FROM ISOLATION TO INTEGRATION

The energy transition as a driver for the revitalisation of port communities in Rotterdam

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Abstract

Due to the urgency of meeting the Dutch Climate Agreement to become carbon-neutral by 2050, the Port of Rotterdam is facing a profound industry shift. Accounting for 20% of the Dutch CO2 emissions, the port is a major greenhouse gas (GHG) emitter (Hentschel et al., 2018), the reason for the urgency of Rotterdam's energy transition. However, the Port of Rotterdam is also closely linked to its adjacent communities, Heijplaat, Pernis, Rozenburg and Hoek van Holland. These villages are concerned about the coming transition because their cultural identity and livelihoods are closely linked to the port activities (Hoek van Holland, 2023).

Therefore, we assessed how these port communities can be revitalised through the energy transition to improve the well-being and maintain the cultural significance. In order to assess this issue, we decided to understand the community aspect by looking at the Port of Rotterdam's spatial evolution in relation to these adjacent port communities, which are nowadays surrounded by the port. This resulted in the isolation of these port communities, because the port acts as a fence around them. Considering that the energy transition will be a large-scale development, which will change the spatial structure of the Port of Rotterdam (Port of Rotterdam et al., 2019). We believe that this energy transition can be an opportunity to tackle this isolation, and these port communities can be revitalised by improving their connections to their surroundings and improving the spatial qualities to make these villages more attractive. In order to manage this vision, we proposed an approach that includes the local stakeholders in the decision-making process to find a mutual consensus on how to envision the future of the Port of Rotterdam while going through the process of the energy transition.

The result of this project is a proposal that seeks to erase the hard barriers that delimit and divide the port and these port communities, in order to reduce the isolation experienced by their inhabitants today, as well as to improve the living conditions of these places and achieve an economically, environmentally and socially sustainable model using the energy transition as an opportunity.

Keywords: *Port of Rotterdam, Just Energy Transition, Community Engagement, Resilient Port Communities, Sustainable Port Development.*

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INTRODUCTION

1.1 The Urgency of the Energy Transition

Anthropogenic activities have contributed to a rise in global temperatures, primarily due to the extensive use of fossil fuels. Greenhouse gases (GHG) released into the atmosphere as a result of the combustion of fossil resources accelerate climate change and pose environmental and socioeconomic challenges. These challenges, which affect populations all around the world, include the rise in extreme weather events, the loss of biodiversity, and rising sea levels (Bashir et al., 2025; IPCC, 2023).

In response to these challenges, the global energy transition trend aims to shift from fossil fuel dependency to renewable energy sources, such as wind, solar, or biomass. Through these mitigation strategies, the energy transition aims to lower the anthropogenic impact on global warming, while improving energy security and fostering sustainable economic growth. The current energy transition trend aims to lower the GHG emissions and contamination that result from the fossil-based industries (Bashir et al., 2025). Even though of the current efforts to meet the climate threshold of keeping the increase in temperature below 1.5 °C, thee Intergovernmental Panel on Climate Change (IPCC) has released a report in which they argue that this goal is likely not going to be met and the 1.5 °C threshold will be most likely be surpassed halfway through the 21st century. Additionally, the IPCC stated that the main contributors to the GHG emissions are the energy sector and transport, industry and building sector (IPCC, 2023).

1.2 Context about the Energy Transition in the Netherlands

Historically, the Netherlands has heavily depended on fossil resources to meet its energy needs. Fossil resources made up 83% of the energy supply in 2023. However, these resources have to be imported, considering that the Netherlands does not have enough own resources to meet its energy demand. Therefore, 77% of the Dutch residents are dependent on the import of fossil energy sources from other countries (CBS, 2023). Due to this dependence on fossil energy, the Netherlands is vulnerable to geopolitical tensions. For example, the Russian-Ukrainian war has recently been impacting the energy supply and energy prices. In particular, after the European Union (EU) implemented sanctions against Russia in 2022, the energy prices have skyrocketed (CBS, 2023). Therefore, the shift from the current fossil fuel regime through the energy transition can be seen as an opportunity to gain more energy independence (Bosman et al., 2018).

However, not only is the fuel dependency posing an issue of the current fossil fuel regime, but also the pollution that comes with it, as mentioned earlier in section 1.1. The combustion of fossil fuels also creates GHG emissions and pollution. These pollutants can impact the health of people living close to high-emission zones stemming from air pollution, noise pollution, water pollution, etc.

In our research, we identified the major pollution sources in the Netherlands. Based on Figure number 1, where we compared the population density and the amount of CO2 kilotonnes emmited in 2024, we identified port areas, like Eemshaven, IJmuiden, and Rotterdam as major pollution sources in the Netherlands. Because of the great importance of the Port of Rotterdam as the largest port of Europe and the high popultaion density in the region, we decided to focus on this location. The Port of Rotterdam is an important energy hub for Europe, considering that it covers approximately 12% of Europe's entire energy demand, which is mainly transported to other industrial clusters in the Netherlands and Germany (Port of Rotterdam, 2022). Nevertheless, being an energy hub in a fossil-fuel regime comes with its trade-offs. The Port of Rotterdam is accountable for 20% of the Dutch CO2 emmisions and makes up 10-20% of the Dutch energy demand, making the port the major consumer of energy in the Netherlands (Hentschel et al., 2018; Port of Rotterdam Authority, 2020). The Port of Rotterdam's focus on a fossil fuel-based economy requires a strategic transition to renewable energy practices. This shift can mitigate the environmental impacts of the port.

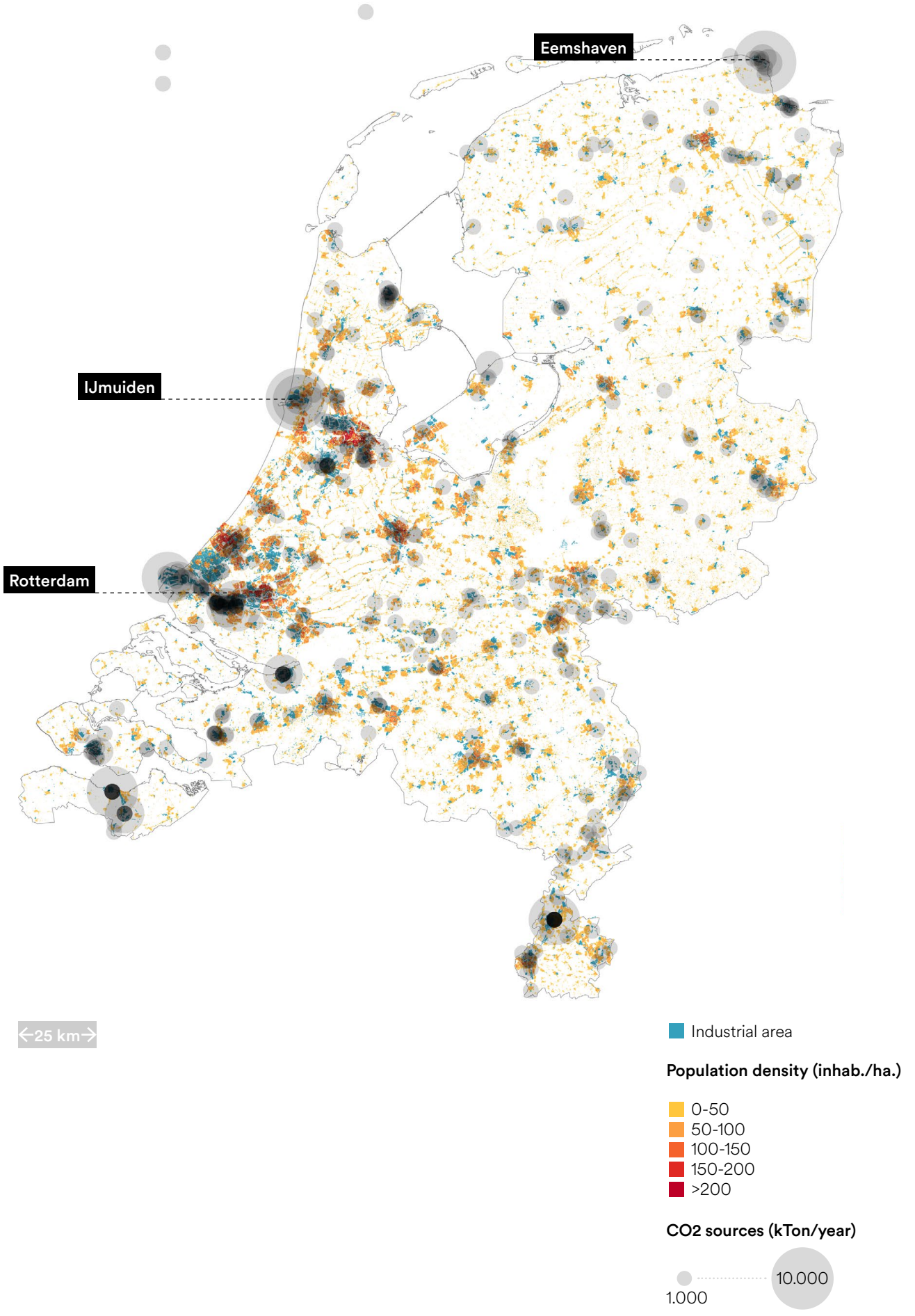


Fig. 1: *Spatial relationship between CO2 sources, industrial areas and population density in the Netherlands*

Image 1: *Magnum Power Plant in Eemshaven*
Note: *Image taken from Nationaal Waterstof Programma*

Image 2: *Tata Steel factory in IJmuiden*
Note: *Image taken from Tata Steel Nederland*

Image 3: *Shell Energy and Chemicals Park Rotterdam*
Note: *Image taken from Flying Holland*

02

METHODOLOGICAL FRAMEWORK

2.1 Problem Statement

The Port of Rotterdam is a key contributor to the Dutch economy, considering that it is the largest European port and a hub for global industries and international trade (Port of Rotterdam, 2025). The phasing out of its fossil-fuel industry to a less carbon-intensive industry in order to meet the Dutch climate goals by 2050 puts the Port of Rotterdam under significant pressure (Government of the Netherlands, 2025). While the plans for the Port of Rotterdam's energy transition are currently in the planning process, which includes improving energy usage efficiency, developing new renewable energy systems, and sustainable fuels (Port of Rotterdam et al., 2019). Although these efforts are crucial for environmental sustainability, they also cause potential risks for the port communities, like the loss of their cultural identity, unemployment and changes to their socio-economic landscape (van Duuren, 2023).

The Port of Rotterdam needs to protect the villages embeded in its industrial area -Heijplaat, Pernis, Rozenburg, and Hoek van Holland- where locals are concerned about their cultural identities and livelihoods, which are closely connected to port activities (Hoek van Holland, 2023). These risks were impacted by the spatial planning process of Rotterdam, in which the port and the city are seen through two separate lenses, the port lens and the Rotterdam lens (Hein et al., 2021). This comes from the fact that the port was seen as problematic entity due to its polluting industry and negative outside perception. Consequently, policymakers and planners overlooked the aspect of the cultural significance of its residents.

By disconnecting the port from the city, they also impacted these villages and fuelled their image as a port-village instead of 'getting rid' of the negative and improving the image of the village as well (Hein et al., 2021). Therefore, the challenge of the energy transition lies in the implementation process, which must not only mitigate environmental impact but also preserve the cultural significance and improve the well-being of the port communities. This requires an approach that integrates sustainable development with preservation of the cultural identity and economic stability. In order to implement the Port of Rotterdam's energy transition in a balanced approach, it requires a comprehensive analysis of the local stakeholders' needs, such as residents, employees, industry representatives, and policymakers. This strategic planning proposal aims to create a resilient port with vital port communities by utilizing the energy transition as an opportunity for the revitalisation of Rotterdam's port communities.

2.2 Research Question

Based on the previously described problem, we posed the following research question, with its respective sub-questions related to the diverse factors that the main question addresses:

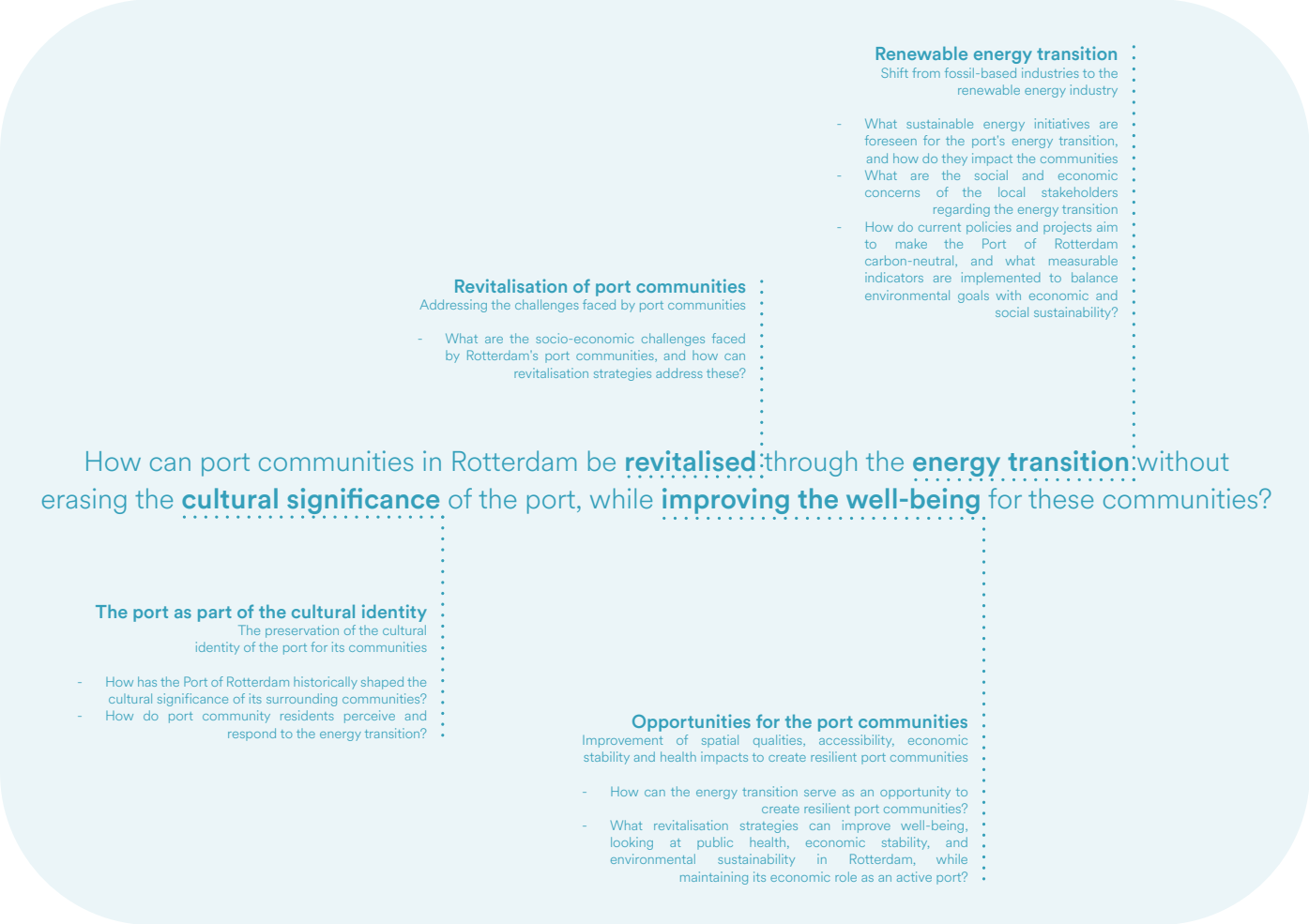


Fig. 2: *Research question and research sub-questions diagram*

2.3 Methodology

This research addresses how Rotterdam's port communities can transition sustainably while preserving their cultural significance and improving the well-being of the surrounding villages. The Port of Rotterdam is currently one of the main drivers of climate change in the region; it contributes to 20% of the Dutch CO2 emissions and consumes 10-20% of the entire Dutch energy demand (Hentschel et al., 2018; Port of Rotterdam Authority, 2020). Therefore, we decided to focus our research on the energy transition of the port, because if the Netherlands wants to meet their climate goals of being net-zero by 2050, the port undoubtedly must face transitions (Scheepers et al., 2022). However, the transformation of an industry regime can directly impact the residents closest to it due to unemployment, dependence on the industry and the erasing of the cultural significance of the port for these villages. Nevertheless, the Port of Rotterdam is going to be spatially reshaped, and this can also be an opportunity for a new spatial structure and positively influence its surrounding port communities as well.

We decided to assess the port communities' revitalisation potential in our research. This has been done through a spatial analysis of the Port of Rotterdam and its surrounding area and qualitative research of primary and secondary data sources. In our qualitative research, we made use of several methods, such as literature review, media analysis, semi-structured interviews and a policy review. This methodology provided us with a comprehensive understanding of the socio-spatial and socio-technical dynamics that affect these port communities.

2.3.1 Theoretical Framework

Sustainable Port City Development: Sustainable port city developments require an inclusive approach that integrates economic stability, environmental sustainability, and social well-being. Jansen & Hein (2023) highlight in their research the link between ports and their surrounding residential areas, advocating for these to coexist in symbiosis.

Over the past hundred years, the port has been distancing itself from the city, which has resulted in the creation of hard borders between the port and residential areas. According to Hein (2019), this has led to a pattern of diverging needs between the port and its associated city. In particular, as both cities and ports continue to grow, they are increasingly in need of more space -space that is often unavailable in these densely developed areas. Therefore, Hein, (2019) introduces the idea of "port cityscapes," referring to a collaborative governance structure aimed at solving the spatial development challenges of port cities and dissolving these hard borders.

In addition to the "port cityscapes," Jansen & Hein (2023) propose an ecosystem value approach, referring to the different layers of capital that need to be considered in sustainable port city development. These capitals include natural, cultural, social, human, industrial, and creative capital (Jansen & Hein, 2023). Over the past century, economic perspectives have often been prioritized over environmental and social ones. This framework aims to ensure that spatial improvements align with environmental and societal interests, rather than focusing solely on economic growth (Hein, 2019).

Just Energy Transition: The just energy transition stresses that all people are benefiting and harmed equally by the shift from fossil fuels to renewable energy sources (Sovacool & Dworkin, 2015). According to Sovacool & Dworkin (2015), energy justice is based on eight principles. These principles include availability, affordability, due process, transparency, sustainability, inter-generational equity, intra-generational equity, and responsibility. In order to meet these principles, energy justice is divided into distributive justice, procedural justice and recognition justice. Distributional justice ensures the fair allocation of energy, procedural justice focuses on inclusive decision-making processes, while recognitional justice emphasises identifying marginalized communities that were impacted in the past by the energy systems (Sovacool & Dworkin, 2015).

Energy justice, combined with the energy transition, can determine how to align technological improvements with social equity to benefit and harm everyone equally. Therefore, this just energy transition framework can detect potential injustices prematurely and ensure that the energy transition advocates for sustainability as well as social equity.

The Small Core Approach: The Small Core Approach (‘Kleine Kernen Aanpak’) refers to the joint vision that the four port communities of Rotterdam -Heijplaat, Pernis, Rozenburg and Hoek van Holland- developed and adopted in the past years. In this approach, they address their uniqueness as villages of the Municipality of Rotterdam, but they are still quite isolated from the city centre. Additionally, the Small Core Approach addresses the common challenges that these communities face, such an ageing population, the decreasing employment in the port, (partly) an outdated housing market and an unattractive image, which add up and result in the vitality of these communities to slowly seep away (Hoek van Holland, 2023). Therefore, the Small Core Approach aims to strengthen the resilience of these port communities, such as local communication and welfare, through the advocacy for tailor-made policies.

