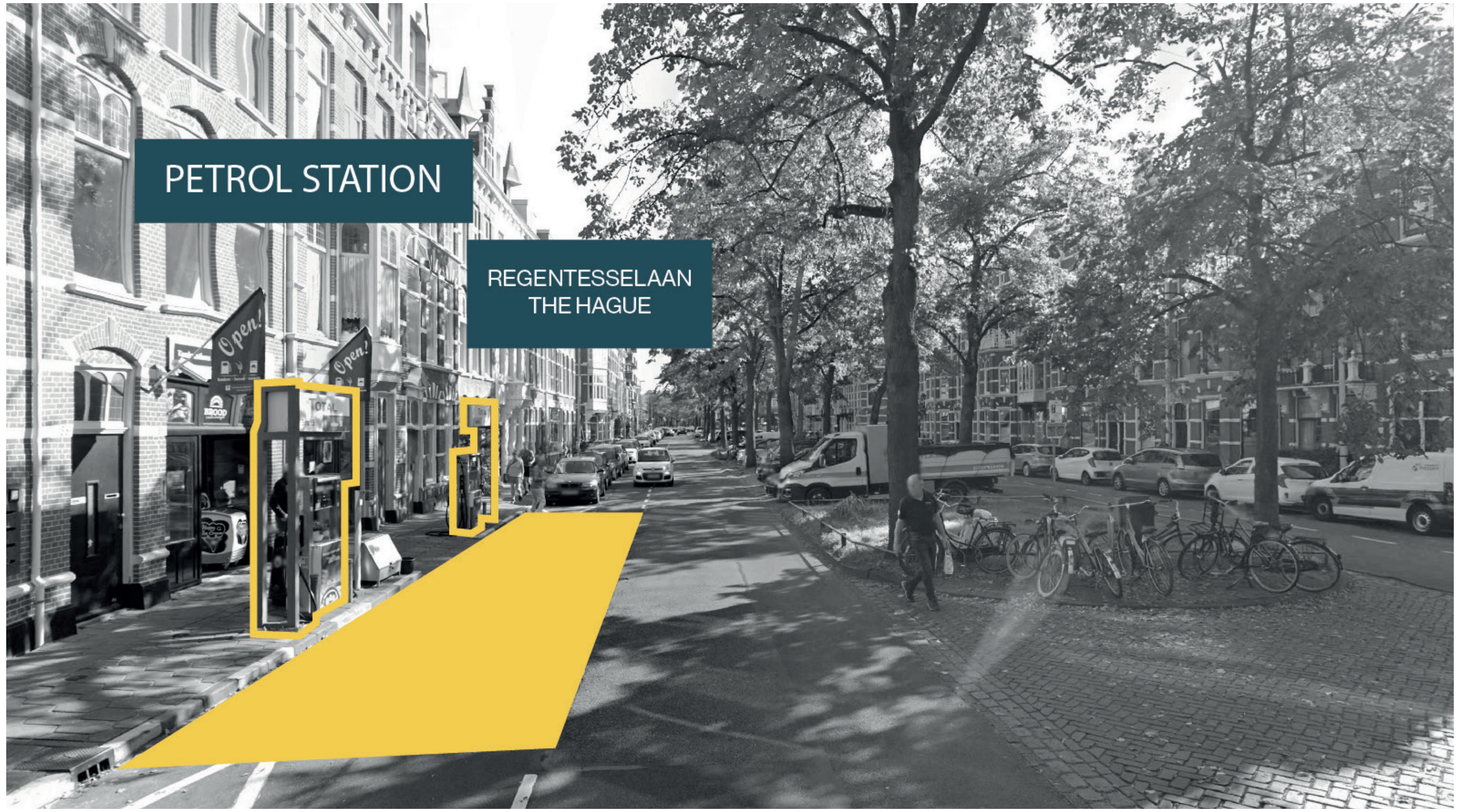


Figure 20: Petrol stations urban area based on Google Streetview (2020)

The area it occupies is therefore quite small, compared with the size of the oil tanks on the previous page and the petrol station on the next page.

The vast majority of the petrol stations are located on the outskirts of residential areas, like the one on the Swanlaweg in Zevenhuizen, see figure 21. These kinds of petrol stations are more striking in the street scene and cover a larger area, than the ones within city centres.

Figure 21: Petrol stations rural area based on Google Streetview (2020)

petrochemical buildings

occupied areas

ENERGY SYSTEMS - THE POTENTIAL OF BIOFUELS

To bridge the gap from fossil fuels to a clean future, the Dutch government has identified the use of biomass as necessary for a more sustainable economy (Klimaatakkoord, 2018). Biomass comprises all matter that lives, has lived, or originates from life. Biofuels have biomass as source of energy. Biofuels are part of the bio-based economy principle. This represents an economy in which all social and industrial processes have green materials as a source, instead of fossil materials (Rafiaani et al., 2018). Appendix 1 discusses the sources and applications of biofuels in more detail.

Figure 22 shows the numbers of the clean energy supply of the Province of South Holland in 2020. A significant part of the renewable energy currently comes from biomass because of the versatility and the possibility to use current installations and vehicles, but also because of the great potential in South Holland. In the region about a quarter of the land is cultivated and half is agricultural land (CBS, 2019). Waste flows from cities and agriculture offer opportunities for biobased energy and materials.

Currently, biofuels are being mixed with fossil fuel diesel. Only certain bio sources are suitable for biofuels, the so-called liquid biofuels, such as edible oils, animal fat and frying fat. The potentials for those sources are shown on this map.

However, there are a fair number of drawbacks associated with the use of biofuels. First of all, CO2 emissions released in the processing of biomass is a controversial topic. In the biomass chain there are emissions from cultivation, extraction and processing, transport and land use change. To compensate for the emissions, the burnt biomass is replanted, so that the emitted CO2 can be ejected from the air. However, it takes decades before a tree is able to store enough CO2, which means that biomass is not a CO2 negative source (Natuur en Milieu, 2018). Besides, biomass is aa source that has relatively many logistical challenges. Wind and sun are omnipresent, biomass must be continuously moved to the refinery.

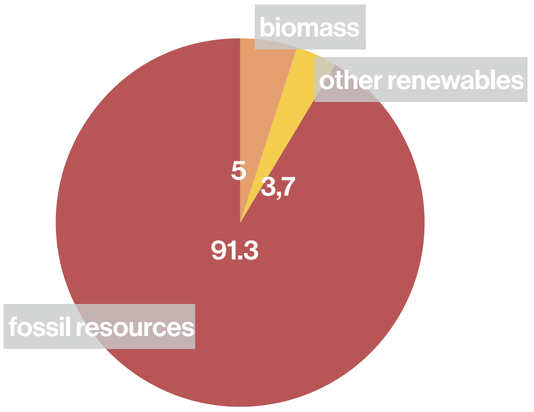


Figure 22: Energy Resources in the Netherlands in %, based on information from Nederland in Cijfers (CBS, 2020)

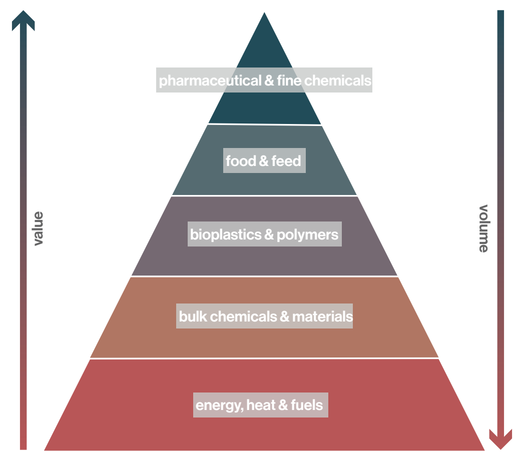


Figure 23: Biobased value pyramid, based on a variant of Stegmann & Londo (2020)

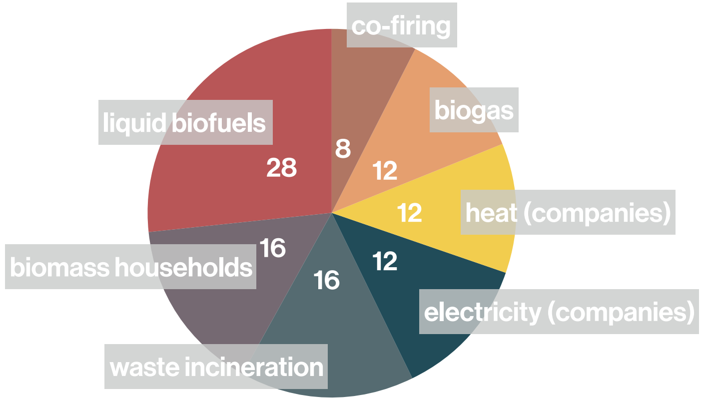


Figure 24: Destination of biomass in the Netherlands in PJ, based on information from Nederland in Cijfers (CBS, 2020)

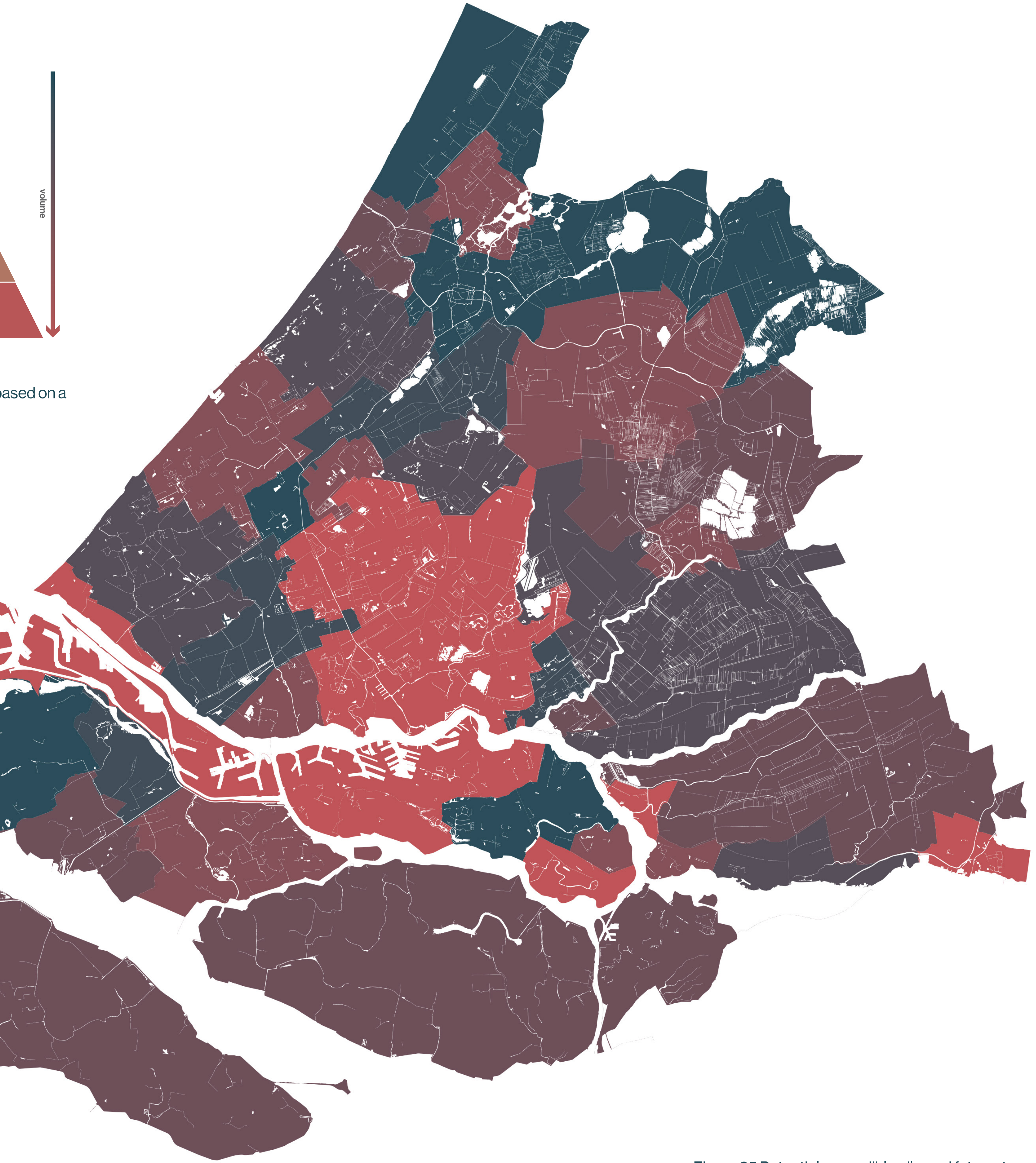


Figure 25 Potential map edible oils and fat waste

There is no possibility of local and equivalent production of biofuels. In the current system, there is centralisation of (overseas) sources and massive production in industrial (local) areas. About 1.8 billion kilos of biodiesel are produced in the Netherlands, but nowadays about half of it goes abroad (CBS, 2019).

The (overseas) carbon footprint of biofuels has been under intense discussion. Rainforests and peatlands containing CO2 must make way for production-plantations and buildings due to financial considerations. Land-change can therefore have a very negative impact on the CO2 balance of fuels (Johnson, 2009).

A final reason not to interpret biofuels as the solution, but more as an intermediate option, is an insight that we gain by looking at the application possibilities of biomass. Biofuels are not a high-quality application of biowaste, as biofuels cannot be reused or repurposed after use. This is visualised in figure 23, which shows the biobased value pyramid. An application from the upper part of hierarchies is preferable (Stegmann et al., 2020). In South Holland, a province with low potentials for oily biomass, the production of local biofuels is therefore quite difficult.

ENERGY SYSTEMS - RENEWABLE ENERGY POTENTIALS

Nowadays, around 93% of the energy we use is derived from fossil fuels (Milieu Centraal, 2021). If we want to have a clean, sustainable and circular future, we should get rid of fossil fuels, and shift to other, sustainable, and renewable energy resources. Today we are using more and more sustainable energy facilities, such as solar panels, wind turbines and geothermal plants, to fulfil our daily energy demand.

When implementing other energy resources, we consider the spatial impact for instance. While one, centrally located, fossil power plant can supply a whole region, we need several sustainable energy resources to supply the same size of area. Next to that, the supply of fossil fuels is quite consistent, while the supply of renewable sources can fluctuate, because it is largely dependent on the weather when looking at solar and wind energy.

This means that if we want to have a stable energy system in the province of South Holland, we should use several available potentials in a specific region. The highest energy potentials in the province are wind and solar energy. These systems call for large-scale infrastructure and constructions, and therefore require large investors, to make the energy transition happen (Milieu Centraal, 2021) (Rijksoverheid, 2018).

In figure 29 all potential areas for renewable energy resources in the province are depicted, in relation to spatial restrictions, such as protected landscapes. While wind and geothermal energy are very much bounded by specific areas, solar energy has potentials all over the province, whether it is on rooftops or along highways. This flexibility contributes to the possibility of a more decentralised energy system in the province.

WIND ENERGY POTENTIALS

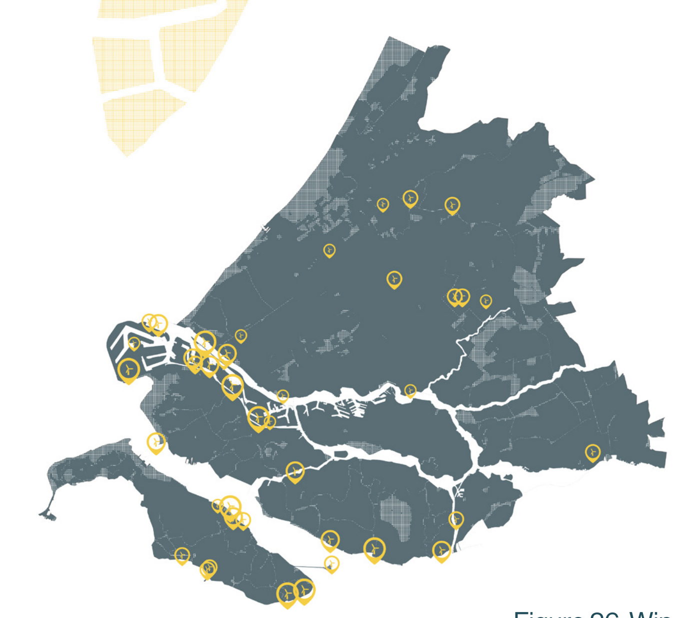


Figure 26: Wind energy potentials

SOLAR ENERGY POTENTIALS

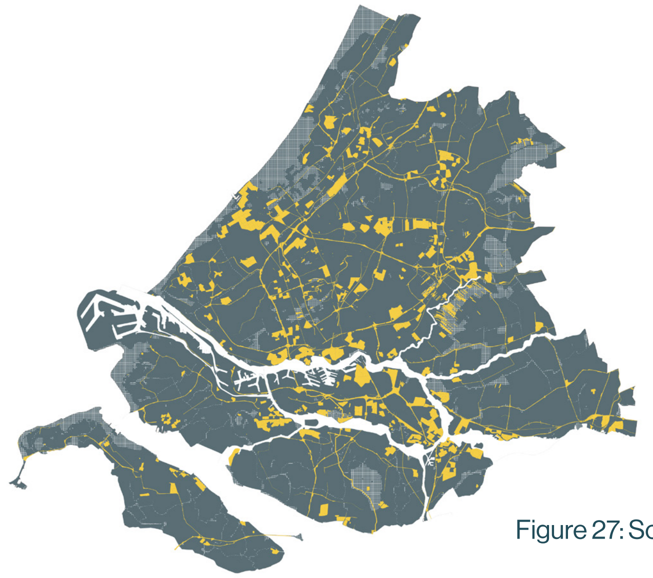


Figure 27: Solar energy potentials

GEOTHERMAL ENERGY POTENTIALS

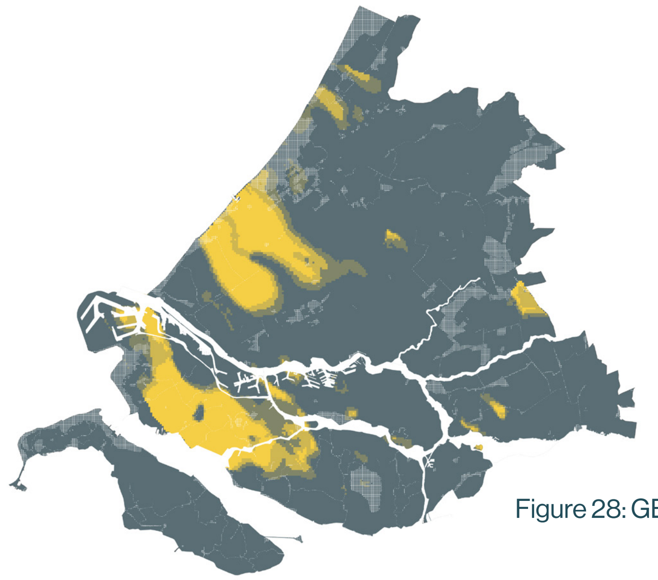


Figure 28: GEO energy potentials

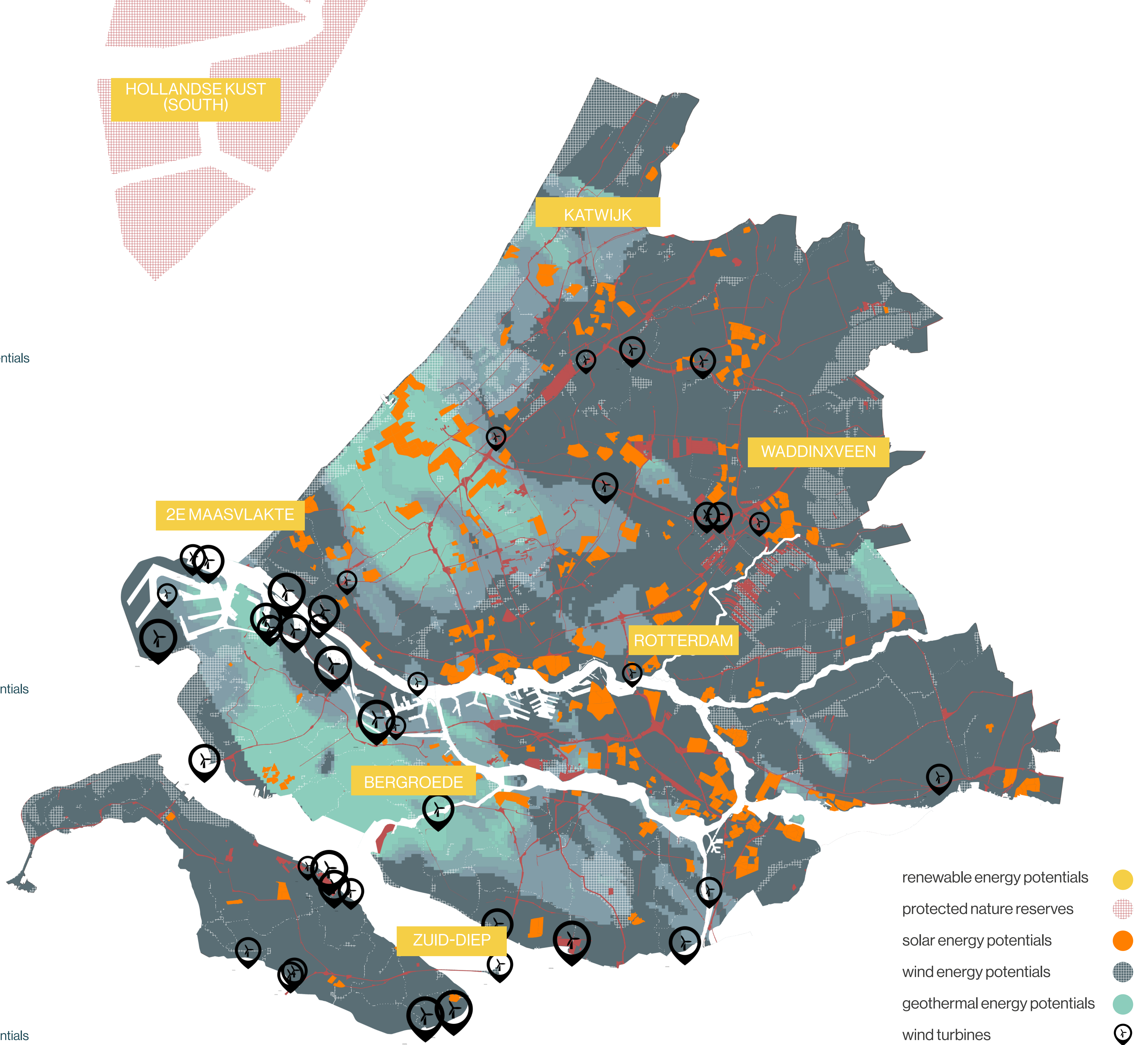


Figure 29: renewable energy potentials based on Opendata portaal provincie Zuid-Holland(2019)(Lisa, 2018)

02.3 MOBILITY SYSTEMS

Urgency of changing the current mobility system

From different developments and events in society, urgency for a new mobility system has arrived.

The pandemic has shown us a significant decrease in travel, with international transport more than halved in big cities (Ellen McArthur, 2020) and in the Netherlands by at least 35 % (CBS, 2021), we need to reconsider how we move ourselves and our goods around when the covid-restrictions are lifted.

The existing high density of the Netherlands and the Randstad and the steady increase of urbanisation (CBS, 2020) would indicate the potential for short traveling distances. However, when looking at the use of the national highways we see a steady annual increase, with over 60% of commuters opting for the car (CBS, 2019).

Finally, the polluting factor of the mobility sector requires serious attention to comply with international agreements and ensure a healthy environment, when the freight-transport sector of the Netherlands accounts for about a quarter of the total nitrous oxide pollution (CBS, 2019).

Car dominance

Currently, the car dominates our mobility system. The habit of using a car is still deeply rooted in the Dutch population. Currently, more than 7.8 million private cars take up space in the Netherlands. Cars in companies' possession take up another 1 million parking spaces (CBS, 2020). With quick math, this means approximately 110 million m2 of public space is dedicated to parking. Next to this, cars also dominate the transitional spaces of the public space, like streets and roads. In this spaces, speed and efficiency is prioritised over recreational traffic, as well as social interaction and playing children for example.

The car dominance is seen a form of radical monopoly, a definition of philosopher Ilvan Illich that explains the impact of just one specific industrial process. Car use is so deeply woven into our society, glued into it, that the system is hardly tested or innovated anymore. It does not only dominate the developments in technology, but it also controls our dependence on machines, which goes far beyond technological developments, which affects our relationships, our jobs, our activities, our lives (Van Rinsum, 2020).

To change this system of radical monopoly, there are two ways: either innovate this car, or slowly phase out the car. Both options are included in our project.

MOBILITY SYSTEMS - SITE ANALYSIS

To get a better picture of the spatial impact of existing mobility systems in the province, such as large parking lots, pictures at eye level are very valuable. Due to the COVID-19 we were not able to visit those sites in real life, however, Google Street View still gives the possibility to get an idea of the size of the buildings and areas the specific element occupies in relation to their environment.

Figure 30: parking lot in urban area, based on Google Streetview (2020)

In figure 30 a parking lot of almost 9600m2 is visible. It is located on the edge of the old city centre of Leiden, and next to a newly built neighbourhood.

petrochemical buildings

occupied areas

MOBILITY SYSTEMS - INFRASTRUCTURE

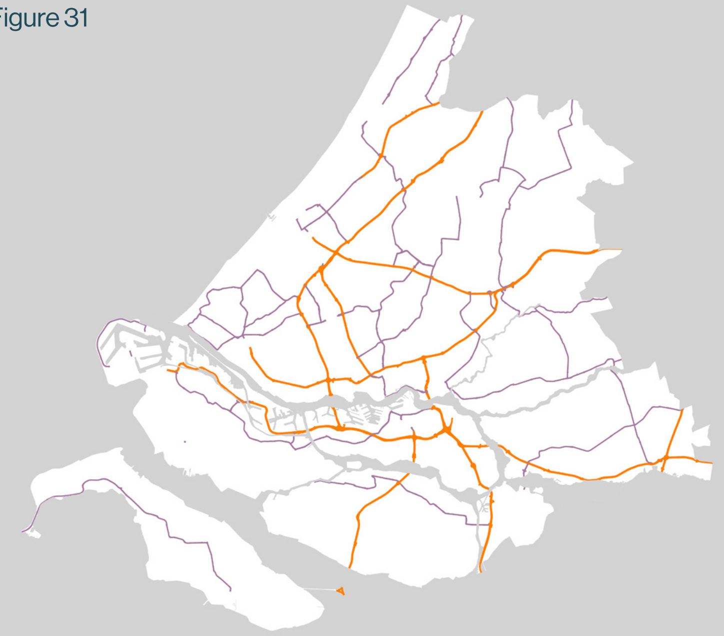
In 2019, The Netherlands was once again named as the country with the best quality of its infrastructure in the world (World Economic Forum, 2019). In this rapport, the WEF investigates and compares the quality of the railways, roads, and electricity supply of 141 different countries all over the world.

As visible in figure 34, the province of South Holland has a well developed and expanded infrastructure for both train and car, within the province and within its hinterland. Only Goeree-Overvlakkee lacks train links and highway connections (A-roads) and is therefore the least accessible part of the province. The rest of the province is well interconnected.

In figure 33 is also visible that there are quite a lot of petrol stations in the province, 367 in total (LISA, 2018). Most of them are located along national roads (purple strokes) or in cities, for instance, Rotterdam and The Hague. Only a few of them are located directly next to a highway.

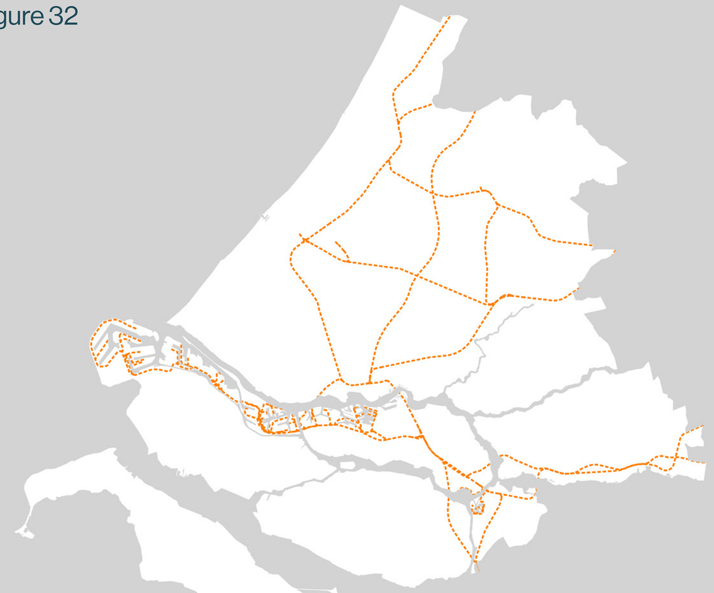
HIGHWAY, MAIN ROADS

Figure 31



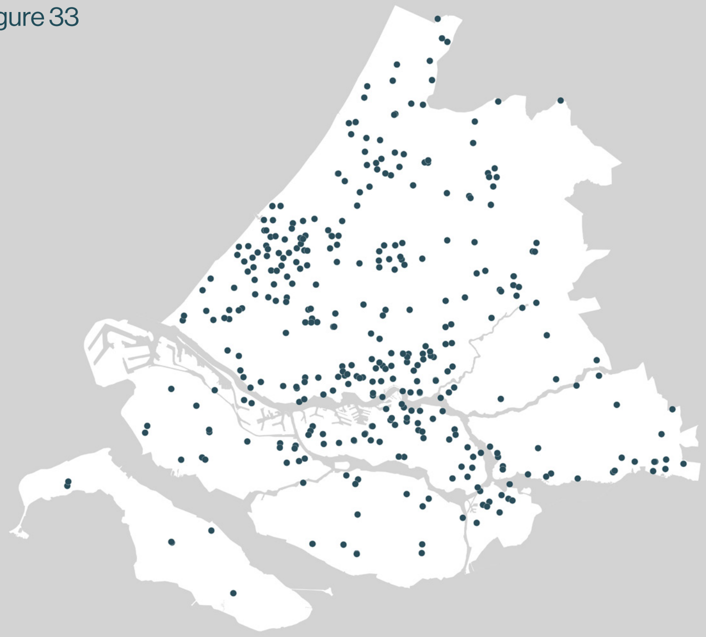
RAILWAY

Figure 32



PETROL STATIONS

Figure 33



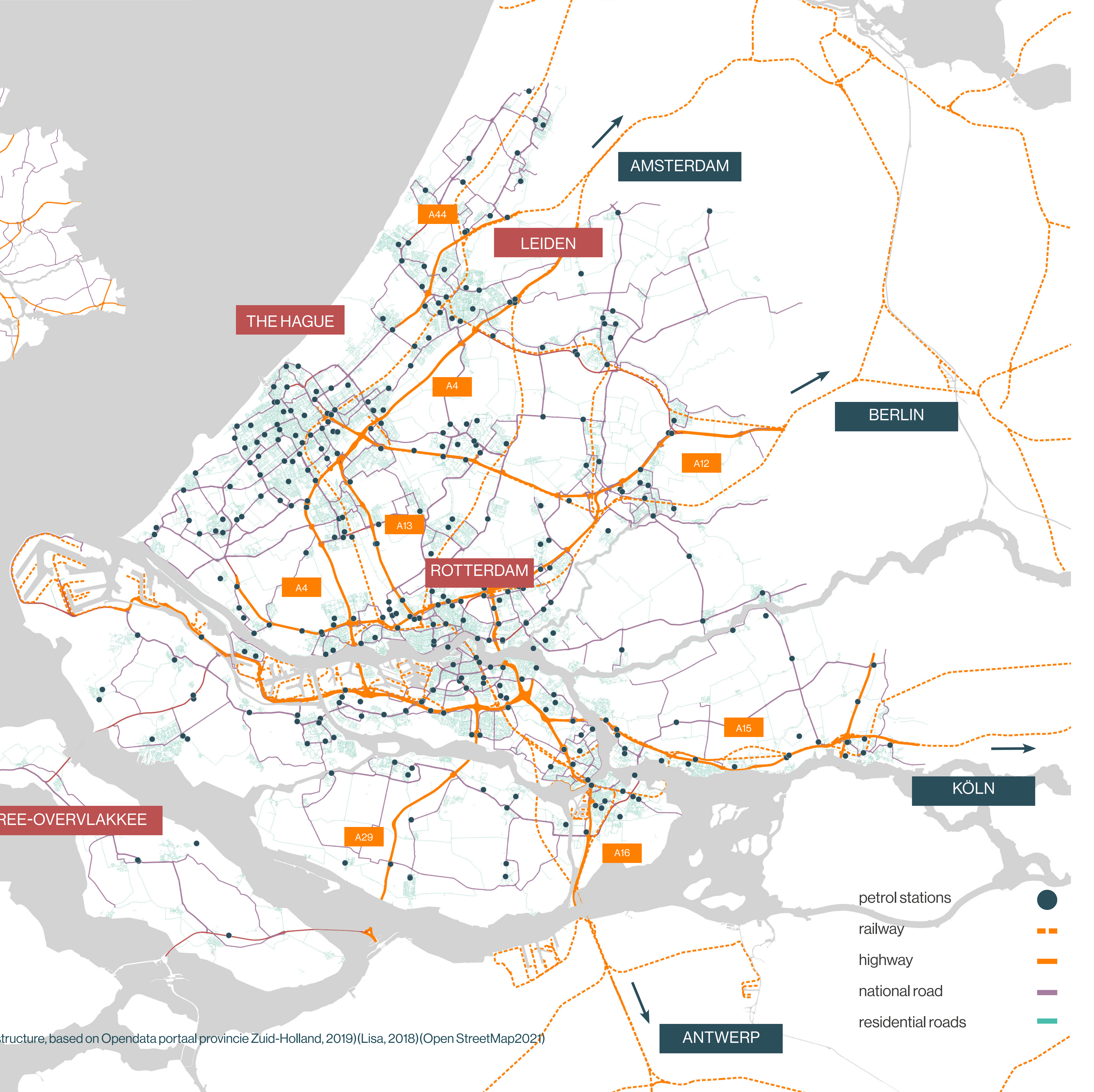


Figure 34: network of infrastructure, based on Opendata portaal provincie Zuid-Holland, 2019)(Lisa, 2018)(Open StreetMap2021)

02.4 SOCIO-ECONOMIC SYSTEMS - STAKEHOLDERS

The representation and the significance of the urban environment signifies a construction of power systems (Hein, 2018). The petrochemical industry has fabricated path dependencies in the urban landscape of the Province of South Holland that got different actors intertwined at different locations, even across nations, due to oil dependencies (Hein, 2018). These path dependencies and stakeholder connections are difficult to overcome, but not inevitable and offer opportunities to construct new connections. The Sustainable Development Goals set by the United Nations foresee a future where partnerships are intensified and the entire population is represented (United Nations, 2021). In order to proceed with stakeholder analysis in the Province of South Holland we identified the most influential stakeholders and their interests, power and values. The first identification includes XX key stakeholder groups: governance, research institutes, petrochemical and biofuel industries, Port of Rotterdam, car companies, electric stakeholders, public, private. An overview can be found in figure XX. Key stakeholders in the petrochemical industry in the port are big companies. The key research stakeholders are either located in The Hague, Delft and Wageningen and the smaller electric stakeholders are scattered in the entire country. Connecting them results in a cluster of public and private. Problems derive in centralising them, since they are not meeting at the same place and some stakeholders hold more power and interest than others. Therefore, synergies are sometimes difficult to take place, and collisions can arise. To make the transition successful, it is important that these different stakeholders meet each other. The level of interest will grow as soon as the possibilities within the energy transition are more noted by all the stakeholders. The level of power, on the other hand, is not something that will change automatically. Government bodies, such as the Province South Holland, can mediate between the different stakeholders to make sure all communities are represented. Looking at figure 35 three main clusters are identified: governmental institutes mainly reside in The Hague, research institutes are located in bigger cities such as The Hague, Rotterdam, Delft and Wageningen and the petrochemical industry centralised around the Port of Rotterdam. The key stakeholder groups will be discussed in the next section.