Fig. 3: *Location of the Small Cores within the Municipality of Rotterdam*

2.3.2 Conceptual Framework

The conceptual framework of our research is centred around the vital port communities with the energy transition as an overarching trend. This should highlight the importance of the energy transition, but in the process of the energy transition, it is important to highlight the role of the port as an economic and cultural hub for these communities, and these should not be forgotten during the energy transition process. Our conceptual framework is set up based on three interconnected levels to address this challenge:

a. Central Level: Vital Port Communities

At the centre of the framework is the vitality of the port communities of Hoek van Holland, Rozenburg, Pernis, and Heijplaat. These villages have strong ties to the activities of the port, shaping their social fabric and local identity. Due to these strong ties, the port became culturally significant to these port communities. However, as the energy transition progresses, these communities must face changes that affect their economies, spatial development, and cultural significance. The idea of this concept is to develop these communities that are vital for the people living there and attractive for new potential residents.

b. Intermediate Level: Small Cores of Rotterdam

In the intermediate level, we want to investigate the needs of the Small Cores of Rotterdam to create vital port communities in the process of the energy transition. This level examines the balance between the implementation of energy transition without neglecting the port communities' needs.

c. Outer Level: Participatory Governance, Sustainable Development, and People-Centred Approaches

The outer level of the framework consists of three concepts, which inform the revitalization process to create vital port communities:

Participatory Governance: We decided to utilize participatory governance to emphasise inclusive decision-making processes where civil society, private stakeholders and public stakeholders collaborate to shape the future of the port area. This approach ensures that the ongoing energy transition aligns with residents' needs and aspirations. A key element of this is shared vision-making, which strengthens the link between governance structures and community priorities. Another key element is to create resilient port communities by engaging the stakeholders through the participatory governance approach. The voices can be heard, and the planning outcome will please the stakeholders. A important stakeholder in this process are the residents of the port communities because as mentioned in the section 'Small Core of Rotterdam' they are struggling with demographic development and decreasing employment by integrating them and their needs the transition of the port can become more vital and also include their needs to make these port communities more attractive (Hoek van Holland, 2023).

Sustainable Development: By recognizing the importance of economic, environmental, and social sustainability in our planning approach, we want to ensure that these factors of sustainability are in equilibrium, and one does not overpower the other two factors. Therefore, economic diversification can safeguard sustainable development by introducing renewable energy industries with different energy sources. These industries provide long-term resilience for port villages. Furthermore, resilient port communities emerge when sustainable development strategies

are directly aligned with cultural preservation and socio-economic stability to make these port communities more vital and attractive for current and future residents.

People-Centred Approaches: The well-being and cultural identity of residents are taken into account by capacity-building policies that improve public well-being and economic stability. By linking shared vision-making with people-centred approaches, the framework ensures that community engagement remains a fundamental component of the energy transition process, fostering a sense of ownership in the decision-making.

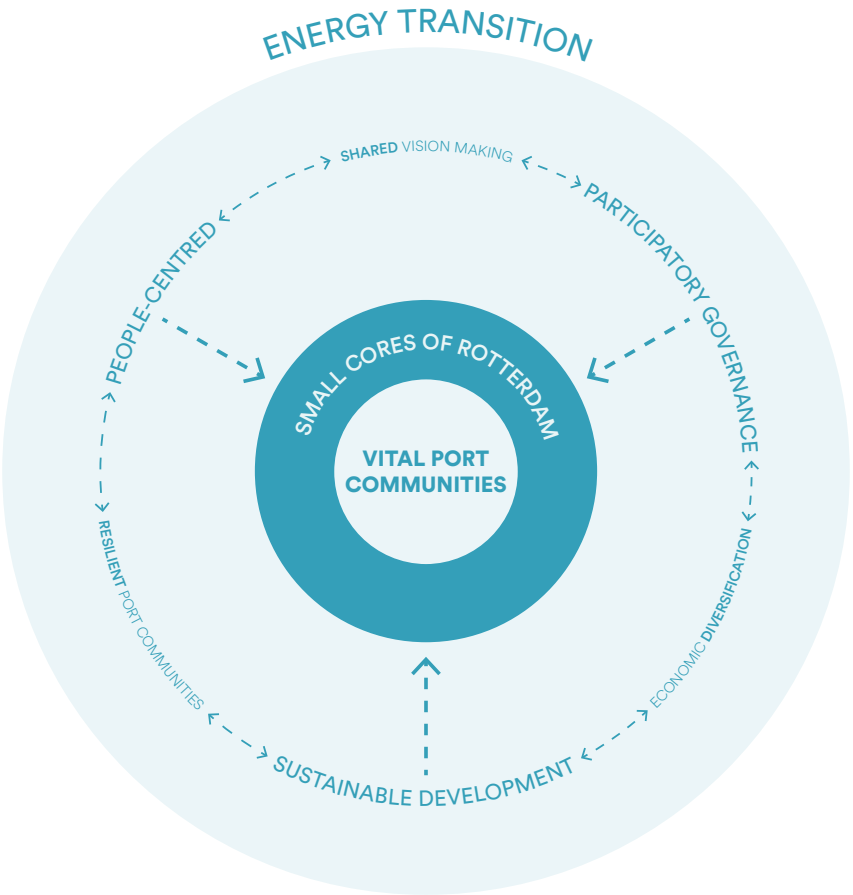
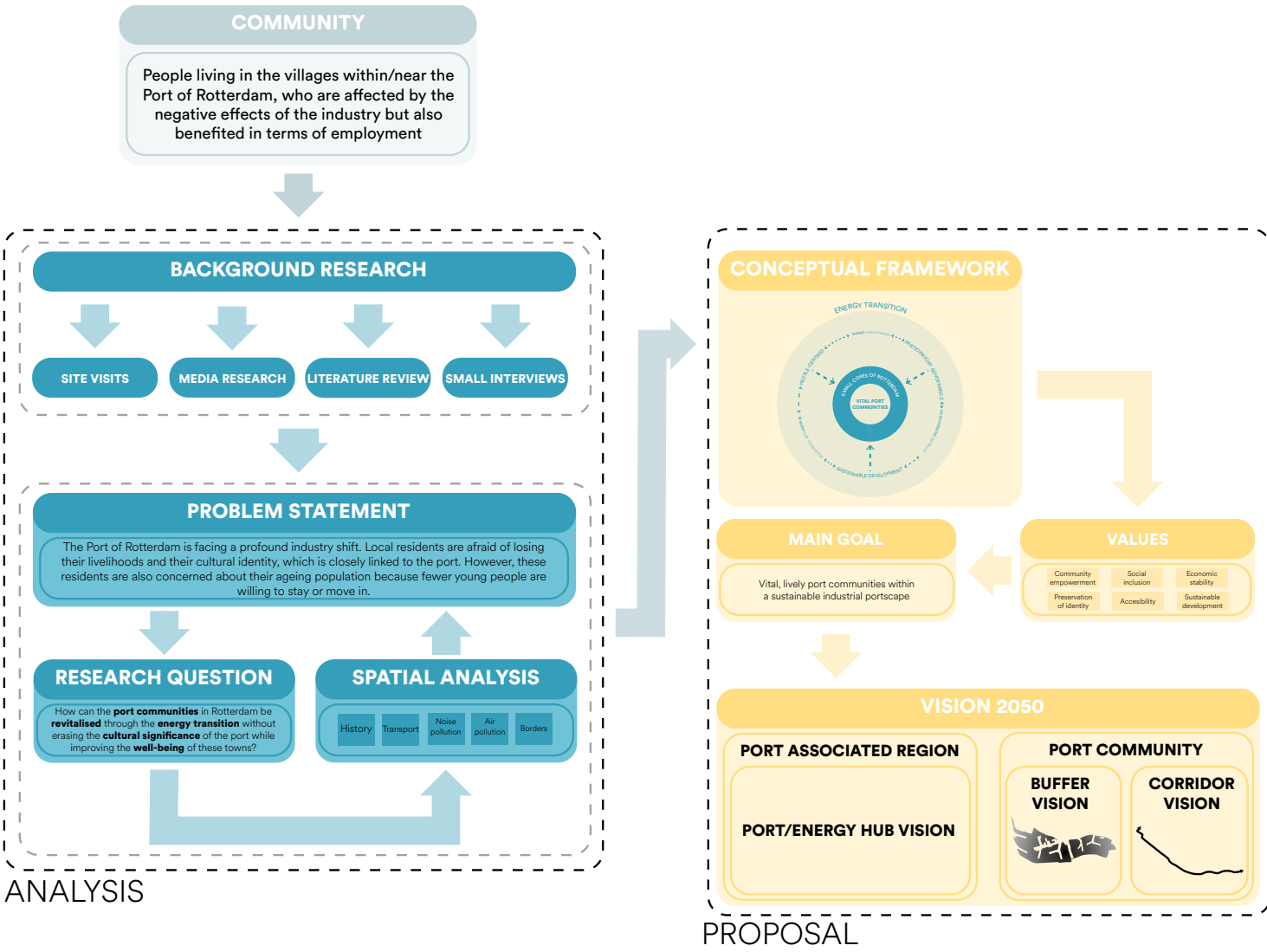


Fig. 4: Conceptual framework diagram

2.4 Methodology Diagram



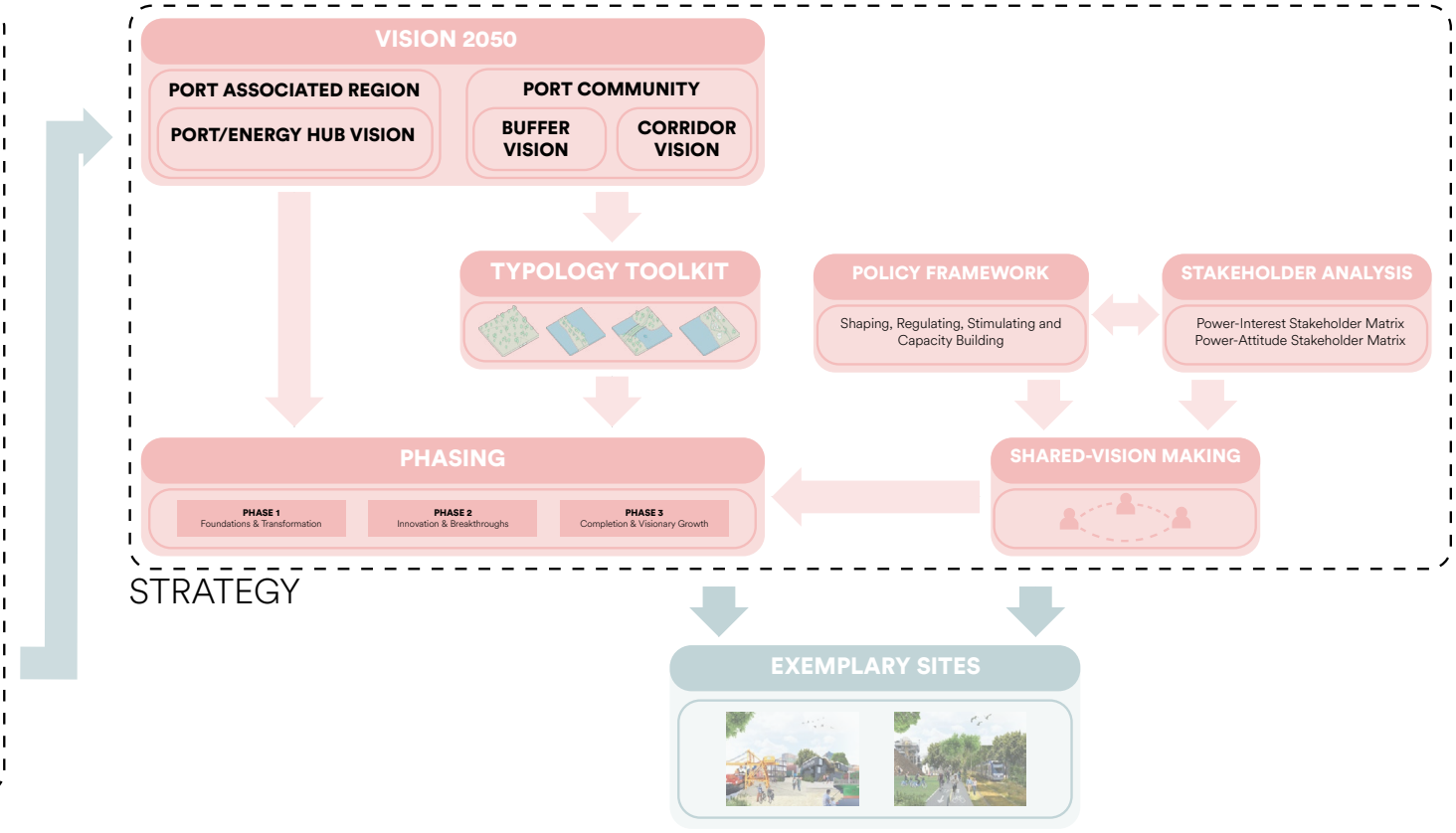


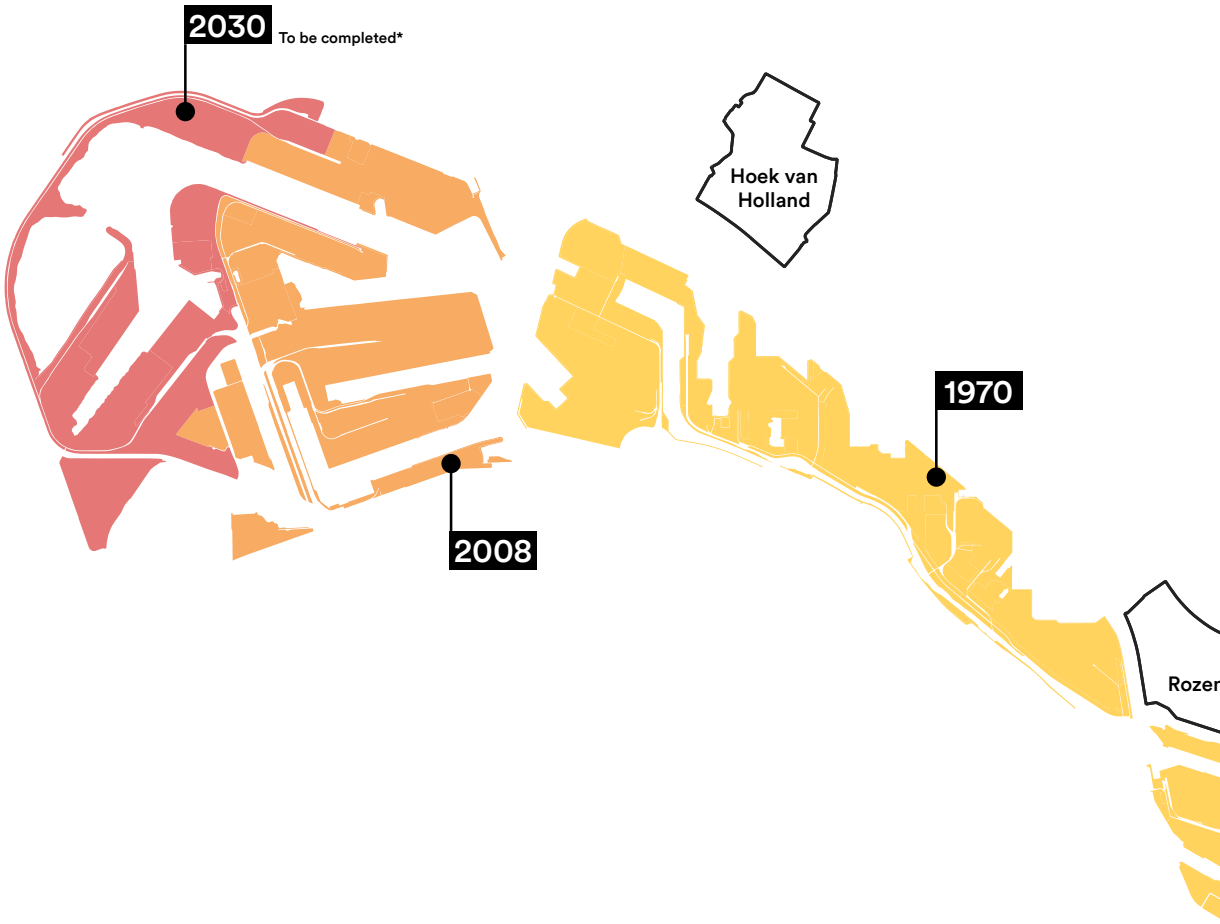
Fig. 5: *Methodology diagram*

03

ANALYSIS: UNDERSTANDING THE CURRENT SITUATION

3.1 Historical Evolution of the Port and its Communities

To better understand the background of the spatial and economic relationship between the Port of Rotterdam and the communities, we conducted a brief historical analysis in which we studied how the evolution of the port from the early 20th century onwards influenced the development of these communities. During the first research, we found out that the port was developed in nine diferent stages. Therefore, to carry out this analysis and link the expansion of the port with that one of the communities, we equated the historical development of the four communities with these stages of port expansion. The results are evident and follow the same basic trend in all four cases: once the port infrastructure had been built around the communities, they experienced accelerated urban development. This already provided us with an initial idea about the close relationship between the port and the communities since the last century.



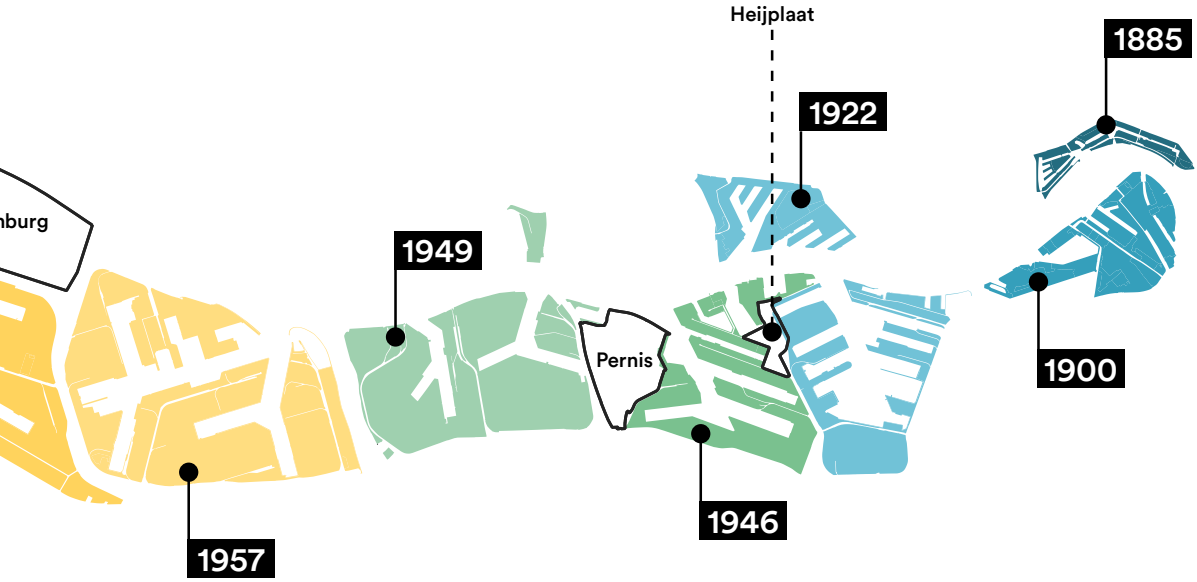


Fig. 6: Map of the development stages of the Port of Rotterdam
Source: Adapted from Port of Rotterdam 2023, Geschiedenis van de haven

Hoek van Holland

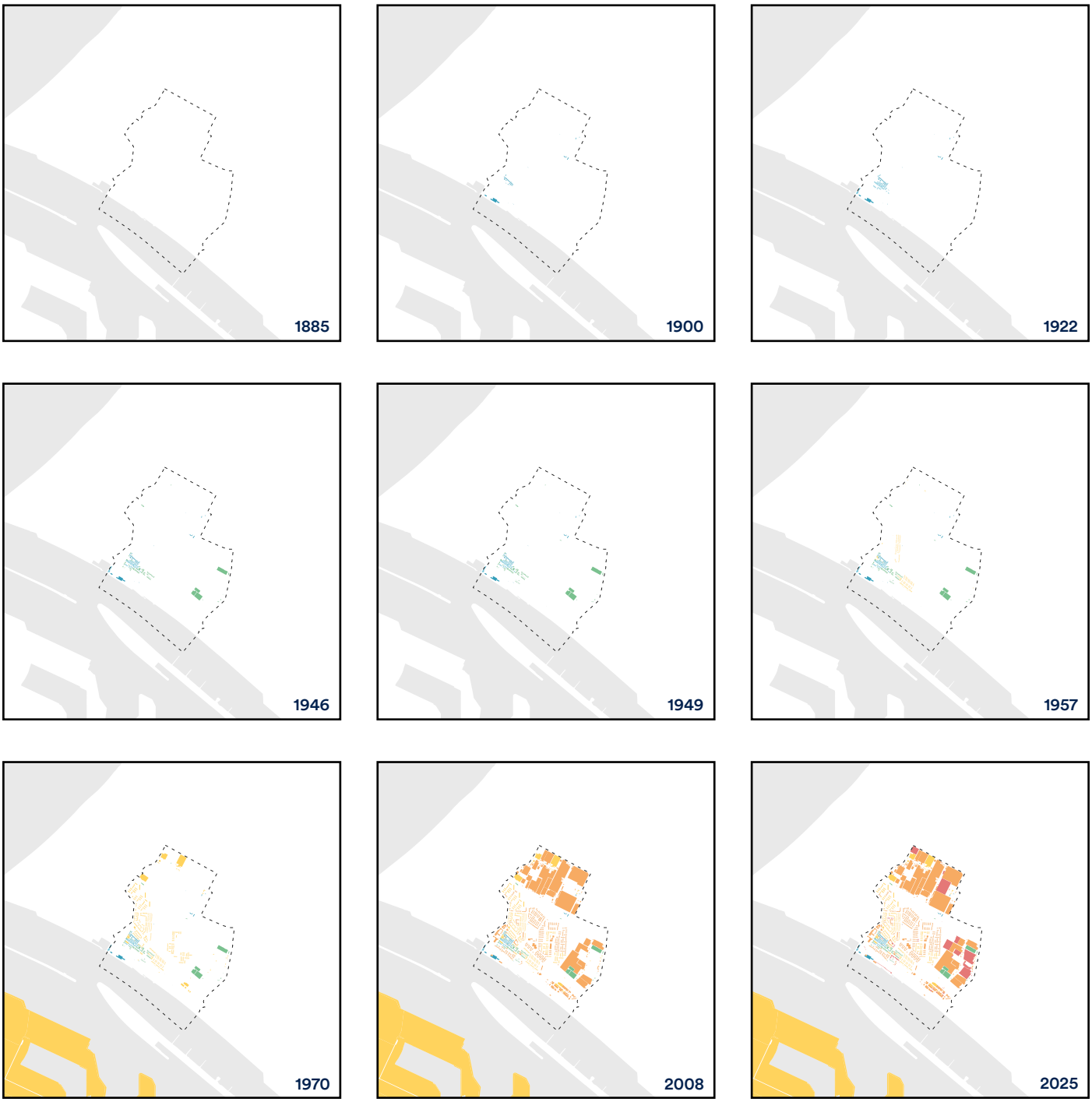


Fig. 7: Historical evolution of Hoek van Holland in relationship to the Port of Rotterdam

Rozenburg

Fig. 8: Historical evolution of Rozenburg in relationship to the Port of Rotterdam

Pernis and Heijplaat

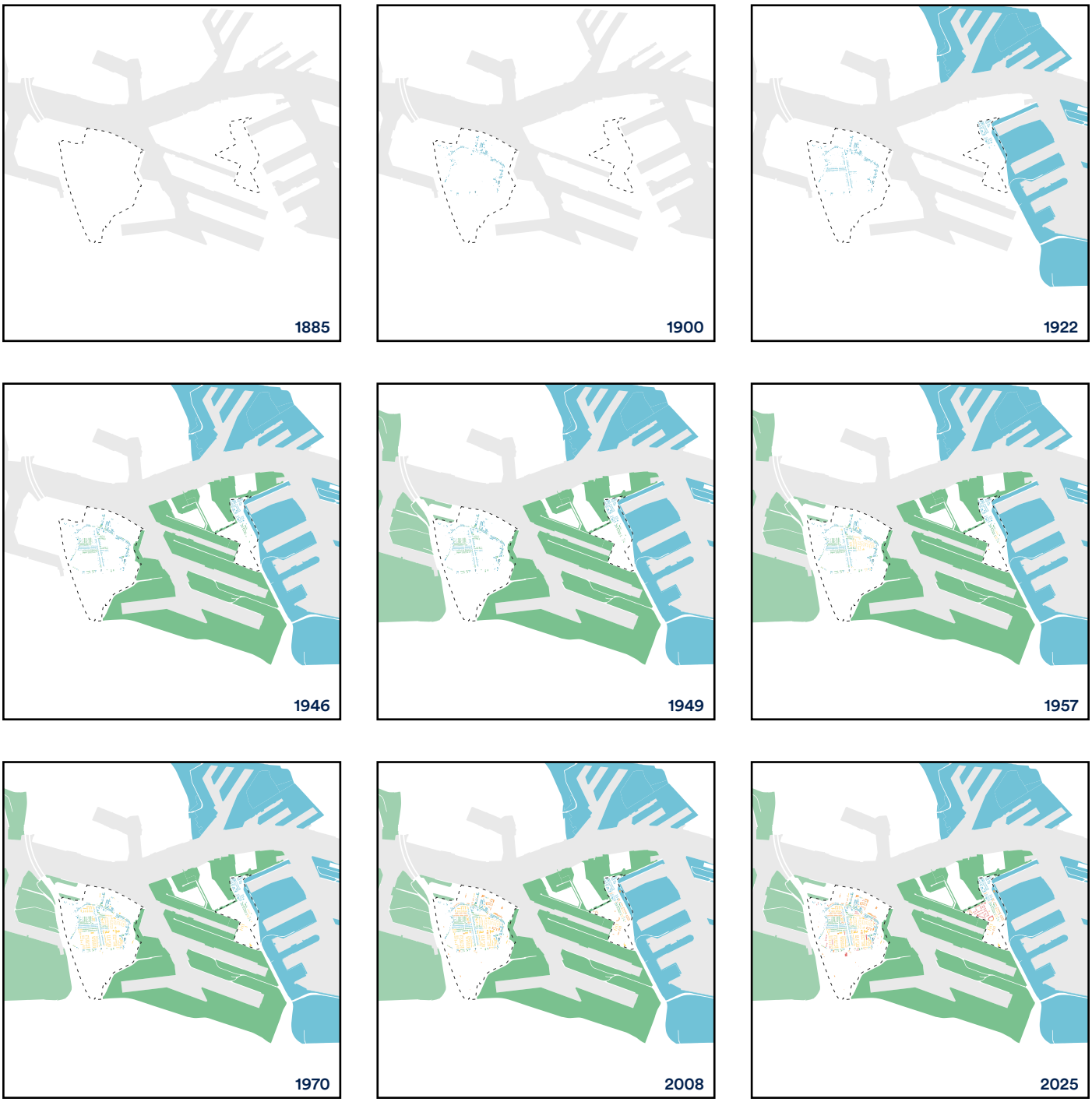


Fig. 9: Historical evolution of Pernis and Heijplaat in relationship to the Port of Rotterdam

3.2 Community and Social Dynamics

3.2.1 Interviews and Media Analysis

To have an in-depth and clear view of the research some field research was done as well. We visited both Rozenburg and Pernis on a fieldtrip to gain some knowledge about the problem in these villages. What surprised us, was that most people we interviewed were quite happy about the current circumstances. Some people mentioned that the industry around had some impact, but others just had positive things to say about the industries. We also noticed that the industry also played a huge role in the daily life of these people, either by providing jobs or by financing facilities in the villages.

Besides this, we also carried out a brief media analysis. One of our main findings was that the Port of Rotterdam had a really bad image from the outside, what also plays a big role in the problems with finding employees (see articles on the left side). Also, we found out that there were a lot of concerns from the port communities about future developments in the port, e.g. the planning of ammonia or hydrogen plants close to their villages. It was clear that the residents were quite worried about the future of the port.

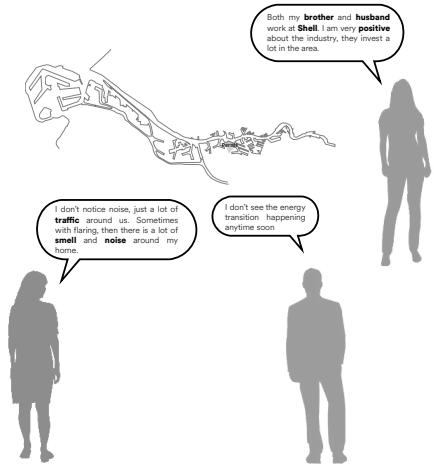


Fig. 10: Main impressions of the interviews (Pernis)

Fig. 11: Main impressions of the interviews (Rozenburg)

Fig. 12: Media analysis insights

3.2.2 Community Concerns

In addition to the interviews and media analysis, we also considered the common concerns among these four communities that are mentioned in their individual visions. All four visions share a section in which they describe the common challenges that these villages currently face, which contribute to their loss of vitality. As mentioned earlier, these challenges are an aging population, an obsolescent housing market that no longer meets current needs, and the decreasing number of job opportunities at the port. To gain a deeper understanding of these community concerns, we conducted research on these specific issues, which is shown in the following sections.

Fig. 13: *Vision documents of the port villages.*
Note: *Images taken from Gemeente Rotterdam*

3.2.3 Demographics

The research conducted on the demographic situation of the Small Cores, and more specifically, on the different age groups of the population, revealed to us that in fact, in three of the four villages the percentage of population over 65 years of age is higher than the Rotterdam average, while the number of inhabitants between 18 and 39 years of age is lower, which in turn probably has to do with the problem described in the following section on the situation of the value of the average housing unit.

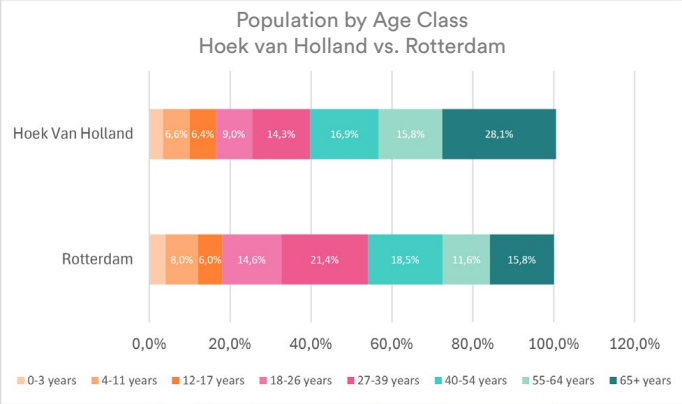


Table 1: Population age by class Hoek van Holland vs. Rotterdam
Source: *Adapted from mapalize.nl, 2024*

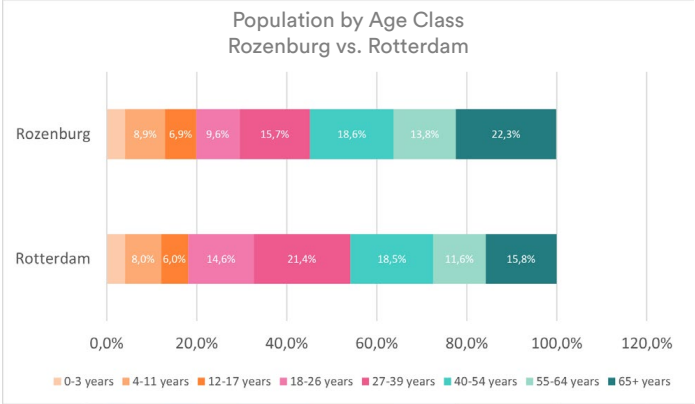


Table 2: Population age by class Rozenburg vs. Rotterdam
Source: *Adapted from mapalize.nl, 2024*

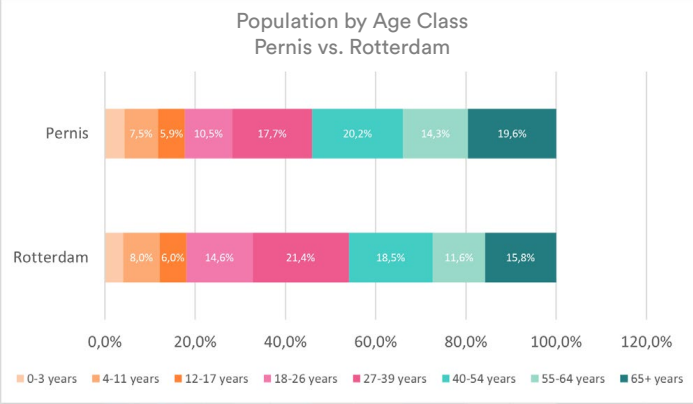


Table 3: Population age by class Pernis vs. Rotterdam
Source: *Adapted from mapalize.nl, 2024*

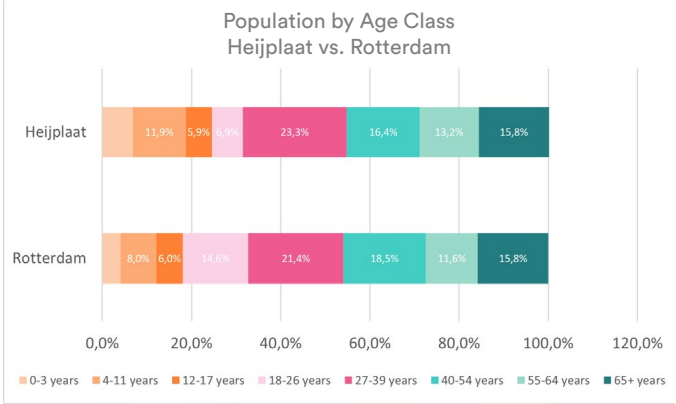


Table 4: Population age by class Heijplaat vs. Rotterdam
Source: *Adapted from mapalize.nl, 2024*

3.2.4 Housing Market

The community's concerns about the housing market situation turned to have a strong rationale. Research on this aspect revealed that the average housing unit value in the four towns has been following an uncontrolled upward trend over the last twelve years, in some cases even doubling. This certainly represents a major hardship for people seeking to make a life in these places, which partly explains why the young population is lower here than the Rotterdam average.

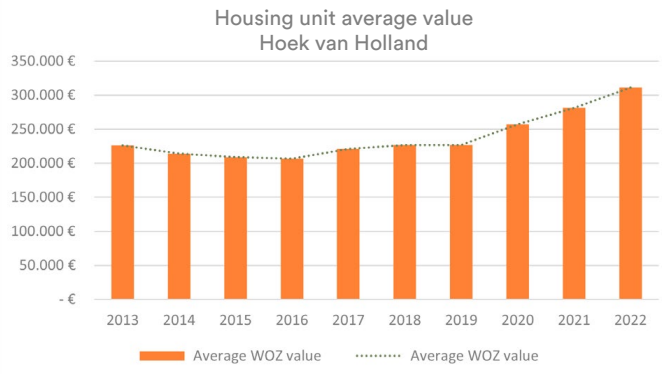


Table 5: Average housing unit value in Hoek van Holland
Source: *Adapted from allecijfers.nl, 2022*

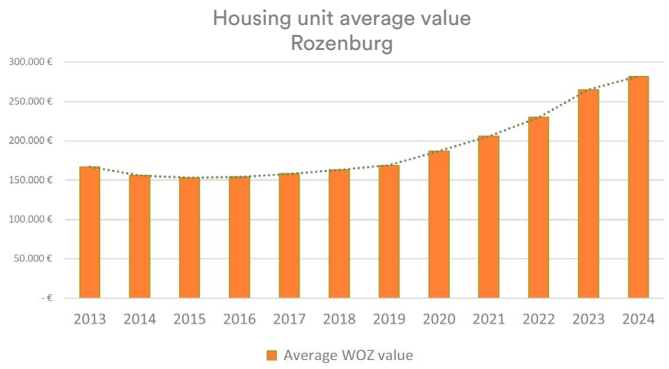


Table 6: Average housing unit value in Rozenburg
Source: *Adapted from allecijfers.nl, 2024*

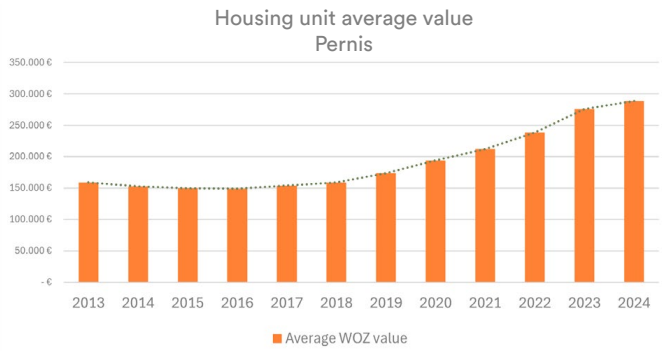


Table 7: Average housing unit value in Pernis
Source: *Adapted from allecijfers.nl, 2024*

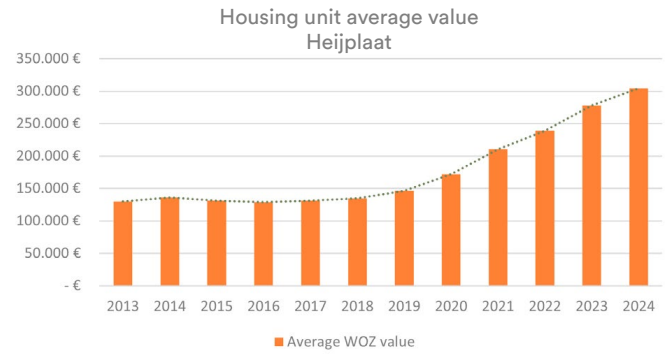


Table 8: Average housing unit value in Heijplaat
Source: *Adapted from allecijfers.nl, 2024*

3.2.5 Employment dependence

Although we were unable to prove statistically that the supply of jobs is decreasing in the port (which is one of the main concerns of the Small Cores' communities), we did find that the trade and catering and industry and energy sectors are either the main employer sector or play a relevant role in the job market, which may lead us to infer that many of these jobs are in the port. This would explain the expressed concern of the population about this apparent decline.

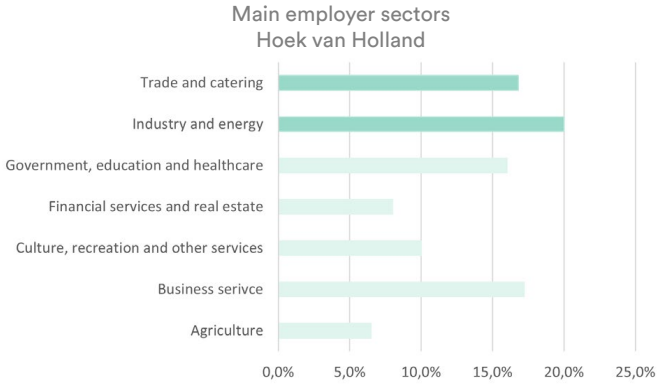


Table 9: Main employer sectors in Hoek van Holland
Source: *Adapted from allecijfers.nl, 2024*

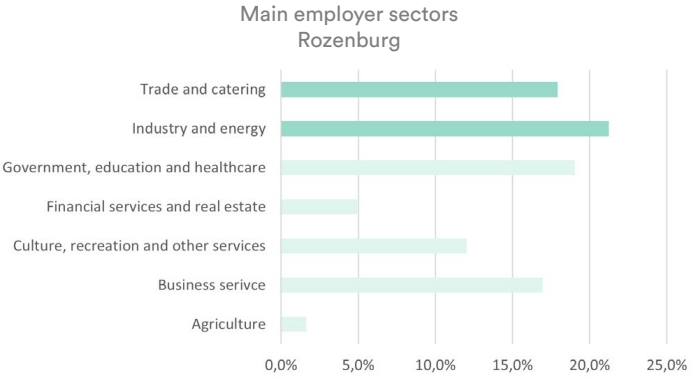


Table 10: Main employer sectors in Rozenburg
Source: *Adapted from allecijfers.nl, 2024*

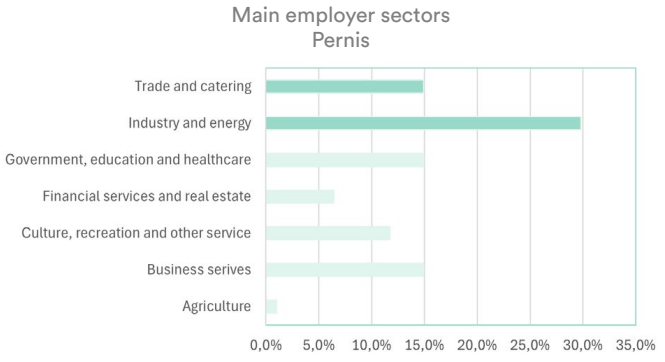


Table 11: Main employer sectors in Pernis
Source: *Adapted from allecijfers.nl, 2024*

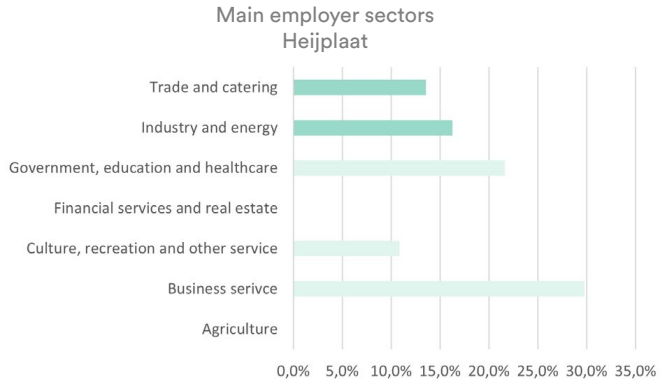


Table 12: Main employer sectors in Heijplaat
Source: *Adapted from allecijfers.nl, 2024*

3.3 Spatial Analysis

3.3.1 Edges

When analysing the Figure 14, a clear spatial edge between the industrial areas and the Small Cores or surrounding greenery and residential areas shows up. Here, we highlighted the established port edges in yellow. These clearly show the contrast between the densely built area and the sparsely built surroundings.