EU The European Union is a coalition of 27 member states in Europe. The European Parliament jurisdiction and can penalise the member states when not abiding by the legislation and not obeying the agreements. In order to come up with a powerful energy transition, moving from petrochemical to renewable energy, the EU can play a crucial role in setting the tone for port and renewable energy development. The EU can provide policies and promote initiatives to move towards a more sustainable future.

The national, regional and local governments The national government resides in The Hague, with twelve ministries that set up laws and can provide policies for stakeholders and residents. Also located in The Hague, the Province of South Holland, not directly elected by its electorate, is responsible for decisions that are related to the province, e.g. road works. The municipalities, in total 52 in the Province of South Holland, have a closer connection to its residents and stakeholders and therefore have the responsibility to let their voices be heard. A mobility and fuel transition overlooks borders, therefore cooperation is required within regions and seven different Regional Energy Strategies (RES) are set up within the province. These RES actively look for stakeholder connections and how to achieve climate goals by the year 2050 (Ministerie van Economische Zaken en Klimaat, 2019).

Research Institutes In order to stimulate the mobility and fuel transition innovation plays a key role in achieving the vision of 2060. At the moment, research still needs to develop possibilities to store energy properly. In order to achieve close cooperation and better innovation it is crucial that research institutes, such as universities work closely together and share their knowledge, also with private organisations. Currently, these research institutes reside not in close to the port, with exemption of Erasmus Universiteit, for future research relations it is important to collaborate effectively and be in proximity. This way production can become more local as well.

Petrochemical stakeholders As mentioned in other parts of this report the petrochemical industry has a dominant spatial imprint in the province, and with its power difficult to exclude from decision-making. With the transition in mind this industry has to move away from its polluting resources. This relation is difficult and may cause conflict if this stakeholder is not included in the transition. The industry needs to come up with new initiatives to take part in the transition and come up with solutions. Connecting them with renewable energy stakeholders may stimulate new innovation. Providing practical targets, taxating and stimulating innovations can aid this transition within the petrochemical industry.

Renewable energy stakeholders Currently, renewable energy stakeholders have a smaller representation, may not be as powerful as other fuel companies and are located in different areas of the province or even the country. However, their importance will grow over time and since they have a lot of potential to create synergies it is important to connect them together but also with research institutes. Conflicts may arise betwe

fuel companies, however, synergy can also take part between them.

Citizens In order for a transition to succeed residents need to participate as well, they are the consumers in the end and need to change their behaviour. Giving them a voice, stimulating them and including them in the process can result in a

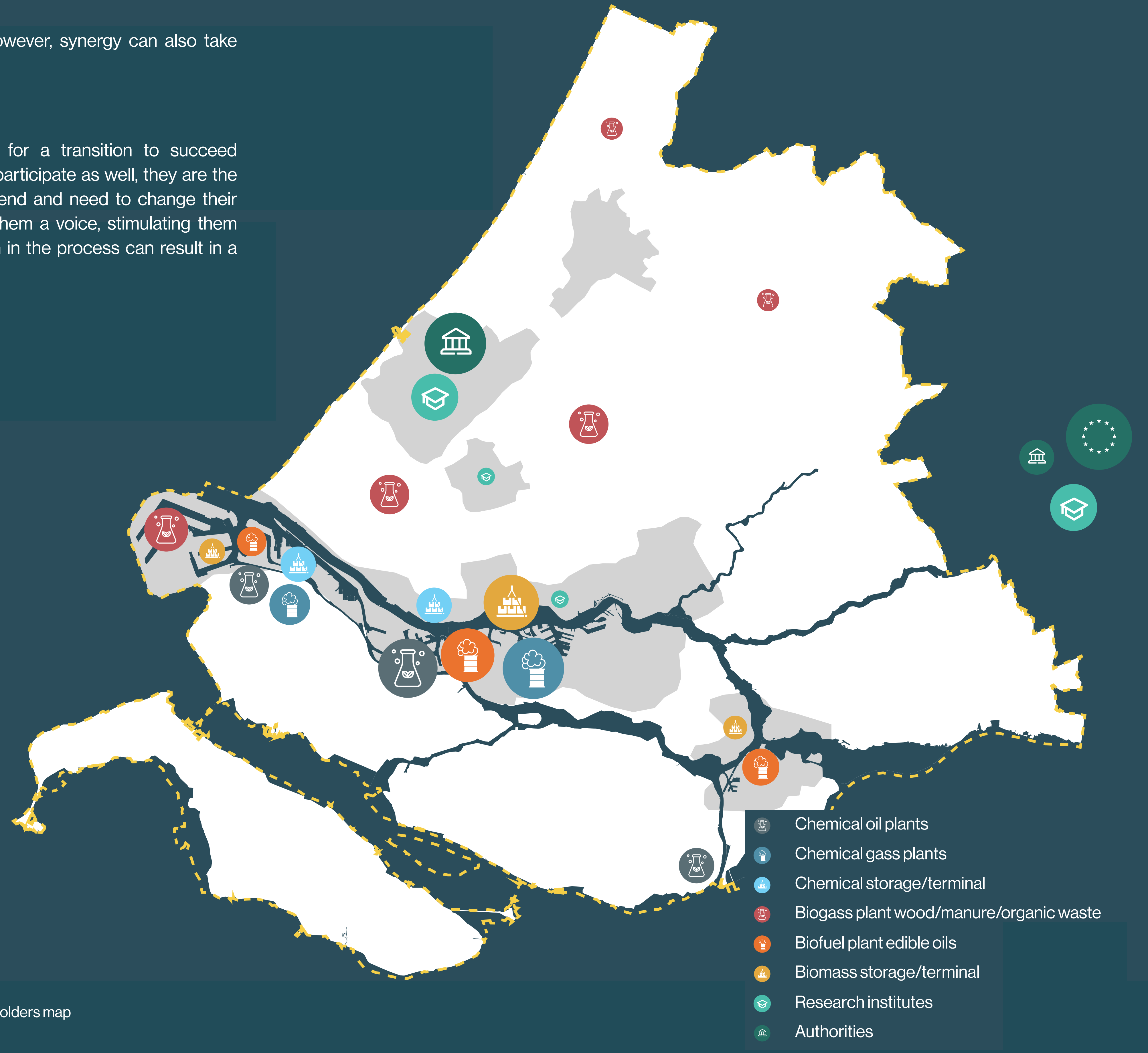


Figure 35: stakeholders map

SOCIO-ECONOMIC SYSTEMS - STAKEHOLDERS

The matrices in figure 36 demonstrate the level of power, influence and interest stakeholder groups hold in the development of the province.

As seen in the matrices there are four quadrants: high power - high interest, high power - low interest, low power - high interest and low power - low interest. Each quadrant demonstrates a different approach to include the stakeholders in the envisioned vision of 2060. Stakeholders in the high power - high interest quadrant need to initiate and be entangled in the transition (Marcin, 2021). The stakeholders in the second quadrant, high power - low interest, need to be updated to enable them to participate. The third quadrant, low power - high interest, need to be advised and informed in order for them to not miss the boat. The stakeholders final quadrant where interest and power is low need to be provided for, since most of these groups are less represented and are sometimes not given a voice (Rocco, 2021).

In order to let the mobility transition succeed all stakeholders need to be connected. Partnerships have demonstrated to be successful in large scale projects (Heurkens, 2013; Salet, 2018). In order to achieve development ideas stakeholders have different powers: voting (residents), economic (companies and investors), political (governance) and legal (property and land owners) (Wilson, 2017).

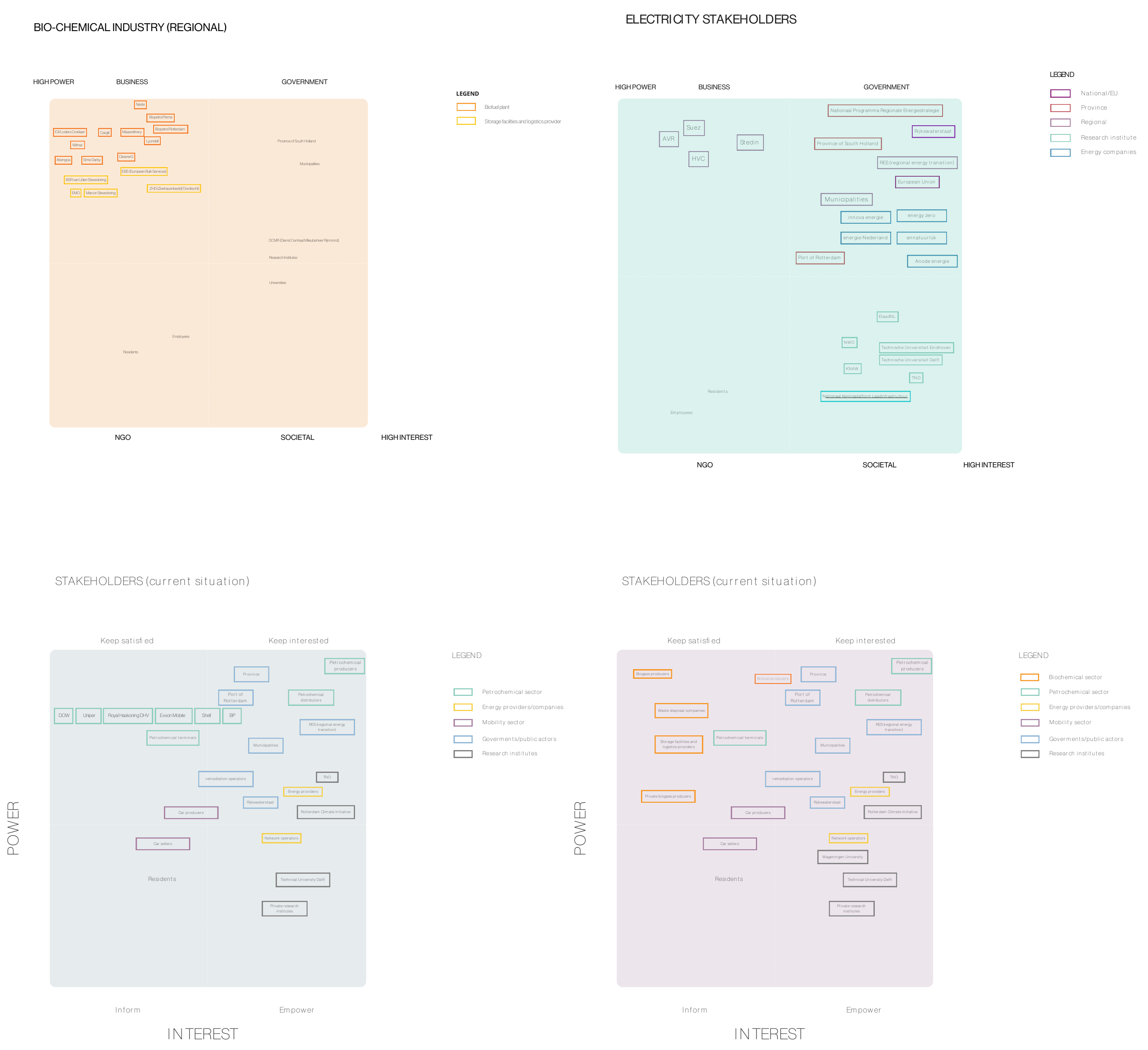


Figure 36: stakeholder matrices

SOCIO-ECONOMIC SYSTEMS - SWOT ANALYSIS

Figure 37: SWOT

SOCIO-ECONOMIC SYSTEMS: SWOT ANALYSIS

To get insight into the current strengths, weaknesses, opportunities and threats of the Province of South Holland, a SWOT (Strengths, Weaknesses, Opportunities, Threats) analysis has been used. In this analysis, a distinction is made between internal and external drivers. Whereas strengths and weaknesses define positive and negative features within an urban area, are opportunities and threats more about positive and negative external influences on the province (Comino et al., 2016). These kinds of analyses are used to help designers to find the elements in a certain area that should be developed further, that should be eliminated, protected, or rather neutralised or solved (Rooij, 2021).

In figure 38 all main opportunities are written down on the sidelines, and all strengths are visualised on the map. The main strengths of the province are:

- dense and robust network of infrastructure (purple lines);
- strong oversee connections (green dashed lines);
- high population densities and knowledge axis (orange drops);
- presence of leading petrochemical companies (yellow drops);
- strong worldwide position of the port of Rotterdam (green drop).

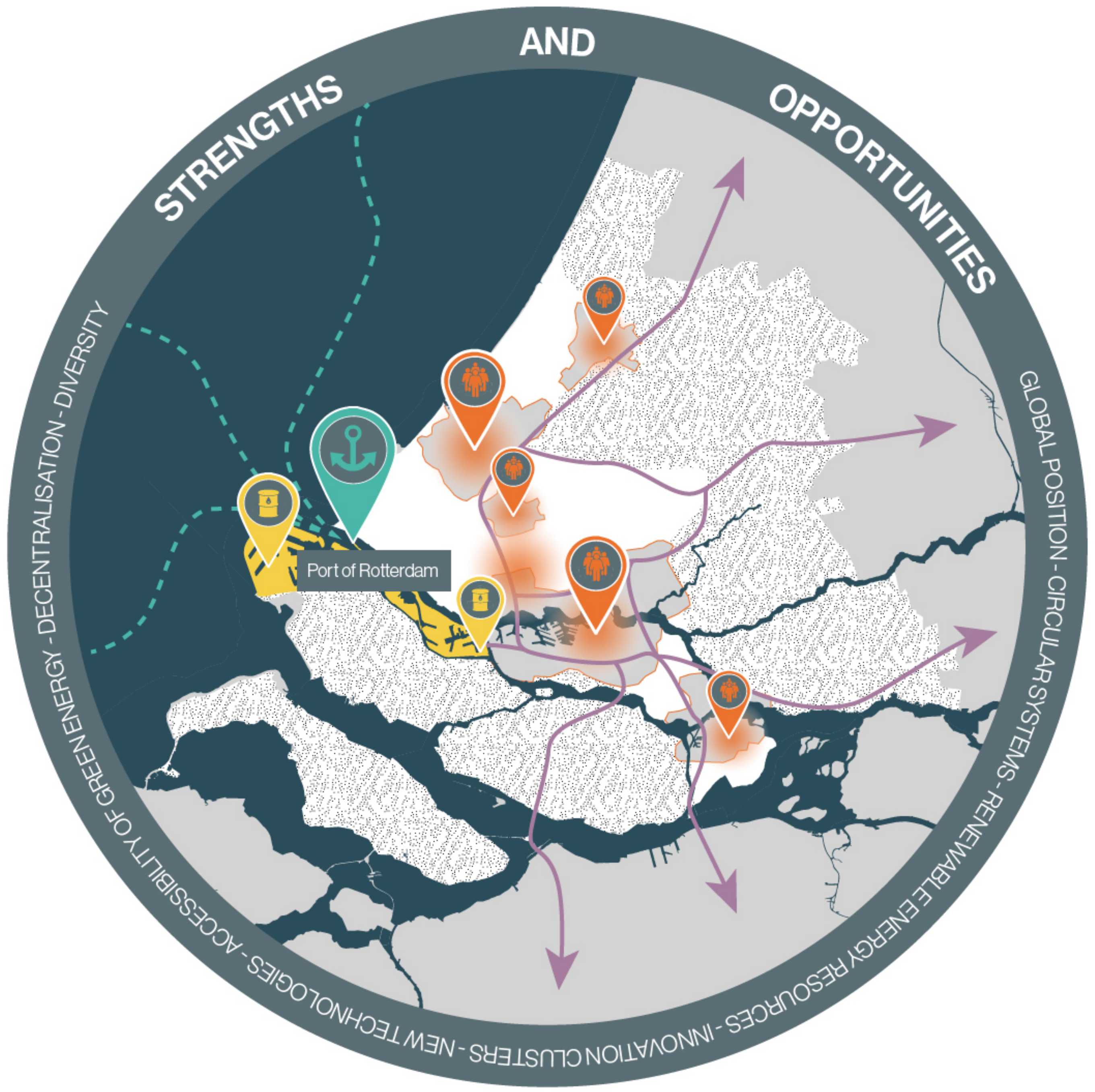


Figure 38: SO-map

population density
port of Rotterdam
petrochemical companies
city centres
infrastructure
international infrastructure
agricultural land

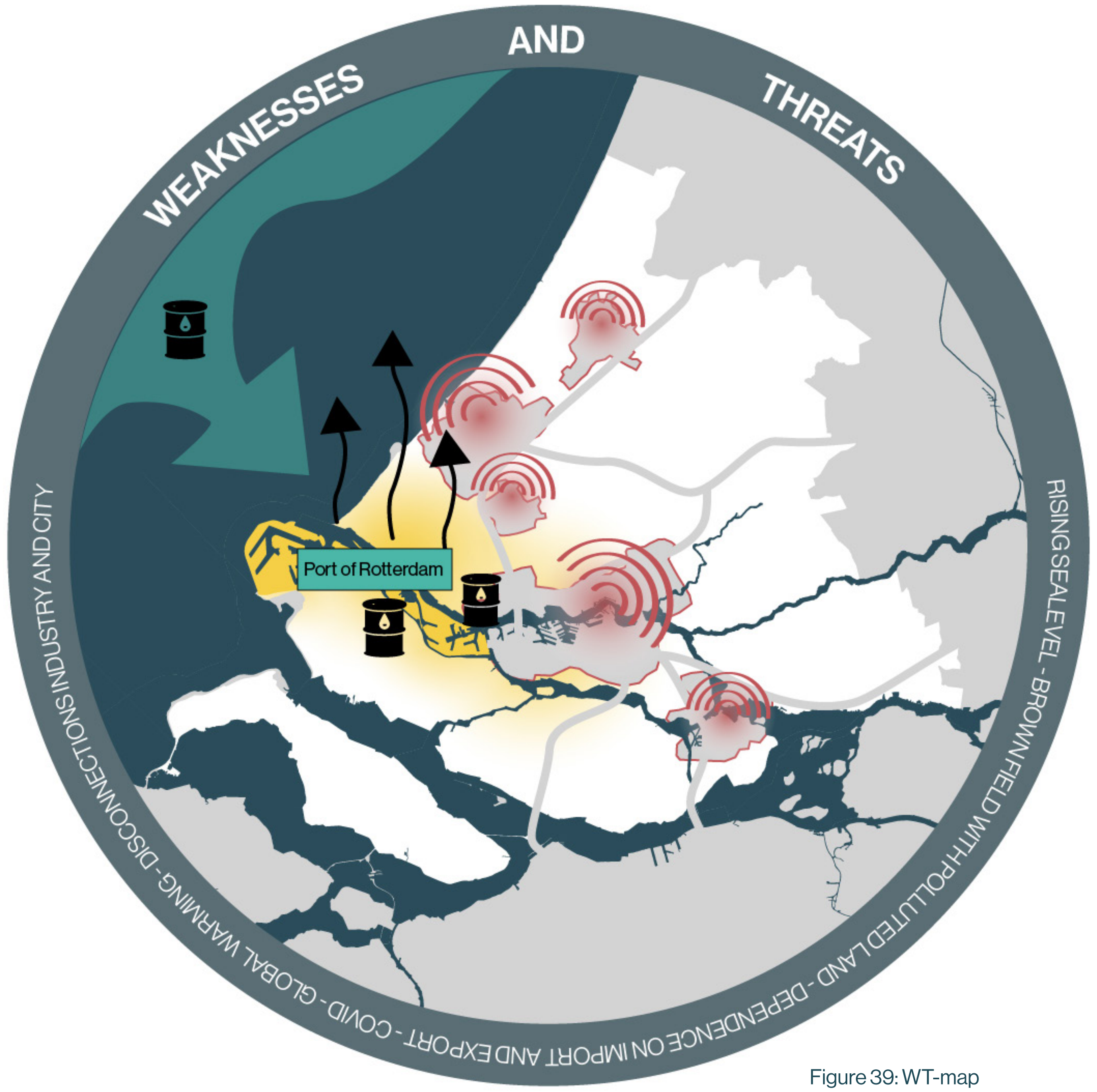


Figure 39: WT-map

In figure 39 all main threats are written down on the sidelines, and all weaknesses are visualised on the map. As shown in the map, the province has to deal with:

- dependency of crude oil (yellow area);
- sound pollution in urban areas (red semi-circles);
- highest co2 emission in The Netherlands (black arrows);
- petrochemical industries owned by global players (black tanks).

On the next page, an overview of all different strengths, opportunities, threats and weaknesses of the province is visualised in a SWOT-scheme. Some of them are clustered based on overlapping themes, such as: spatial implications, networks, social connections, location and sectors.

sound pollution urban zones
urban zones
import crude oil
infrastructure
petrochemical industries
CO2 emissions industries
port of Rotterdam

A PETRO-FREE SOCIETY 03

03 A PETRO-FREE SOCIETY

03.1 VISION STATEMENT

IN 2060 THE PROVINCE OF SOUTH HOLLAND WILL HAVE A MORE INTEGRATED AND FULLY ELECTRICAL MOBILITY NETWORK, TRANSFORMED A SIGNIFICANT AMOUNT OF WASTESCAPES FROM THE PETROCHEMICAL INDUSTRY, AND HAVE A HEALTHY LIVING ENVIRONMENT FOR THE OVER 4 MILLION RESIDENTS NOW RESIDING IN THE PROVINCE .

PETRO-FREE COMMUNITIES HAVE ACCESS TO AMENITIES AND JOBS WITH LOW IMPACT TRAVELING OPTIONS.

THE PORT RETAINS ITS INTERNATIONAL STATUS AS A BUSINESS HUB BUT IS ABLE TO DOWNSIZE IT'S LAND-USE THANKS TO THE EFFICIENCY AFFORDED BY DIGITIZATION EFFORTS, ALLOWING A BETTER CONNECTED PROVINCE ACROSS THE MAAS.

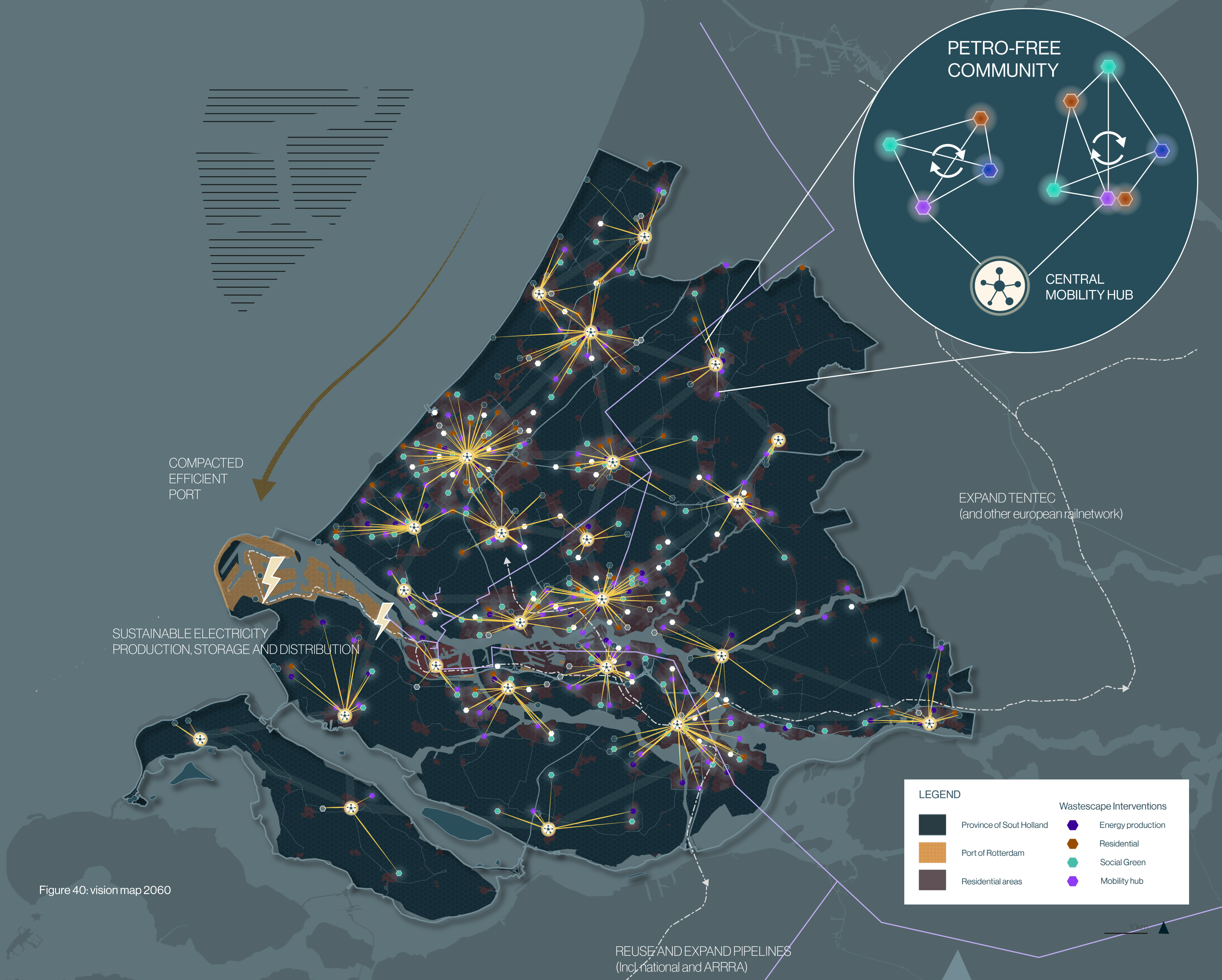


Figure 40: vision map 2060

03.2 FUTURE OF MOBILITY

In order to tackle the problems that are now embedded in the mobility system, we have to focus on a system in which cars are electric, shared and automated.

EV

Under the Green Deal 198 the Netherlands has committed to the electrification of cars (2018). Herein the ambition is to have at least 15% of the cars entering the market to be fully electric by 2025. Road traffic currently accounts for about 1/5 of the greenhouse gases in the Netherlands. As a private user of a 100% electric car you can apply for a subsidy and also be exempt from taxes. Electric vehicles (EV) are cleaner, quieter and more economical than cars driving on liquid fuels. The national government indicates that by 2030 all cars that come on the market have to be 100% electric (Rijksoverheid, 2020).

The emergence of EV's also presents challenges. The biggest spatial challenge is the provision of accessibility to charging infrastructure. In 2030 there will be about 1.9 million electric cars on the road. There must also be 1.7 million charging points in the Netherlands. This will mean approximately 360,000 posts in South Holland. According to research by Vattenfall (2020), the aim is currently a maximum walking distance of 150m to a charging station.

Another innovation trend for mobility is the rise of automated vehicles (AV's). AV's will mainly result in less congestion and accidents in traffic. The rise of AV's in combination with the shift from mobility as a product to mobility as a service means great developments in the functioning of the mobility system. Shared autonomous vehicles (SAVs) are seen as the optimal ride-sharing service. These services will reduce private car use, and therefore fewer parking spaces will be required in this system. According to Kane and Whitehead (2017), "vehicle sharing and ride-sharing also have the potential to radically change mobility patterns and the makeup of our urban transport systems." A social consequence of AVs is the increase of the digital environment in our everyday life, when vehicles have the ability to exchange data and function as a computer. Besides, people in self-driving cars have time for other activities in the car, such as work or interaction. Releasing our responsibility in traffic is not yet fully accepted among the population (Seuwou, Banissi & Ubakanma, 2020). This acceptance process is something to be included as a possible limiter or even destroyer of the development.

Despite the connectivity in the region already being a strength, the mobility system must be thoroughly revised. Urban growth is increasing and it is needed to apply new and clean technologies. In a region with strong agglomeration force, such as in South Holland, the aim is to provide as many travel types as possible with the right means of travel. Mobility hubs are a useful link between new subsystems and the current public transport system.

Figure 41: vision impression

STRATEGY 04

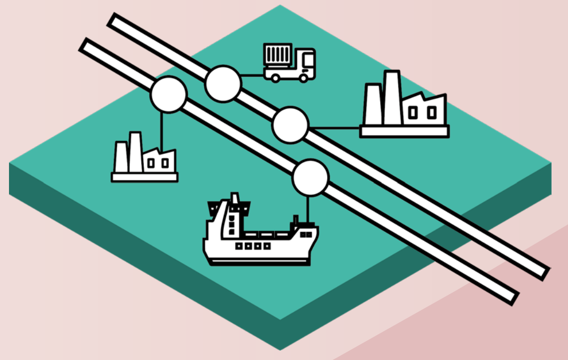
04 STRATEGY

04.1 THREE STRATEGIES

Moving away from petrochemical-based mobility towards a healthy, ecological and sustainable future needs to be adduced from a social, environmental and economic perspective. To attain this, three pragmatic strategies are defined to push the current situation to the right direction.

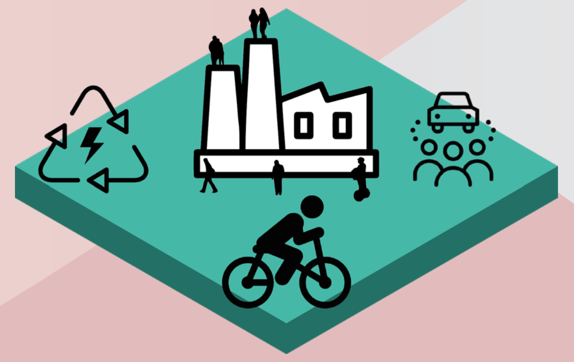
SUSTAINABLE CONNECTIONS

This strategy of establishing sustainable connections elaborates on the abstract and physical network of South Holland. To create connections strategically, the focus lies on connecting experimental innovative stakeholders in an early stage. They will give an impulse to not only change the current radical monopolist system of stakeholders, but also implement sustainable innovation in the physical space. Also, focus lies on strengthening the connections along potential transformation-sites to enhance the connectivity of the region.



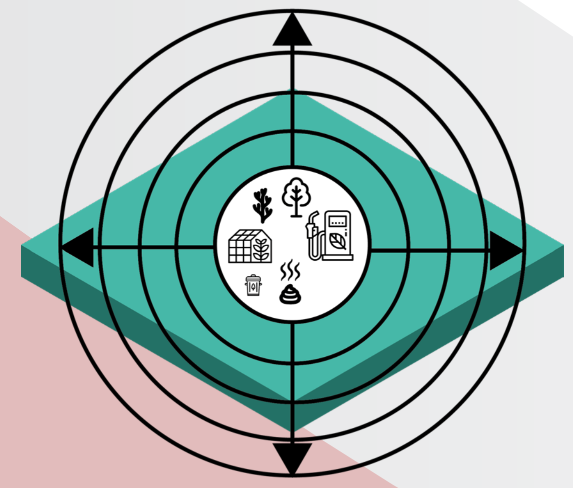
CHANGING CONSUMER PATTERNS

The strategy of changing consumer patterns evolves from the transitional nature of the vision. According to Rotmans & Loorbach (2009), 'a transition is a radical, structural change of a societal (sub)system that is the result of a co-evolution of economic, cultural, technological, ecological, and institutional developments at different scale levels.' Therefore, consumer patterns will play an essential role in catalysing the transition. By means of governmental stimuli and initiatives on the local scale, consumers will get used to a completely new societal system. Bottom-up incentives to generate energy and enhanced accessibility to public and private mobility systems by diversifying the sector are part of this strategy.



WASTE TO VALUE

Aligning with the environmental goal of the Port of Rotterdam to become a waste-to-value hub, we defined this strategy as a leading principle in all the work. With the Port as an economic centre, the region has an extensive position in achieving new goals as closing loops and adding value to waste streams (Port of Rotterdam, 2019). Part of the circular economy is the idea that today's goods are tomorrow's resource, which is done by valorising waste. Waste valorisation concerns biological cycles that are embedded in nature, city and agricultural land. In this project, also spaces are interpreted as waste. Due to the energy transition, spaces dedicated to fossil-fuel based activities will become the wastescapes of the future. This is interpreted as a great waste-to-value potential in spatial terms.



04.2 TIMELINE & PHASING

The mobility transition within the Province of South Holland to renewable energy concerns three main components:

1. preparation phase;
2. shifting phase, and;
3. circular phase.

Within these phases three strategies are set: sustainable connections, consumer patterns and waste to value. All can be found in figure 42 and will be explained in accordance to each phase.

Figure 42 [timeline] demonstrates the timeline of stakeholder interactions and strengthening these connections. An important shift in the stakeholder dynamics takes place in the second, shifting, phase where new synergies are taking place due to proximity and dominant stakeholders are more in balance with other stakeholder power structures.

Research hubs will be connected to the port, close to the logistical interchange of the urban areas, industrial nodes and research institutes in order to proceed innovation on energy generation and storage. Stakeholders active in the mobility (commons), while working towards their agenda setting, will attain circular mobility. This way the existing knowledge axis of Leiden-The Hague-Delft-Rotterdam will be extended to the Port of Rotterdam. Future policies and plans can stimulate this towards Dordrecht and Moerdijk to achieve a full integration of transitioned industrial landscapes.

Investing in research institutes and connections can aid to preserve the competitive benefits of South Holland as it moves from a petrochemical based economy to a renewable and circular economy, through methods of export and trade of innovation and knowledge based services.

PREPARATION FASE

SHIFTING FASE

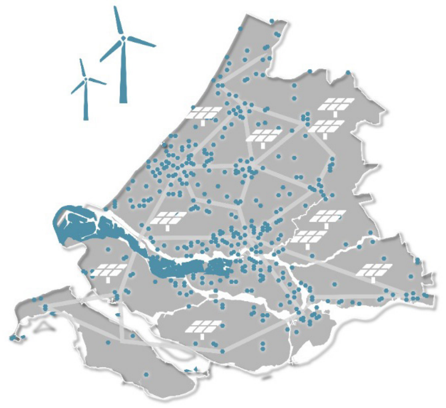


Figure 42: Project timeline

TIMELINE & PHASING - POLICIES

Obtaining equality in sustainable mobility requires transformative change to the current systems. Sustainably progressive policies are often politically unfavourable as they go against the electorate or they impact upon public financial streams. Therefore, transitions need to be managed strategically from exploring the provincial's dynamics, to setting an agenda and engaging actors (Roorda et al., 2014). The process of reframing the regional development agenda towards equality is beginning to occur in various sectors of science and practice. The challenge is in bringing people back into the equation of planning, balancing the physical dimensions with the social (Bakker et al., 2014).