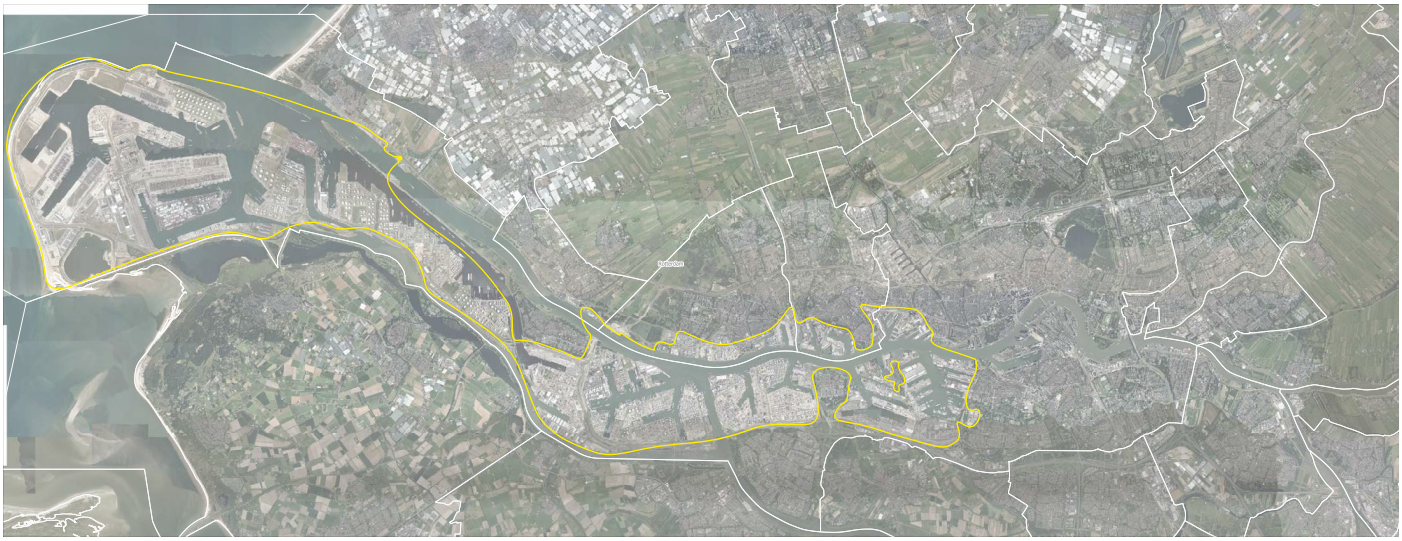


Fig. 14: *Edges of the Port of Rotterdam*

Upon examining the characteristics of these edges more closely, three types can be identified: Water, Road and Greenery, as shown in Figure 15.

The western part of the port is primarily bordered by water and is distant from other types of land uses. In contrast, the eastern part is mainly bordered by streets and green infrastructure. In the case of Pernis, a greenbelt surrounds the area, separating the Small Core from the surrounding industry. Heijplaat, on the other hand, has a different situation: the streets between the port industry and the village are narrow, and, unlike Pernis, there is no greenbelt creating a buffer zone. The differences between Pernis and Heijplaat are illustrated in the pictures of Figure 15, where Pernis is surrounded by a greenbelt, the houses in Heijplaat are next to industry without a greenbelt acting as a buffer. Hoek van Holland and Rozenburg have a different kind of relationship with the edges of the port. Hoek van Holland is the farthest from the port industry of all the villages, while Rozenburg is sandwiched between the water and the industry, with a wide access street separating Rozenburg from the industrial area.

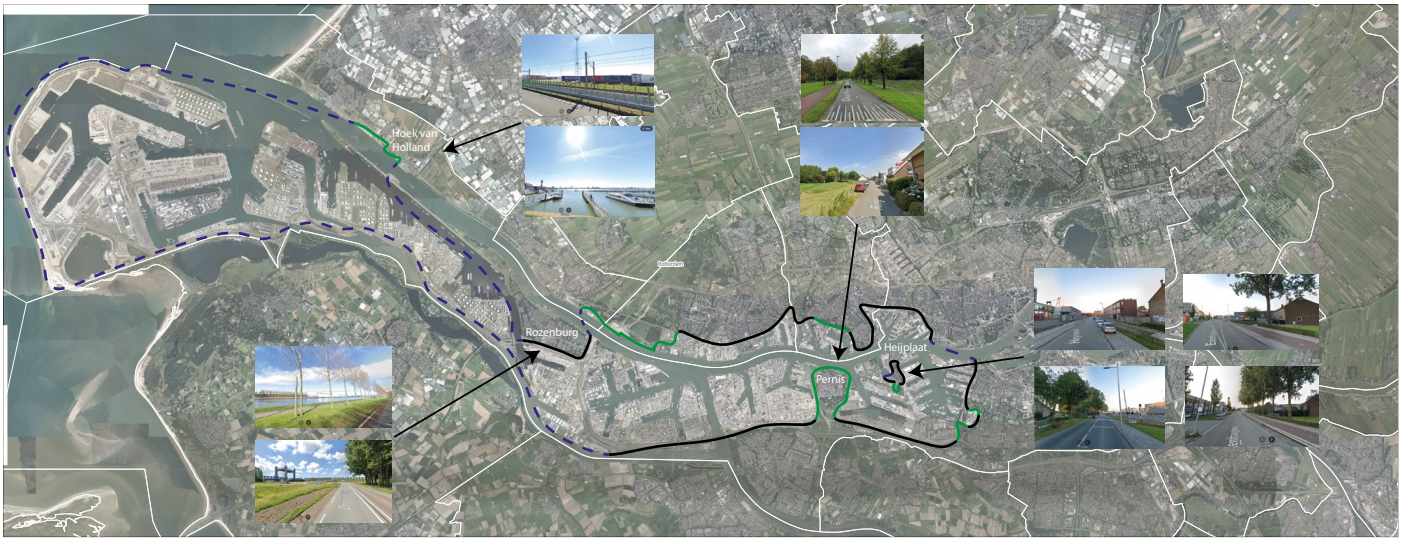


Fig. 15: *Types of edges of the Port of Rotterdam*
Note: *Images taken from Google Street View*

Figure 16 illustrates the current sections of the port edges in relation to the Small Core villages. By analysing the port border further, we found that there are containers, fossil bulk or chemicals/ refineries located next to the Small Core villages.

In summary, there are edges between the villages and the industry. The edge types are characterised as green, street or water border as seen in the spatial impression of Figures 17, 18 and 19. These borders fragment the small cores into isolated entities within the port area.

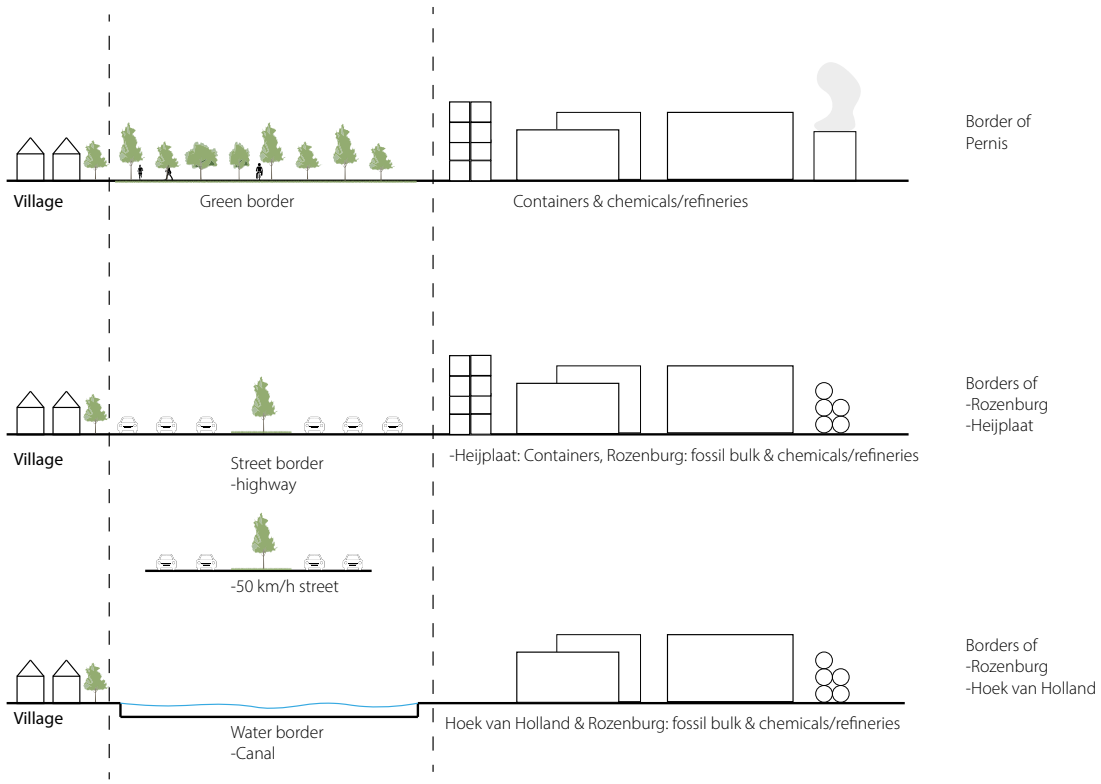


Fig. 16: *Sections showing the different types of edges*

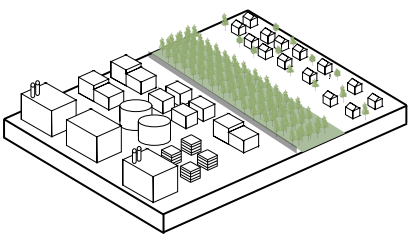


Fig. 17: *Isometric view of a green edge*

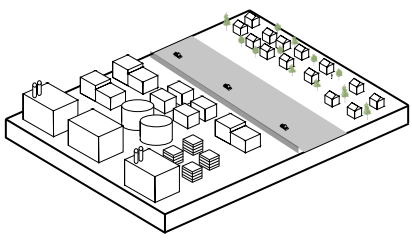


Fig. 18: *Isometric view of a road edge*

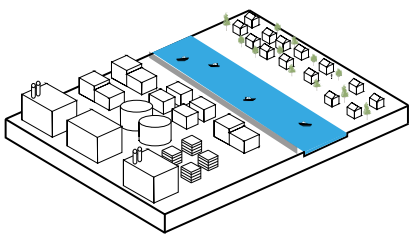


Fig. 19: *Isometric view of a water edge*

3.3.2 Environmental impact

Noise pollution: As shown in the 'Introduction' section, the Port of Rotterdam is an important source of CO2 emissions. Besides the CO2 emissions there is noise and smell pollution.

In the Figure 20 (Rijksinstituut voor Volksgezondheid en Milieu, 2020) we see that the Small Cores are within or surrounded by noise pollution. As shown in the maps, this noise pollution primarily comes from the industry and port-related activities reaching 93 dB., while 55 dB is typically the target for residential areas to prevent severe disturbance. (World Health Organization, 2009)

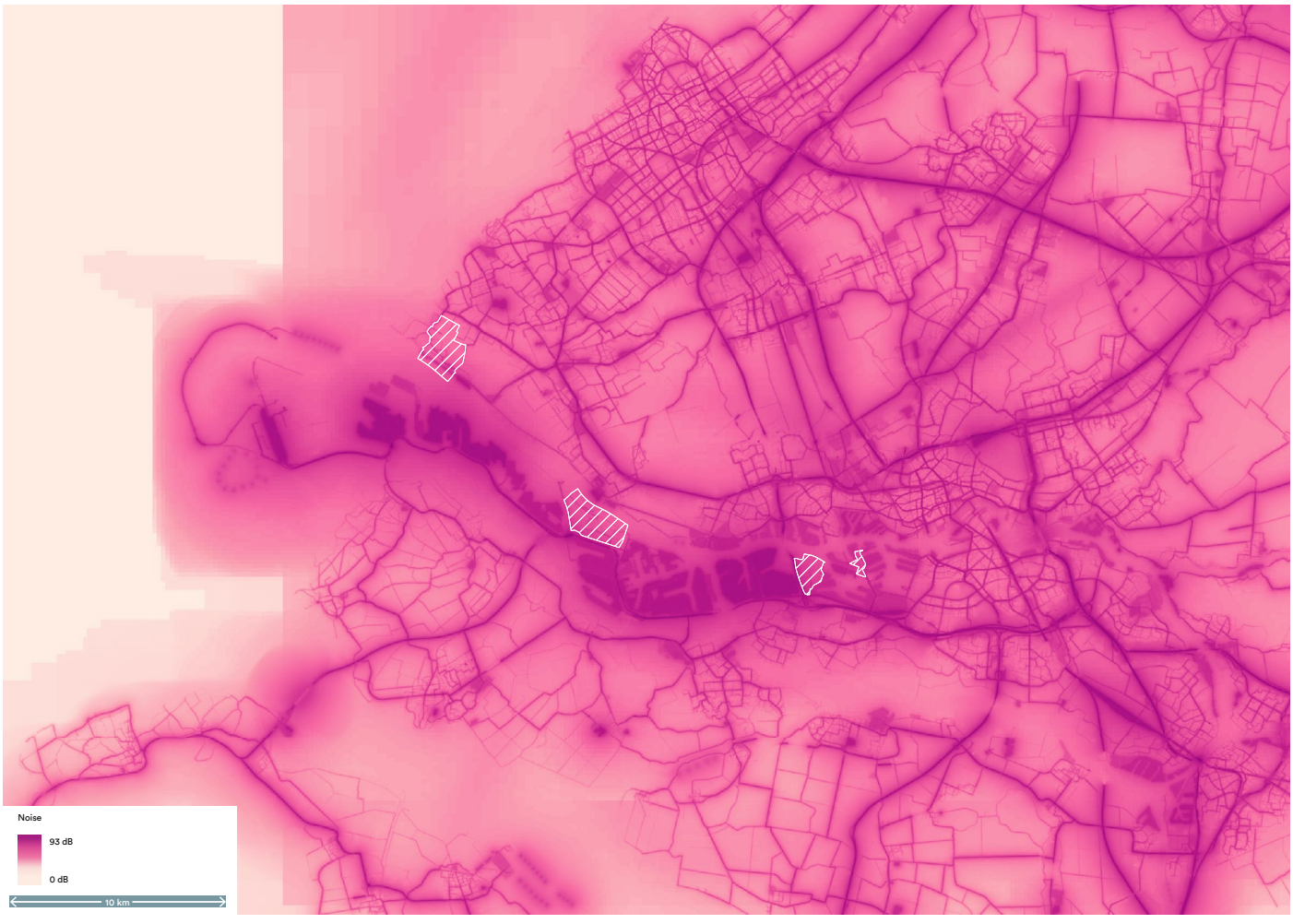


Fig. 20: *Port of Rotterdam noise pollution map*
Note: *Image taken from Rijksinstituut voor Volksgezondheid en Milieu*

Smell pollution: In Figure 21 (DCMR, n.d.) we see the smell that is present in Rotterdam. We see that the Smal Cores are affected by the smell since they are close to the concentration of high smell odour units. Compared to the other Small Cores, Pernis is highly affected by smell, reaching the highest odour units.

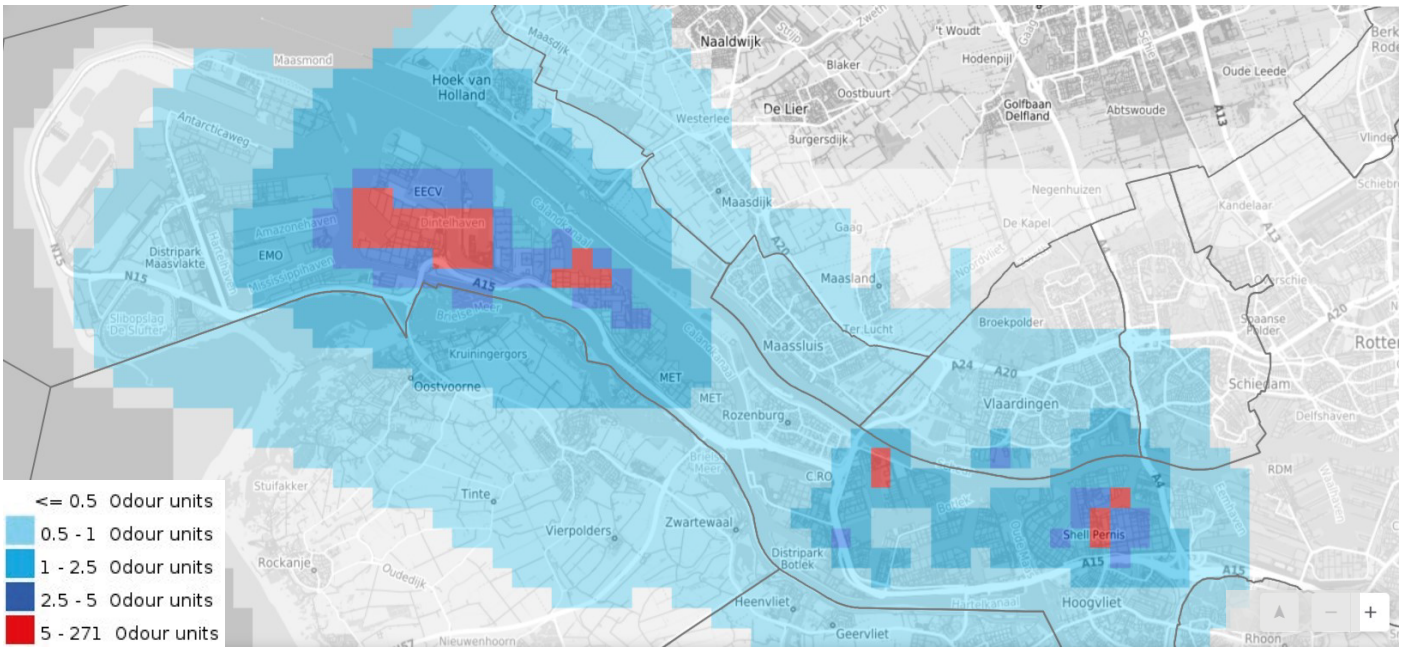


Fig. 21: *Port of Rotterdam noise pollution map*
Note: *Image taken from dcmr.nl*

Environmental health risk: In Figure 21 (DCMR, n.d.) we see the smell that is present in Rotterdam. We see that the Smal Cores are affected by the smell since they are close to the concentration of high smell odour units. Compared to the other Small Cores, Pernis is highly affected by smell, reaching the highest odour units.