In order to achieve a just decision-making process and a fair share of benefits and burdens, shifting in the power-interest matrices needs to take place. Dominant stakeholders, such as the Port of Rotterdam and the petrochemical industry, will have to diminish their power to make place for other stakeholders whose voices are less heard, e.g. residents, nature or smaller renewable energy companies. The goal is that powerful stakeholders will become more inclusive in the decision-making and the ones with less power or interest will participate in the process.

As seen in figure 43 the market steering of policies within the projects falls apart in three phases: policy stimulating, policy enforcement and policy circular status quo and international promoting.

As portrayed in figure 43 policy steering with market instruments can be approached in four ways: shaping, regulating, capacity building and stimulating. According to the strategy in this report the emphasis is set upon mostly stimulating (hard instrumental steering) and to a lesser extent capacity building (soft relational steering) (Kirchherr et al., 2018). This is in line to attain circular mobility. Capacity building brings the opportunity to collaborate between stakeholders and with stimulating the province is able to steer the direction of the transition. The reason to steer in a stimulating manner is to empower vulnerable groups as well within the transition and decision-making. Therefore, stimulating provides an overview of the interests of the community.

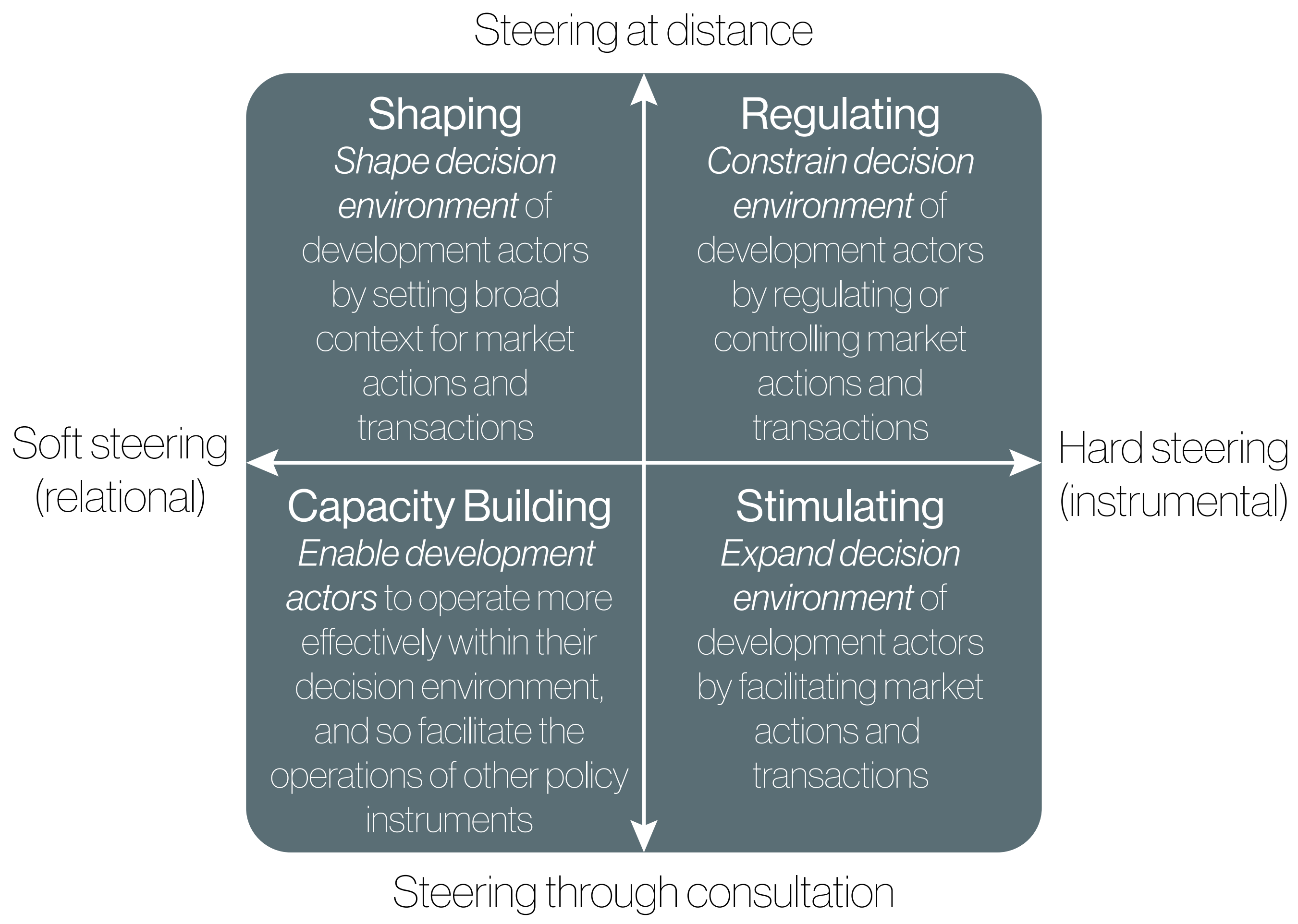


Figure 43: Policy matrix, based on policy steering lecture by Fred Sanders at TU Delft (2021) (Kirchherr et al., 2018)

TIMELINE & PHASING - STAKEHOLDER SYNERGIES

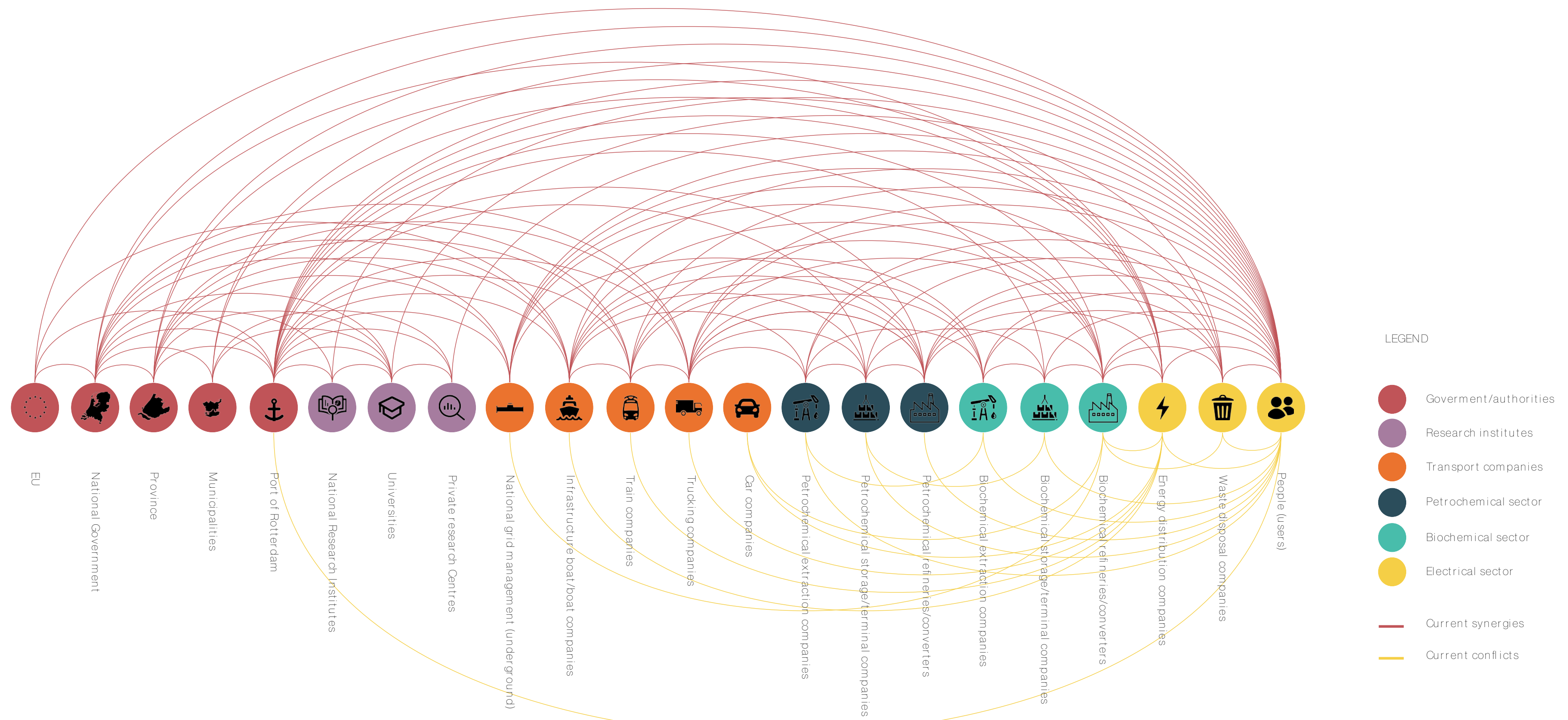


Figure 44: Current synergies

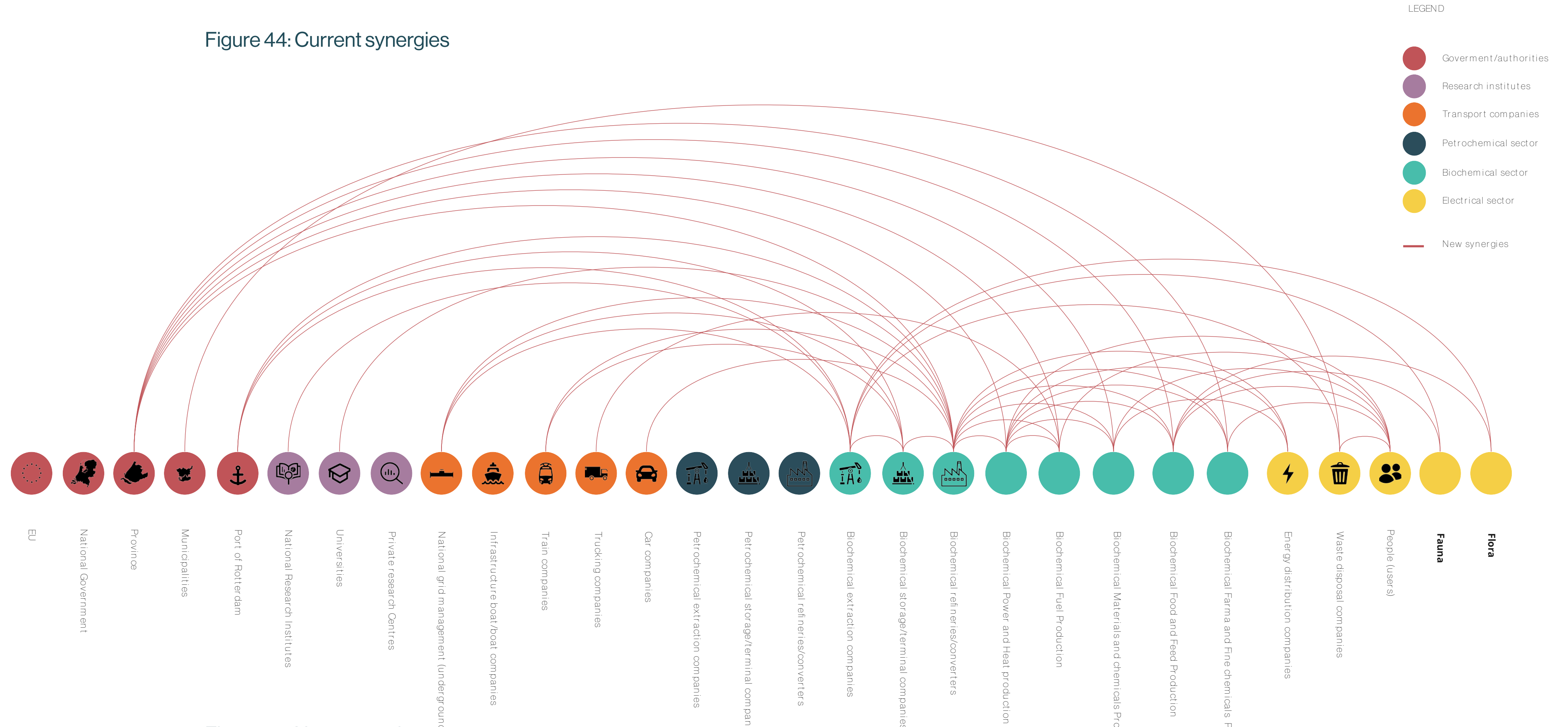


Figure 45: New synergies

04.3 PHASE 1: PREPARATION: 04.3.1 LOCATION OF WASTESCAPES

The deindustrialisation of sections of the existing port and the urban densification trend are key factors in creating wastescapes and/or drossscapes as described by Alan Berger(2006) Rapid urbanisation and the changing industrial landscape can result in a variety of wastescapes. These wastescapes have a high potential to aid in the transition towards a circular economy and a more sustainable urban environment by redeveloping and becoming test sites for initiatives such as Eco-Innovative Solutions (Amenta & van Timmeren, 2018).

The petrochemical industry, and its associated mobility structure leaves behind wasted (contaminated) places, wasteful places (such as large parking lots) and actual waste.

Three categories of wastescapes expected to result from the breakdown of the petrochemical industry, are considered in this report. These are the Industrial areas, the petrol stations and the parking lots. These wastescapes fall into a range of different scales, influencing their potential transformation.

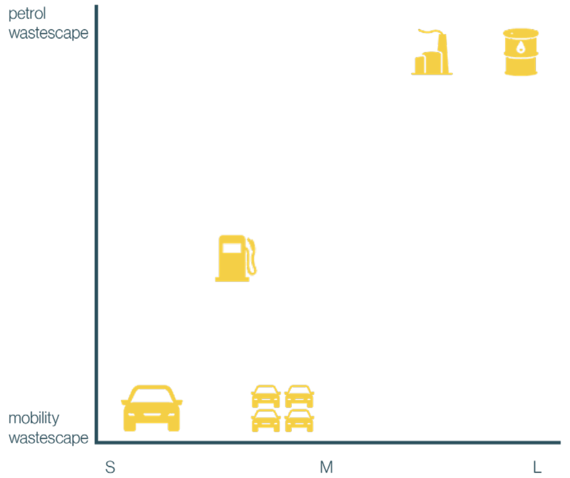


Figure 46: Schematic scale and function of identified wastescape typologies

Petrol Industry

These cover the terminals and refineries in which the oil is processed and stored. These sites are generally centralized around the port, offering direct access to transportation between other (international) industrial sites. They leave behind contaminated soil, an area unconnected to other urban social functions and structural elements.

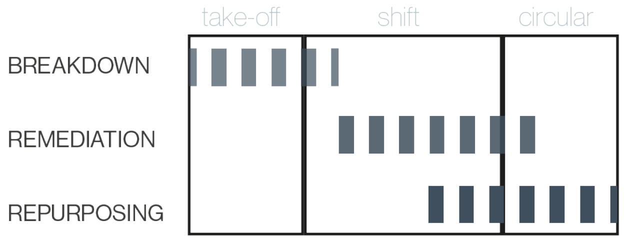


Figure 47: Timeframe phasing out Petrol

Petrol stations

Consistently connected to the road infrastructure, the petrol stations are spread out intermittently and are more frequently located along the periphery of an urban area, though we see the size appears to correlate with the urban density, showing larger petrol stations along the highway and in peri-urban areas in comparison to the inner city. These locations leave some contamination and structural elements.

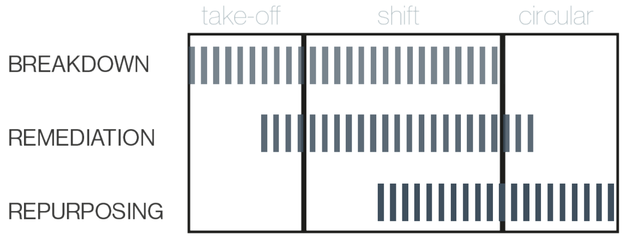


Figure 48: Timeframe phasing out

Parking lots

Parking spaces can be generally organized in individual street parking or clustered parking stacked or single level and outside or indoors resulting in leaving behind a range of different plot sizes with either minimal pavement or heavy concrete constructions.

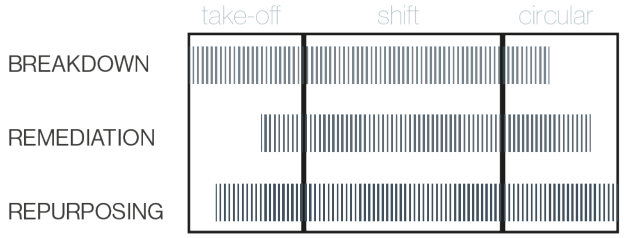


Figure 49: Timeframe phasing out Parking

WASTESCAPES - PETROLINDUSTRY

In the port of Rotterdam there are 21 oil refineries and terminals covering a surface of 16,5 km2 (Port of Rotterdam, 2016). Including the 5 additional ones spread throughout the province the petrol industry sites cover an estimated area of 24 km2, about the size of the City of Delft.

Figure 50: Delft, based on Google Earth

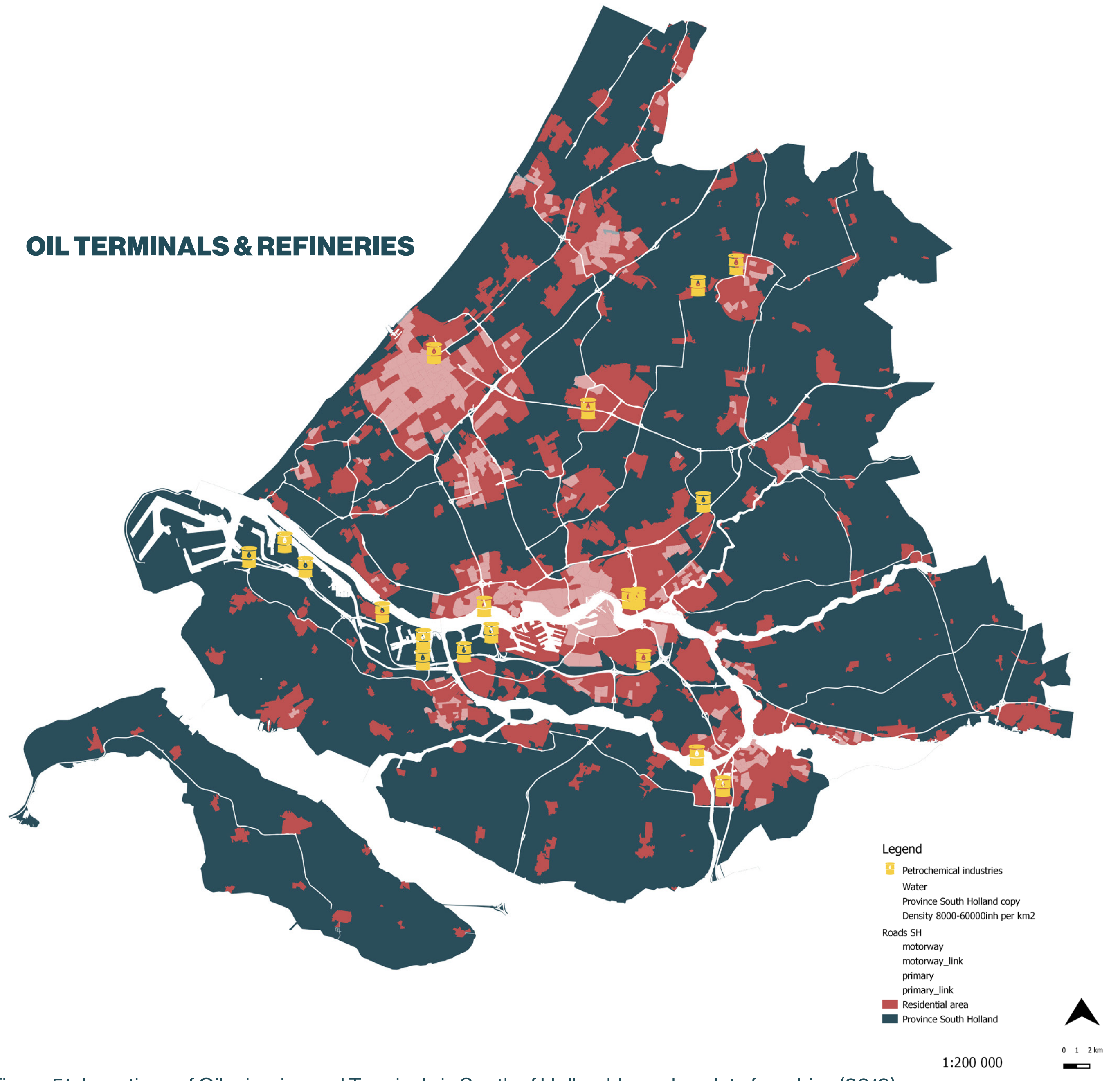
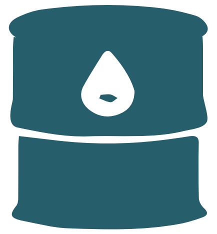


Figure 51: Locations of Oil reineries and Terminals in South of Holland, based on data from Lisa (2019)

26 x  **covering 24km2**

WASTESCAPES - PETROLSTATION

There are 367 petrol stations in South Holland (Lisa, 2021) with an average surface area of 2000m2 they cover a total of 734 000m2 comparable to the surface area of the Center of Ridderkerk.

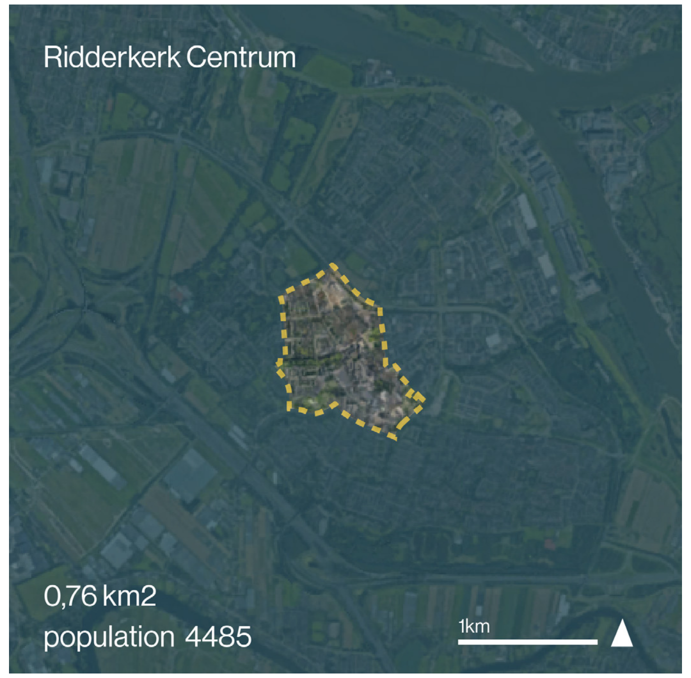


Figure 52: Ridderkerk Centrum. Own image based on Google Earth

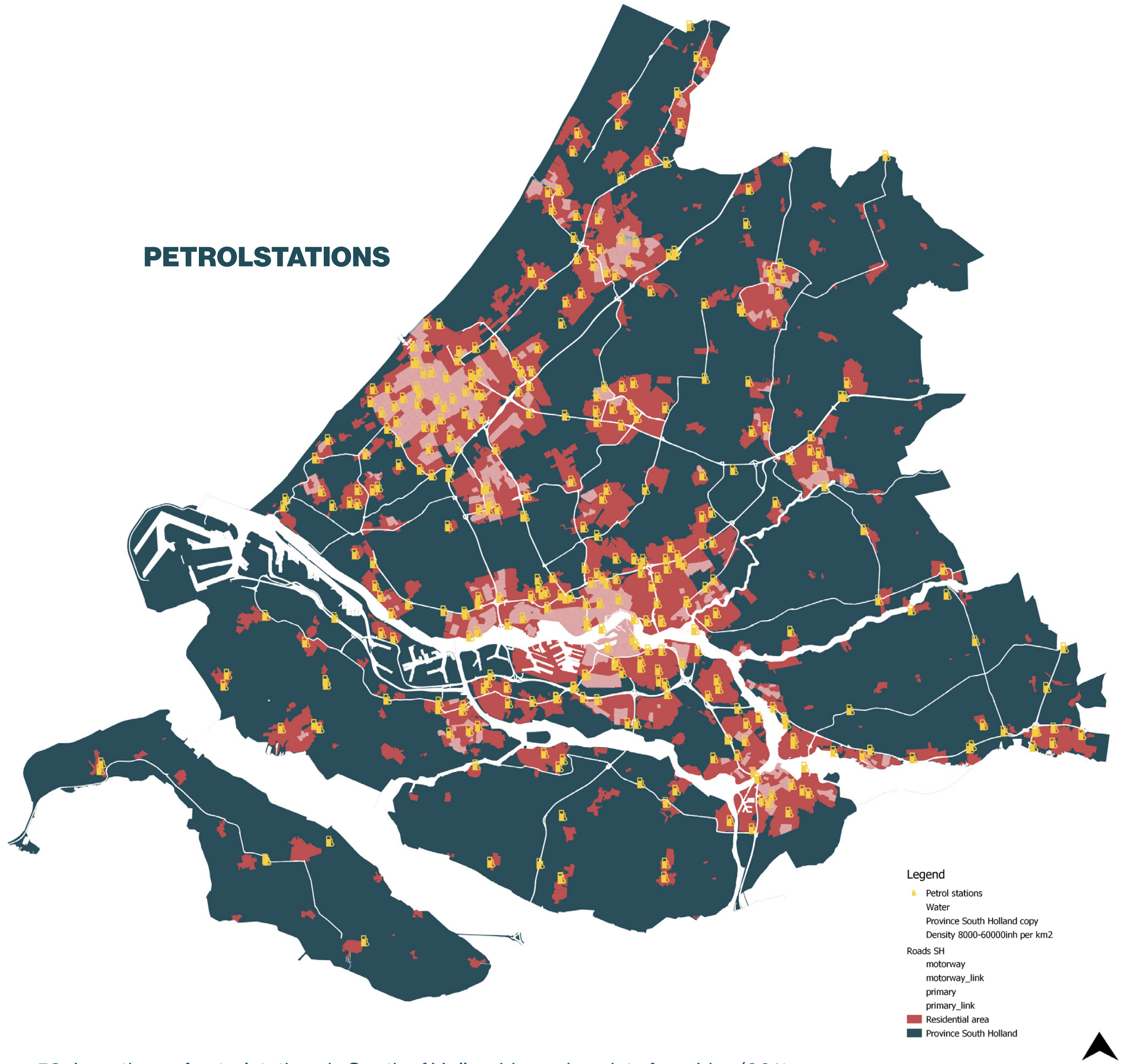


Figure 53: Locations of petrolstations in South of Holland, based on data from Lisa (2019

367 x covering 0,73 km2

WASTESCAPES - PARKINGLOT

The exact amount of parking spots in the Netherlands is not known. However, it is estimated between 14-18 million (KiM, 2018).

Based on the percentage of inhabitants and jobs in the province of South Holland in relation to the rest of the Netherlands being 21% (CBS, 2021), there would be about 3,4 million parking spots spread around the province. When considering the parking sizes, access facilities and compensating for stacked parking lots this would amount to covering a surface area of about 100 km2 or equal to the size of the city of Dordrecht.

Figure 54: Dordrecht. Own image based on Google Earth

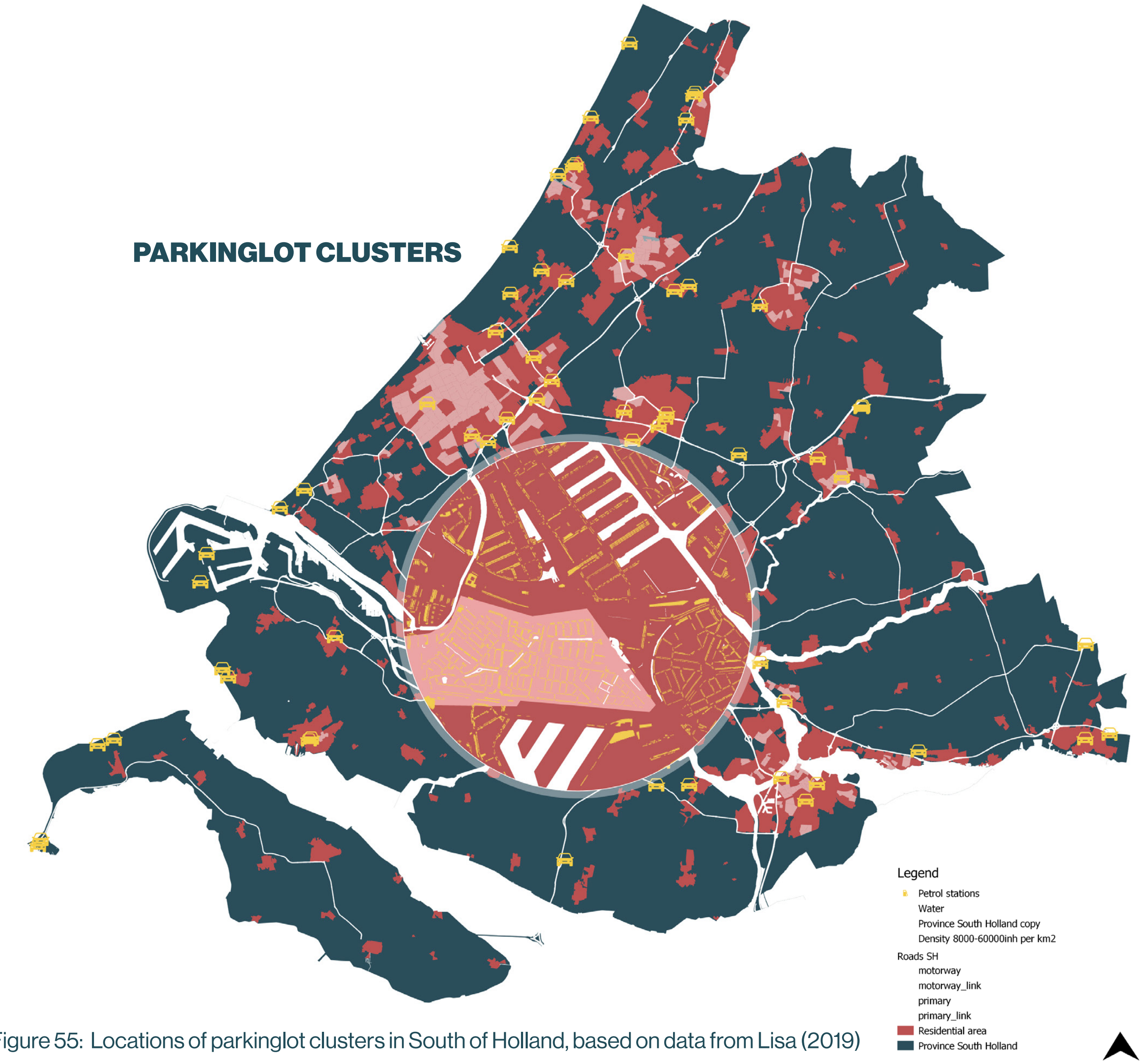


Figure 55: Locations of parkinglot clusters in South of Holland, based on data from Lisa (2019)

~16 000 000 x covering ~100 km2

04.3.2 SOIL REMEDIATION

Soil needs to be considered a non renewable source (EC, 2020) and can be used for a range of different functions, of which human activity is just one. Other functions are; biomass production, storing and filtering, aiding in biodiversity, source of raw material, carbon container and heritage site (EC, 2006).

Besides generating air pollution through the use of petroleum products, the petroleum industry causes pollution during transport, production and storage as well. Both due to the processing techniques as well as unforeseen accidents such as offshore oil spills. The sites housing refineries and storage containers in the port of Rotterdam are currently identified as "severely polluted" by the DCMR (2021). Soil quality is an important determinant of a healthy ecosystem and as Keestra et al. noted this influences practically all SDG's related to grounduse (2016). A variety of methods are available to remediate the soil depending on the type of pollution, location, financial means and for what purpose the area needs to be used. The Dutch government categorizes the methods along more and less invasive techniques such as excavation, dredging, in-situ cleaning, isolation and processing (Bodemrichtlijn, 2021). One of the more sustainable remediation techniques are the Gentle Remediation Options (GRO's), in which contaminated soil can be improved through plants, fungi or bacteria. Though durable, as it doesn't simply displace the contaminants, it is time consuming and still in development. The GREENLAND Project has shown promising results in a variety of industrial sites by applying specific plant species and setting up a framework to allow for transferability of phyto management strategies(Cundy et al., 2016). As the wastescapes from the petrochemical industry are fragmented and will be assessed on a case by case basis these methods would hold the preference in remediation.