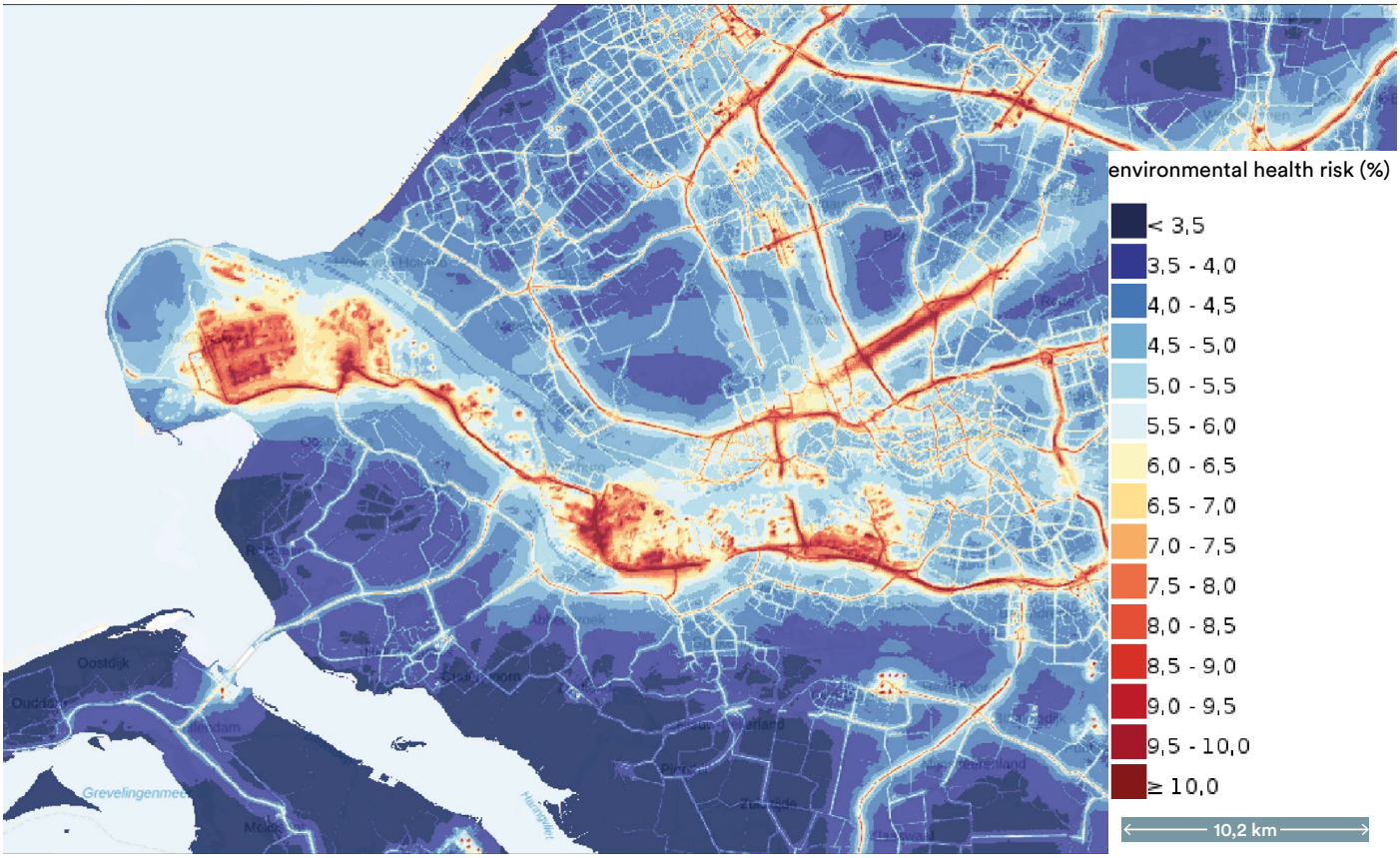


Fig. 22: Port of Rotterdam environmental health risk
Note: *Image taken from Rijksinstituut voor Volksgezondheid en Milieu*

3.3.3 Public transport connectivity

In the Figure 23, the isolation of the Small Cores is shown from a mobility perspective. Although Hoek van Holland and Pernis are well connected by metro with Rotterdam (same travel time as by car), it is clearly visible that Rozenburg and Heijplaat are not as well connected. The average travel time by public transport is more than twice as by car because of the lack of access to public transport. This is an important factor that contributes to the feeling of isolation perceived in these villages.

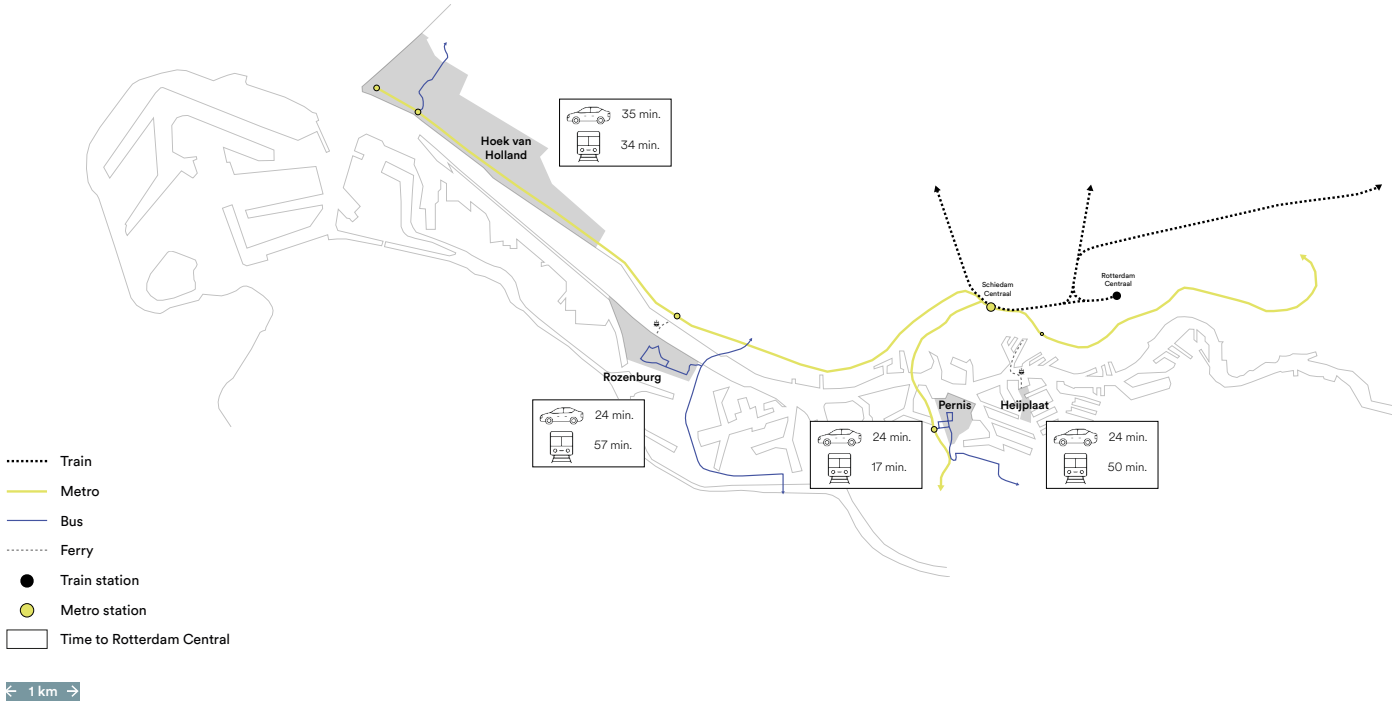


Fig. 23: *Travel time from the Small Cores from/to Rotterdam Centraal with different transport modes*

3.4 Policy Analysis

The energy transition is one of the biggest global challenges of our time. One of the most impactful global policies targeting this problem is the Paris Agreement. This international treaty, adopted in 2015, aims to limit global warming to below 2°C above pre-industrial levels, with efforts to pursue a 1.5°C target. (United Nations Framework Convention on Climate Change [UNFCCC], 2015)

The Paris Agreement has functioned as a catalyst for climate policies around the world, stimulating countries and regions to take action. This led the Netherlands to the development of the Climate Agreement of the Netherlands. 'Klimaat Akkoord', in 2019 (Dutch Ministry of Economic Affairs and Climate Policy, 2019). In parallel, the European Union introduced the European Green Deal in the same year, aiming to make Europe the first climate-neutral continent by 2050 (European Commission, 2019).

At the national level, the Netherlands has launched several initiatives inspired by the 'Klimaat Akkoord'. These policies, together with the national 'Klimaat Akkoord', have also encouraged local entities, including municipalities, provinces, and key industrial players like the Port of Rotterdam, to take their own steps toward achieving climate goals. As illustrated in Figure 24, these policies are interconnected and required for the overall success of the transition.

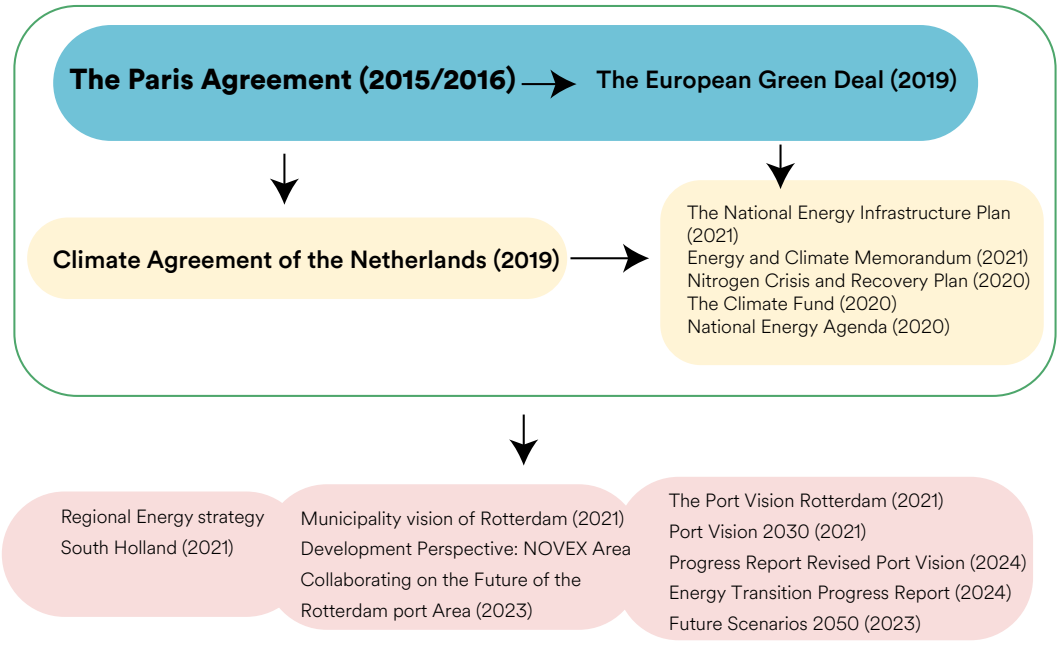


Fig. 24: *Structure of the global to local climate policies*

Key relevant policies for the Port of Rotterdam include:

- **Regional Energy Strategy (RES) South Holland (Provincie Zuid-Holland, 2021):** A collaborative initiative involving the province, municipalities, water boards, and various stakeholders such as the Port Authority, Greenport West-Holland, energy and network operators, and housing associations. The strategy presents plans to sustainably generate energy through wind and solar power, explore alternatives to natural gas for heating, and promote sustainable transportation options.

- **Municipality Vision of Rotterdam - Rotterdam, City of the Future (Gemeente Rotterdam, 2021):** This municipal vision shows the future development of Rotterdam, highlighting sustainability, inclusivity, innovation, and the energy transition.

- **Development Perspective - NOVEX Area, collaborating on the future of the Rotterdam Port area (Ministerie van BZK et al., 2023):** This document explores 5 scenarios the port can be developed into. This document is doing precisely what we aim to do with this report from a community perspective.

- **Energy transition progress report published in 2024 (Port of Rotterdam, 2024):** This document evaluates and inventories the various energy transition projects in the Port of Rotterdam.

Figure 25 elaborates into the climate goals of the Dutch government, the Municipality of Rotterdam, the Port of Rotterdam, and the largest companies in the port. While public stakeholders have clear climate deadlines for 2050, in alignment with the Paris Agreement, the various port companies have different deadlines for their climate goals, with an emphasis on achieving them before 2050. Overall, public stakeholders have two climate goals: one for 2030 and one for 2050. In contrast, not all companies have two or the same climate goal deadlines. When summarizing the climate goals, we see that the overall aim is to reduce CO2 emissions by 50% in 2030 and achieve CO2 neutrality by 2050.

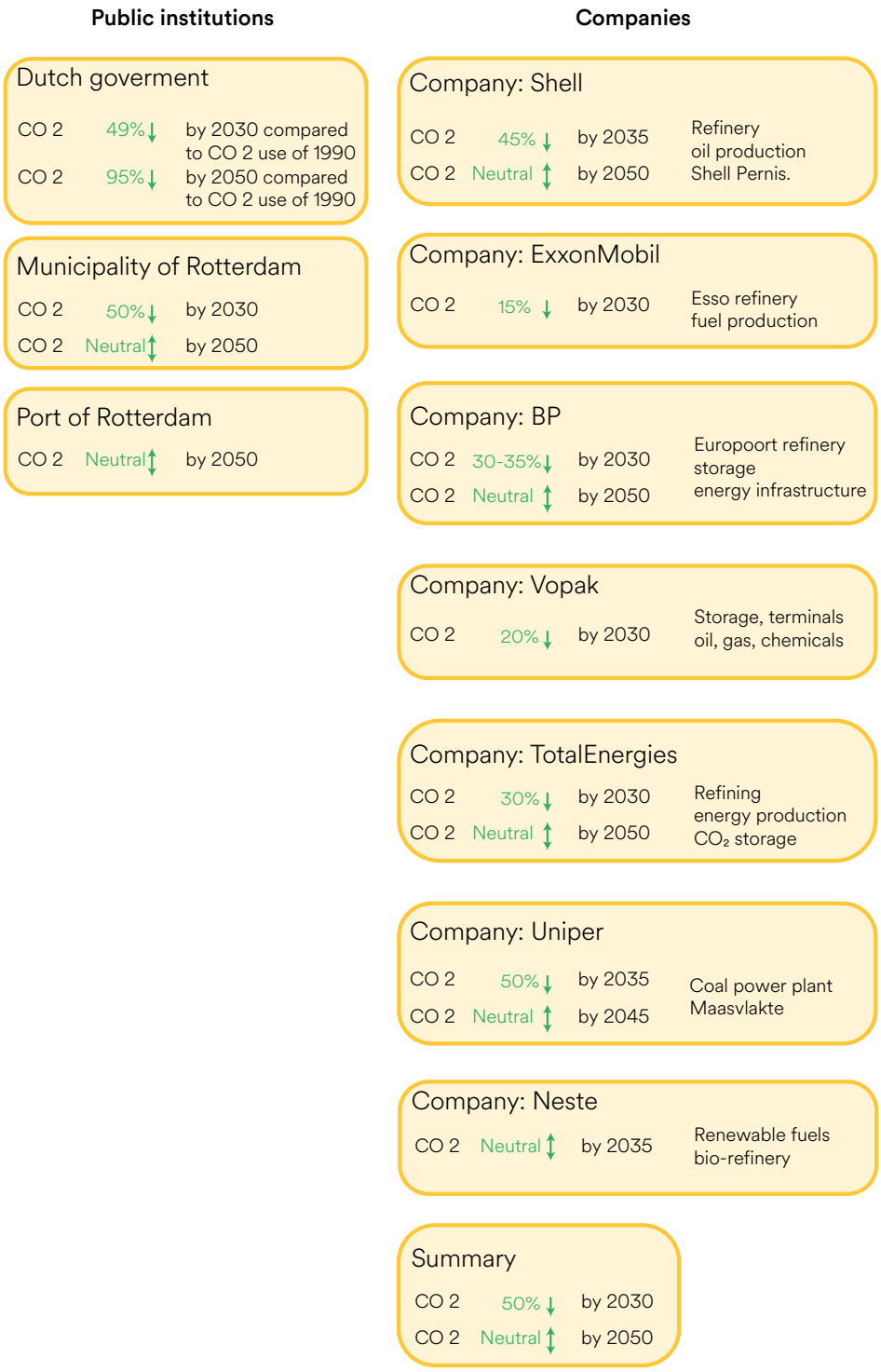


Fig. 25: *Emission reduction goals from main public insitutions and companies related to the Port of Rotterdam*

3.5 Current Energy and Economic Transition Trends

As we mentioned before, the Port of Rotterdam is facing an industry shift, which is founded on the current energy and economic transition trends. Nevertheless, the question remains: What are the reasons for this energy transition? Is it solely founded on environmental concerns and the resulting national and international agreements on climate change?

Climate change is an important driver of the energy transition, but there are also other factors that contribute to the energy transition. One important aspect is the Dutch dependency on fossil resources from other countries. For example, in 2022, the Dutch imported 77% of their natural gas (CBS, 2023). Therefore, the Netherlands is dependent on other countries that have better resources, like the USA, Russia and the Middle Eastern countries (Bosman et al., 2018). This made the Netherlands vulnerable towards geopolitical conflicts, just like with the Russian-Ukrainian war (Ministry of Economic Affairs, 2025). Another factor is that the fossil fuel industry in Europe is stabilising, and the consumption of fossil fuels has not largely increased in recent years (Bosman et al., 2018). This was partly caused by the increase in fossil fuel costs, but also because of emerging technologies such as biofuels and electric mobility that are starting to replace fossil fuels as an energy source (Bosman et al., 2018; Ministry of Economic Affairs, 2025).

As depicted in Figure 26, the Port of Rotterdam is mainly focused on fossil fuel-based industries, Bosman et al. (2018) refers to it as the fossil-fuel monoculture of the Port of Rotterdam. Considering the dependency of the Netherlands and the Port of Rotterdam's industry on fossil resources, it poses a threat to the economic stability of the port based on the current energy transition and economic trends.

Fig. 26: Current land use in the Port of Rotterdam

On the other hand, if we take a look at the port's future projects, either planned or already being developed, it is visible that throughout the whole industrial area of the port, new projects are coming up, all focused on greener and more sustainable energy production.

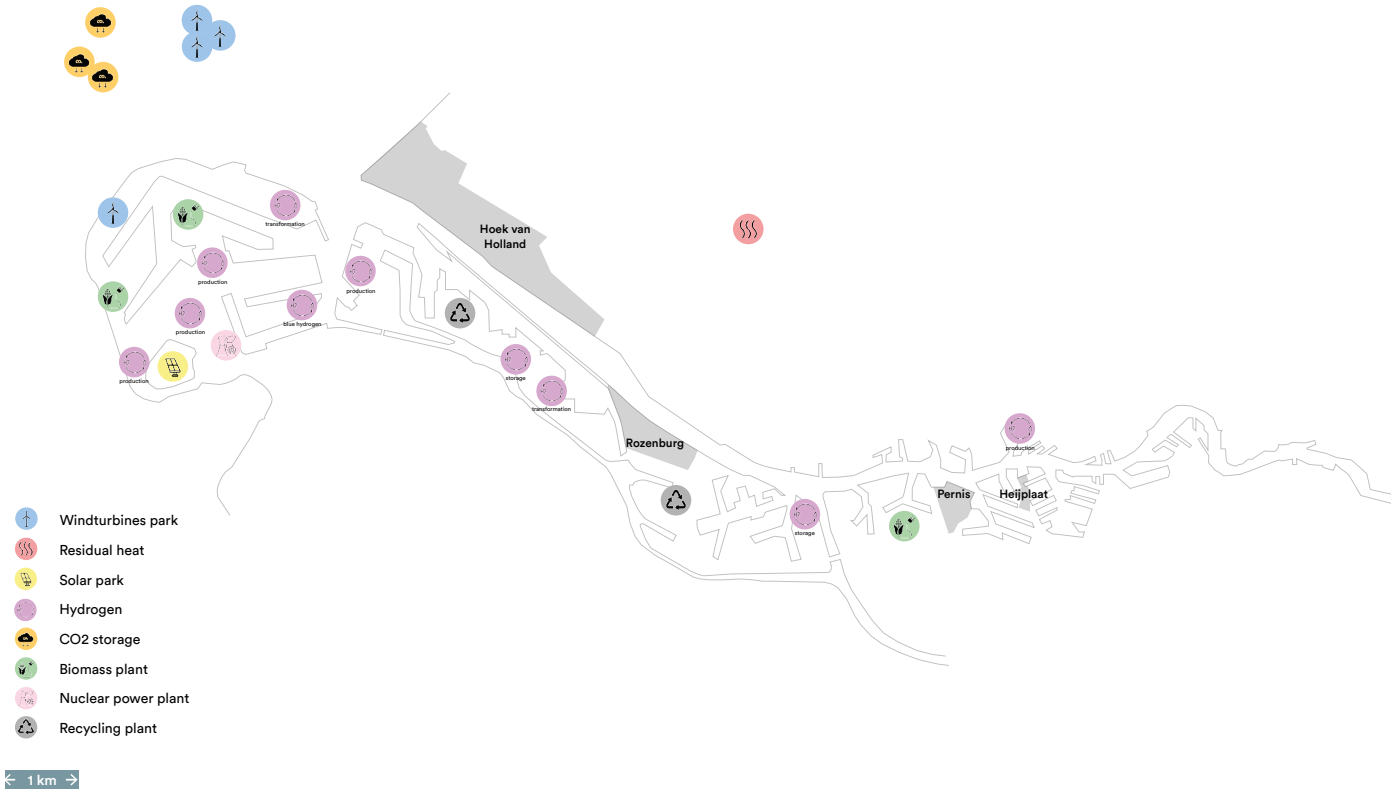


Fig. 27: Ongoing and future energy projects in the Port of Rotterdam

3.6 SWOT Analysis

3.6.1 Strenths and Weaknesses

Focusing on the strengths and weaknesses first. The strengths highlight the existing strong points of the area, including spatial points of interest, connections and collaborations. The weaknesses on the other hand show the more negative circumstances in the area, such as environmental impacts and current problems in the villages.

Fig. 28: Small Cores' strengths map

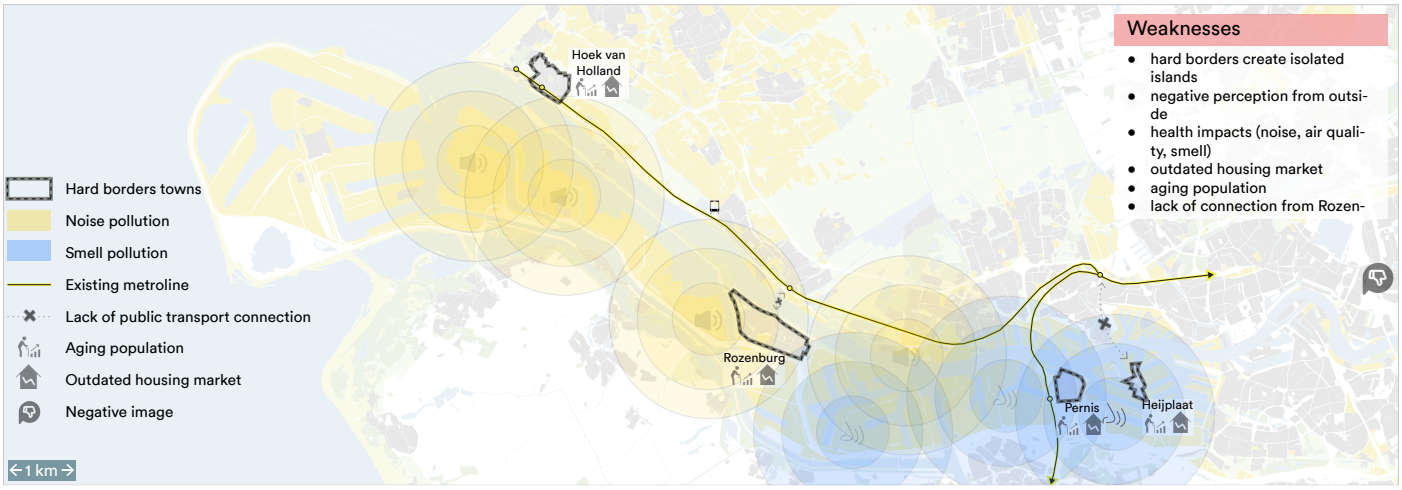


Fig. 29: Small Cores' weaknesses map

3.6.2 Opportunities and Threats

Following that, we make a conclusion of the opportunities and threats of the area, that are more based on future, possible scenarios. The opportunities are more about the spatial chances, such as possible connections that can be developed or current conditions that can be optimized. Opposite of the opportunities we have the threats, that show certain things we have to consider with creating our vision.

Fig. 30: Small Cores' opportunities map

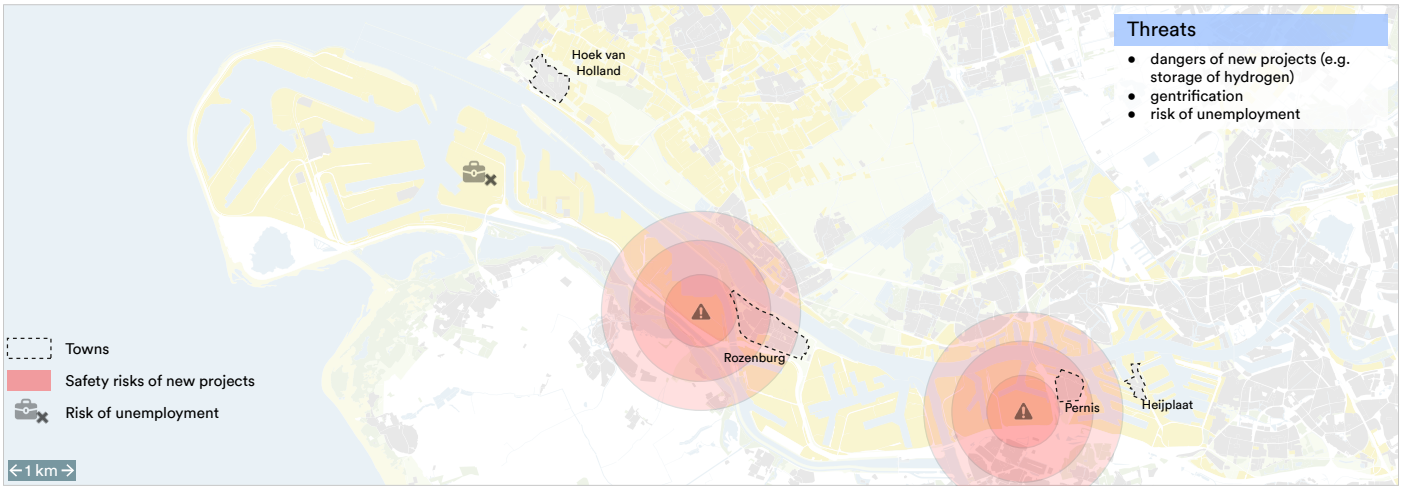


Fig. 31: Small Cores' threats map

04

VISION

4.1 The Future Energy Scenario for the Rotterdam Region

Based on the findings made during the analysis stage, we determined which, in our view, are the energy sources with the greatest potential to make the energy transition effective in the Rotterdam Region. For this, we took into account not only the potential of each renewable energy source existing in the region, but also the current infrastructure of the port, which in some cases offers a huge potential for reuse for storage or production of other energy sources.

The phasing out of gas, oil and coal leaves a gap that in our vision is filled by a new and diverse range of energy sources, the main ones being biomass and hydrogen, which are precisely two of the forms of energy that could have a place in the port of Rotterdam by reusing the existing infrastructure.

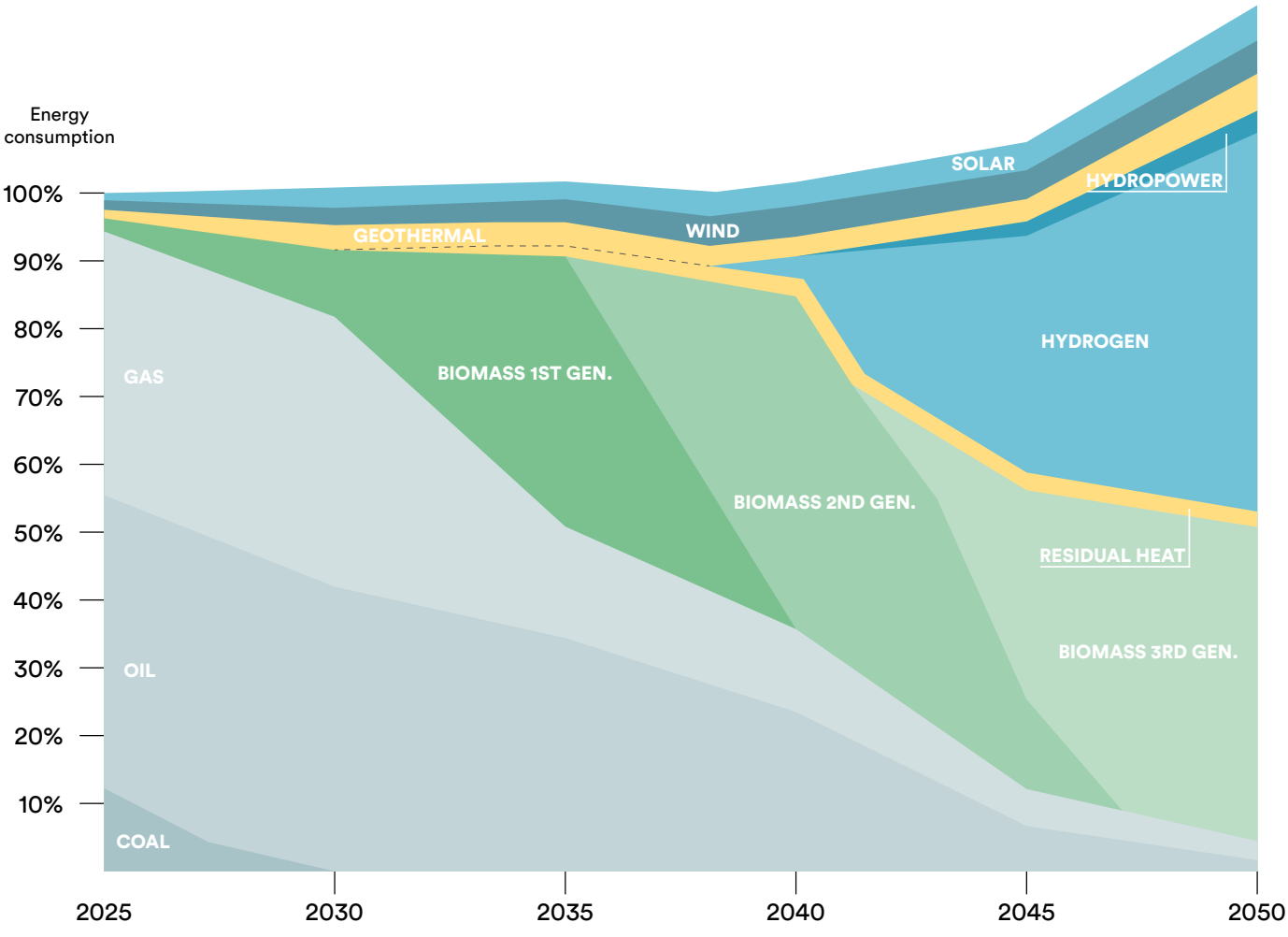


Fig. 32: *Planned energy production phasing for the Rotterdam Region*
Source: *Adapted from Sijmons, D. et al. 2014, Landscape and Energy*

4.2 Vision Values and Goals

To achieve the proposed model in a way that favors the Small Cores communities, we defined a set of values that guide the project and shape its main goals.

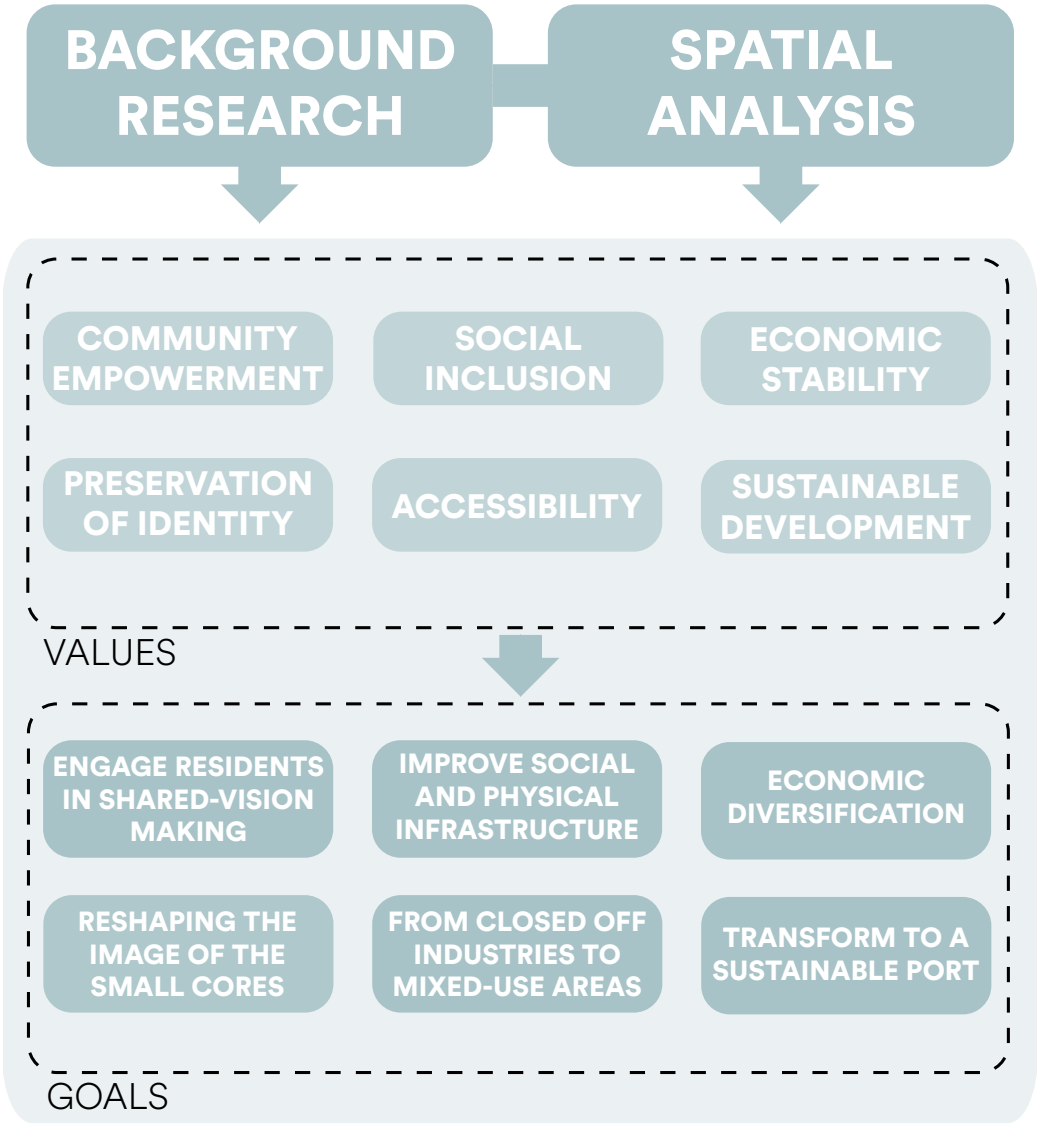


Fig. 33: *Values and goals diagram*

4.3 Relation to the UN Sustainable Development Goals

GOOD HEALTH AND WELL-BEING

- Improving the living conditions
- Creating spaces for recreational purposes
- Revitalising these places through buffers, green infrastructure, accessibility and creation of identity in terms
- Reduce pollution: noise, smell, air, and industrial emissions (PM, toxic aerosols, etc.)

AFF

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SUSTAINABLE CITIES AND COMMUNITIES

- Enhancing the liveability of port communities through better urban planning
- Addressing spatial isolation by improving accessibility and infrastructure
- Strengthening community participation in decision-making processes

CLIMATE ACTION

- Reducing pollution and e in port operations and su villages.
- Promoting climate adapta strategies such as green infrastructure and mitigat strategies such as clean e consumption

DECENT WORK AND ECONOMIC GROWTH

- Ensuring a just transition for workers in fossil-based industries.
- Supporting new job opportunities in the new economic industry
- Encouraging economic diversification in port cities to reduce dependence on heavy industries

INDUSTRY, INNOVATION AND INFRASTRUCTURE

- Improve accessibility of these villages with a multimodal and low-carbon transportation network
- Circular Economy in Port Industries

FORDABLE AND CLEAN ENERGY

Reduce the dependency on other countries as energy providers (geopolitical issues)
Focus on renewable energy production
Reducing energy poverty in communities (by ensuring accessibility to affordable, sustainable energy)

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PARTNERSHIPS FOR THE GOALS

- Collaborating with governments, industries, and local communities for inclusive decision-making.
- Strengthening public-private partnerships to fund sustainable port development.

Fig. 34: *Related SDG Goals to our goals*
Source: *Adapted from United Nations. 2015, Sustainable Development Goals*

4.3 Main Elements of the Vision

While our vision is comprised of numerous elements and principles, there are five that, due to their scale and/or scope, have the greatest impact and therefore become the main shapers of the plan.

Fig. 35: *Zoning division of the port diagram*

1. Zoning division of the port: The port is divided into two main zones; to the west, the land use remains purely industrial, while to the east a new model of industrial area is proposed to be implemented in which Small Cores and industry coexist, thus allowing to dissolve the barriers that enclose these settlements.

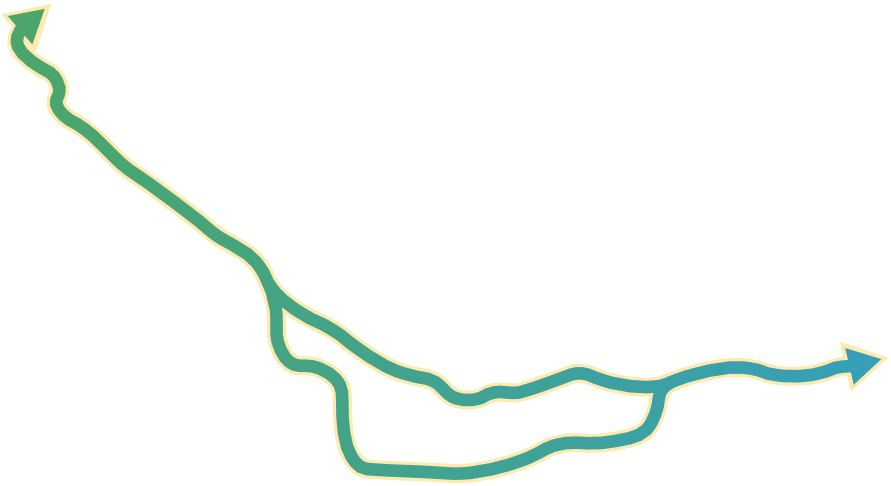


Fig. 36: *Green-blue corridor diagram*

2. Green-blue corridor: To address the problem of isolation, the creation of a green-blue biodiversity corridor along the waterfront is proposed to increase the connectivity of the four villages to each other and to the center of Rotterdam. In addition, the corridor creates a new green connection between the city center and the protected area of the Hoek van Holland beach.

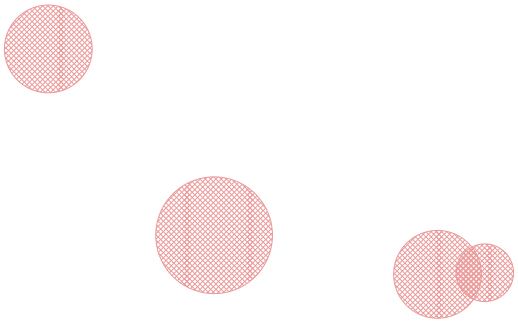


Fig. 37: *Buffer principle diagram*

3. Small Cores' buffers: To dissolve the current strong barriers that separate the villages from the industry in the port, we propose the concept of Small Cores' buffers. These refer to the areas surrounding the existing residential areas in the Small Cores, which in the future will be the scene of urban expansion in which a gradient of mixed land use is created between residence and industry, creating a new neighborhood model in which these two uses coexist.

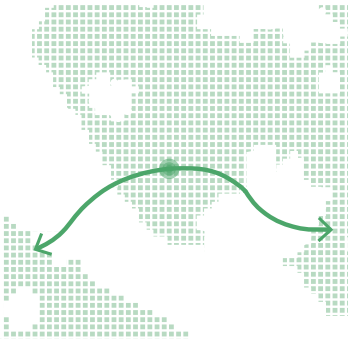


Fig. 38: *Biomass line diagram*

4. Biomass line: Our vision is for biomass as one of the main sources of energy for the Rotterdam Region in the future. To make this logistically possible, we envisage the creation of a new railroad line through which not only organic matter will be transported from the entire region to a biomass power plant, but which will also serve for passenger transport by being planned as an extension of the existing Rotterdam metro and light rail network to the port and southwest of Rotterdam.