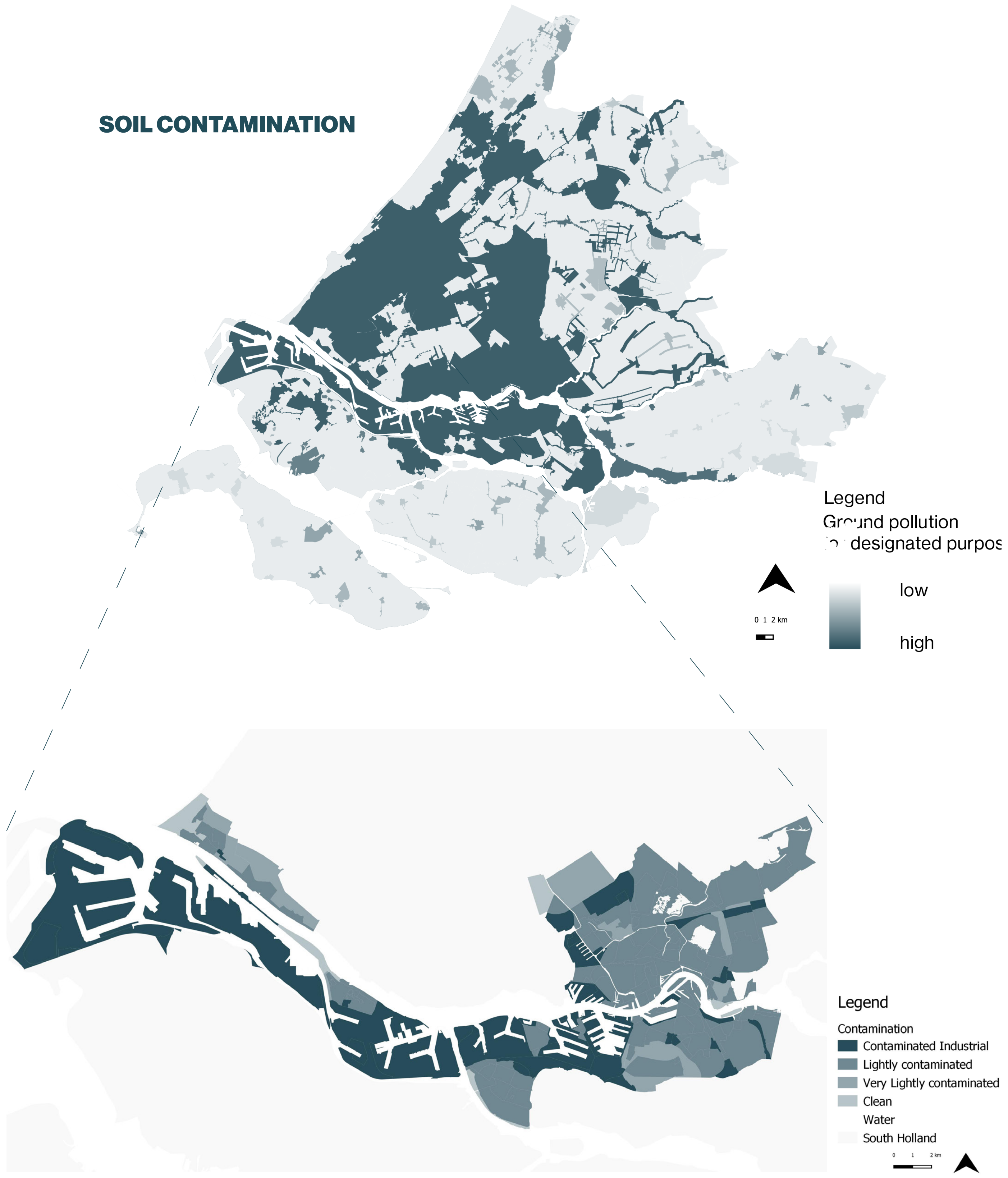
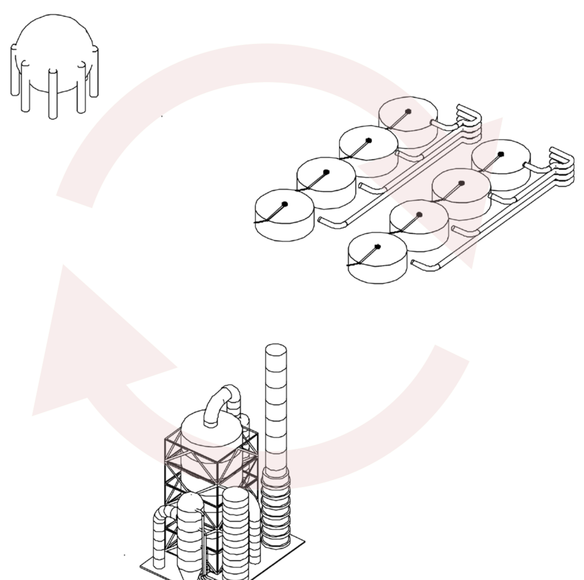


Figure 56: soil quality in the South of Holland and Rotterdam. Based on data from CBS (2018) and Bodemloket (2013)

04.4 PHASE2: SHIFTING: 04.4.1 REUSING THE CONSTRUCTIONS

As one of the aforementioned types of wastescapes, the structural elements placed on top or integrated into the landscape can be considered actual waste (Berger, 2006)

As they contain construction material as well as represent the identity of what used to be, the reuse of these elements may not only comply with the circular economy in terms of recycling but also aid in establishing a unique identity to the area.



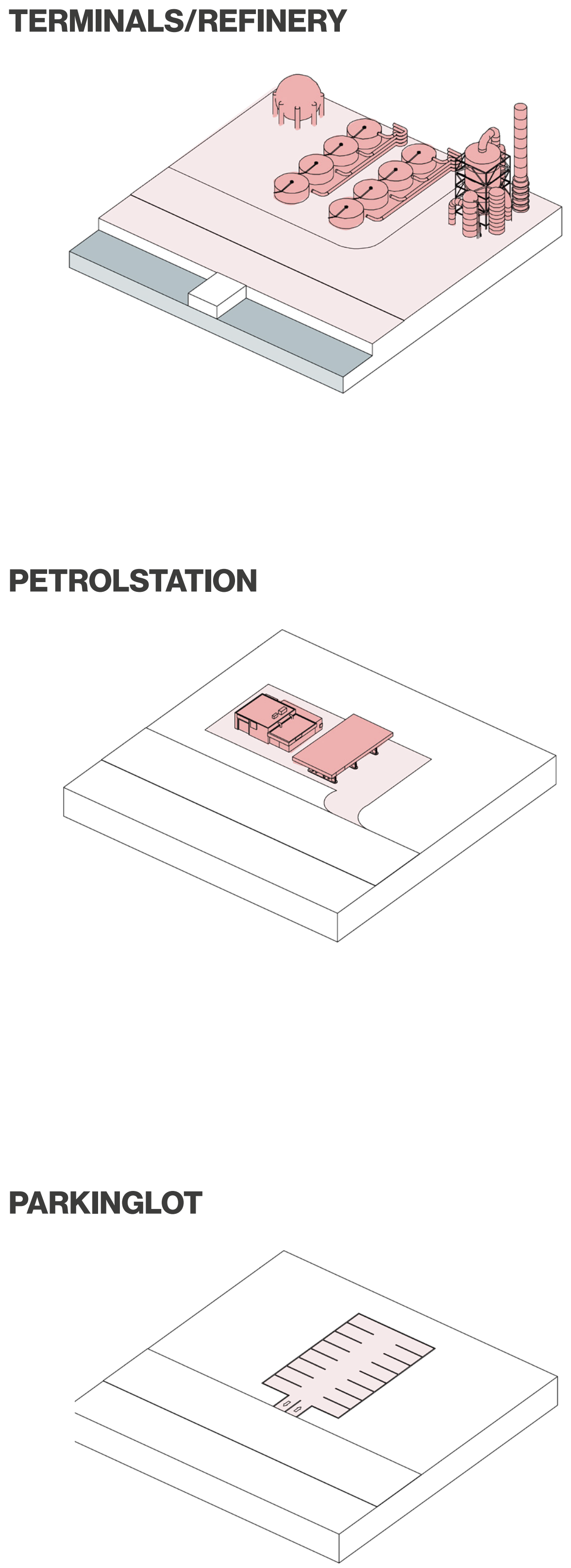


Figure 57: Types of wastescape - actual waste per typology, own image

Reference Projects of transformed industrialized sites show innovative solutions and offer an inspiring architectural environment potentially drawing creatives and SME's to the former industrial sites.

Figure 58: Tranformation project "Gashouder" by Het architectenbureau Image from Google streetview

Figure 59: Tranformation project Gashouder by Braaksma & Roos Image from Google streetview

04.4.2 WASTE COLLECTION

The province of South Holland strives for a circular province in 2050. To achieve this, waste collection and recycling are key happenings, since we can make green energy out of it (Circulair Zuid-Holland, 2019). Per year we produce an average of 490 kg of waste per person. A quarter of this is organic waste (from households) (Ecofys, 2010). Nowadays, in The Netherlands, we recycle 58% of our waste, but the goal is that we are going to recycle 80% of our waste in the future. To achieve this, it is important that people become aware of the possibilities and opportunities of waste cycles. In figure 61 you see all the different waste collectors and recyclers in the province, illustrated by blue dots. As shown in this figure, those waste collectors are mainly situated in and around large population clusters. In figure 62, 63 and 64, is visible that the bigger waste collectors are primarily located on the border of residential areas. Most of them are not easily accessible by foot. As a result, residents cannot easily dispose their waste to larger waste points themselves. So they are dependent on local pick up services to contribute to circular waste cycles of the province.

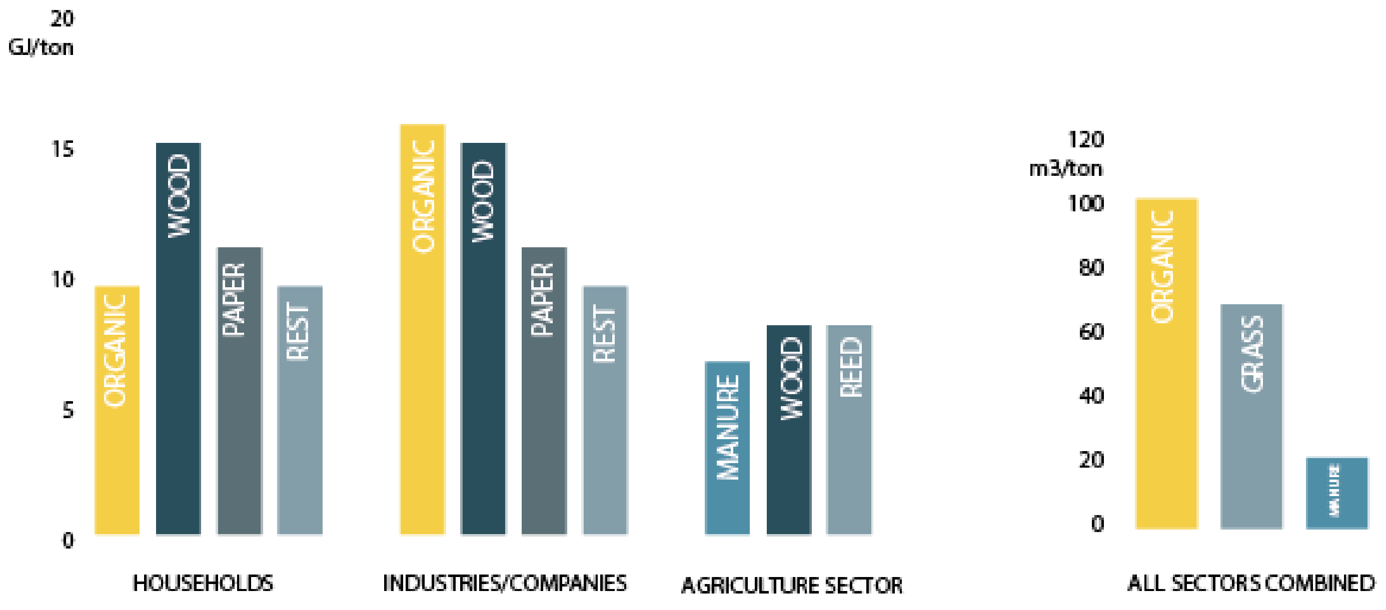
Next to household waste, there are several other waste cycles in the province. For example waste cycles of industries, companies and agricultural land. We can make energy out of these waste cycles whether it is by incineration or fermentation. The amount of energy we could get out of these waste cycles depends on the specific resources. As you can see in figure 60, organic waste and wood waste have the highest energy potential.

WE PRODUCE
490KG
WASTE
PER PERSON
PER YEAR

58%
WE RECYCLE NOW,
80%
COULD BE POSSIBLE

ENERGY POTENTIALS FROM ORGANIC WASTE CYCLES

Figure 60: Biomass energy potentials, based on Biomassapotentieel Groene Hart (Ecofys, 2010)



INCINERATION [GJ/TON] **FERMENTATION [M3/TON]**

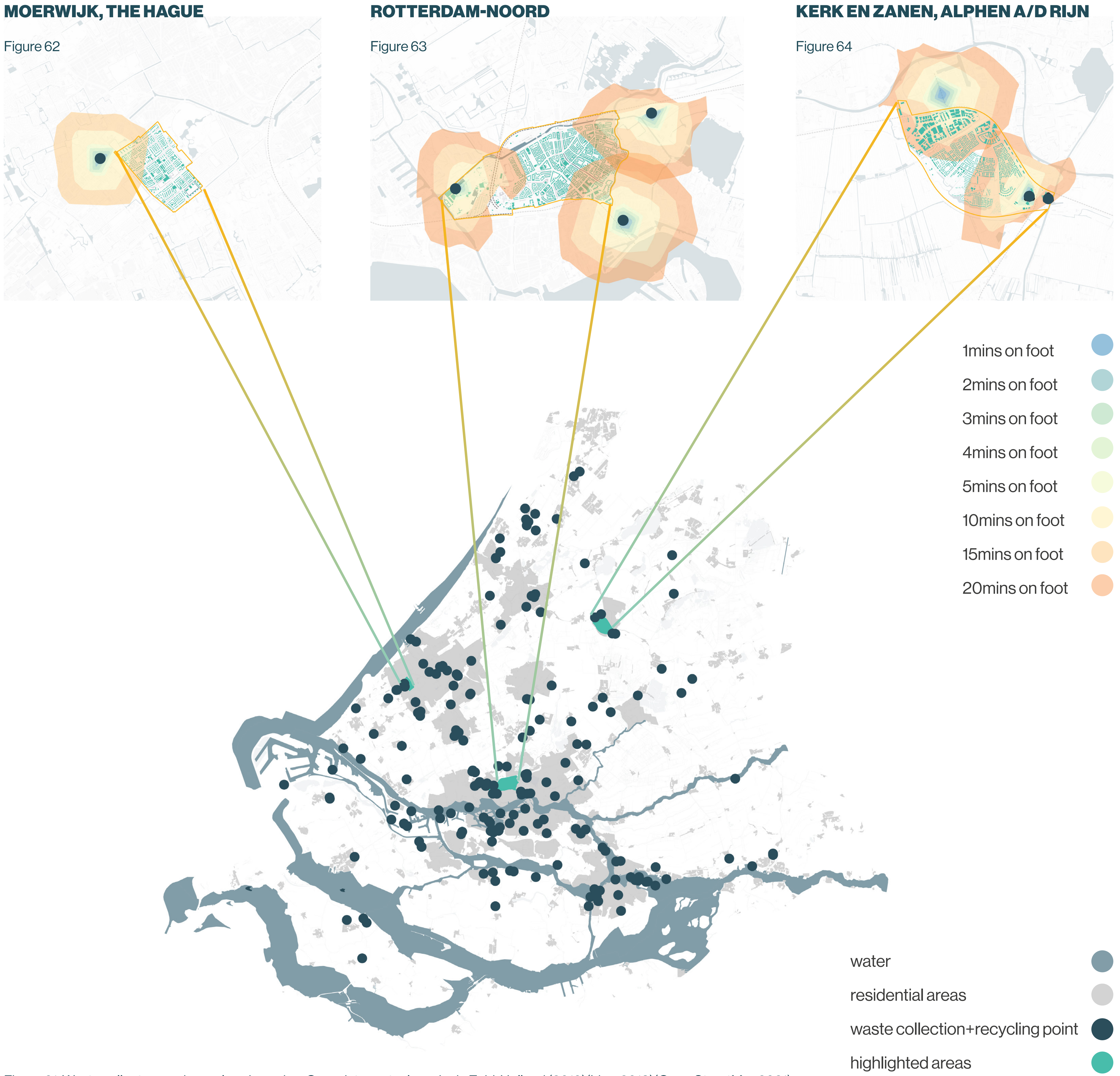


Figure 61: Waste collectors and recyclers, based on Opendata portaal provincie Zuid-Holland (2019)(Lisa, 2018)(Open StreetMap2021)

SHIFTING PHASE - MAP 2040

Around 2040 the Province of South Holland will be in the middle of a shifting phase. This phase of the transition aims at building sustainable connections, turning waste to value and changing consumer patterns. All those themes are related to the production, distribution, and consumption of fossil to biofuels. By replacing the major output of the petrochemical industry and mobility fuels with biofuels, there already will be an enormous decrease in CO2 emissions in 2040. In this way, we can mediate the in-between stages before a full transition into green, renewable energy.

In figure 65 all new connections and cycles in the province by 2040 are depicted. The yellow areas and circles visualise the bio-centres of the province. Where in 2020 there was one petrochemical centre in the province, namely the Port of Rotterdam, there will be various bio-centres in 2040. The energy networks will be more and more spread out into the province in the future. The green, curved lines stand for new, local, organic waste streams, by utilizing the existing potential of the province to improve their consumer patterns.

By all those bio-implementations we foresee a cleaner, more recycle-based province in 2040, in which we see active changes towards fully moving away from the petrochemical while creating a viable environment for the transition for all the stakeholders involved.

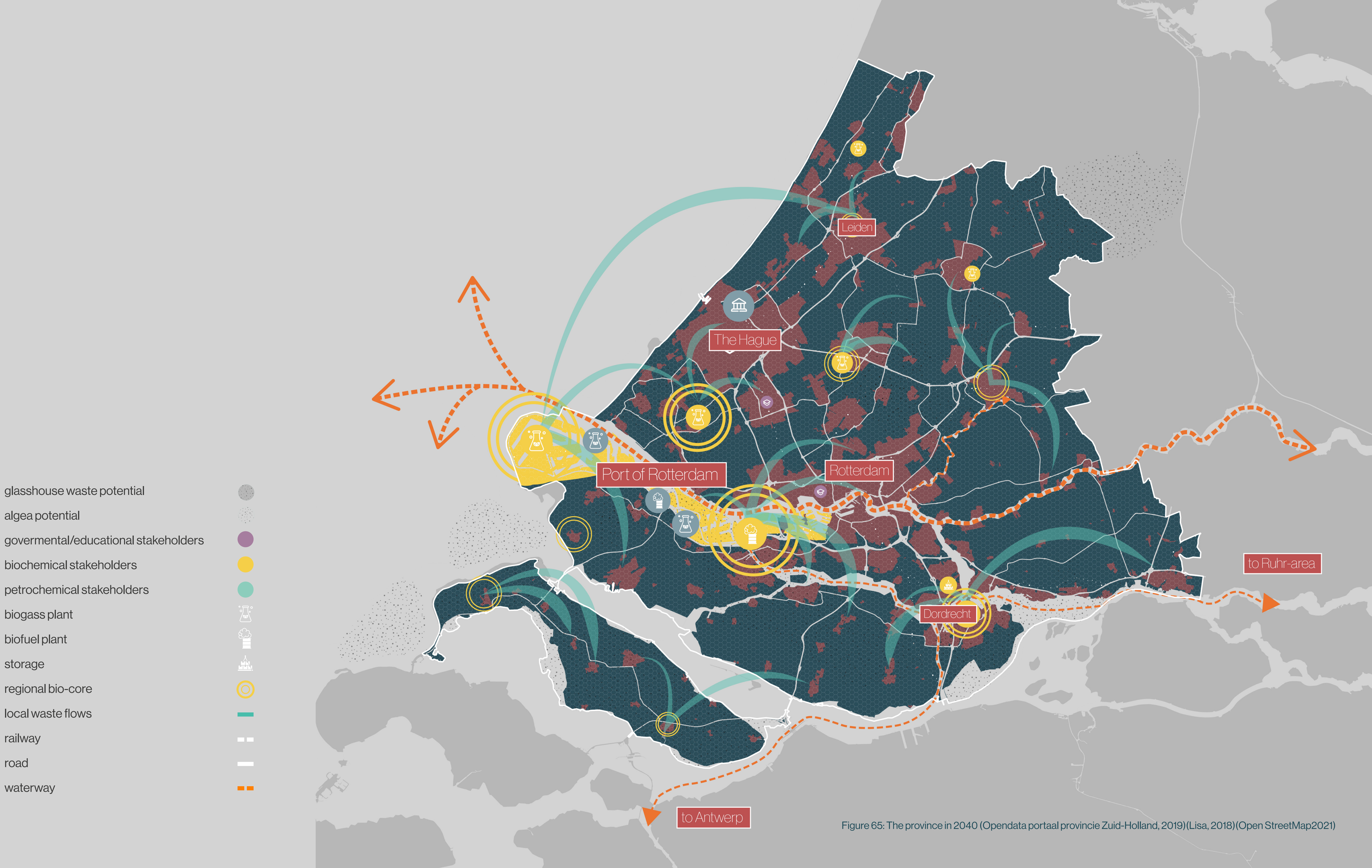
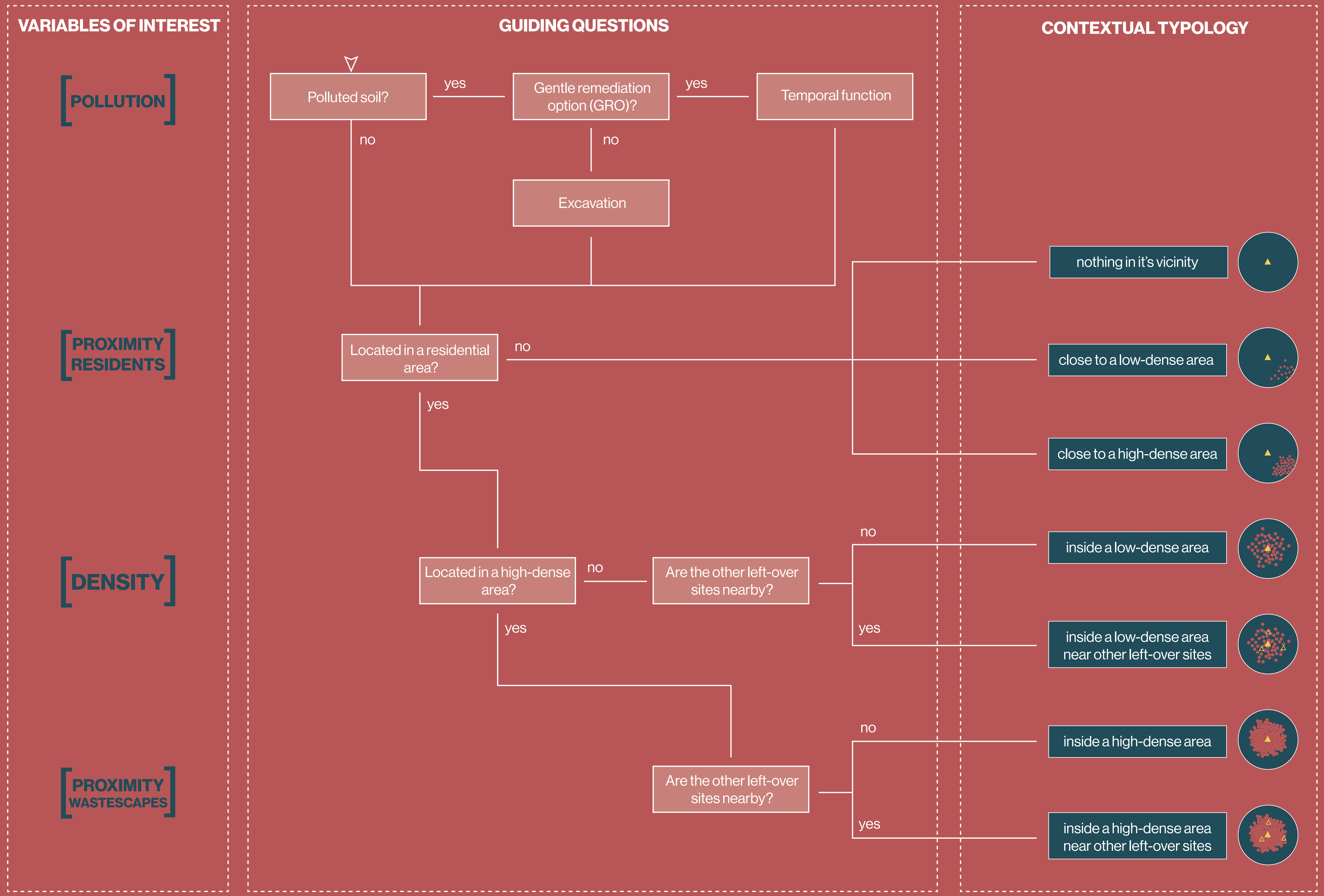


Figure 65: The province in 2040 (Opendata portaal provincie Zuid-Holland, 2019)(Lisa, 2018)(Open StreetMap2021)



DECISION TREE

The last phase consists of a definite redefinition of the new public spaces. The fossil-fuel based wastescape sites are not necessary due to new sustainable developments. To give those sites new beneficial functions, a strategic approach is needed. Several variables are defined to guide the decision process.

The first variable, pollution, has been addressed in the previous section. In the circular phase, the soil is ready to host a new clean function.

The second variable, proximity residents, covers the type of urbanisation of the landscape. South Holland is a very urbanised region, therefore we are able to speak about relatively small numbers. Since motorised vehicles are taken into account, a radius of 1 km is taken as limit number for proximity. Thus, when the wastescape has a residential area within a radius of 2 km, it is concerned as close to a residential area.

The third variable, density, is determined on the basis of the FSI (Floor Space Index) and GSI (Ground Space Index) of the area. In South Holland, urban centers have an FSI of > 1.5 and a GSI of > 0.6 (Harbers, Spoon, van Amsterdam, & van der Schuit, 2019). When the area has values below those limits, it is a sparsely populated area (for example, it is on the edge of the city / village). The degree of density in an area requires different functions, for example, a dense area has more support for small-scale niche companies, and a less dense area benefits more from improving connectivity or day-to-day facilities.

The fourth variable, proximity wastescapes, takes the existing situation into account as well as the future of the neighbourhood. In case wastescapes are close to eachother, new opportunities for the area arise. A combination of functions, exquisitely selected, could be implemented to increase the liveability or the economic position of the surrounding inhabitants. This is a case-specific matter and is therefore not further elaborated in the decision process.

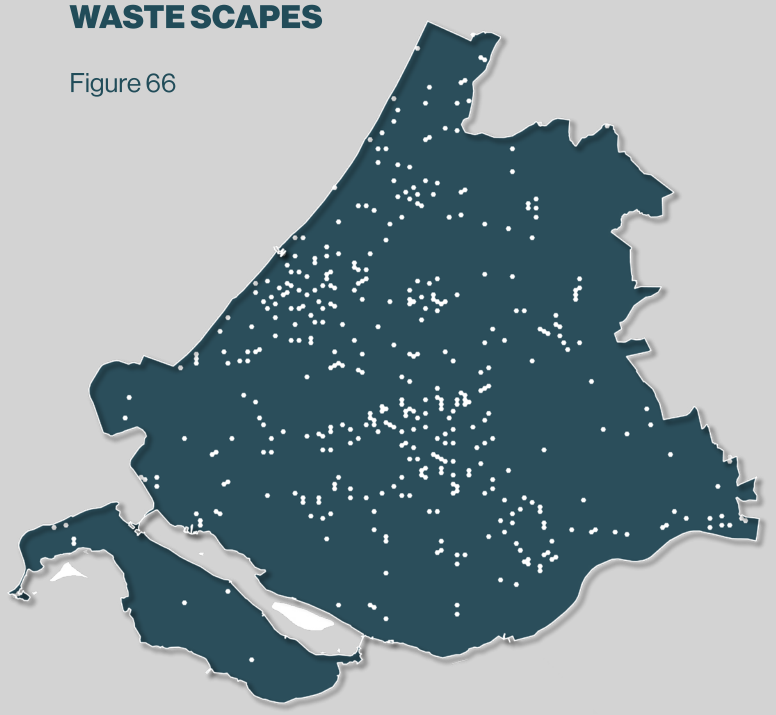
By following the tree, one will end up in one of the 7 contextual typologies. Those will be taken into account while defining the new interventions.

PHASE 3 - INTERVENTIONS MAP

Figure 66 shows where all wastescapes, and so all interventions in the province are situated and how they are connected to each other and to the regional, and national network system. The interventions are visualised by white hexagons. In figure 67, the red areas indicate the residential areas, whereas the white areas visualise the very dense areas within urban areas. These two kinds of areas will mainly determine what kind of new function the specific transformation site will get in the future (see decision tree previous page).

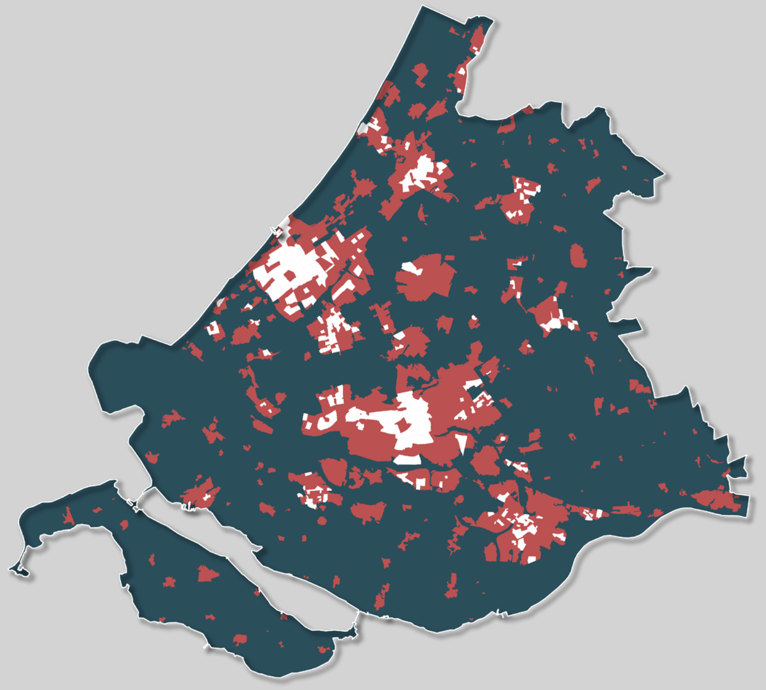
WASTE SCAPES

Figure 66



URBAN (DENSE) AREAS

Figure 67



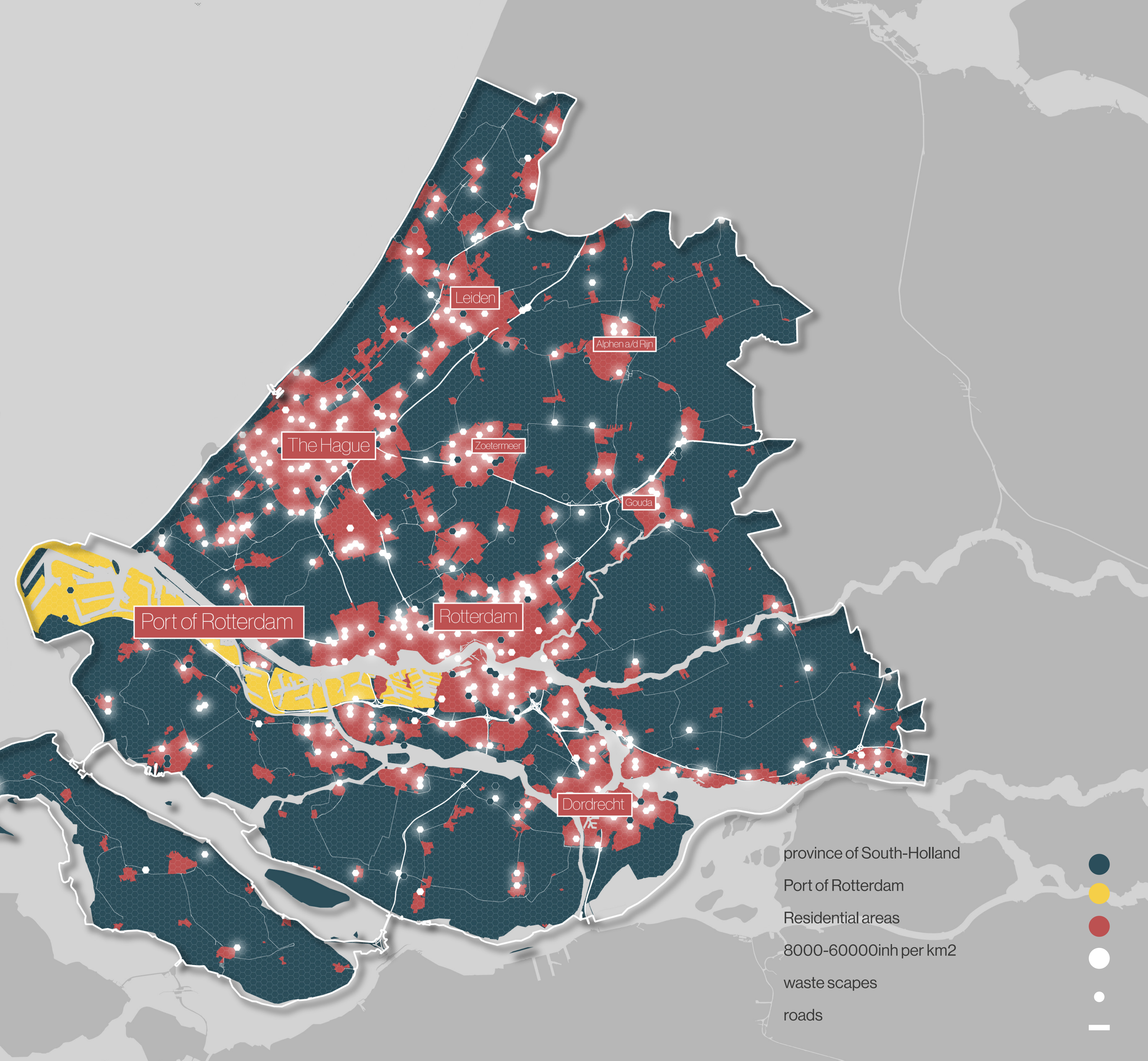


Figure XX: Intervention map (Opendata portaal provincie Zuid-Holland, 2019)(Lisa, 2018)(Open StreetMap2021)

SELECTION OF NEW FUNCTIONALITY

In our strategy, the conceivable functions for each wastescape contribute to future-proof circular South Holland. As the province itself indicates, the focus for the coming years lies in (Provincie Zuid Holland, 2019) 5 lines of action:

1. Boosting networks & chain cooperation

2. Develop and share knowledge & innovation

3. Updating policy & regulations

4. Organize a physical living environment

5. Procurement and tendering

In case of repurposing the wastescapes, this means the following. First of all, the population of South Holland is expected to increase from 3,7 to 4,2 million inhabitants. Therefore, housing and densifications are number one priority.

To enhance chain cooperation and closed loops, small and medium size companies that operate on a local level must be attracted in South Holland. The nature of those companies is diverse, therefore possibility lies in closing different chains. So, options for creating small business clusters, preferably located close to research-based site, is seen as a preferable option.

The four transitional sectors identified by the Province are: construction, plastics, food and the makers industry. Functions that contribute to the circular innovation of those sectors are a plus. Examples are modular construction hubs, regional waste-collection points, space for innovative experiments, local food supply centres, smart industry settlements and sustainable manufacturing.

Preferably, the new function of the wastescape contributes in any way to the new system of circular mobility. In this way, in theory no extra space is needed. In case one of the other purposes named above fits the site very well, this function should be implemented. This hierarchy is visualised in figure 68.

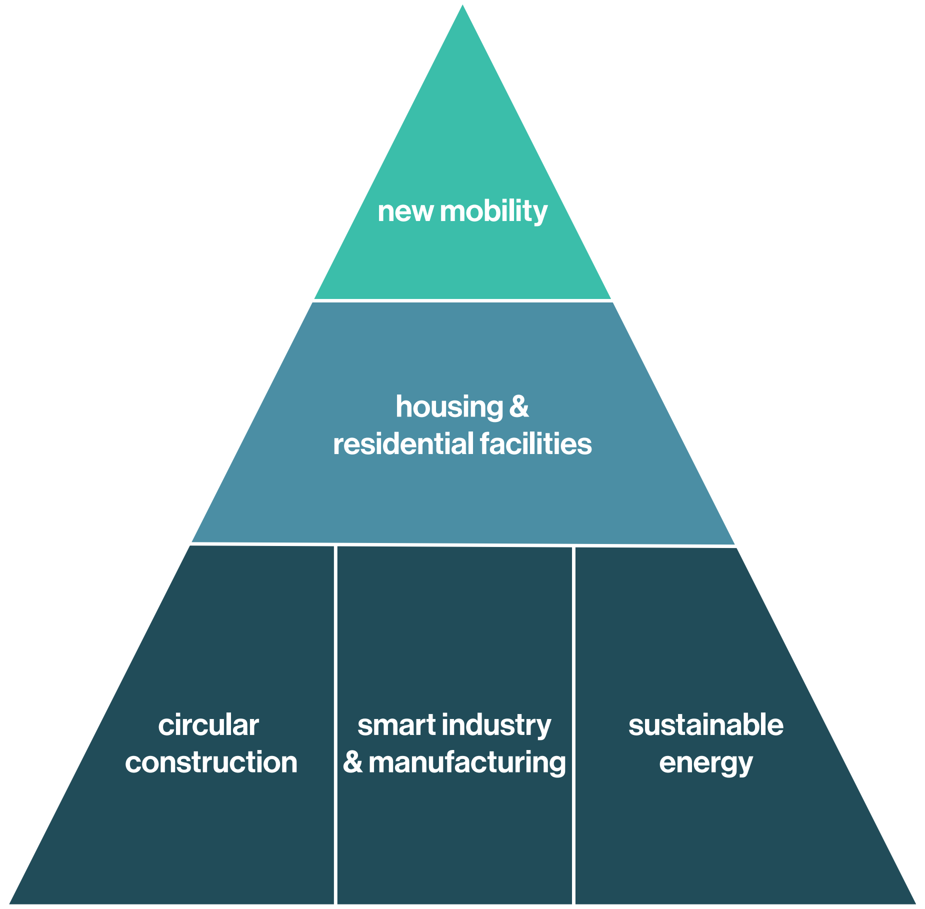


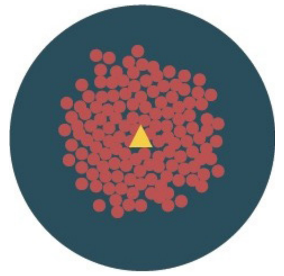
Figure 68: Function value triangle

FUNCTION | LOCATION | TYPOLOGY

production renewable energy
production mobility installations
production of biofuel
production of new urban core
production of installations renewable energy

1 Outside Innercity

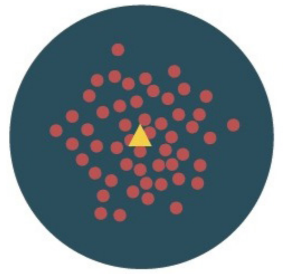
This typology is located outside a high density neighbourhood with no proximity to other wastescapes.



production renewable energy
mobility hub / mobility services
housing

2 Innercity

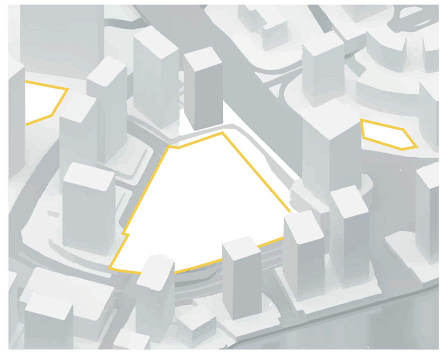
This typology is located inside a high density neighbourhood with no proximity to other wastescapes.

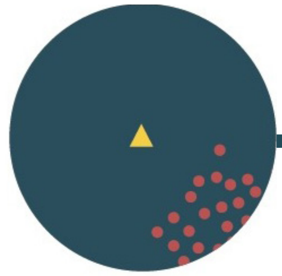


choose a function that adds extra value, by optionally consulting the triangle of functions of interest

3 Innercity several

This typology is located inside a high density neighbourhood with proximity to other wastescapes.





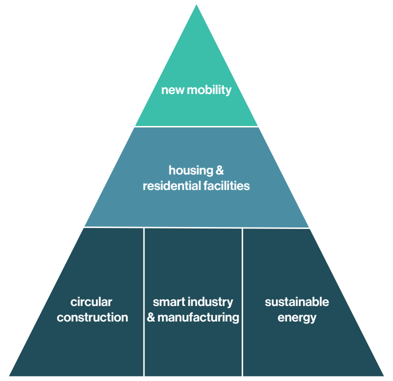
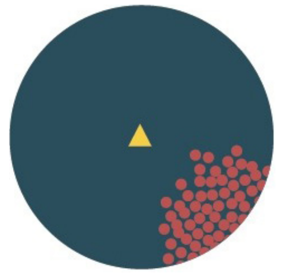


Figure 69

choose a function that adds extra value, by optionally consulting the triangle of functions of interest

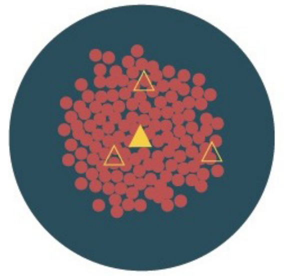
TYPOLOGY | LOCATION | FUNCTION



4 Outside Village

This typology is located outside a lower density neighbourhood with no proximity to other wastescapes.

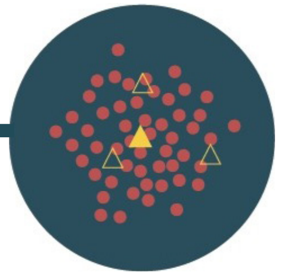
production renewable energy
production mobility installations
production of biofuel
production of new urban core
production (of installations) renewable energy



5 Village

This typology is located in a lower density neighbourhood with no proximity to other wastescapes.

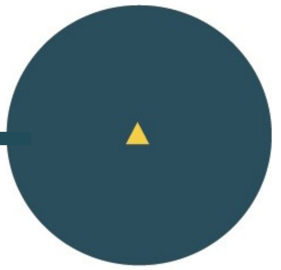
production renewable energy
mobility hub / mobility services
housing

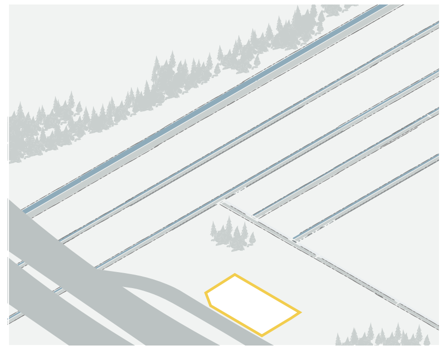


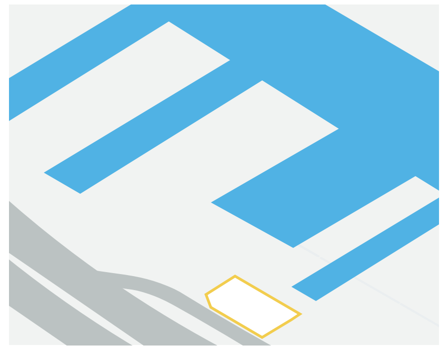
6 Village-several

This typology is located in a lower density neighbourhood with proximity to other wastescapes.

choose a function that adds extra value, by optionally consulting the triangle of functions of interest

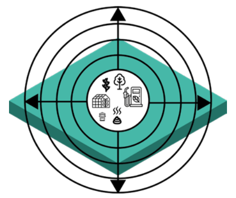


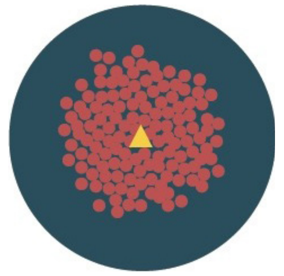




7 Rural

This typology is located in a rural area with no proximity to other wastescapes. This typology is divided into: 1. Rural landsape & 2. Port landscape.





TYPOLOGY 1

Typology 1, also known as our inner-city typology, handles from its downtown character with proximity to high density areas. These high density areas are characterised by highrises with both residential and commercial functions. Within these areas the available spaces are rare. The majority of open space is dominated by infrastructure built for automotive use.

Within this typology the existing area, for example the Shell Hofplein petrol station, is characterised by a petrol station which is enclosed by the urban fabric. The integration within the urban structure of these petrol stations is crucial, these locations have high accessibility scores.. This high accessibility and the fact that the area in which this typology lies is used by a lot of people, whether these people live, work or use these areas for other uses. The high usage of this area makes this typology suitable for a mobility hub. By combining these different modes of transport, an interwoven network with high-speed transport and point-to-point systems will be created.

The practical outcome of the transition of these spaces is displayed in the 3D visual. Hereby we can see that the existing structures will mainly be preserved, but be filled in with different functions. The buildings will be made accessible by the public and they can be used as stops for the different transport lines. Therefore contributing to the seamless transfer between the different modes of transport within the mobility hub such as bike-sharing, subway, car-sharing, air mobility and rail.

CURRENT

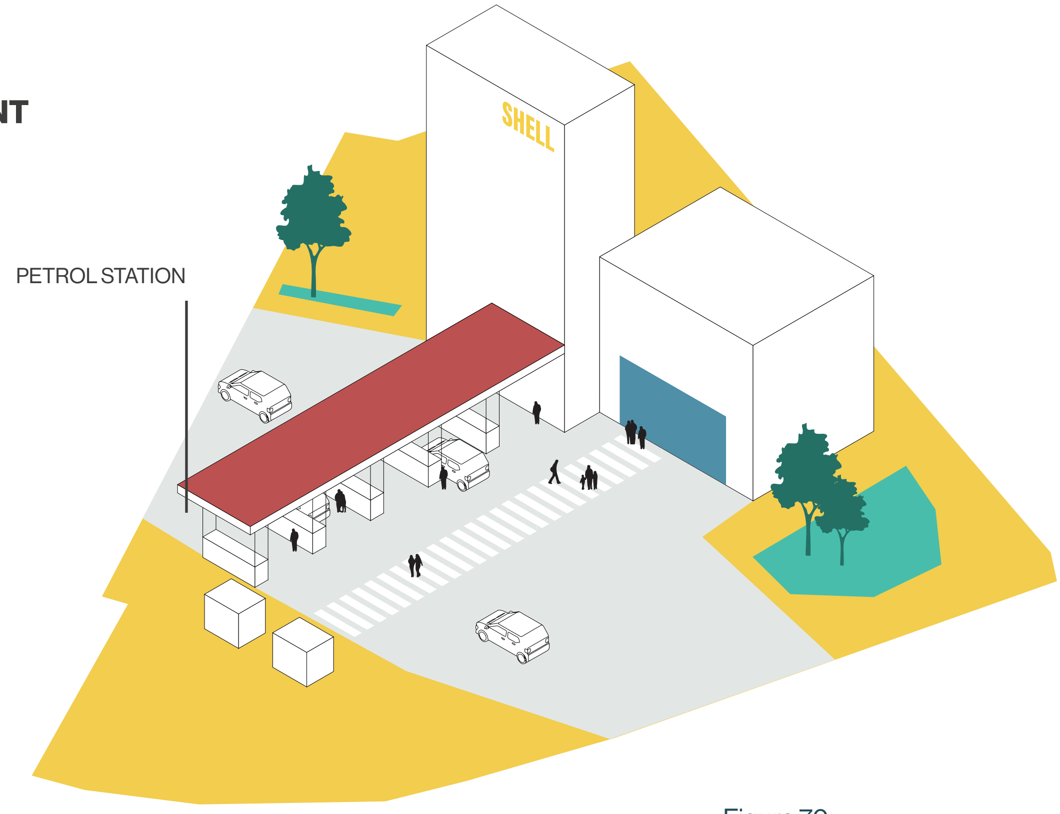


Figure 70

NEW

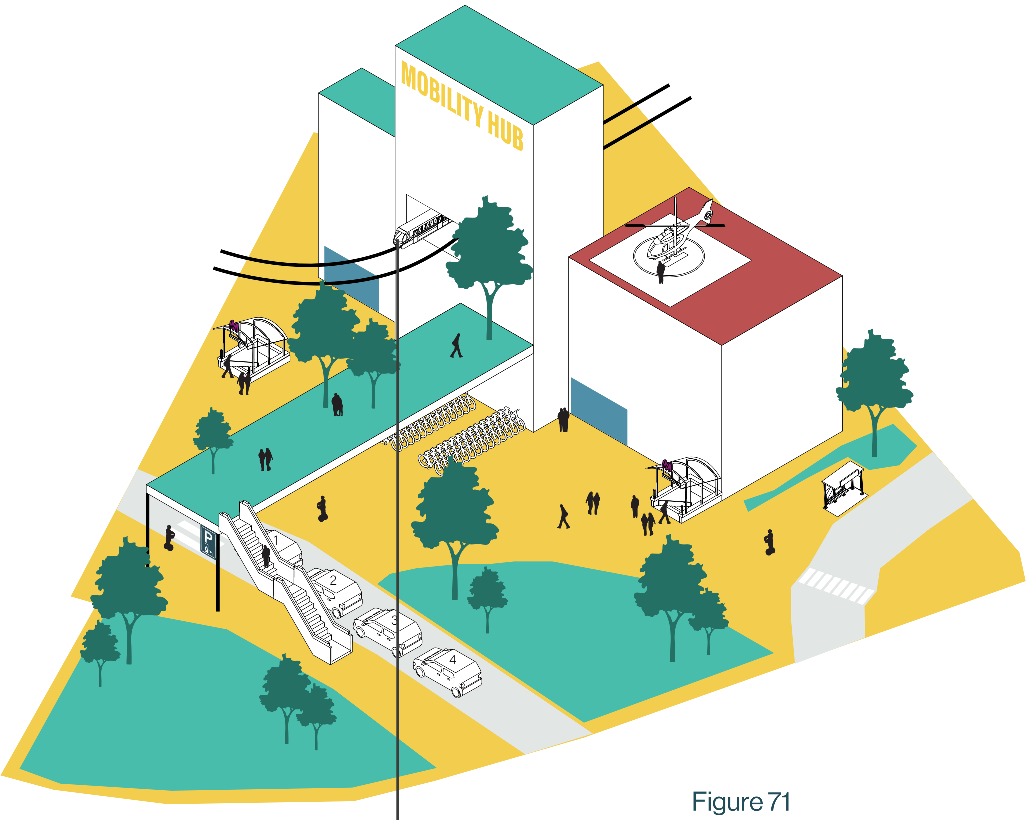


Figure 71

Figure 72 based on Google Maps (2021)

SHELL HOFPLEIN

430m2

LEGEND

PETROL STATION

RESIDENTIAL AREAS

WATER

200 m

TYPOLOGY 2

Typology 2, also known as our inner-neighbourhood typology, handles from its proximity to low-density residential areas. These residential areas predominantly make up for the outskirts of our major cities, but can also be found in between these cities, in smaller villages for example. The majority of open space within these residential neighbourhoods is used for use of the automotive industry, with a coincidental recreational green space in between.

Within these neighbourhoods, the petrochemical industry makes up for a smaller space when compared to the inner-city typology. The character of these petrol stations is likewise different.

The proximity to these smaller residential neighbourhoods make for an ideal place to introduce our transition to the general public.

By being close to these residences, the distance between the former petrol station and the places where people live is extremely small. Therefore, the direct impact on people's lives will be significant. When transforming these former petrol stations into places where renewable energy will be generated, the public will become familiar with this idea of the transition. While these energy outputs won't be large, the public support for larger projects will grow because of it. By introducing these smaller scale energy production locations, the stigmatisation and negative concerns about noise and visibility pollution will likely decrease.

CURRENT

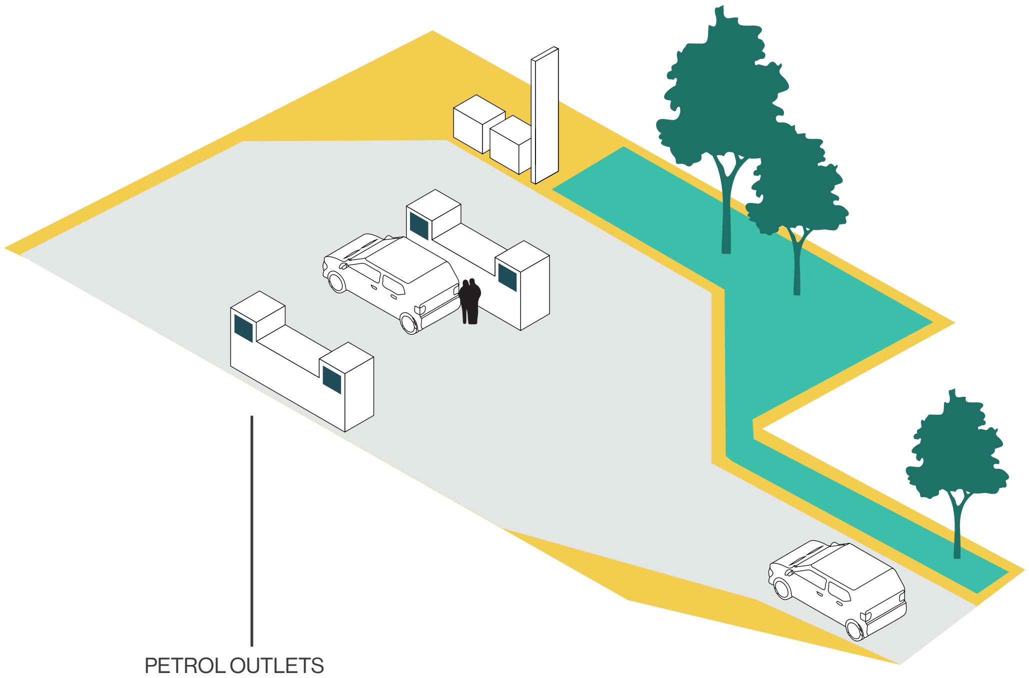


Figure 73

NEW

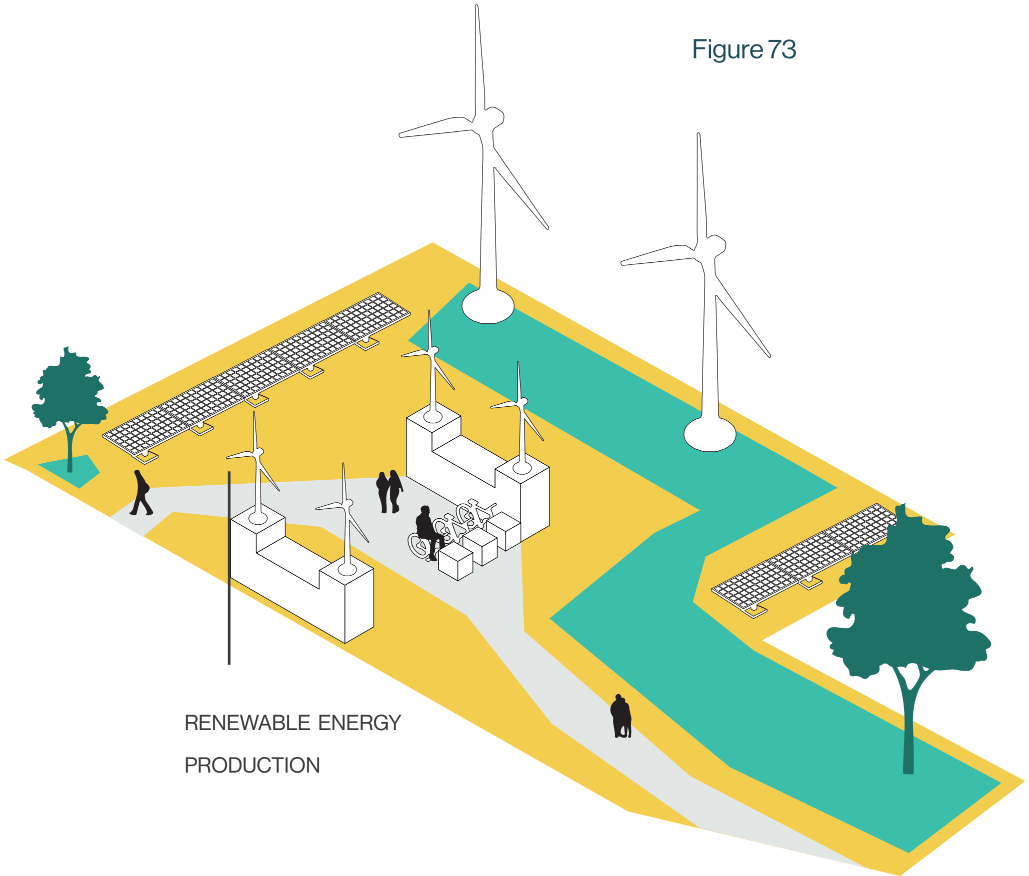


Figure 74

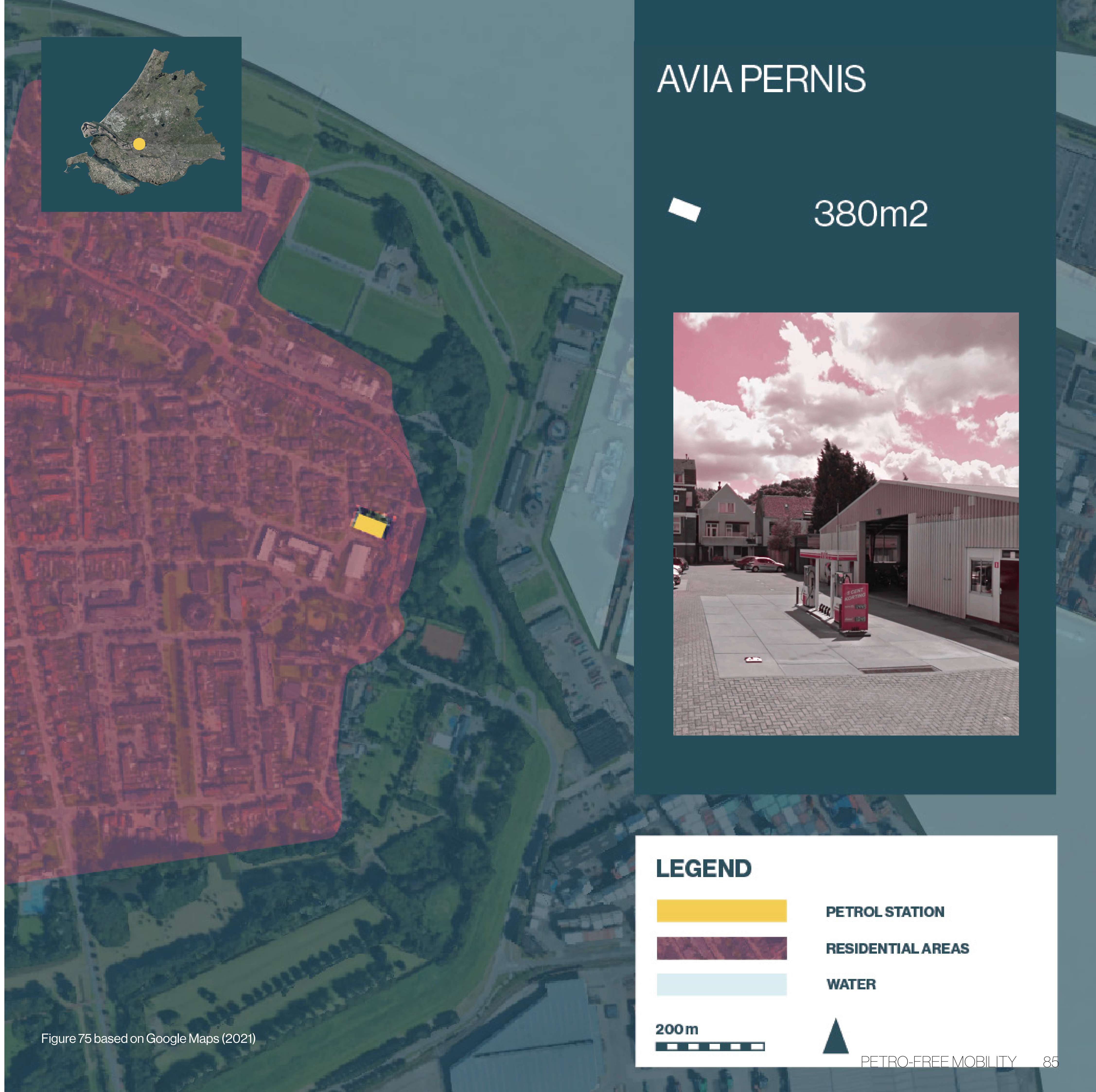
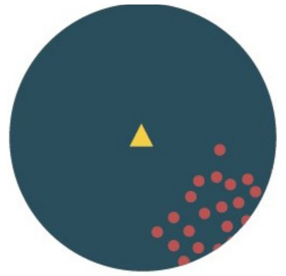


Figure 75 based on Google Maps (2021)



TYPOLOGY 3

Typology 3, also known as our rural transport typology, is focused on the transport structure within the province of South Holland. This typology lies alongside the biggest roads within the area. These roads connect the major urban centers with each other. For example, the Esso Ruyven petrol station lies alongside the highway A13 between the urban centers of Rotterdam and The Hague. This adjacency to the highway ensures high traffic, therefore the surface area of this petrol station is higher compared to the petrol stations mentioned in typology 1 and 2.

In the current situation this traffic predominantly relies on the use of the petrochemical industry. In our vision, these modes of traffic will change significantly. By using these former rural petrol locations to facilitate these new modes of transport, the accessibility of these new types increases.

In this case, the Esso Ruyven petrol station is being transformed into a factory in which electric vehicles are produced. In this case, the factory will house a production and maintenance facility for the production of electric cars by for example Tesla and the production of rail vehicles by Alstom.

CURRENT

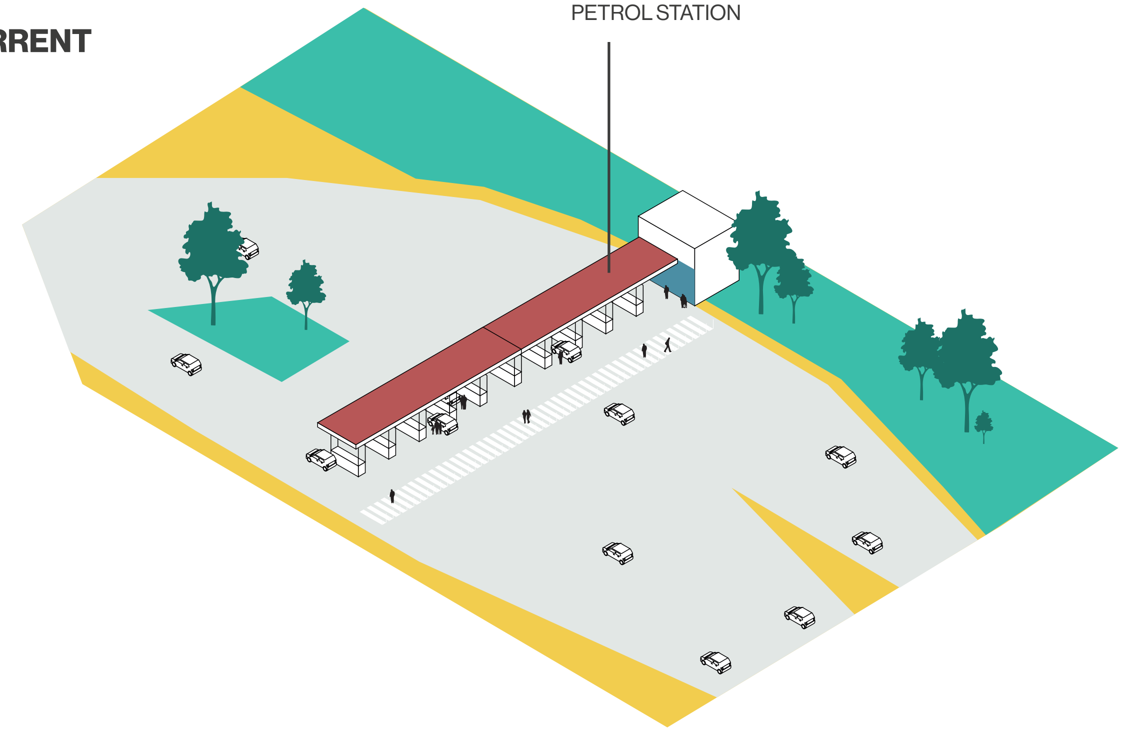


Figure 77

NEW

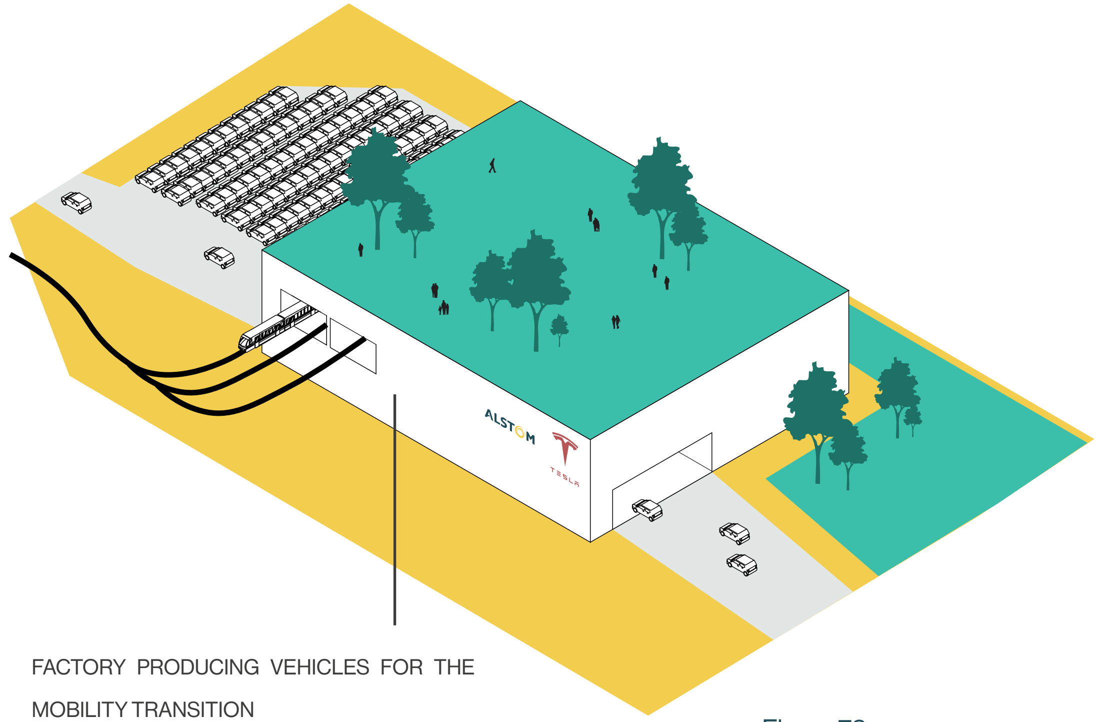


Figure 78

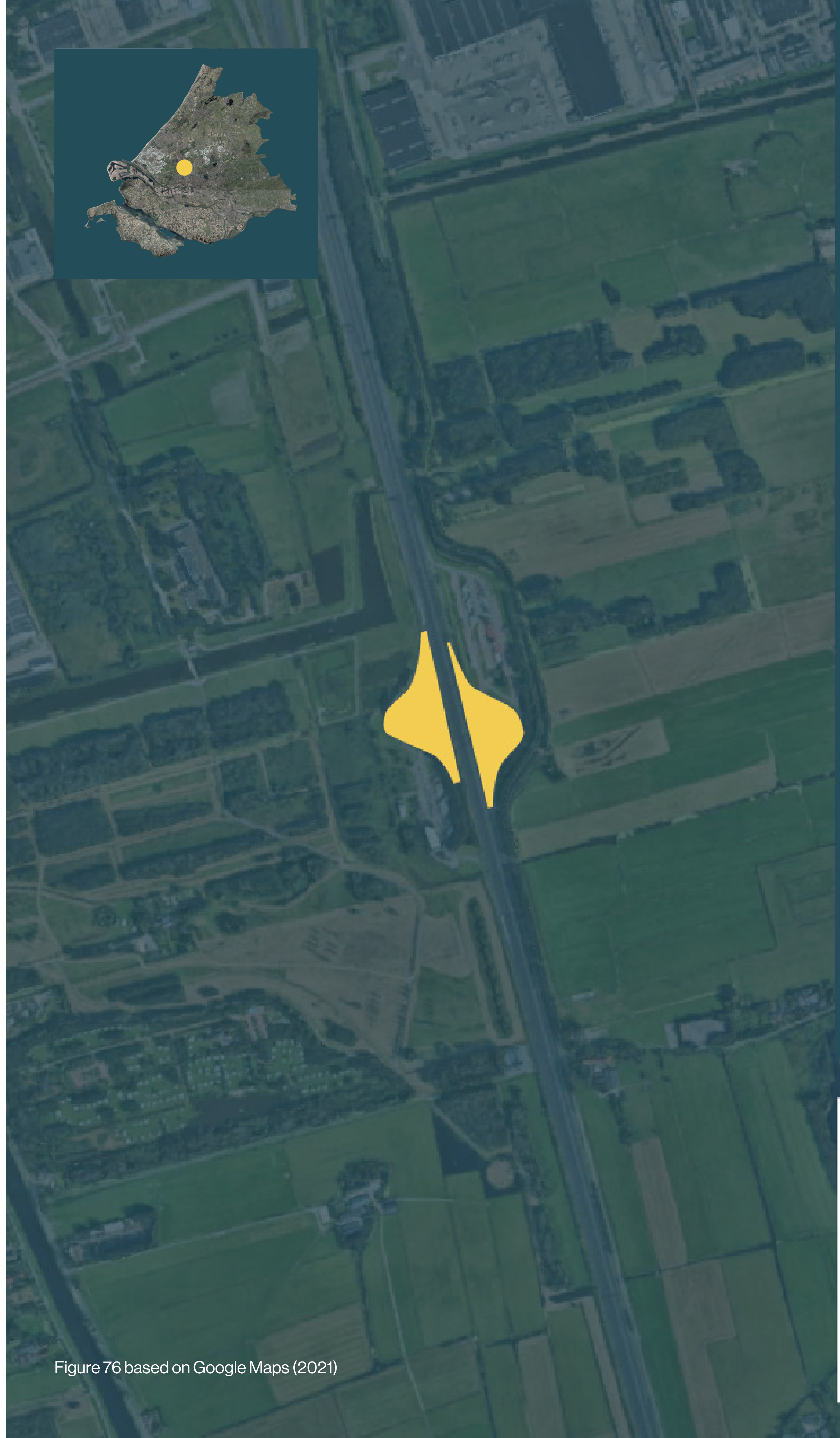


Figure 76 based on Google Maps (2021)

ESSO RUYVEN

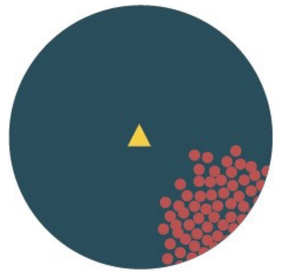
23 300m2

LEGEND

PETROL STATION

RESIDENTIAL AREAS

200 m



TYPOLOGY 4

Typology 4, also known as our outside inner-city typology, is focused on making the connection between the rural transport ways and inner-city mobility. These locations are therefore located just outside the dense urban structure from the inner-city, next to the bigger transportation flows, such as for example the A13 between Rotterdam and The Hague. These transportation flows generate a lot of traffic going into the inner-cities. These inner-cities often are characterised by medieval road structures not capable of handling huge amounts of traffic. While making these cities suitable for automobiles, the liveability in these inner-cities is at stake, as described earlier on in this report.