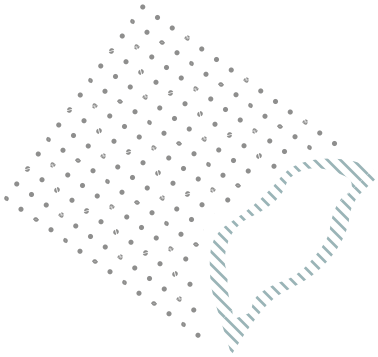
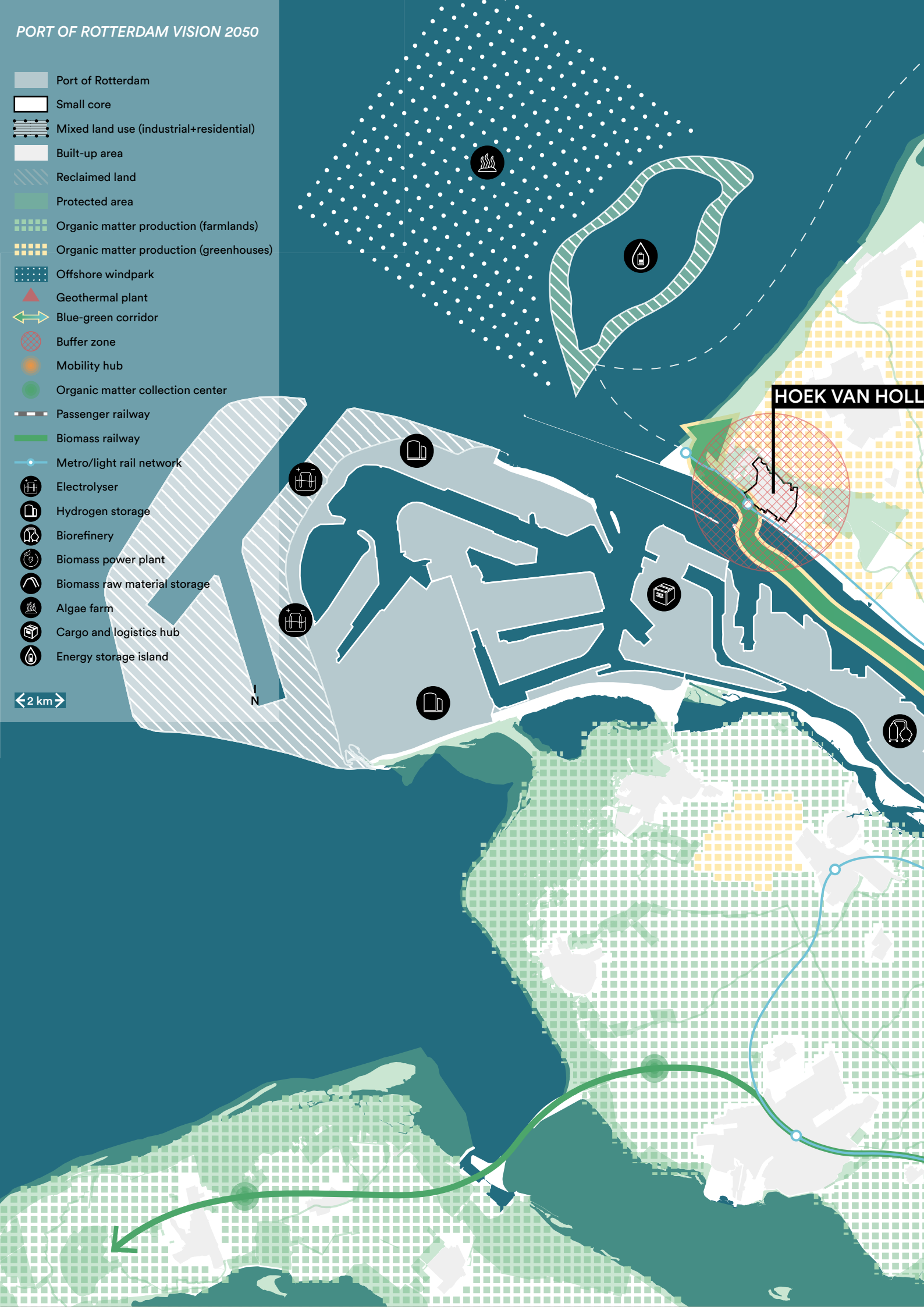


Fig. 39: *Reclaimed land diagram*

5. Land reclamation: The growing energy demand projected for the future in the Rotterdam Region calls for the expansion of new territories over the sea, mainly for the development of two projects. The first is the new hydrogen hub, the storage of which will require large amounts of space, and the other is the creation of an energy buffer island to store the overproduction of wind energy that is not used during off-peak hours at certain times of the day.


PORT OF ROTTERDAM VISION 2050
Port of Rotterdam
Small core
Mixed land use (industrial+residential)
Built-up area
Reclaimed land
Protected area
Organic matter production (farmlands)
Organic matter production (greenhouses)
Offshore windpark
Geothermal plant
Blue-green corridor
Buffer zone
Mobility hub
Organic matter collection center
Passenger railway
Biomass railway
Metro/light rail network
Electrolyser
Hydrogen storage
Biorefinery
Biomass power plant
Biomass raw material storage
Algae farm
Cargo and logistics hub
Energy storage island
2 km
N
HOEK VAN HOLL

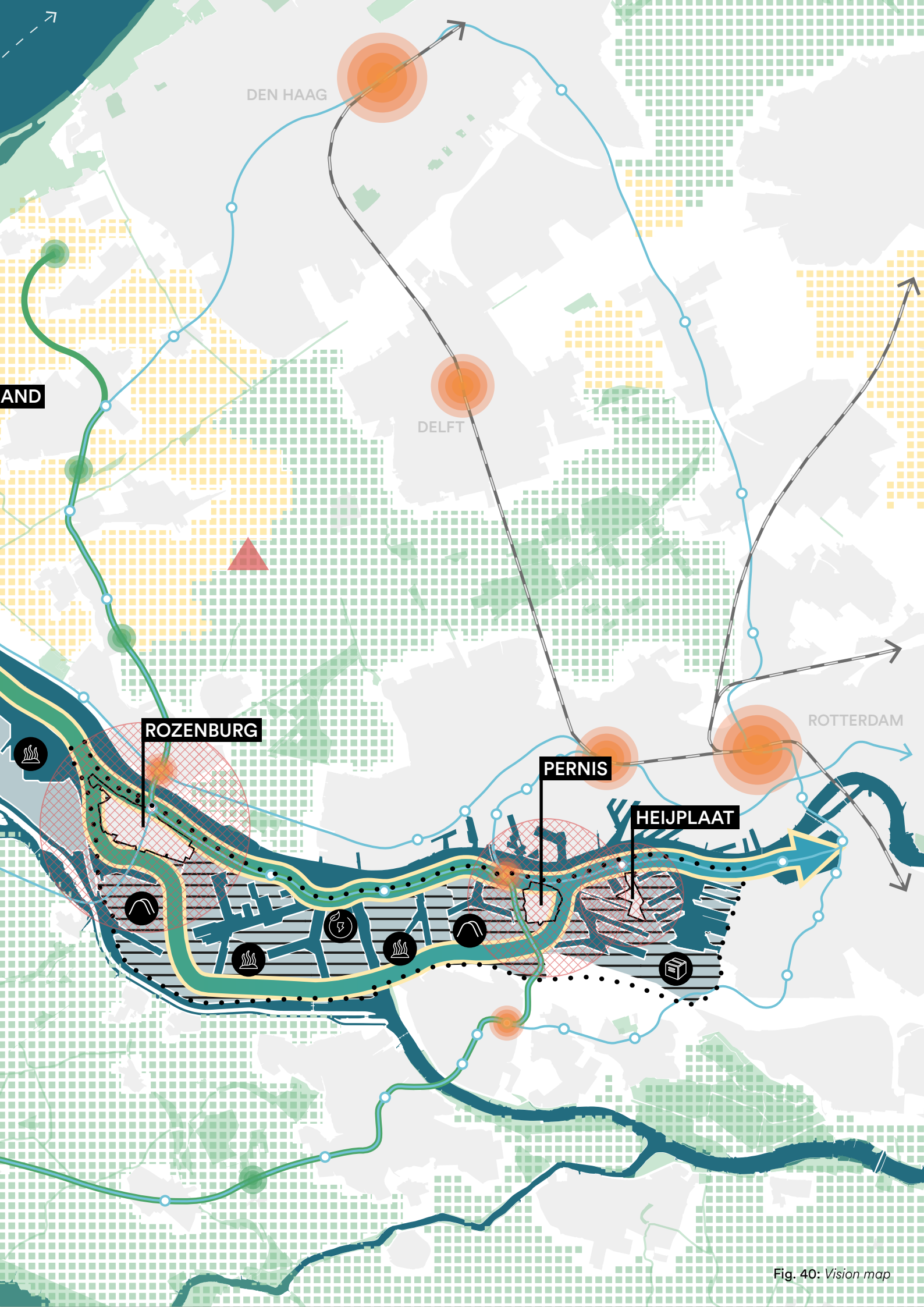


Fig. 40: *Vision map*

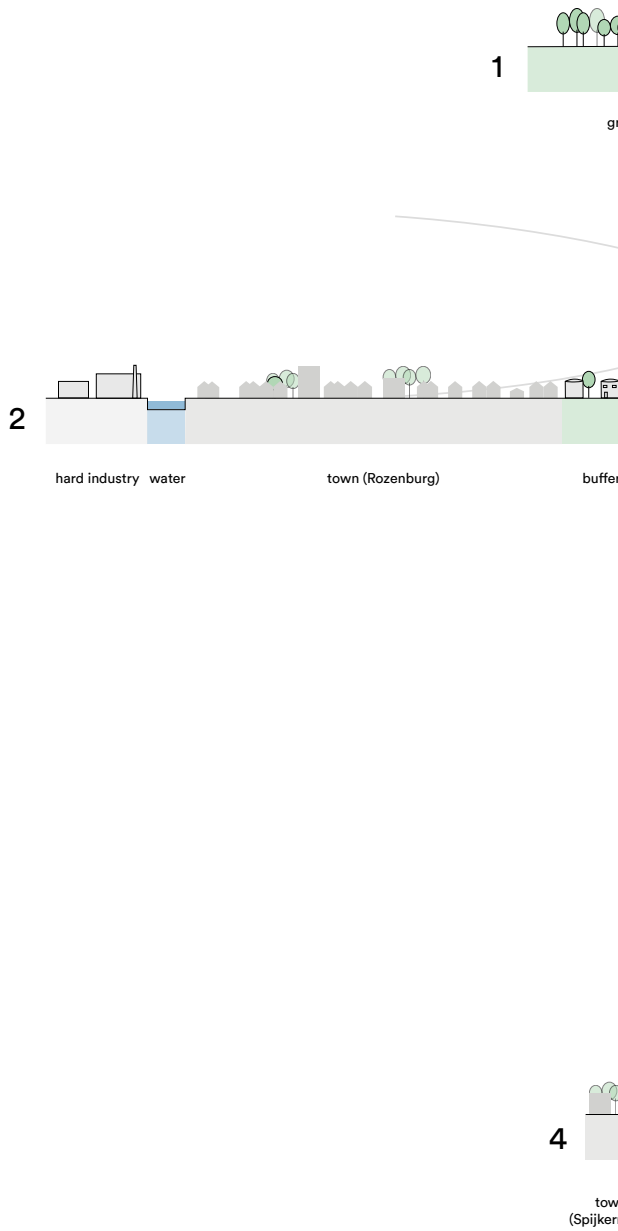
4.5 The Port of Rotterdam 2050

By 2050, the Port of Rotterdam and the surrounding region will have transitioned to a sustainable energy production model, leaving behind almost entirely the current dependence on fossil fuels and the negative effects of their use. In this way, the identity of the Small Cores as port towns will not have been lost, as they will continue to be towns with a close link to the port that has surrounded them for decades, but it will be positively transformed by the new innovative and sustainable character of the new industries that will operate here.

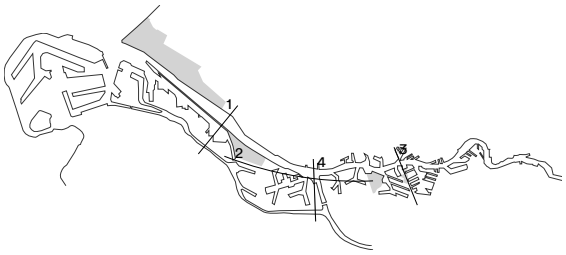
The port will be a hub for sustainable energy production, which will be based mainly on the import and production of hydrogen and biomass, the raw materials for which will be mainly produced locally and regionally. The growing energy demand foreseen for the future in this region will be complemented by the exploitation of the high geothermal energy potential that exists in this region, as well as the waste heat from biomass energy generation. To complete this list, the development of new solar parks and the implementation of wind-hydro energy production will contribute to satisfy this demand.

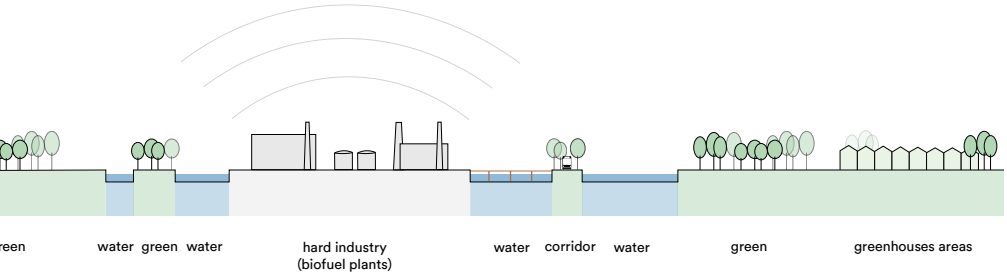
The livability of Small Cores will have increased significantly, and these will be vital, accessible and prosperous sites, where industry and housing will coexist harmoniously as a result of a community-led local planning process.

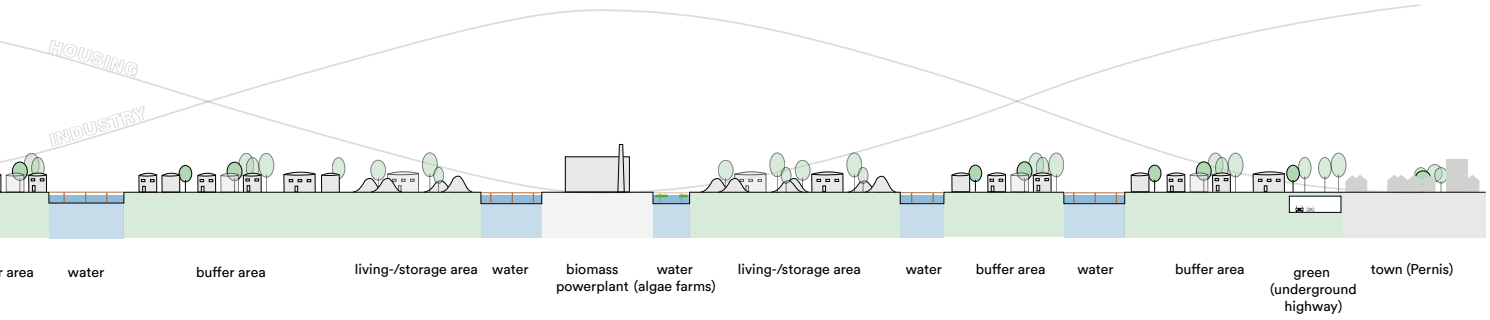
This will be achieved through a strategy that will combine top-down and bottom-up decisions in a balanced way. While the most urgent decisions in the context of climate change (such as phasing out fossil industries) will be made at the highest levels of government, it will be up to the inhabitants of the Small Cores to decide how the opportunities of this transition will be used in their hometowns to directly address the specific issues that each of these sites currently face.

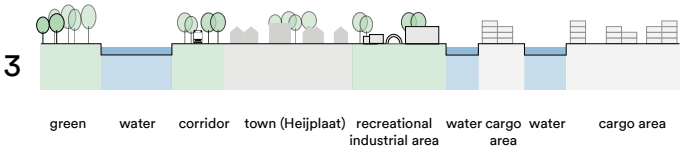


4.6 Spatial Sections









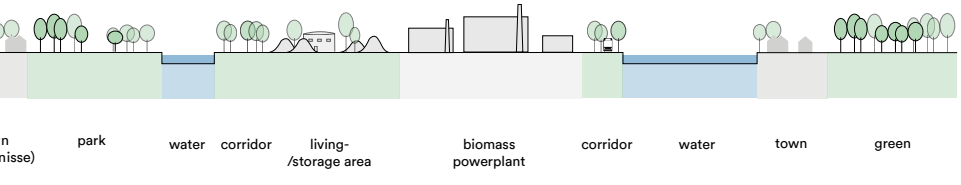
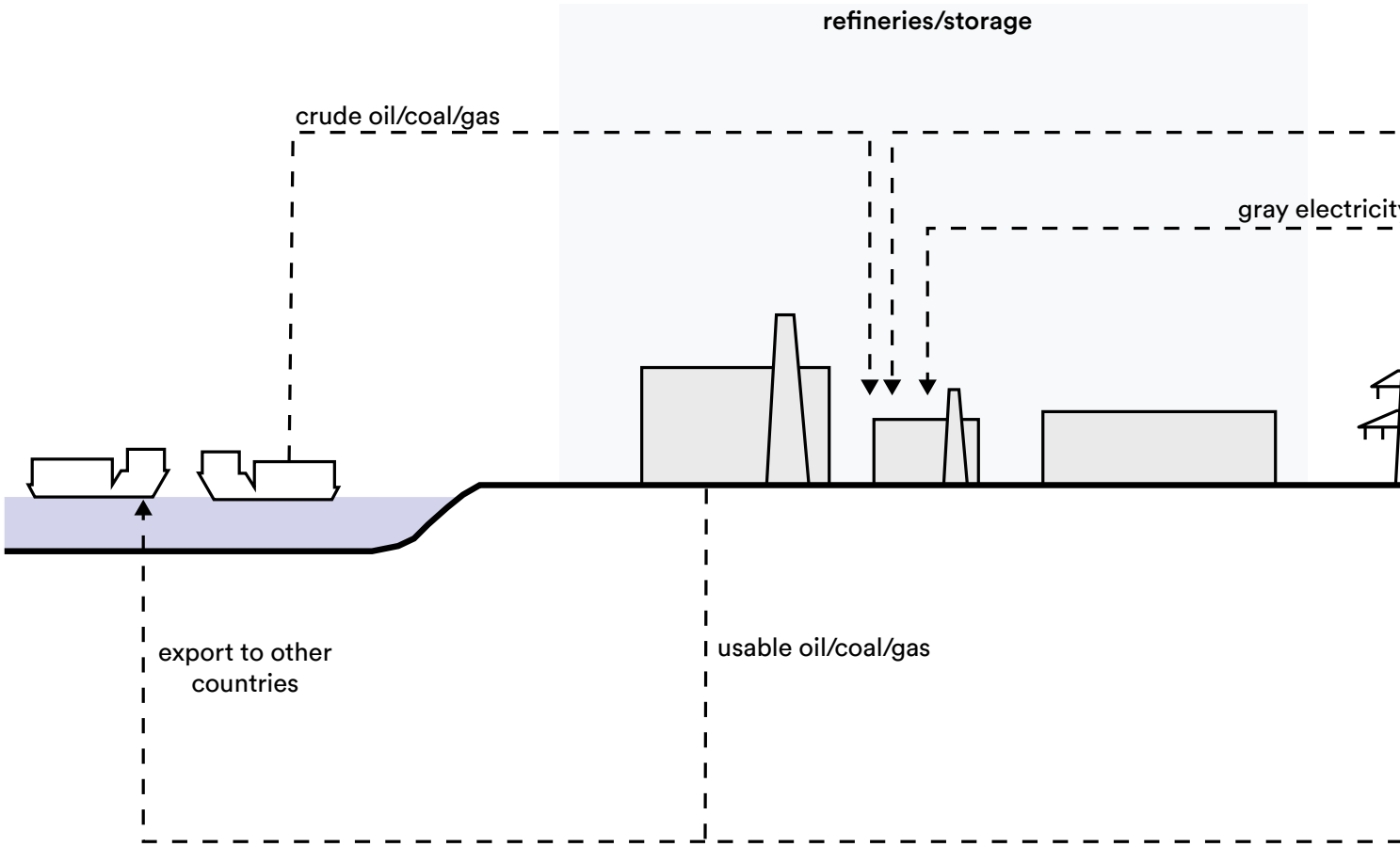


Fig. 41: *Spatial sections showing the buffer principle between the Small Cores and their surrounding industry*

4.7 Energy Sections

These sections illustrate in a schematic way how the energy transition in our vision is implemented in terms of energy. In the current situation the whole system is fossil based, from producing to consuming. The Port of Rotterdam imports crude fossils and by making use of grey electricity this can be refined into usable fossils, that can either by exported or used in our cities.