By choosing these locations, which in the current situation are parking lots, the seamless transition between the faster transportation modes and the transportation modes suitable for use in these inner-city structures can be ensured. These parking spots are being transformed into park and ride-like mini mobility hubs. The smaller mobility hubs allow for parking electric cars and consequently changing onto another mode of transport such as bike-sharing and walking.

In this case, the parking lot along the highway A13 will be transformed from a conventional parking lot used solely for parking usage into such a small mobility transfer. This seamless transfer will encourage automobilists from The Hague and Rotterdam to change travel modes here and visit the city center of Delft by bike.

CURRENT

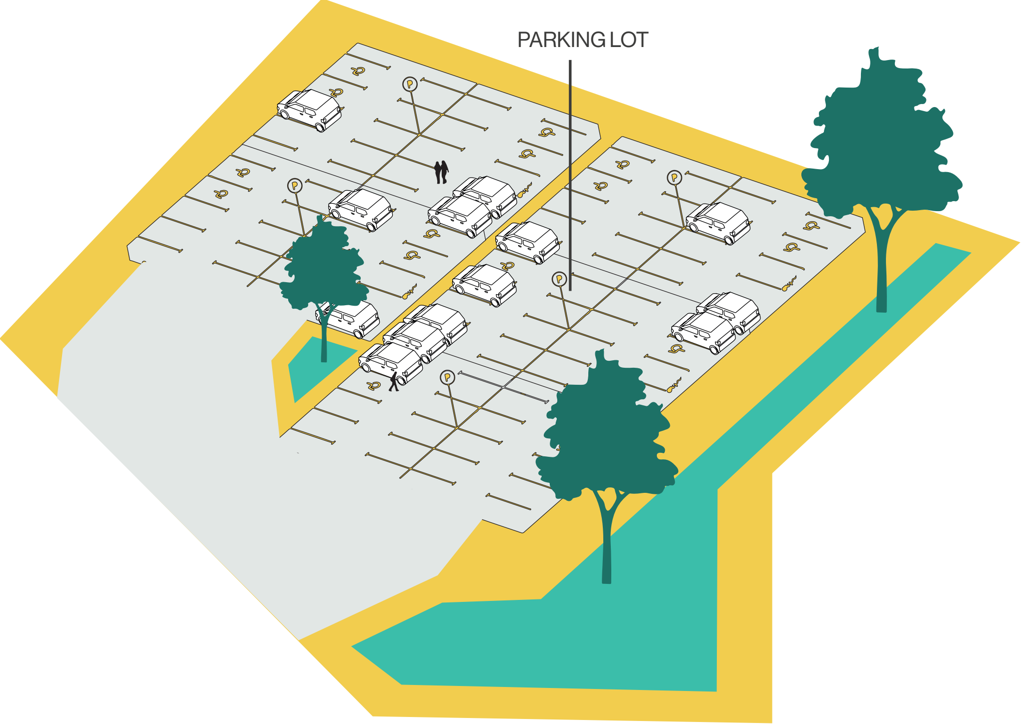


Figure 80

NEW

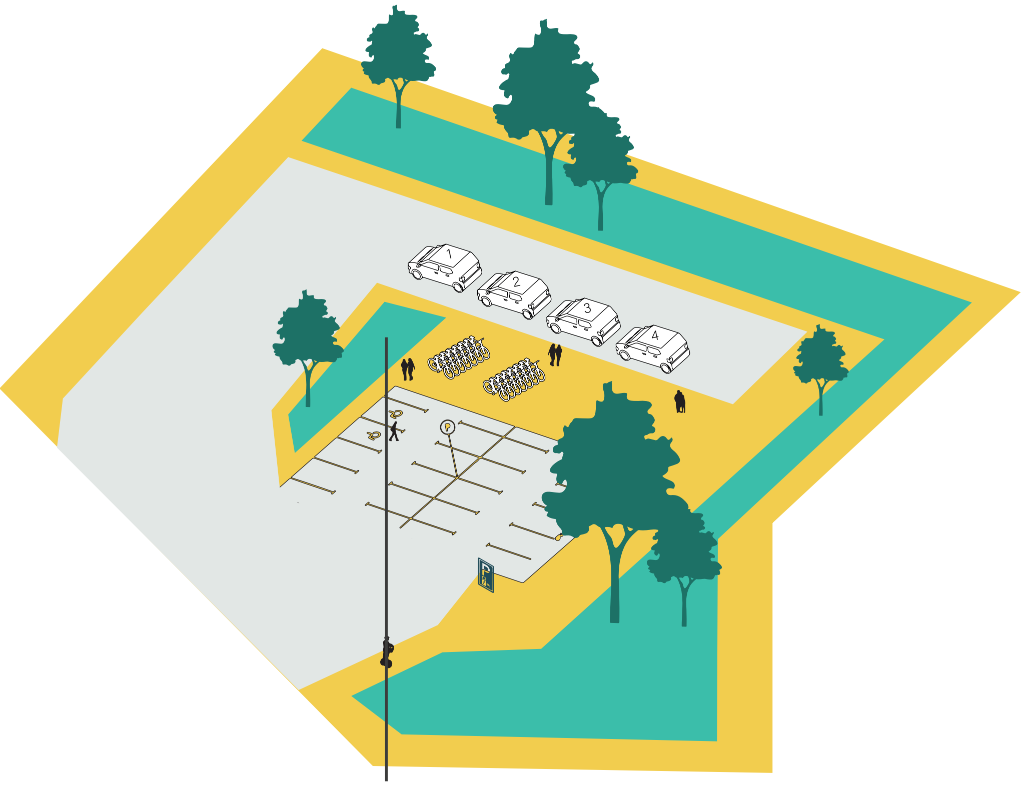
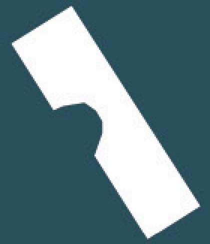


Figure 81

Figure 79 based on Google Maps (2021)

IKEA PARKING LOT, DELFT



Oostpoortweg

x 312

12.000m2

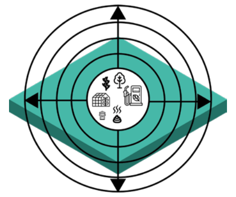
LEGEND

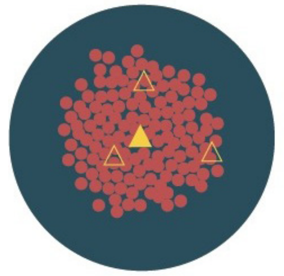
PARKING LOT

RESIDENTIAL AREAS

WATER

200 m





TYPOLOGY 5

Typology 5 is our first typology in which we have several wastescapes in proximity to each other. This leads us to a different approach. The typology 5, which is also known as our inner-city several locations typology, focuses on creating spaces which serve the city well. This is contrary to our typologies which have one specific function derived from the decision tree. Derived from the decision tree, a clear outcome is possible, but in this case the outcome is location-specific.

When looking at these specific locations, it is important to keep in mind that in order to fall into our vision, different functions need to have different priorities. These function-priority patterns can be derived from the value triangle . In this triangle the most important functions are placed at the top, while moving downwards these functions will have less value. These values are derived from the vision of the province themselves.

In this case, the several parking spots in Schiedam are illustrated. These parking lots can be used to serve the number one function: mobility. Or in case of the middle lot, the space can be used to improve the urban livability.

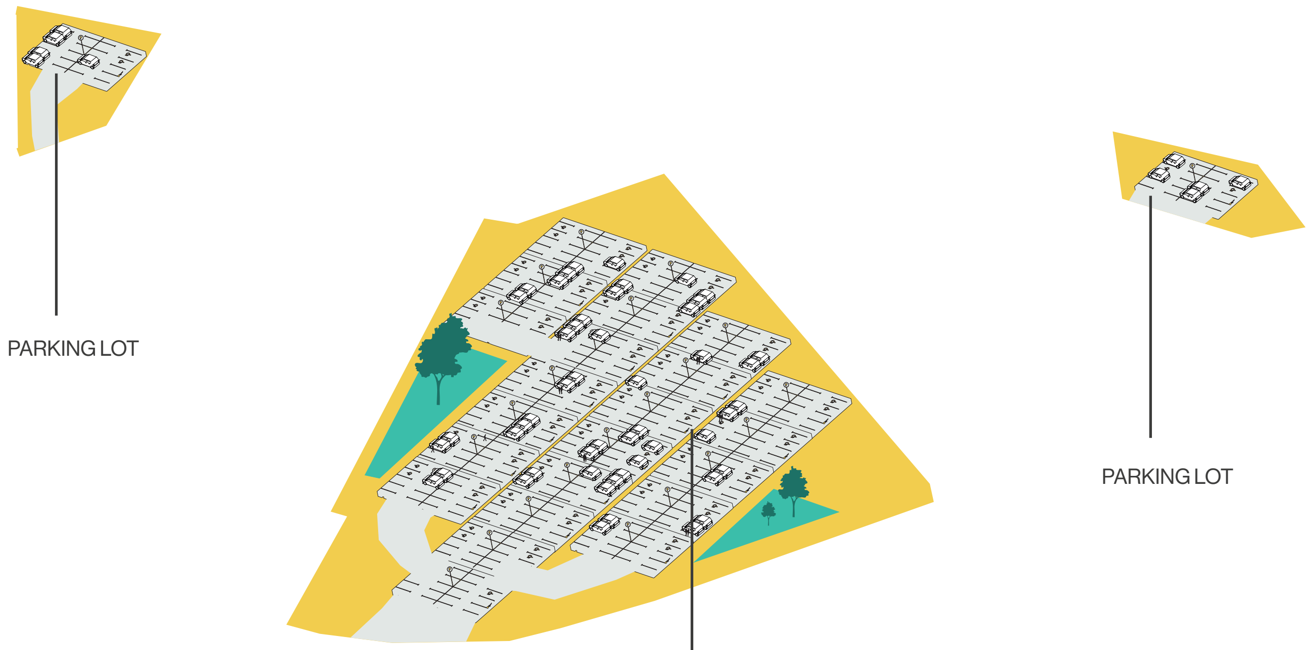


Figure 83

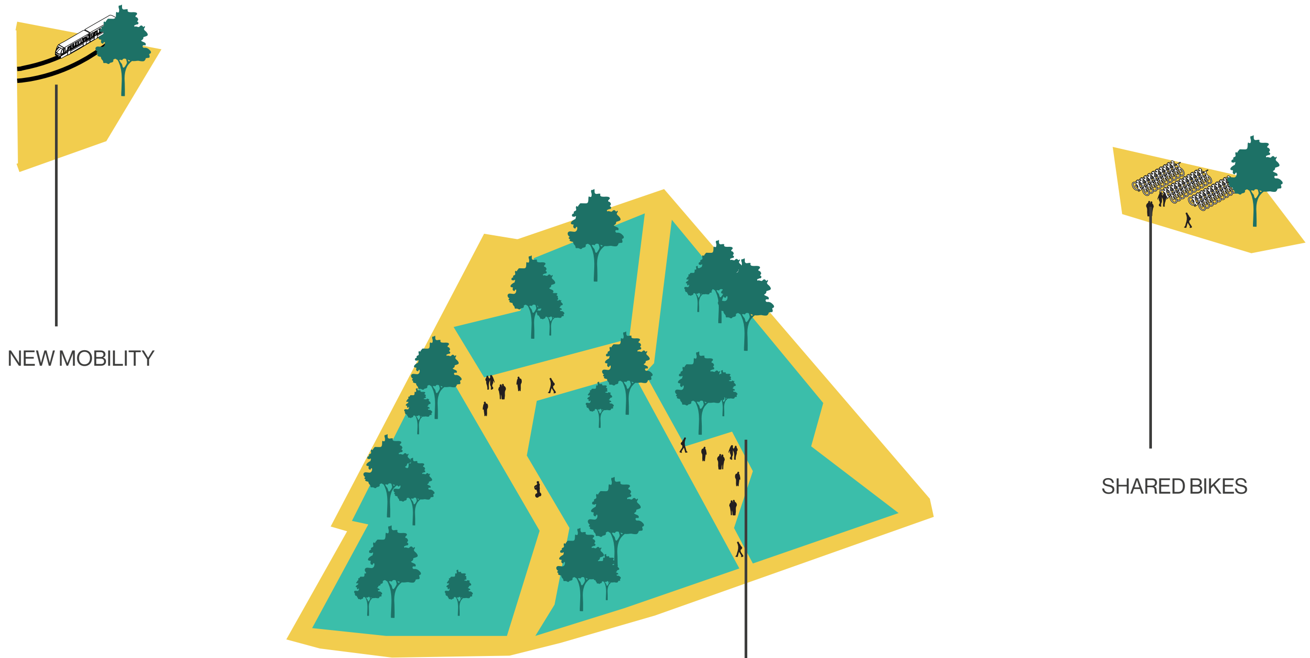


Figure 84

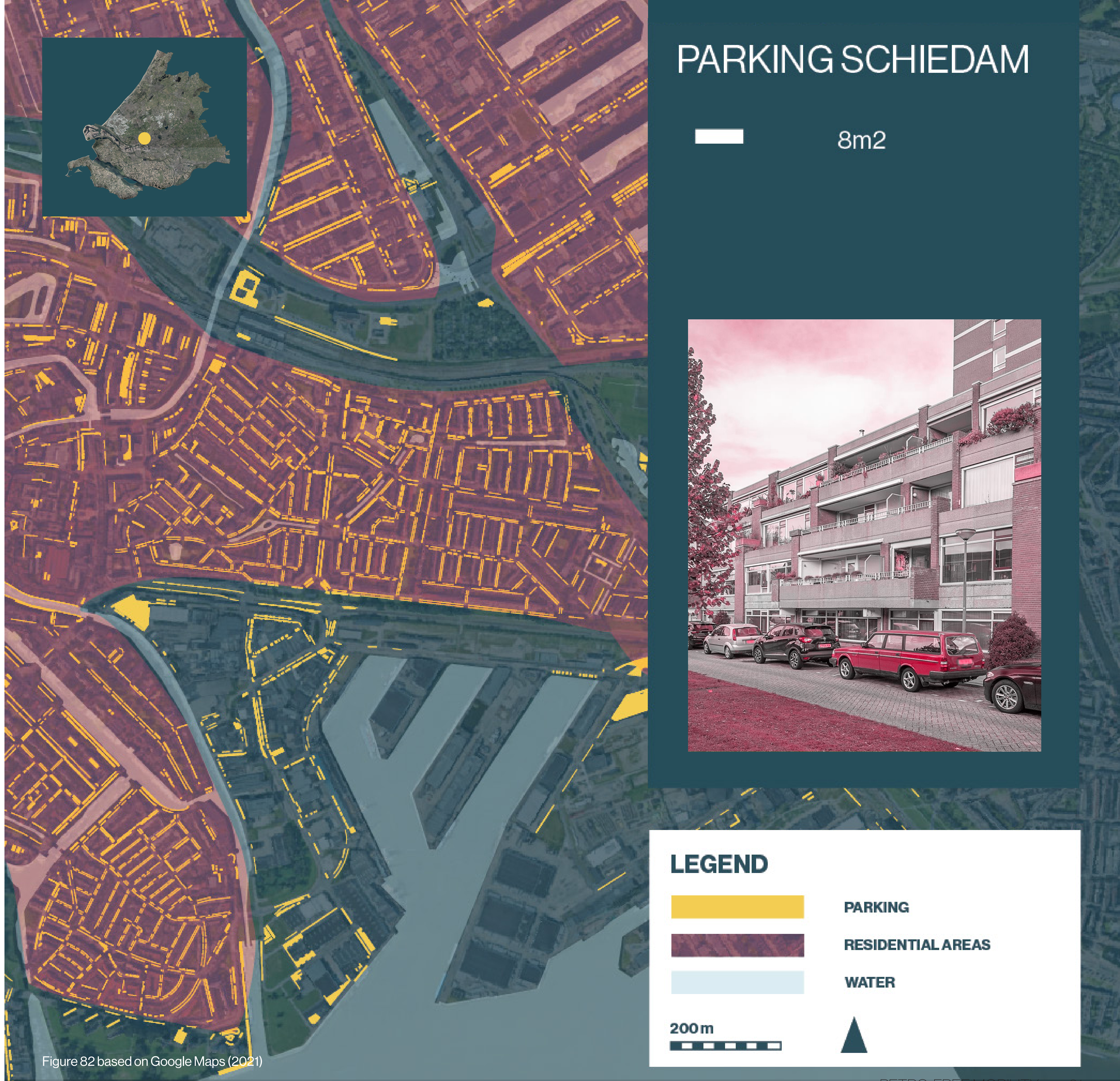
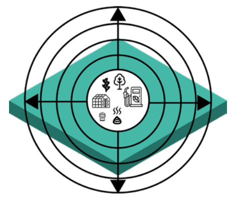
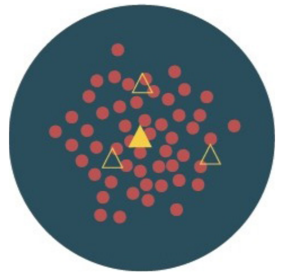


Figure 82 based on Google Maps (2021)





TYPOLOGY 6

Typology 6 is our second typology in which we have several wastescapes in proximity to each other. This time the typology is situated within an area with a lower population density. Therefore we call this typology our lower density-residential several locations typology. Just like in typology 5 this typology does not have a clear outcome from the decision tree, therefore we use the same decision method as described in the value triangle at the previous page.

In this case, several parking spots in Zoeterwoude are taken as an example. These parking spots and petrol stations make up large amounts of the urban space within the overall paved area. Due to this given fact, the location-specific for more urban green is integrated in the final outcome for this location.

CURRENT

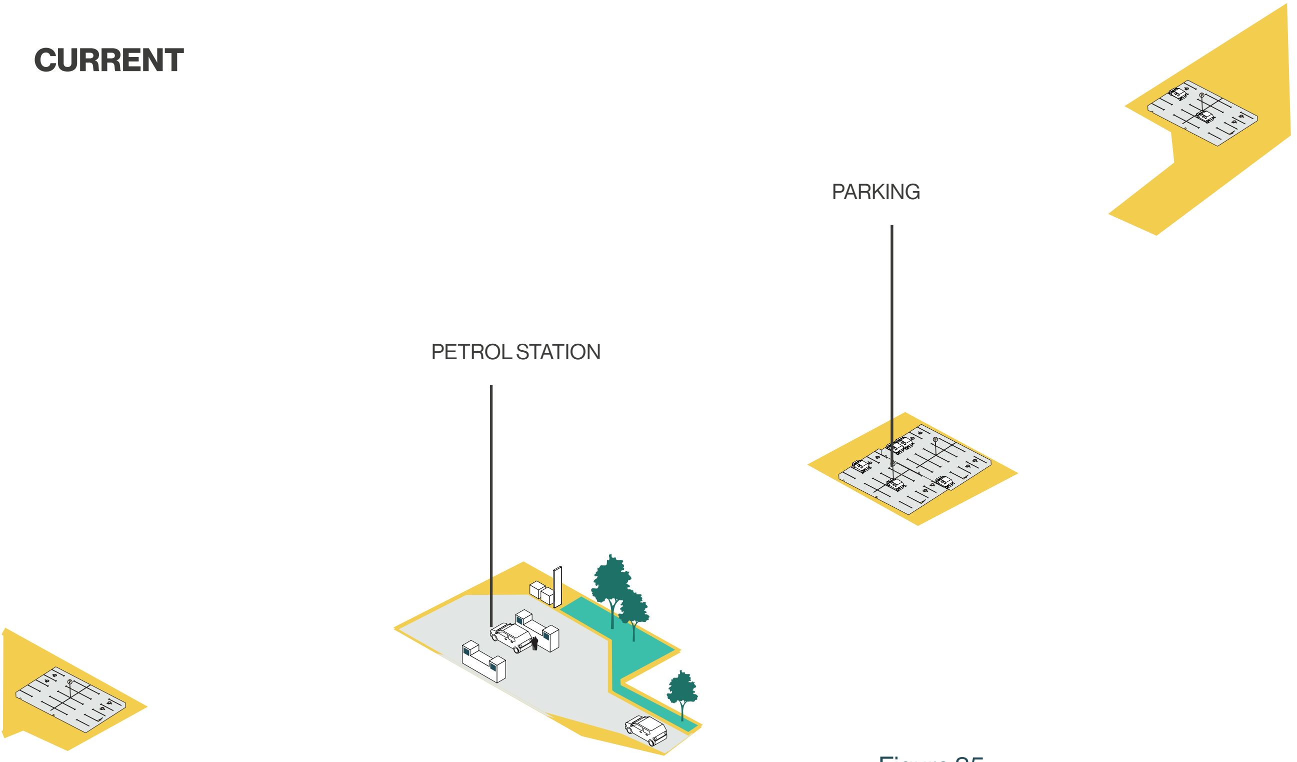


Figure 85

NEW

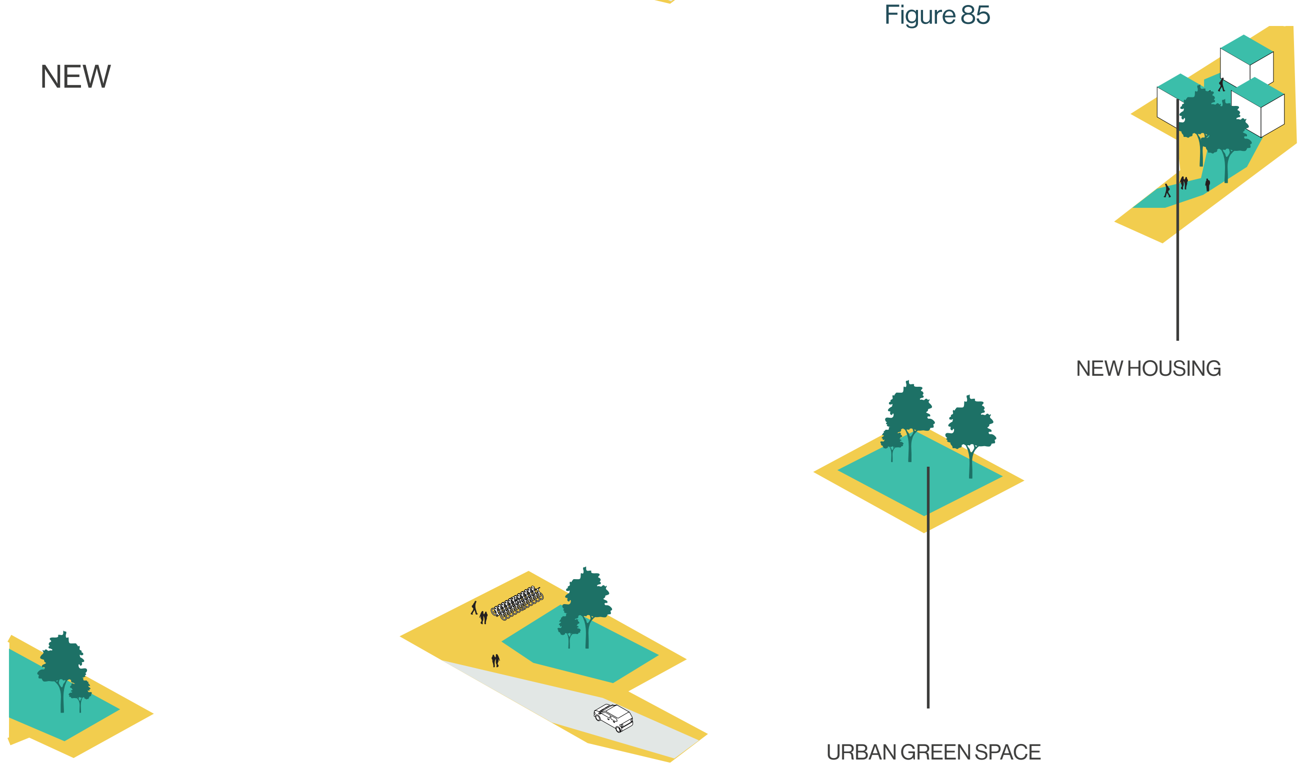


Figure 86

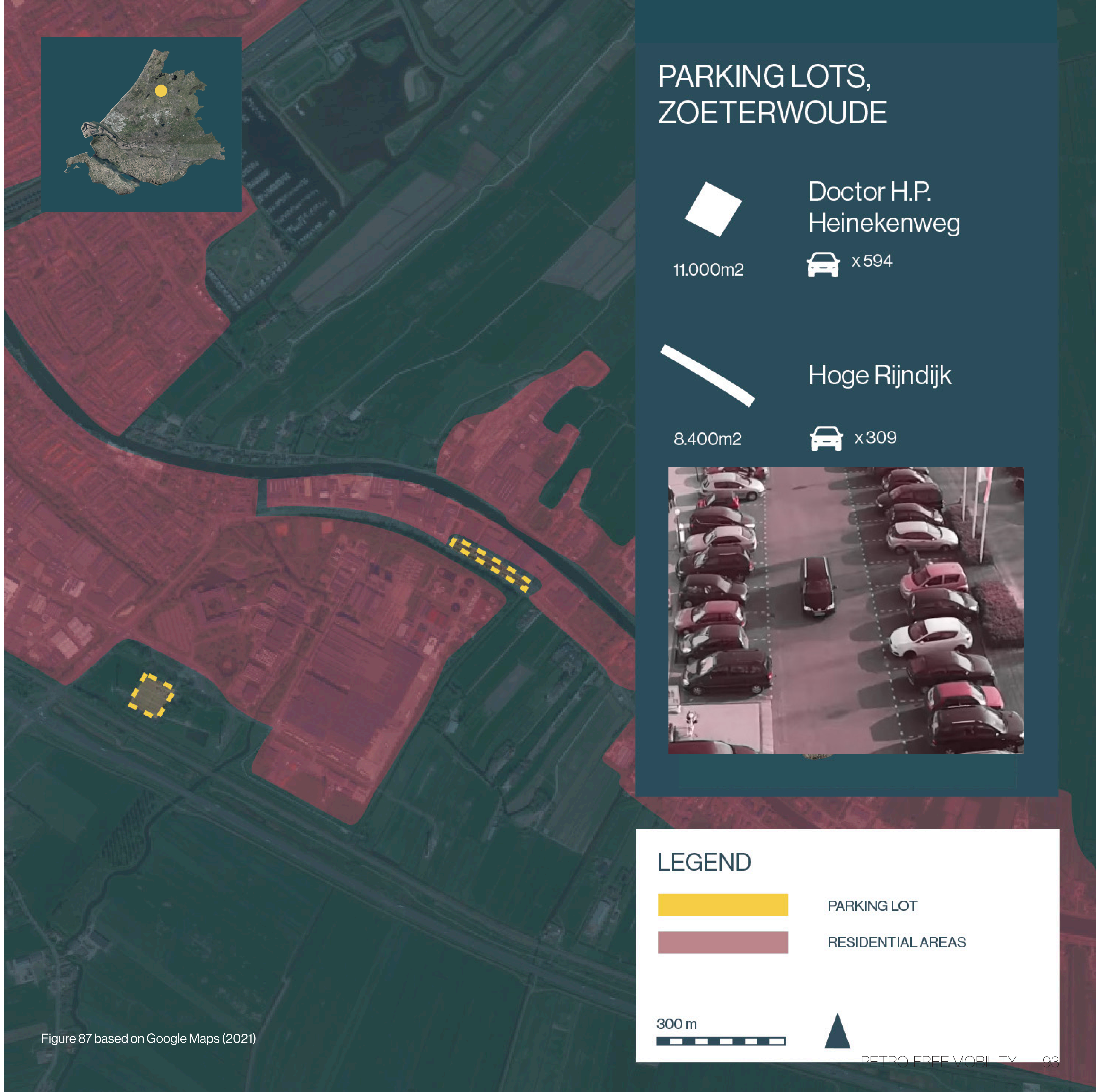


Figure 87 based on Google Maps (2021)

TYPOLOGY 7

Our last typology, typology 7, is focused on the biggest plot type available within the petroleum wastescape, the refineries within the port of Rotterdam. These refineries are mostly left vacant after we have transitioned away from the petrochemical industry. These areas lie within the urban fabric of the harbour and are therefore really complex to transform. The total transformation of these sites could even be a report on itself.

In order to transform these huge plots within the port, we would have to look at what specific functions we can add in order to fit these into our mobility transition. One specific way in which this would be viable, is to use Transit-Oriented Development. This concept is visualised in figure TOD.

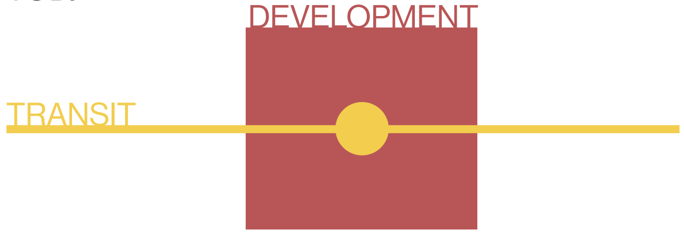


Figure TOD

By using this concept of Transit-Oriented Development within these plots, the new urban fabric will automatically fit into our strategy. The developments will follow the lines of new mobility, therefore ensuring ridership en viability of these new mobility systems. In this case, the Vopak terminal is transformed into a new urban fabric. This urban fabric is situated alongside new public transport. Within this new urban fabric, different functions will find their specific place.

CURRENT

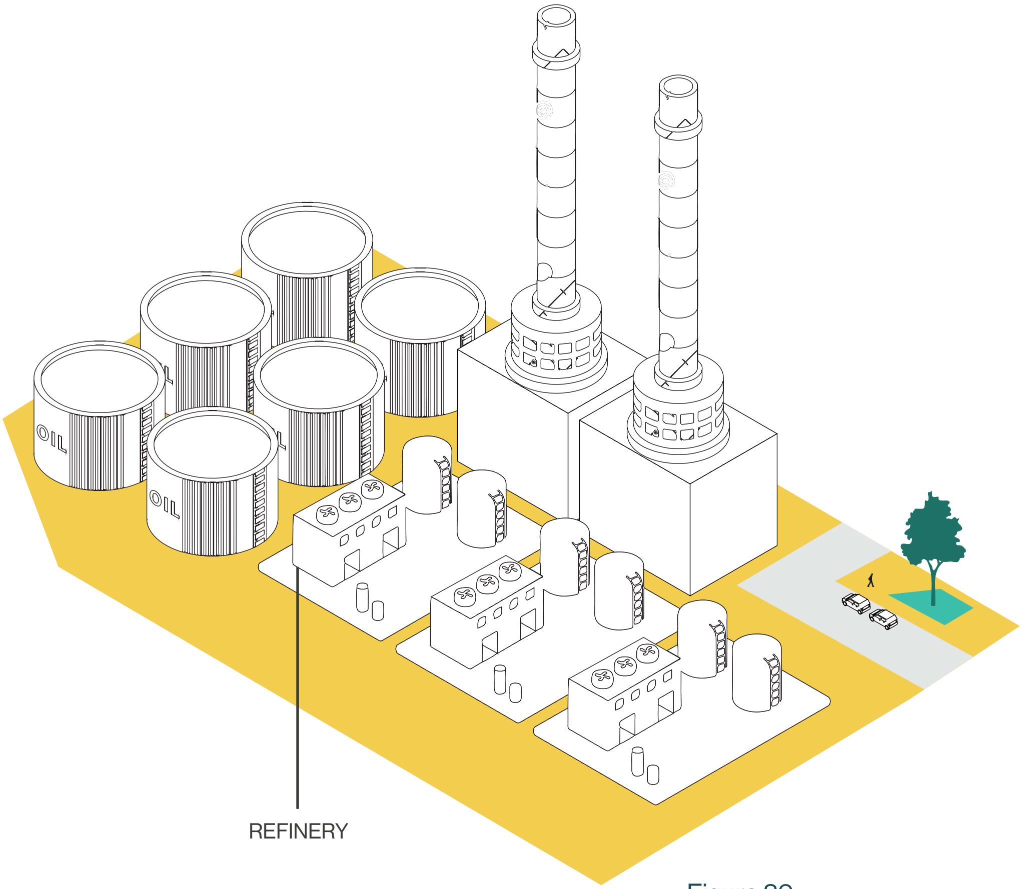


Figure 89

NEW

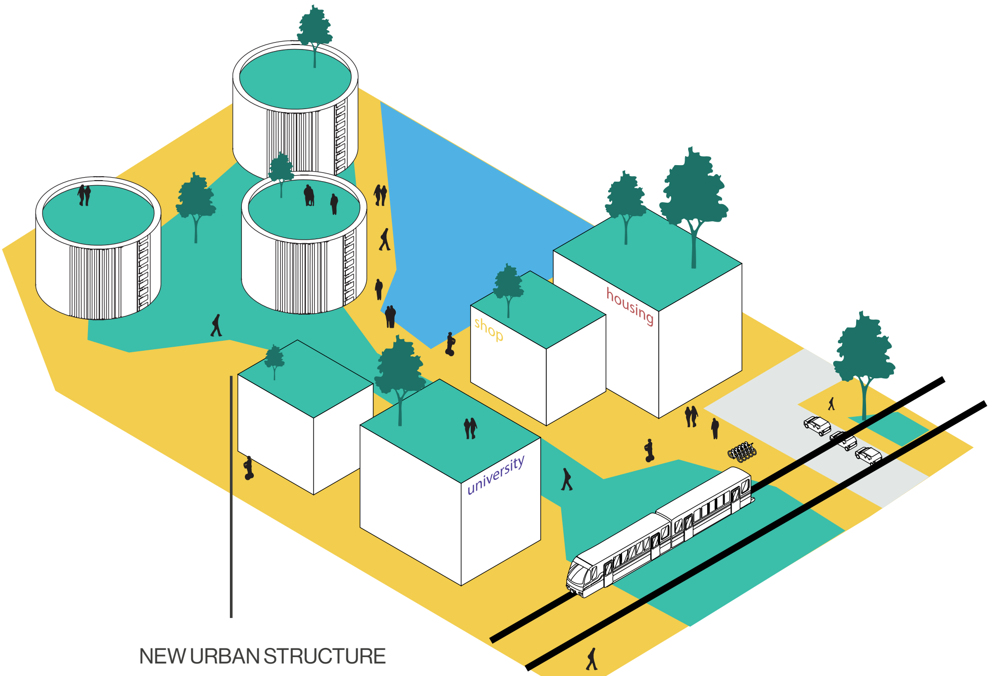
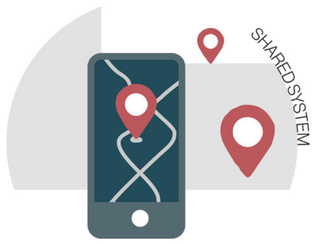


Figure 90

Figure 88 based on Google Maps (2021)

NEW MOBILITY SYSTEM



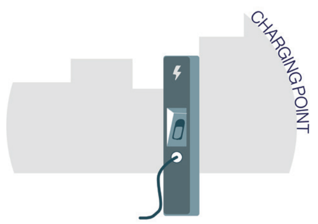


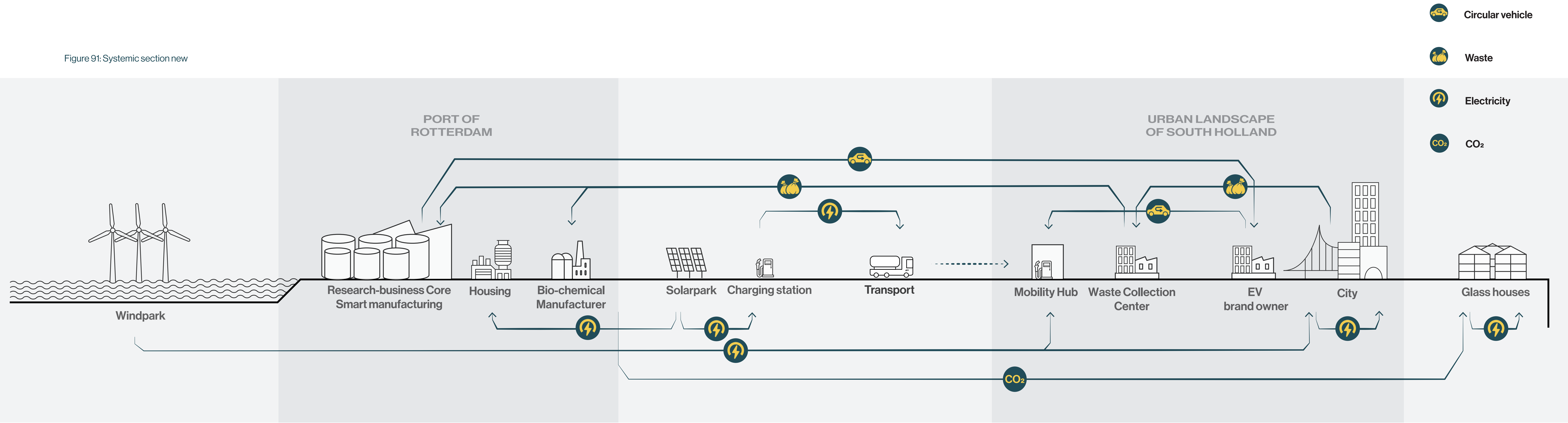
Figure 90

04.6 SUB CONCLUSION

Hereby we present our final systemic section including the new mobility system illustrated on the previous page. The flows have simplified and are now connected to eachother.

A new mobility system is born.

Figure 91: Systemic section new



04.6 SUB CONCLUSION - STRATEGIC PROJECTS

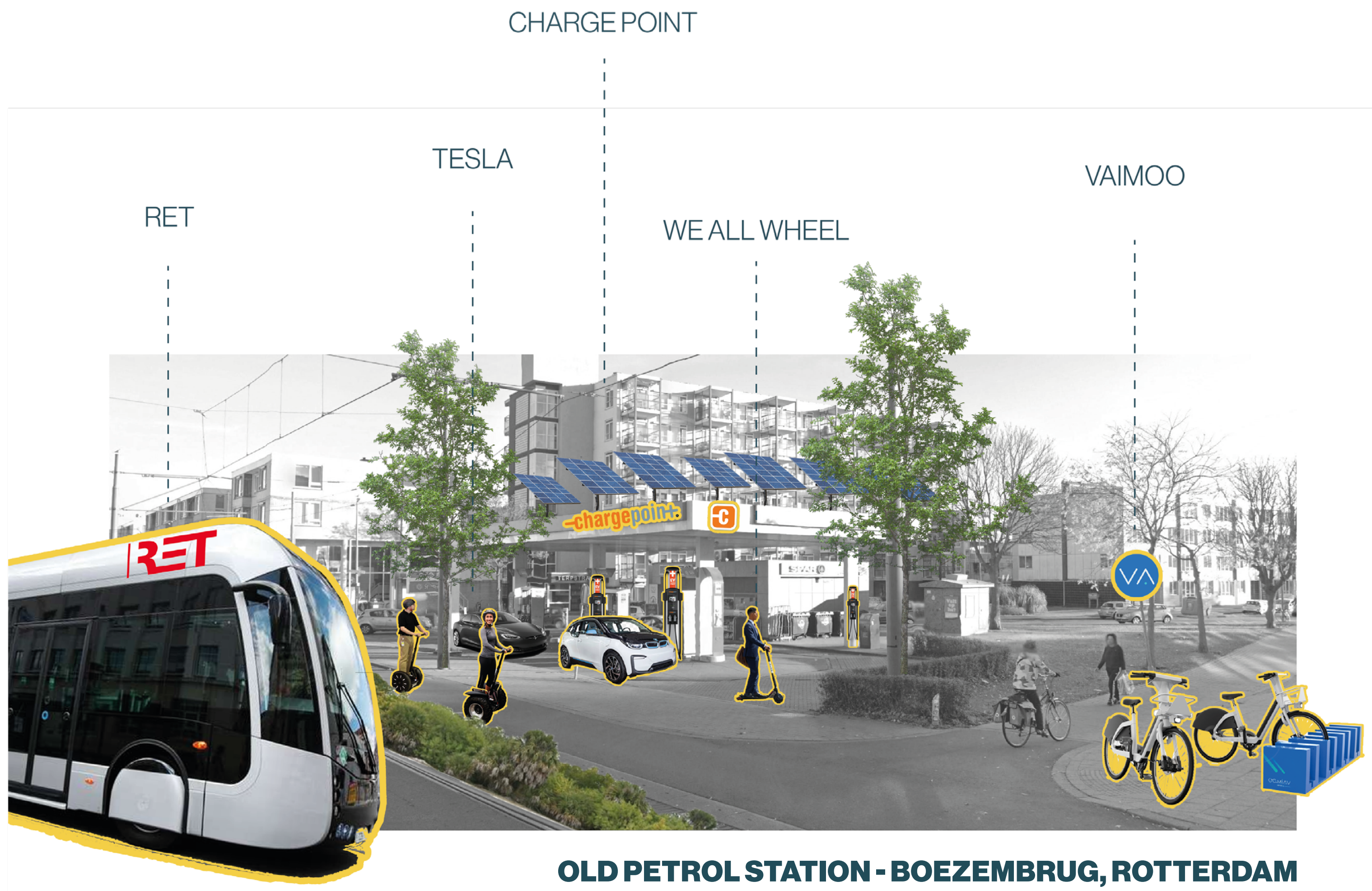
At the beginning of this booklet, we analysed several sites where petrochemical industries make a big spatial and ethical impact on the street scene. We had a look at the area it occupies and the size of the petrochemical buildings themselves. Now, 40 years later, after implementing our strategies in the whole province, there is nothing left but electric vehicles (see figure 92).

Besides, the number of cars will be considerably decreased. Instead, our urban environment will be more drawn by sustainable, and renewable energy resources, which we use for our new mobility systems. Next to that, we foresee that there will be more space for green, lively, engaging, and attractive neighbourhoods. And that there will be more space left to respond to our housing demand (see figure 94).

It is also interesting to see those big petrochemical stakeholders, such as Shell, Tamoil, and BP, will no longer be market-leading, but have been taken over by FastNed, Charge Point, and New Motion. These stakeholders will, in combination with other new sustainable connections, the change of consumer patterns and newly redeveloped waste scapes, reshape our environment, to a petro-free society.

OLD PETROL STATION -SWANLAWEG, ZEVENHUIZEN

Figure 92: Redeveloped petrol station based on Google Streetview (2020)



OLD PETROL STATION - BOEZEMBRUG, ROTTERDAM

Figure 93: Transformed petrol station based on Google Streetview (2020)

OLD PARKING LOT - BLAUWE TRAMSTRAAT, LEIDEN

Figure 94: Transformed parking lot based on Google Streetview (2020)

CONCLUSION 05

05 CONCLUSION

Human driven pollution is causing irreversible damage to the habitability of our planet. Due to these environmental concerns, it has become imperative to move away from petrochemical dependency, as these industries contribute significant greenhouse gases, and cause air, soil and water pollution. About 85% of the petrochemical industry that travels through the port of Rotterdam, the economic centre of South-Holland, goes towards fuels for mobility.

In the project "Petro Free Mobility" project we aim to contribute to a movement away from those current contaminating, and non sustainable conditions. Therefore, our research question is defined as follows: How can a regional design strategy facilitate the transition away from petrochemical dependency towards a circular Province of South Holland? This question has been addressed by means of a vision and a strategy, followed by a set of advisory interventions.

By creating space for sustainable developments towards circular mobility, we accelerate a shift from dependency on the major output of the petrochemical industry, mobility fuels, towards clean alternatives. The aim is to have a Province driving fully on electric mobility in 2060, that prioritises accessibility and fair distribution over the region. The application of biofuels in mobility is taken into account as a temporary option, but is not designated as suitable for a vision for circularity and sustainability in the long term.

To turn desires into reality, a pragmatic approach is needed. Three strategies are proposed:

1. sustainable connections, which puts focus on connecting innovative small-medium size stakeholders in an early stage, combined with improving the physical network.

2. consumer patterns, which emphasises stimulation on the local scale, so that consumers will get used to a completely new societal system.

3. waste to value, which indicates priority to waste valorisation. In this project, also spaces are interpreted as waste.

By splitting the transition into three phases; the preparatory phase, the shifting phase and the circular phase, the road towards a complete circular mobility system has been concretised.

By the use of a decision tree, a structure has been defined to strategically repurpose the released leftover sites of the petrochemical system. Herein, the need for new places that contribute to an all-electric, shared and automated mobility system are prioritised. In addition, environmental as well as social goals of the Province are taken into account for assigning new functions.

By implementing the systemic changes proposed in this report, a step towards 2060 is made. The province of South Holland will have a more integrated and fully electrical mobility network, transformed a significant amount of wastescapes from the petrochemical industry, and have a healthy living environment for the over 4 million residents now residing in the province .

Further research

Further research can be done to reinventing the refineries in the port alone, this project would be really extensive, so we tried to cover it schematically in this report. Further research could provide a detailed design for these enormous wastescapes. The specific functions within the mobility hubs explained could be investigated more likewise.

New sources for biofuel could also be explored, making it viable for the long-term.

Figure 95: Impression 2060

REFLECTIONS 06

06 REFLECTIONS

GROUP REFLECTIONS

INDIVIDUAL REFLECTIONS - TIJMEN

'How does the group dynamic of the design research correlate with your personal growth in this project?'

Well, that isn't the easiest question to give a specific answer to. The complexity of this regional design project together with the sometimes challenging team dynamics make for a genuine interesting connection. This connection exposed the necessity of combining both personal qualities and professional skills when successfully executing the job of the urbanist. In our master studies and more specific in this design course, the main objective is to grow in both of these qualities. But do they grow together in a simultaneous manner? Or do both need different strategies and therefore different approaches in order to get the most out of them?

For me personally, it's a combination of the two. By developing your personal skills, your professional skills will benefit and most likely it works the other way around as well. To understand this correlation, it is crucial to understand my personal and professional objectives stated in the beginning of this project. My personal objectives were focused around becoming more able to stand up for myself, to be able to understand that my opinion does matter and that I can justly stand up for myself, while remaining professional and reasonable. How do I link this to the group dynamics and group process? Well, at first, the presence of five powerful ladies in my group project might sound a bit intimidating, but it really worked out the other way around. The group dynamics made for an environment in which I was stimulated to develop these objectives I set for myself. So yes, I did develop my personal goals during this project, but what about my professional skills? By focussing on my personal goals of being able to show more of my opinion, my professional skills improved simultaneously. By being able to show more of my work, both physically in maps/diagrams and mentally by ideas and visions, I was able to receive more feedback from my group members and therefore improve my professional skills.

In conclusion, in order to develop your professional skills in a project in which group dynamics play a part, the ability to grow personally is crucial. In an environment in which personal growth is facilitated, professional development will flourish likewise. This is what I experienced in this project. A big thank you to everyone involved.

INDIVIDUAL REFLECTIONS - JOËLLE

WHAT?

A rollercoaster!! But it really was a great one! This quarter started for me in the most difficult way ever, because how are you going to deal with two new courses? Four new group mates? The whole COVID-19 situation? And, last but not least, the very sudden death of your father? I DON'T KNOW! In my opinion, I could do nothing more than just starting with everything that comes to you and see where you would end up.

HOW?

The hardest thing for me was the start of the two courses, the way you are going to tell your personal situation via online mediums to people you do not know, you have no idea how they are going to react, and even better, what your own reaction will be. However, it really helped me a lot that everyone knew about my personal situation. Next to that, the "online life" we are in right now, had one great advantage for me, namely, that it was possible to work on this project from different locations. And therefore I was able to attend all lectures and meetings during the day while being with family in the evenings.

But, of course, for this project and the teamwork, it would have worked out even better if we could have had the opportunity to meet more frequently with our group in real life. Mainly to maintain focus during meetings and to get everyone on the same track. This brings me directly to my self-assessment I have done at the start of this quarter (see table below).

How do you assess yourself on...?

(1=outstanding, 2=strong, 3= moderate, 4=bare minimum, 5=unsatisfactory)

1 2 3 4 5	Team commitment
1 2 3 4 5	Communication skills
1 2 3 4 5	Knowledge, skills and abilities in (regional) analysis, design & planning
1 2 3 4 5	Helping the team to focus
1 2 3 4 5	Emphasising high standards for the team

At the start of this quarter, the most important learning objective for me was to communicate more with high context and to learn how to be more confrontational (but still supportive and motivational) to my groupmates, instead of saying "it's okay" or doing the tasks myself. And I think that this more critical point of view is something we have missed within our group during this project. This, in my opinion, was the reason why we really struggled with making decisions and having a focus (vision and strategy) more quickly.

NEXT?

For the next time, one of my learning objectives will again be: "helping the team to focus". Next to that, when looking at the self-assessment tool, I would say that I have now much more knowledge, skills, and abilities in regional design. This all through the combination of the SDS lectures and workshops, the series Capita Selected, the group meetings with the tutors, the AR2U088 lectures and (weekly) exercises. For me I see this quarter just as a start within the field of regional design and I would really like to do my graduation project for instance at this scale, especially to become even more familiar with regional design tools. For now, I will thank everybody who guided me/us and who has worked with me the last few weeks! I really enjoyed the courses and the team we have been working with!!

INDIVIDUAL REFLECTIONS - JULIETTE

Evaluation of the regional design process

Regional design is a complex, integrative, creative and never-ending act, especially in the societal context of intensive urbanisation, global warming, mass consumerism and extreme climate events. In this project I have experienced the pressure that our minister president would feel everyday (I imagine): to find the best solutions for those massive challenges. The answer: those challenges can not be solved in 9 weeks. Off course not.

From that realisation I started understanding the fun of the job, by using different tools and methods, one gets a grab on a massive processes, and is actually able to form a well-founded opinion about the current systems. Besides that, as a designer we are able to add extra value to this, by being visionary.

The vision functioned in our project as a kind of test: at first it seems like an objective, but it is more than that. It is a tool to continuously reflect whether the work that is being done is moving towards a greater good. When this no longer happens, either the work needs another direction, or it is necessary to sharpen the vision. It is a dynamic product, not a deliverable that is completed after midterm.

What I sometimes found difficult was mainly acting on an abstract level, but not getting stuck in that too much. Finding the right moments to zoom in to evocative examples that support exactly what has been researched and envisioned is essential to underpin a convincing vision.

The level of detail in our gained knowledge made me realise regional design really is about local as well as global scale. Besides, the awareness that I'm a inhabitant of this studied region made me curious about new cities and regions (abroad), which would cost me more effort (and fun) to really understand the region from bottom up.

Evaluation of the group process

The last nine weeks have been as a group-tour through a new, yet unknown city, of course on a bicycle, so that everybody was in charge of his/her own actions. The subject of the petrochemical industry was new and challenging to us, and therefore sometimes made us get lost from the main road. To keep track, confidence is needed.

In the group, on the one hand our processes evolved quite dissimilarly, but on the other hand we performed very equally. In my opinion, the dissimilarity comes from the fact that we had different levels of confidence. While the one was quite well developed in processing and analysing data, the other was more language proficient, and again another was mostly confident with writing skills. This diversity in skills made us strong and complete, but also asked for attention, namely to not all fall into our own habits, not challenging ourselves in other fields.

We lacked a specific personality in our group that clearly took the lead. This was okay, because to me the communication in the group was excellent. There was space to talk about the content, but also about the process, improvements and events in our personal life. Therefore everybody took charge of a bit, everybody drove his own bicycle in the group.

Where at times in my studies I could have the feeling that I worked for the best product of the year, that feeling lacked completely in this course, which worked quite well for me. In my opinion, the goal of studying is learning as much as I can (and not necessarily delivering the best result), and when noticing this was in line with the mindset of the teachers, enthusiasm predominated my working attitude.

Besides all this, all kinds of circular processes dominated my mind this 9 weeks, even the weather closes the loop, since we had snow on the first day of the course, and there was snow again in the deadline weekend (oh the climate...).

INDIVIDUAL REFLECTIONS - MIRIAM

Creating a regional spatial vision and its development strategy proved challenging for a few reasons. As the Petrochemical industry is a complex system that is connected to (and effects) the entire world, the amount of actors, variables and epistemic uncertainties make the task of the urban designer a complicated practice. We need to consider fields that we have little to no expertise in and communicate with others effectively to optimize processing all this information into an inspiring (and hopefully activating) vision.

This semester felt like an unraveling and rewinding. In the ways in which we are intertwined with fossil fuels, the urgency of moving towards a circular economy, how our individual stances on design and collaboration work together, and our expectations of being a zoom-student.

The insecurity brought on by the covid pandemic has proved that any long-term strategies require some measure of flexibility. The absence of what used to be self evident brought a new perspective to the subject of mobility. When finding this also to be a crucial bottleneck in the Petrochemical industry we decided to work with the subject of the mobility transition to help guide the narrative.

Throughout the process we each seemed to want to delve further into the information, latching on to interesting tidbits that may be more or less relevant to developing our final vision. After finding that our push towards biofuels was unsustainable it was difficult to redefine our direction, yet reiterated that any scientific practice must not be selective in processing information.

This, in combination with the scale, timeframe and context of the report required a communal focus, challenging my initial goals of working efficiently in a team. However, I now consider this collaborative process both a means to an end as well as an exercise in communicative planning, crucial in any urban design process. By gathering research, commenting on phrasing and concept development and discussing somewhat abstract spatial relationships we were both confronted with our personal views and our relation to the larger urban context. Personally I found myself energized when the pieces seemed to fall together and discouraged when confusion struck, this is something I hope to work on in future projects. Our team, though on paper quite different, seemed to have some overlap in our strengths and weaknesses resulting in extensive conversations in an attempt to delegate work. What I primarily learnt is that a collaborative design process is about consistently requestioning the moving parts of the project, knowing when to recognize a useful element and push forward with it so it has the opportunity to develop into a comprehensive strategy. Though our resulting spatial vision aligns with (inter)national goals and our development strategy is based on a solid foundation it could use further in depth development.

INDIVIDUAL REFLECTIONS - CYNTHIA

Change through communicating

The complex field of urban and regional design is as Healey (1992, p. 156) states “a communicative turn”, where change occurs from “planning through debate”. According to transition management this change is a democratic practice where multiple actors are involved in order to attain “best practices” and the pursuit of a favourable course (Balz, 2021). This progress through regional design attempts to improve the relationships and outcomes between governance, private parties and society (Balz & Zonneveld, 2015). Where participation of these different actors to improve results (Rocco, 2021). Regional design is a complex field with not only dealing with multiple stakeholders, but also different crises and economic demands. And, this web of different parties and voicing their needs has been difficult to grasp. In our regional vision and strategy, we attempted to unite both top-down and bottom-up processes to achieve just outcomes (Carter et al., 2014). However, designing during a global pandemic has proven even more difficult. During normal circumstances we would be capable to do fieldwork and interview stakeholders to have a better grip on the regional site. Also, the petrochemical industries demonstrated to be a far more complex topic than initially envisioned. We realised that this industry was deeply rooted in the urban landscape of the Province of South Holland and had dominant “path dependencies” (Hein, 2018). At times we wondered if trying to solve this puzzle this is called “the petroscapes” was a wise one. At times this puzzle was exciting, sometimes challenging and even frustrating.

I would like to start that I could not have wished for better team mates than I had in this project. Even though we had our struggles with the project and sometimes to express our frustrations. We always tried to stimulate each other with positive feedback and help each other when in need. One thing that did not help us at times was that each one of us was slightly chaotic, therefore, at times it was difficult to maintain structure throughout the project.

At the start of the project I wrote down two goals:

1. Not to hyper focus on one topic in order to prevent being overwhelmed by the multitude of accessible information.

2. My strength lies in understanding other people’s needs and voicing theirs, however, I tend to forget mine sometimes. Setting boundaries and not dwelling in endless flexibility was important for me (I will always remain a campaigner though).

Have I met these goals? Mostly yes. The first goal was achieved successfully by really communicating my strengths and my pitfalls. The group always supported me and helped me by working together on certain topics. The second goal was a bit more difficult, since this quality is deeply rooted in my personality. However, due to personal circumstances in the first two weeks I was forced to open up to my group members. This resulted in a deep understanding from their part and better group work in the end.

“I try to take every conflict, every experience, and learn from it. Life is never dull.”

– Oprah Winfrey

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APPENDIX 08

08 APPENDIX

JOIN US ON OUR JOURNEY THROUGH THE BIOMASS JUNGLE ;)

What is biomass?

“Biomass is organic, non-fossil material of biological origin (plants and animals) used as a raw material for production of biofuels. It can be also called biomass feedstock or energy crops. It includes wide range of materials harvested from nature or biological portion of waste.” (Eurostat, 2019)

What if biochemicals replace all oil in petrochemical production in South Holland?

In order to understand the biomass sector, some research has been done in the process of biomass. Following different types of sources, a flow chart has been made to map the inputs, the conversion and the outputs of biomass.

From the news-items we know biomass is a controversial topic. What are the +’s and –’s of this process?

renewable, no depletion	harmful substances are released during processing
carbonaceous resource, which is essential for some products	nature become unbalanced: threat for biodiversity
interpreted as CO2-neutral	nature become unbalanced: threat for biodiversity
possibilities for upscaling because of existing infra	many biomass resources are important, lacking knowledge of working conditions and environmental impact
available in the region	bio-energy production competes with more sustainable applications of biomass (wood)

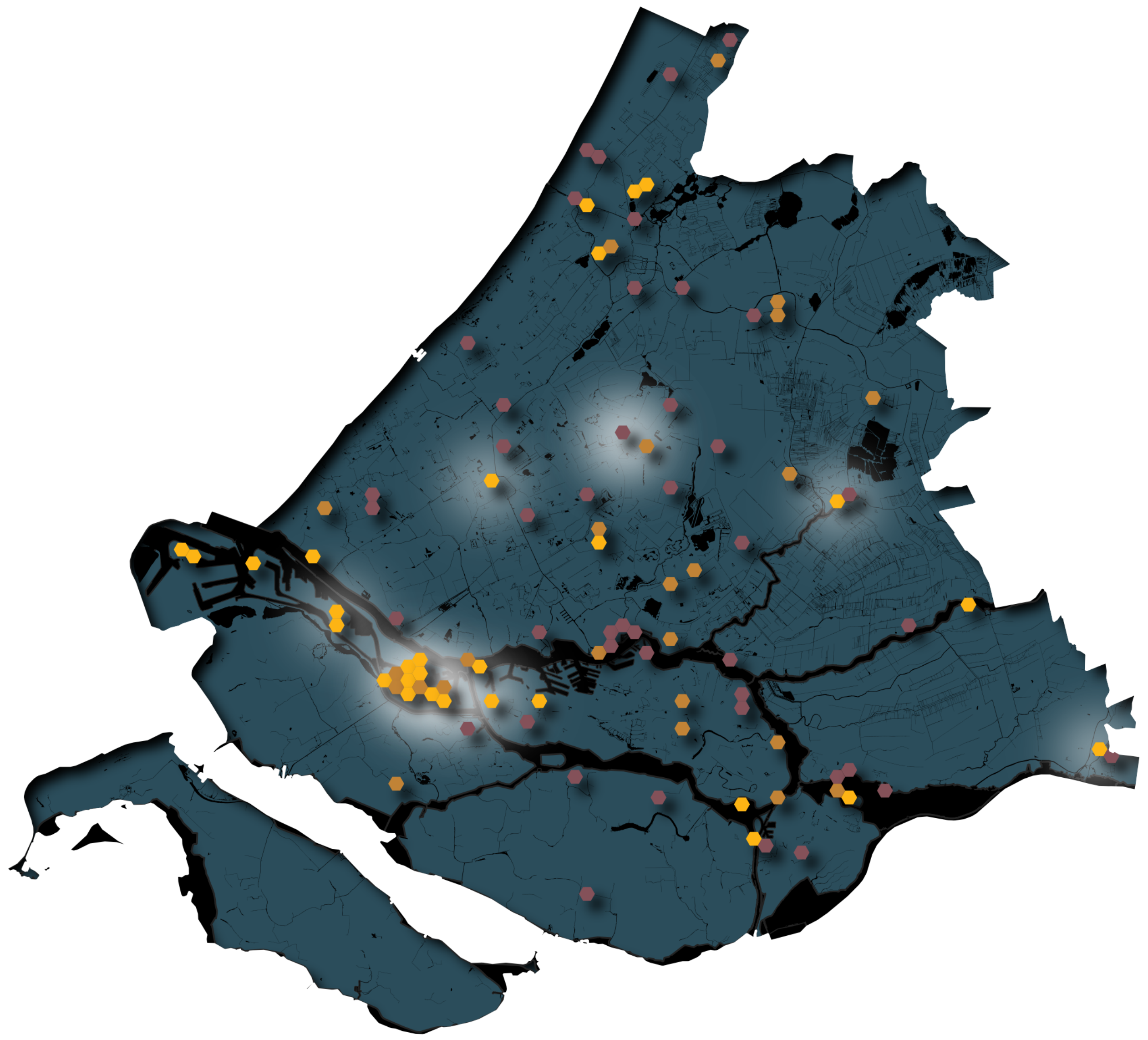
And what processors/companies are already present?

Jobs in (bio-) chemical industries in South-Holland

Research Question: How many fulltime jobs are there in the chemical products industries? And which of them are in the manufactures of organic chemicals?

Annotation: Showing the amounts of fulltime jobs in the (bio-)chemical industries in the province of South Holland in relation to the bio-chemical industries.

Sources: LISA-data, KRW RWS, ESRI



Legend

Fulltime jobs in the (bio-)chemical industries (per hexagon)

- 1 - 20
- 20 - 100
- 100 - 500
- 500 - 1422
- Bio-chemical industries
- Province South Holland
- Water

1:500 000

0 10 20 km

What types of biomass resources exist?

On the basis of information and data from WUR (2020), Strengers & Elzenga (2020), van Dam, Elbersen, van Ree, & Wubben (2014) and Klimaatakkoord (2020), an investigation of different biomass types have been made, which are listed under the input-category in the flowchart. Different types of wood and crops are used in different types of biomass processing. In The Netherlands, approximately 25 percent of the biomass comes from woody materials (Klimaatakkoord 2020).

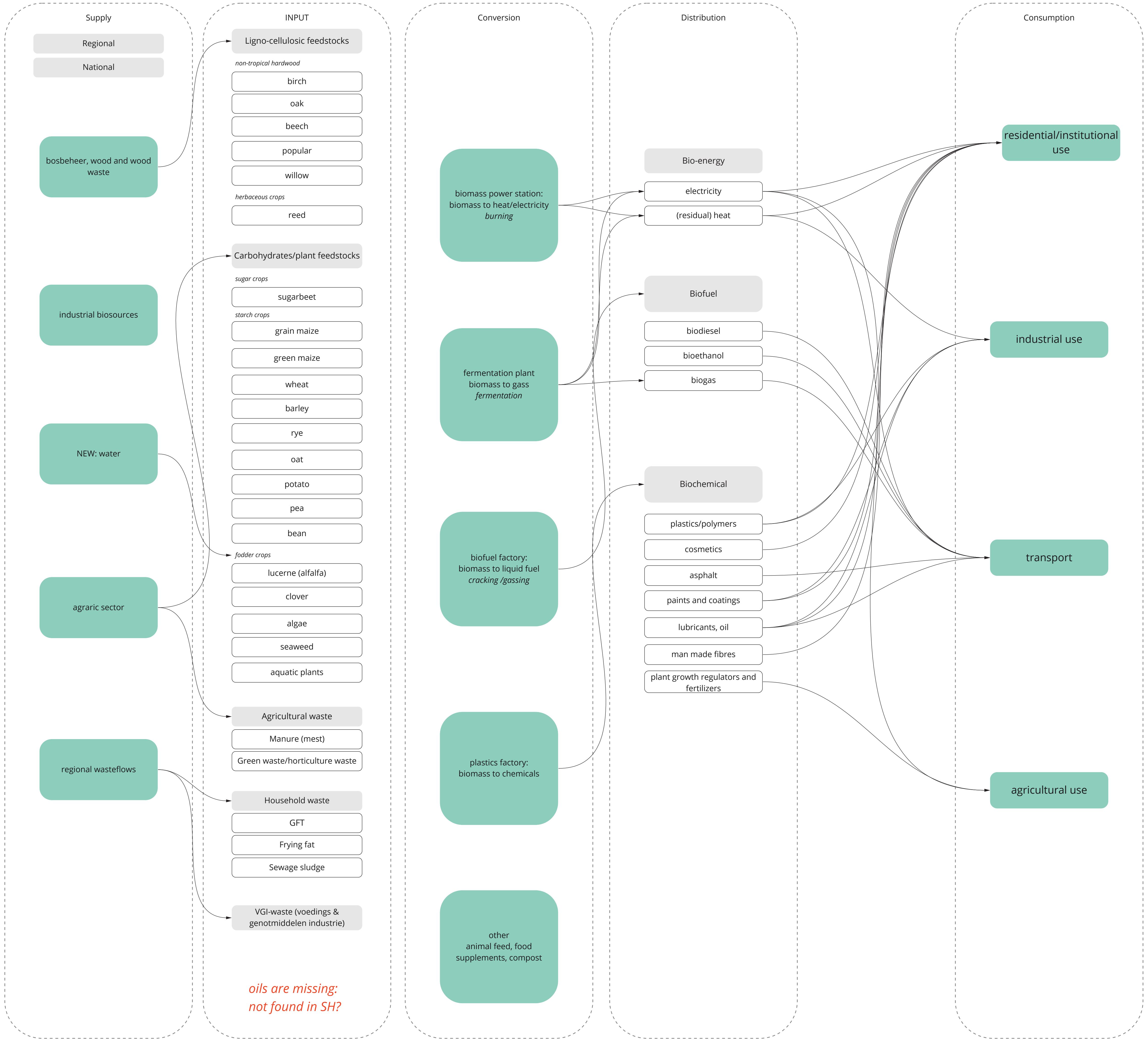
What type of processes for conversion of biomass exist?

Three biomass-processes are identified: burning, fermentation and cracking. All those processes are contributing to the production of low-valued outputs, according to the value pyramid, such as fuels, electricity and heat.

Most of the biomass is used for burning. The woody materials are burned en masse, whereafter the steam is used to generate electricity.

In the fermentation process, biogas becomes an output. In the digester, methane and carbon dioxide is produced. When treated, the biogas is suitable for the gas network or it could be used as a fuel.

Liquid fuels are made in the bio-refineries by cracking the liquid biofuels. Biodiesel and bioethanol serves as the liquid bio-versions of diesel and gasoline.



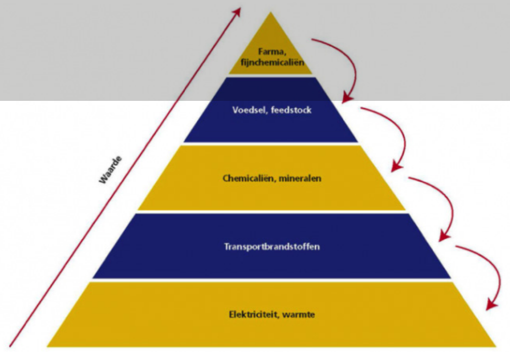
What types of applications of biomass output do we identify?

Bio energy is understood by the generation of clean energy. Co-firing of biomass in power stations is currently considered as a bio-based energy production. Coal-fired power stations in the Port of Rotterdam are capable of using 20-30 percent biomass in their firing (Port of Rotterdam, 2019). The outcome is mainly electricity.

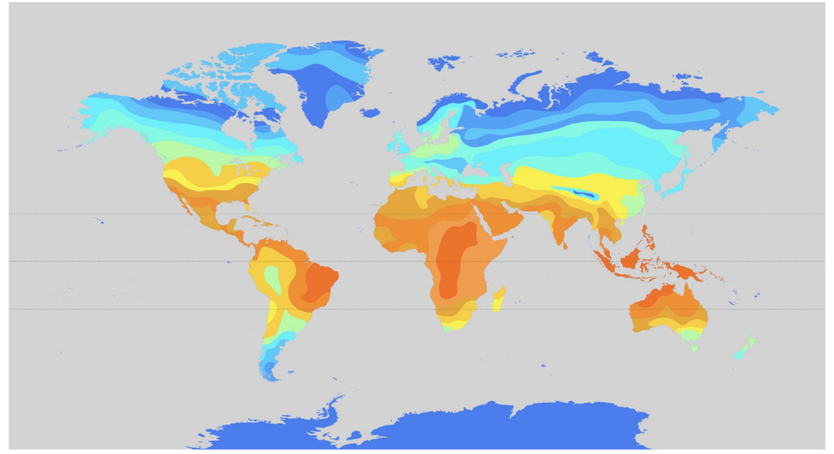
Biofuels are alternative fuels, made from plant material or organic waste. Oily plant materials as palm oil, rapeseed and sugar cane serve as the biggest group of bio-fuel resources. When biofuels are made from waste, agricultural waste, frying fat and algae serve as potential resources. Currently, 10% of all fuels in transport origin from a bio-based resource (Ministerie van Economische Zaken, 2018).

Biochemicals are defined by the Port of Rotterdam (2019) as a biological replacement of petrochemicals. Examples of biochemicals are cosmetics, paints, fertilizers and plastics.

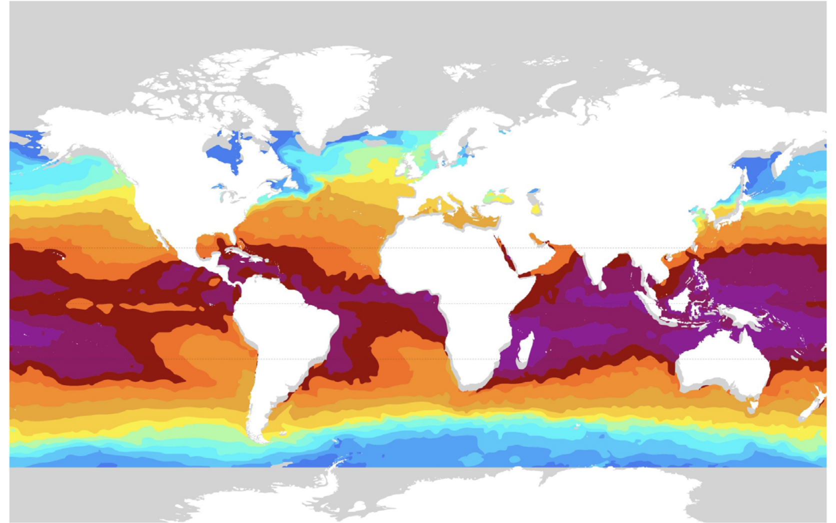
To understand biomass in the context of value, the outputs are categorised in the value pyramid of biomass (figure XX), which is also used by the Province of South-Holland (2020) in their strategy for biomass. From this pyramid, we have learnt that idealiter biochemicals are made from biomass. Vervolgens kan het een cascading process doorlopen, wat eindigt in bio-energy. However, depending on the types and availability of resources, this pyramid could not always be applied.



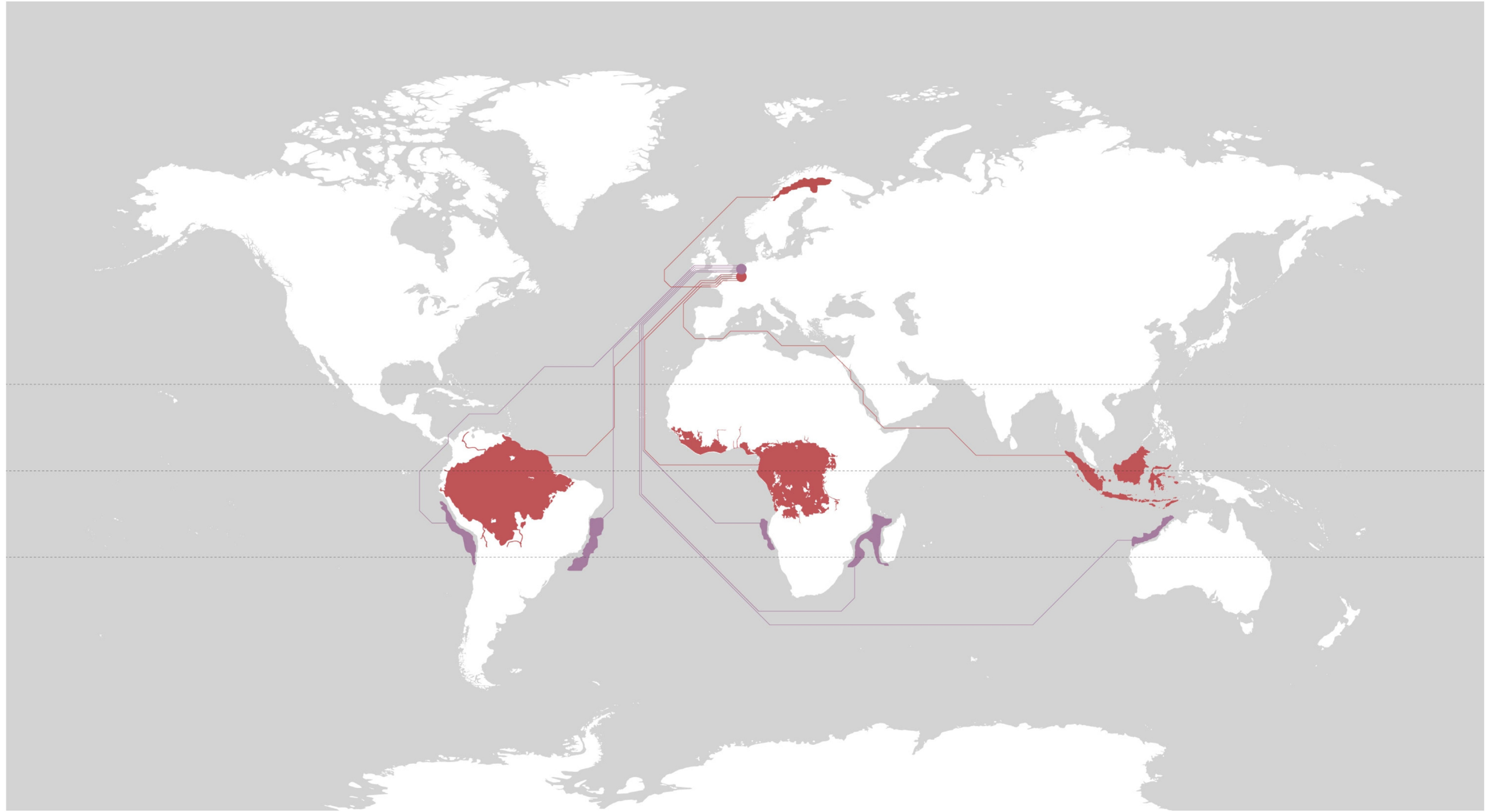
Where in the world does this biomass come from?



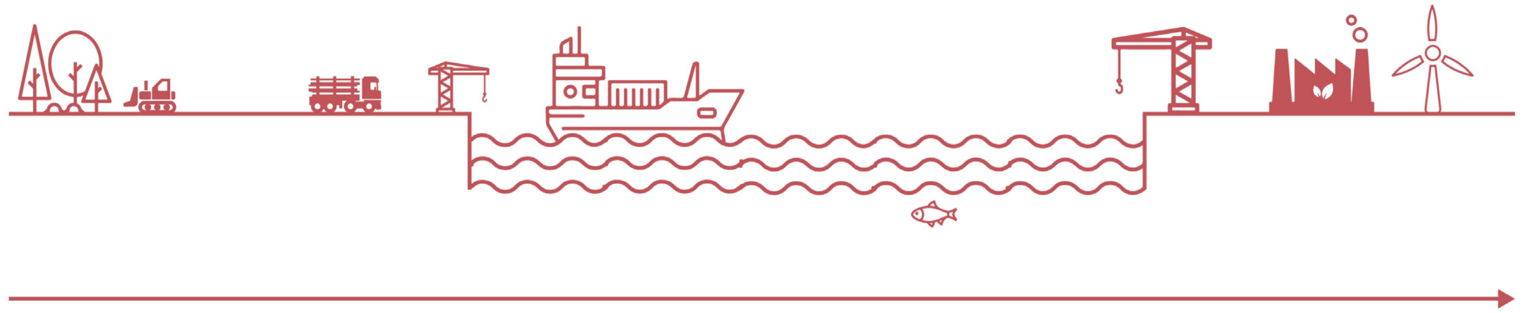
Biomass potential (own work)
-higher potential around the equator
-coastal regions
-includes all kinds of biomass potential (wood, algae etc)



Sea temperatures as of 17 FEB 2021 (own work)



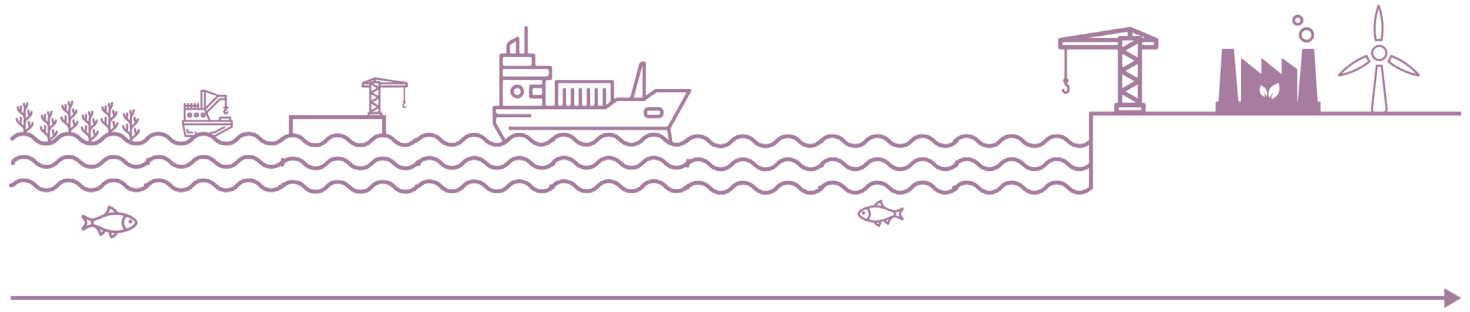
International sources of Biomass transport routes to the port of Rotterdam (own work)



Schematic flow diagram biomass from wood products & byproducts (own work)

pro:
-use of residual waste
-already existing infrastructure

con:
-heavily dependent on transportation
-needing wood (deforestation) as a base

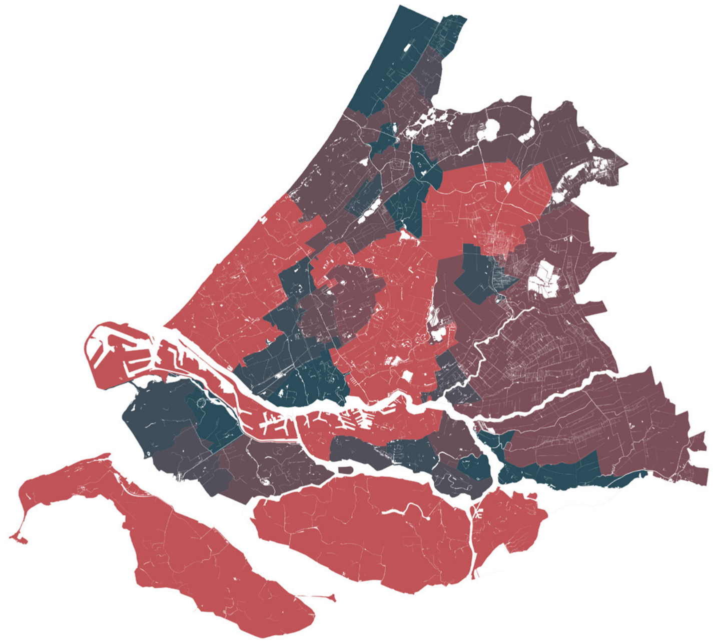


Schematic flow diagram biomass from algae & seaweed (own work)

pro:
-renewable (algae grow themselves)
-land which is left empty

con:
-expensive
-still needing transportation (seek for local sources)

So, now we know transport is a disadvantage of the biomass-process. Let's try to make it local. What resources are present in the region?



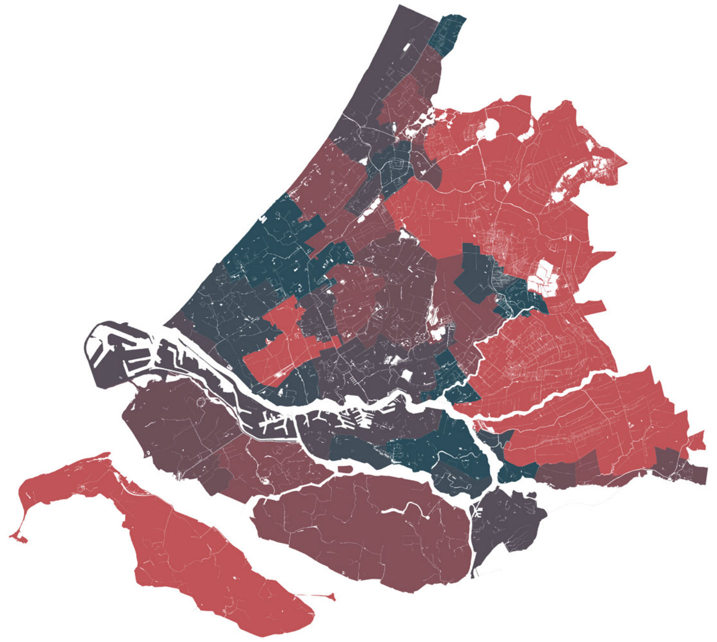
Organic waste of households per municipality per year

Theme:
Description:
Maker:
Date:
Source:

Legend

Organic waste in kton/year
- 0,8 - 1,9
- 1,9 - 2,2
- 2,2 - 3
- 3 - 4
- 4 - 4,95
- 4,95 - 12,8

1:200 000



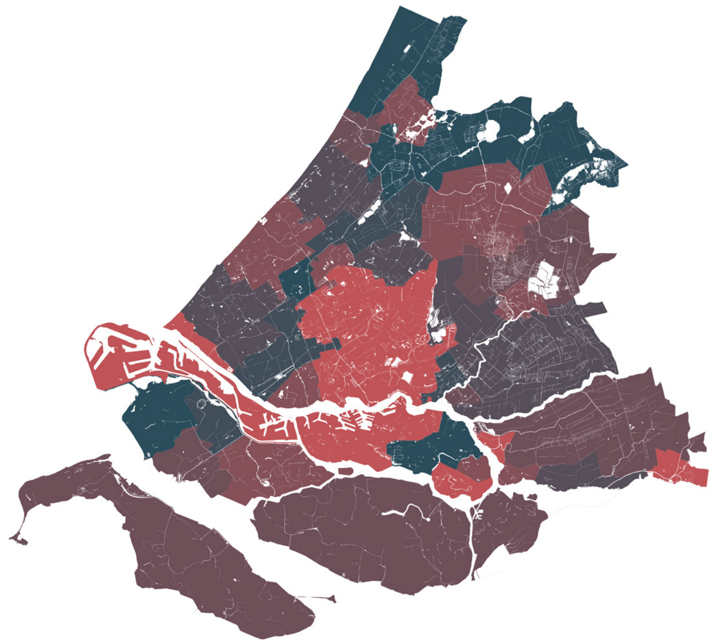
Amount of manure/fertiliser per municipality per year

Theme:
Description:
Maker:
Date:
Source:

Legend

Manure/fertiliser in kton/year
- 0 - 1
- 1 - 3
- 3 - 9
- 9 - 21
- 21 - 75,5
- 75,5 - 801

1:200 000



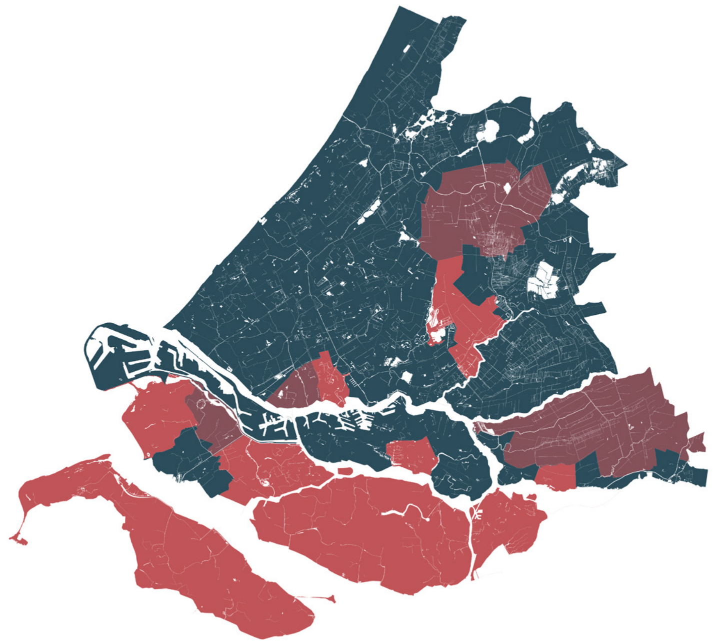
Edible oils and fat waste from companies/ industries

Theme:
Description:
Maker:
Date:
Source:

Legend

Edible oils/fats in kton/year
- 0 - 0
- 0 - 0,13
- 0,13 - 5,34
- 5,34 - 75,96
- 75,96 - 560,1
- 560,1 - 3798,59

1:200 000



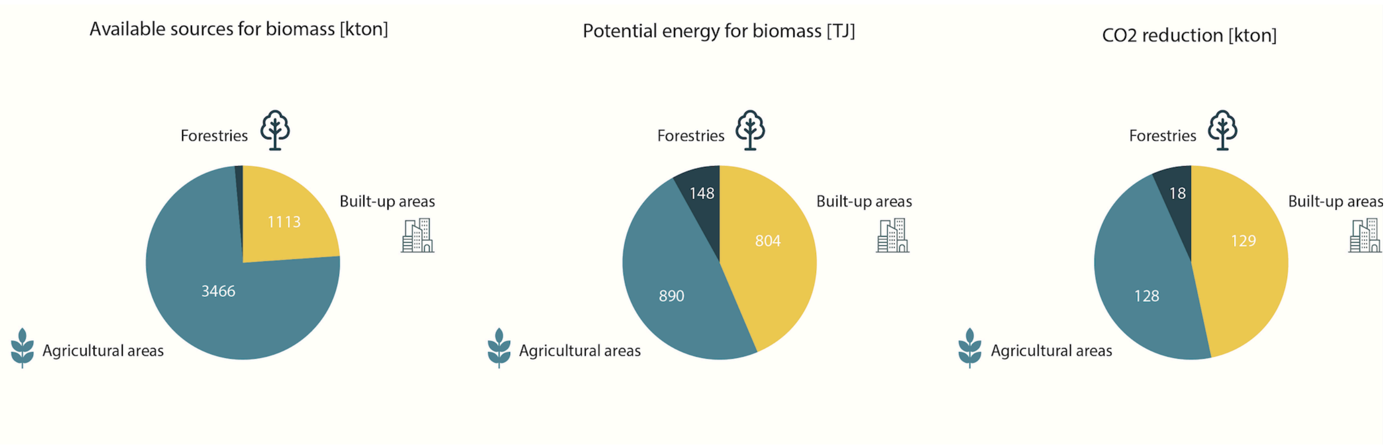
Wood waste forestry

Theme:
Description:
Maker:
Date:
Source:

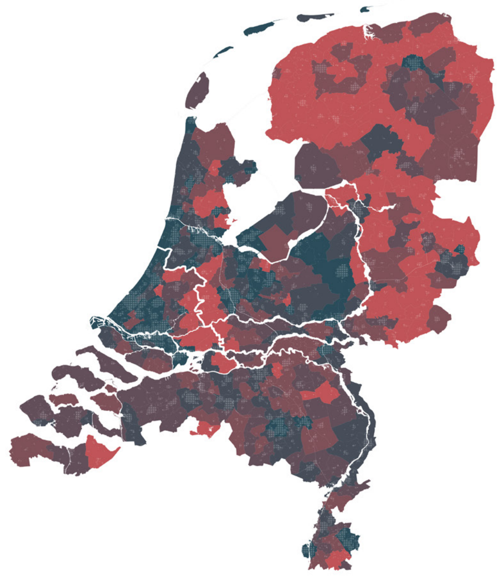
Legend

Wood waste in kton/year
- 0 - 0
- 0 - 32
- 32 - 2024

1:200 000



How are we going to transform this biomass to energy and fuels we can use?



THE NETHERLANC

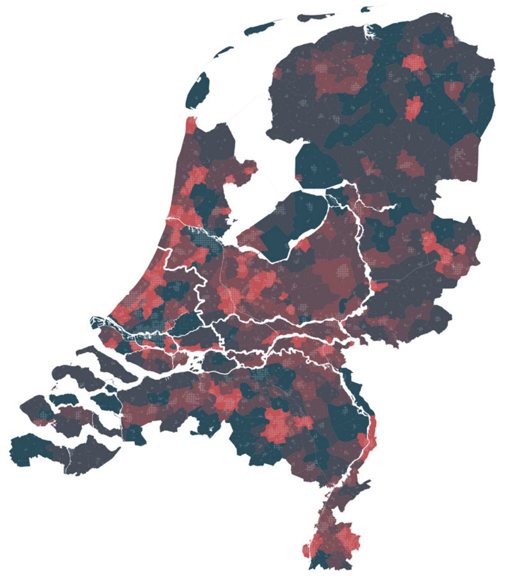
Theme:
Description:
Maker:
Date:
Source:

Legend

Province South Holland co
CBS Bevolkingskernen 20:
Water

Totaal potentieel houtachtige b
- 0 - 23
- 23 - 45
- 45 - 57
- 57 - 68
- 68 - 98

1:200 000



THE NETHERLANC

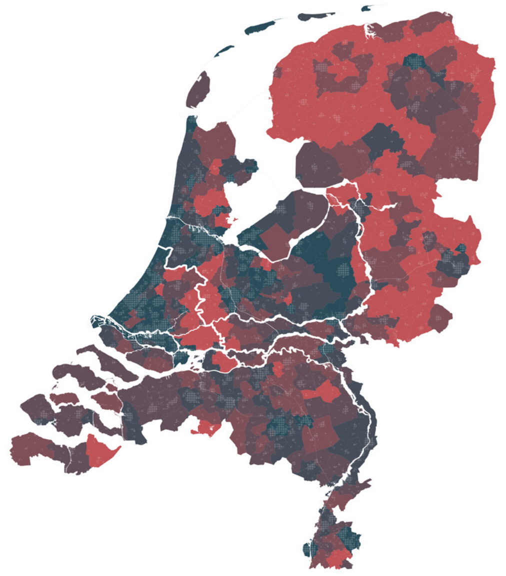
Theme:
Description:
Maker:
Date:
Source:

Legend

Province South Holland co
CBS Bevolkingskernen 20:
Water

Totaal potentieel houtachtige b
- 0 - 0,32
- 0,32 - 0,63
- 0,63 - 1,09
- 1,09 - 2,02
- 2,02 - 8,01

1:200 000



THE NETHERLANC

Theme:
Description:
Maker:
Date:
Source:

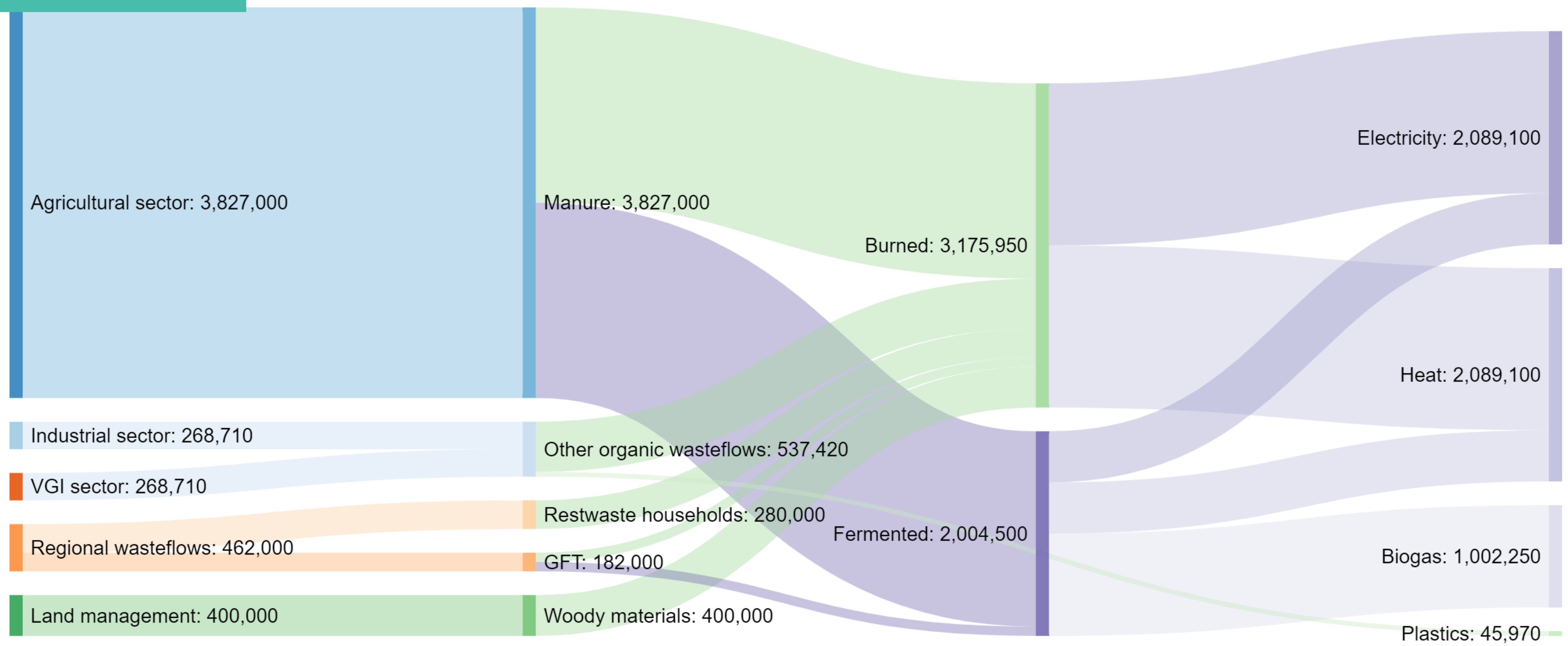
Legend

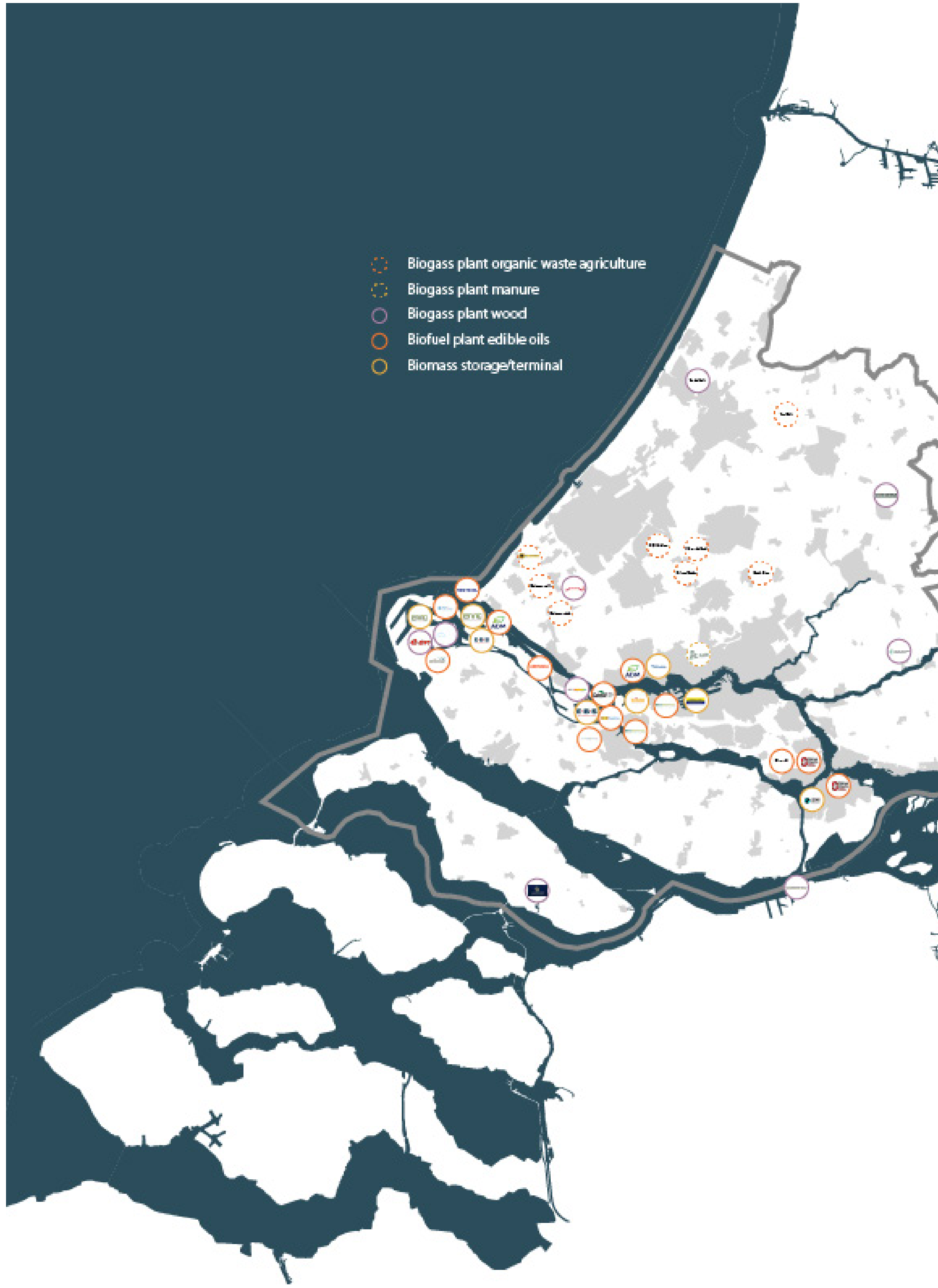
Province South Holland co
CBS Bevolkingskernen 20:
Water

Totaal potentieel houtachtige b
- 0 - 23
- 23 - 45
- 45 - 57
- 57 - 68
- 68 - 98

1:200 000

Let's show the flow!

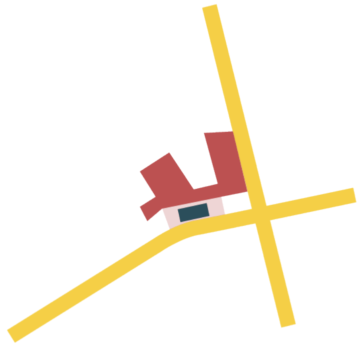





FUELING THE JOURNEY FROM PETRO TO BIO
EASING INTO A PETRO-FREE SOCIETY

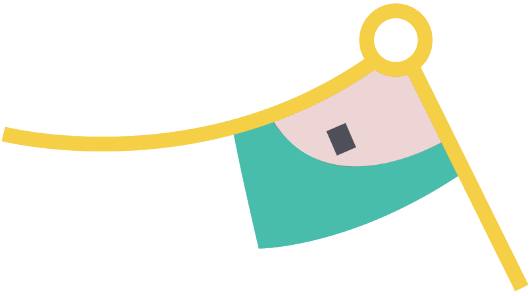
And what would the potential outputs of these bio-fuels? Namely the petrolstation-types we identified.

BUFFER
Buffer for residential to busy crossing



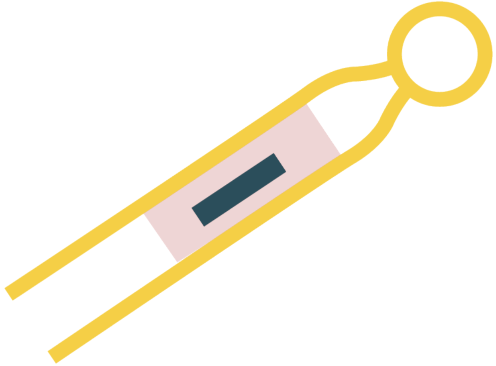
TINQ BAANWEG
89 m2

CAMOUFLAGED
Encapsulated by Green



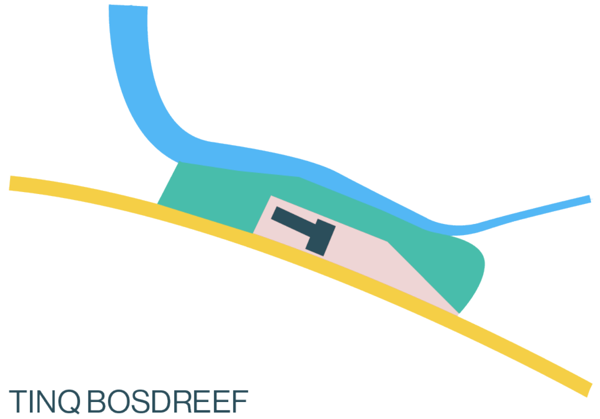
ESSO BOEZEMBURG
910 m2

ABSORBED
incorporated in the Infrastructure

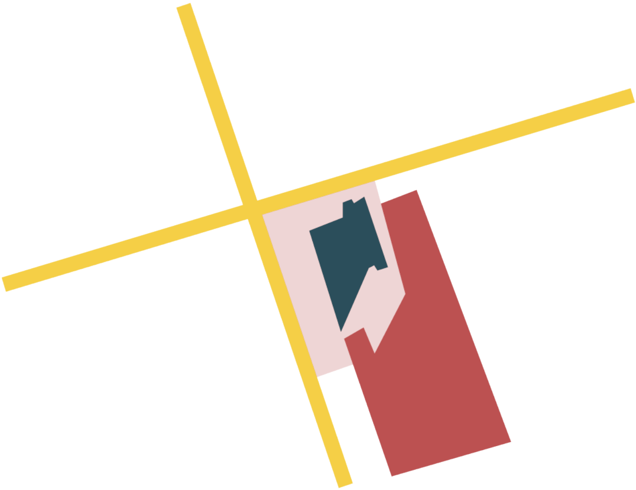


BP VLAARDINGWEG
1100m2

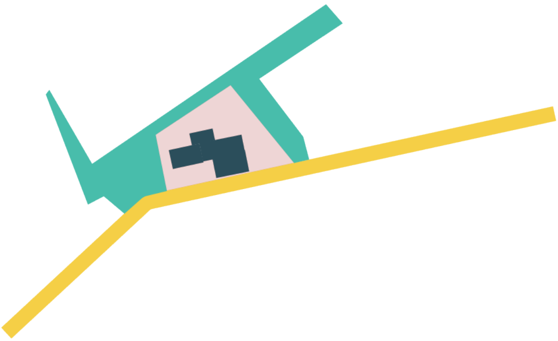
SANDWICHED
Connected on mltiple levels



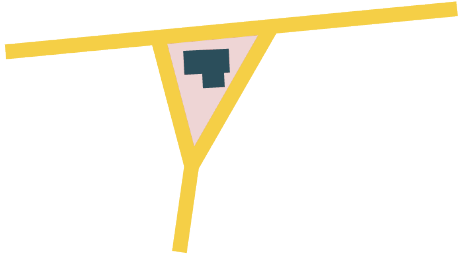
TINQ BOSDREEF
540 m 2



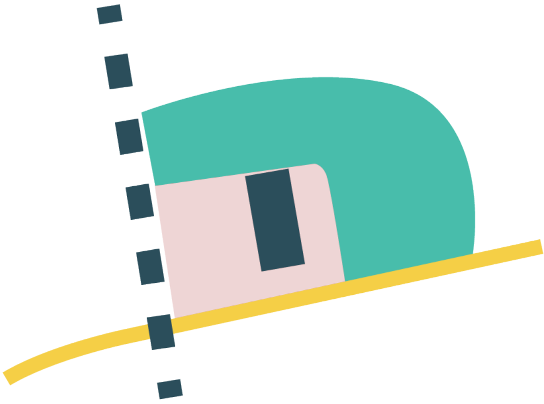
TOTAL 'S-GRAVELANDSEWEG
1290 m2



TAMOIL BOEZEMBOCHT
790 m2



ESSO BOEZEMBURG
380 m2



ESSO GORDELWEG
930 m2

POTENTIAL SPATIAL POCKETS
BACKEND / LONGTERM

Petrolstations
industrial pockets of land within the urban landscape.