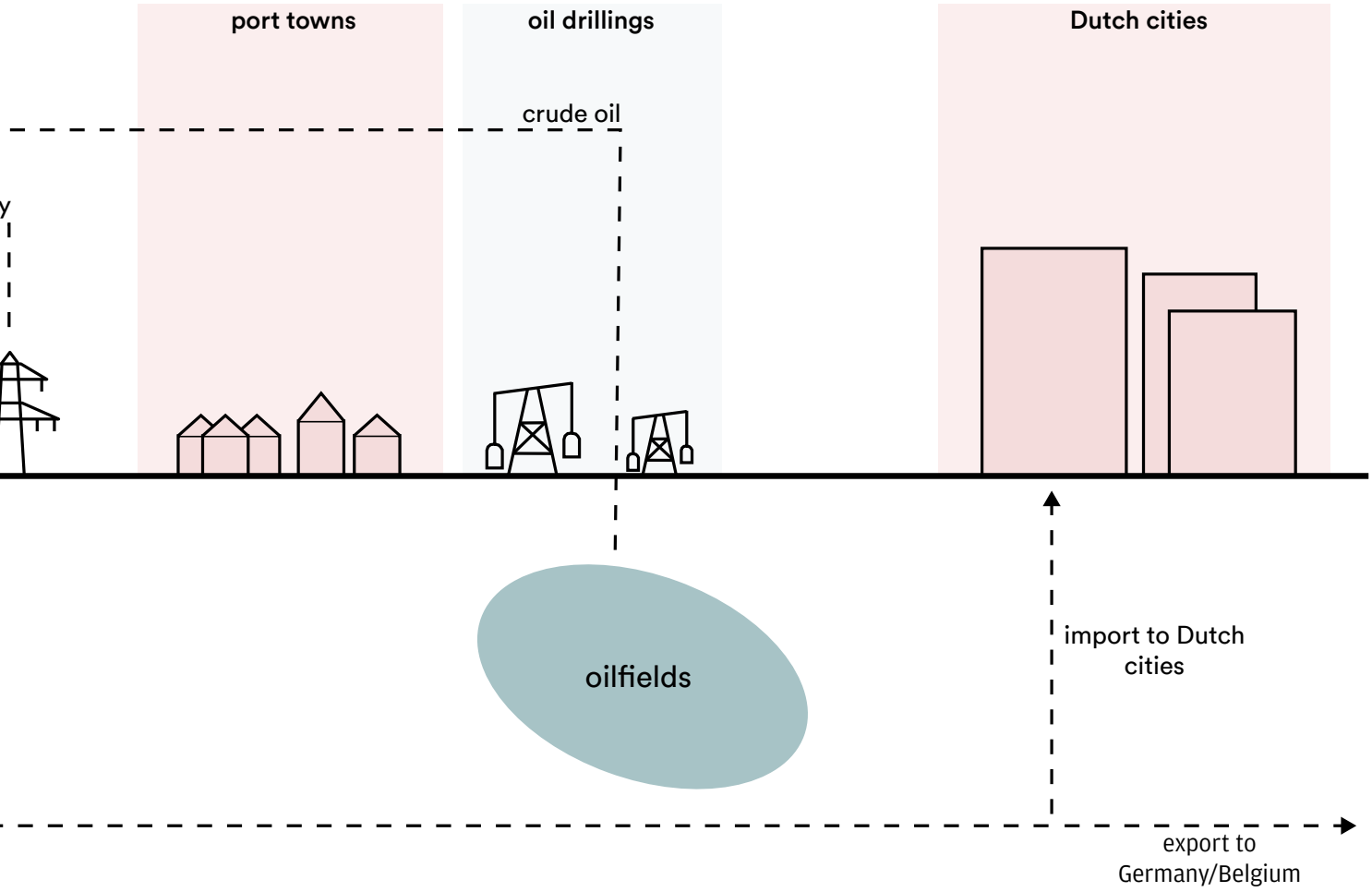
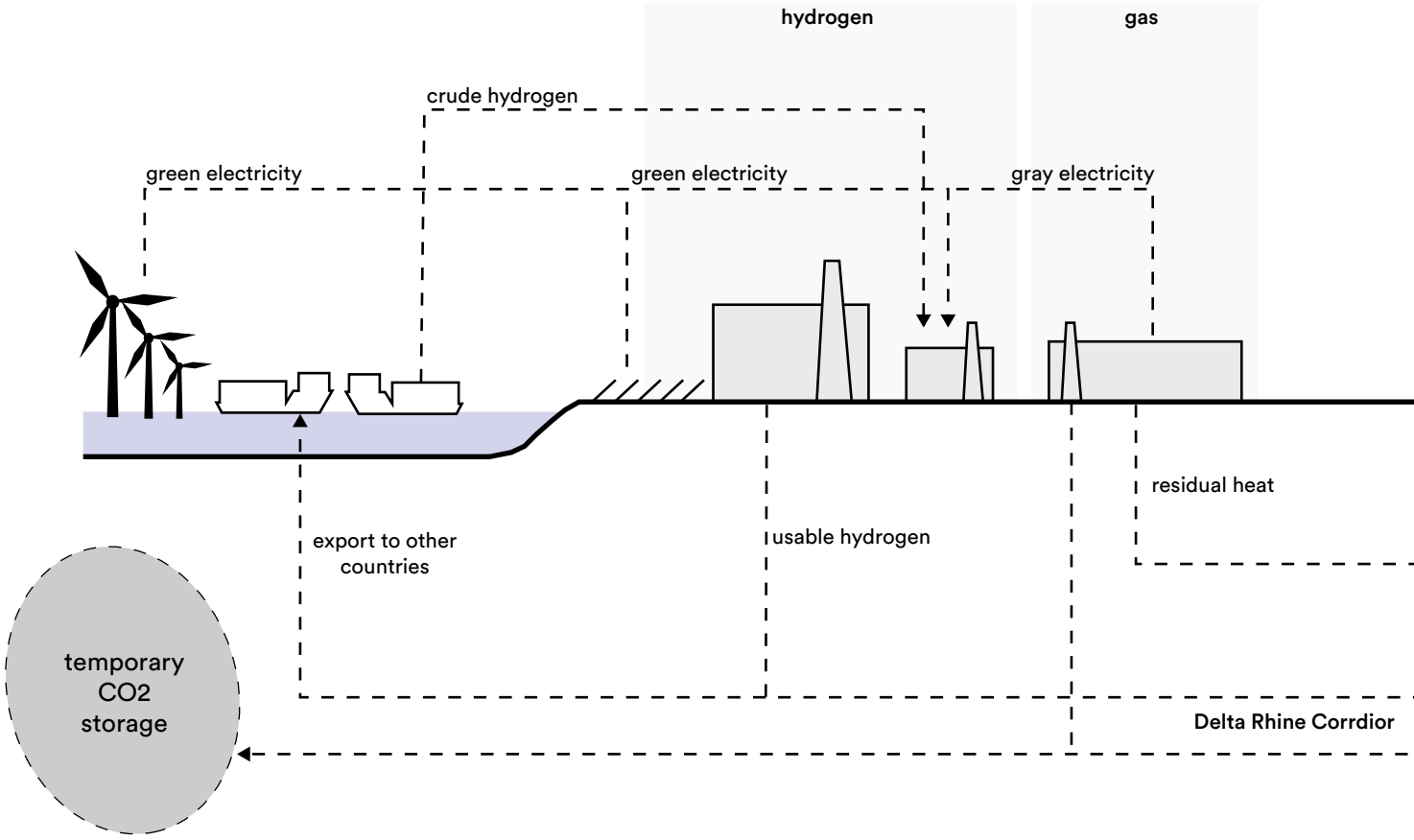


Fig. 42: *Systemic section showing the current energy flow in the Port of Rotterdam and related region*

In the second section the transition phase is shown. Here, some parts of the port are already transformed towards the hydrogen hub, while the fossil industries are phasing out. Renewable energy is used to create usable hydrogen from crude H2, while biomass also produces green electricity for houses. Besides this, also the Delta Rhine Corridor is being installed to export the hydrogen and (temporarily) transport CO2 towards the storage under the sea.



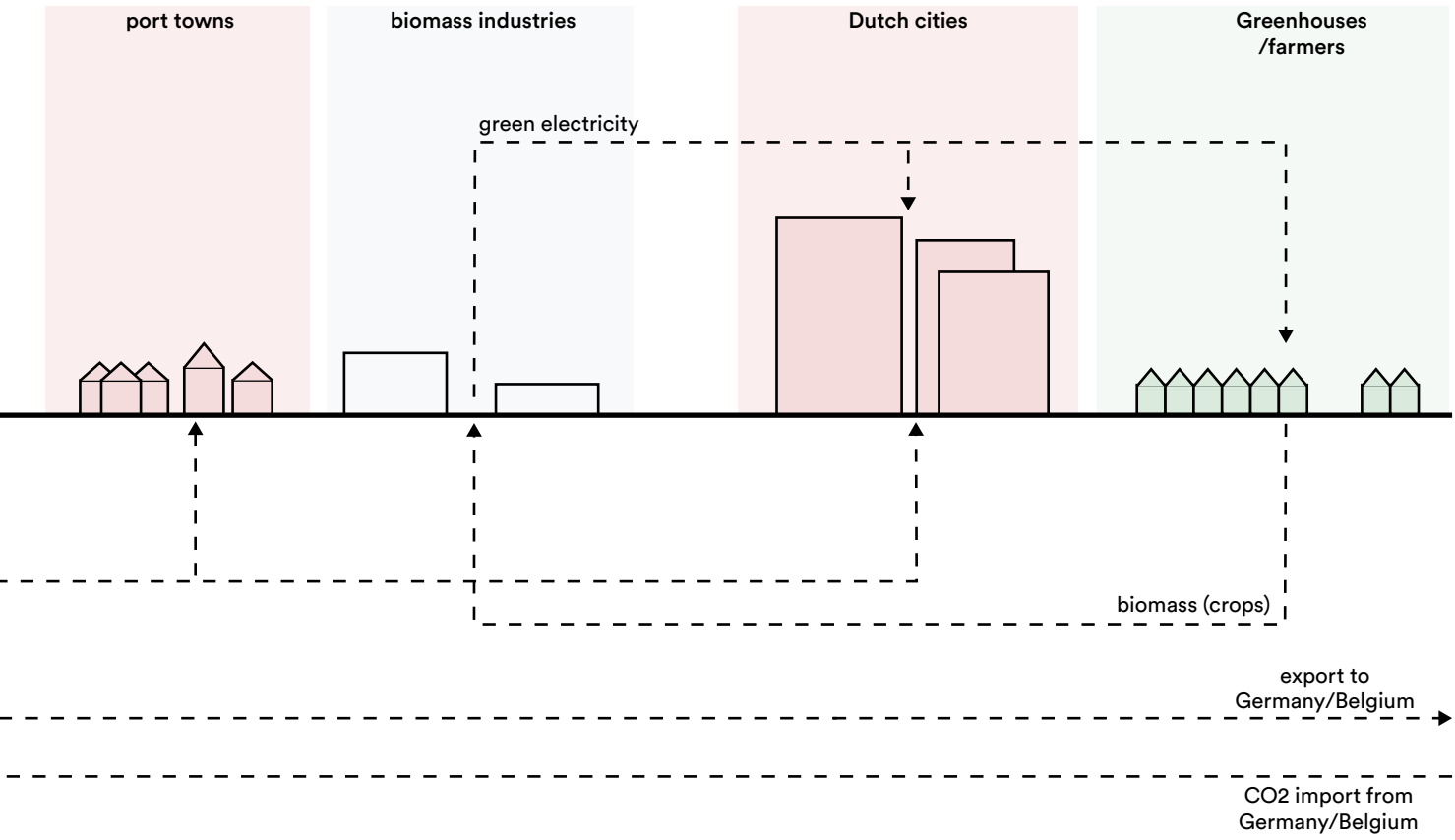
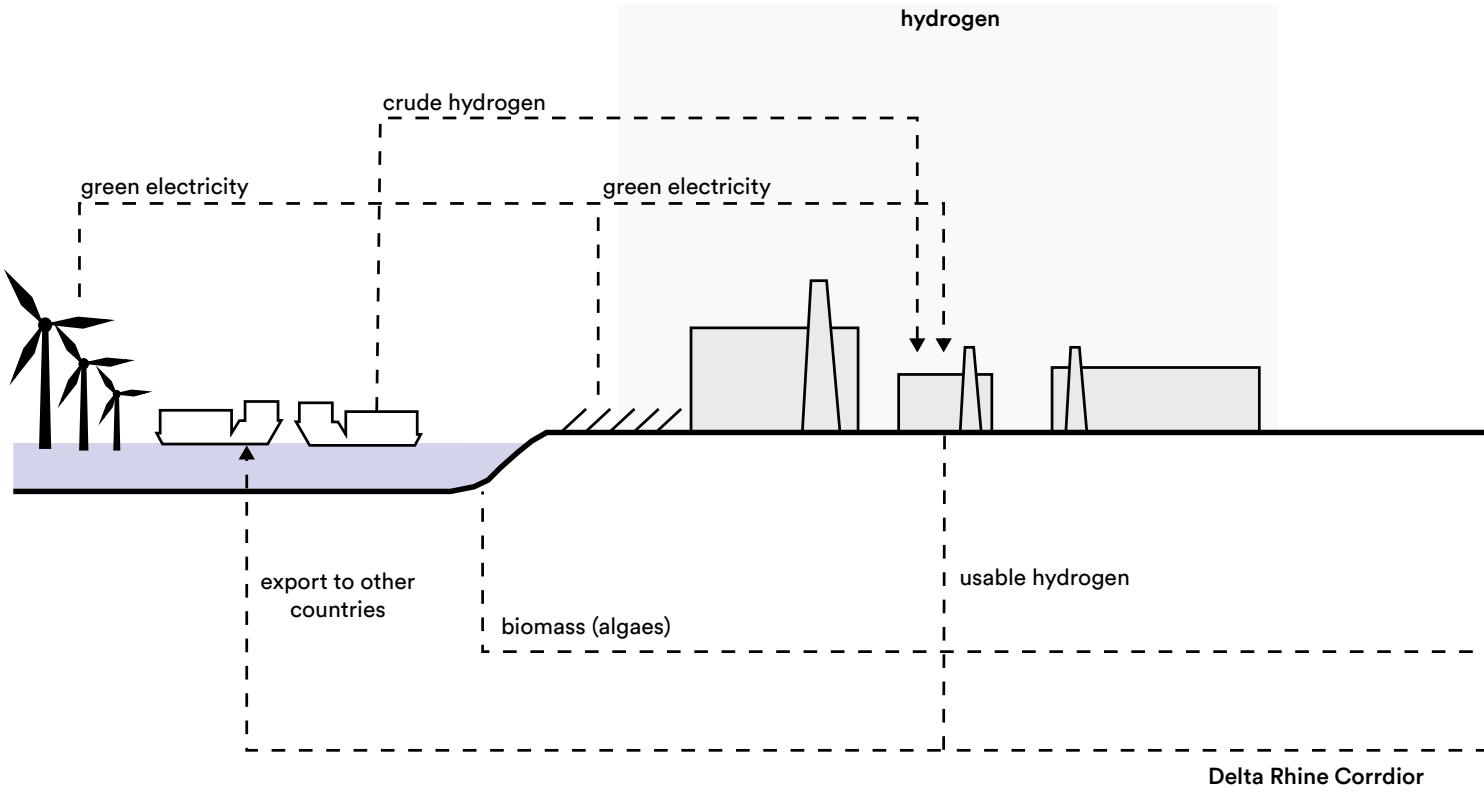


Fig. 43: *Systemic section showing the energy flow in the Port of Rotterdam and related region in 2030*

By 2050, most of the fossil industries vanished and made place for renewable industries. The CO2 storage is not needed anymore and is dismantled while geothermal energy takes its place for the heating of houses in cities around the port. The third generation of biomass will be introduced to complement to the second generation of biomass (waste). In this stage the port of Rotterdam transitioned completely towards a new energy hub.



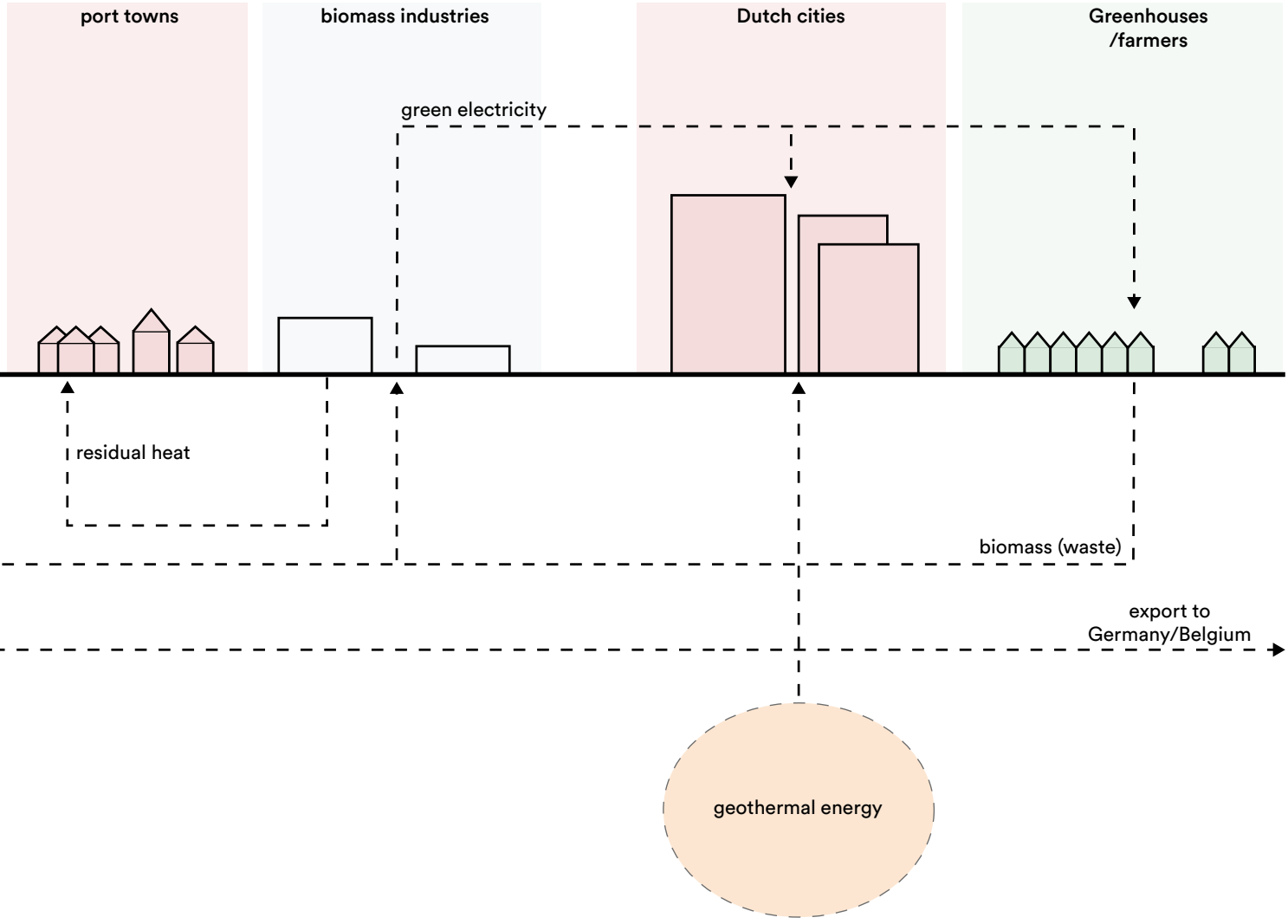


Fig. 44: Systemic section showing the energy flow in the Port of Rotterdam and related region in 2050

05

STRATEGY

5.1 Decision Making

Our vision contains a range of interventions to be implemented within the designated area and beyond. We distinguish between several types of projects: some that follow a top-down approach, others that are primarily managed top-down but with input from the communities about the details, and two key projects that are fully driven by a bottom-up approach.

Project	Top-down approach	Bottom-up approach	Explanation
Expansion Maasvlakte III	●		mayor projects such as these, that are further away from the communities and have less impact on them are taken top-down.
Delta Rhine corridor	●		
Hydrogen hub	●	●	communities had influence on the location of the hydrogen developments by expressing their safety concerns.
Biomass powerplant	●	●	communities will have influence on the exact location of the biomass powerplant due to environmental impact, but still the mayor decisions come top-down.
Biofuel refineries	●	●	communities will have influence on the exact location of the biofuel refineries due to environmental impact
Energy island	●	●	the energy island influences the tourism in Hoek van Holland, so the residents will have a say in the final design and the touristic aspects of the island.
Biomass rail line	●	●	communities will have influence on exact location and stops of rail line (because of public use)
Corridor project		●	communities will have direct designing influence on the project and can choose/change design options. Although the initiative comes top-down, the defining and design comes from the communities*
Buffer project		●	communities will have direct designing influence on the project and can choose/change design options. Although the initiative comes top-down, the defining and design comes from the communities*

*in the section about Community Engagement this will be further elaborated

Table 13: *Top-down and bottom-up decision making plan*

5.2 Spatial Strategy

5.2.1 The Corridor

The first major spatial strategy proposed in our project is the creation of this green-blue corridor that will connect the Small Cores to each other and to the center of Rotterdam. To do this, we needed to first understand how the space is currently configured on the site through which we propose to build this corridor. That is why we created a list of typologies that reflect how the space is currently configured in the places through which the corridor would pass. Based on these typologies, the potential that each of them offers and the specific needs of each section of the corridor, we developed a toolkit showing the different future scenarios for each of the identified existing typologies. In this way, we determined four spatial configurations in the space that the green-blue corridor will occupy: Residential, Nature, Industrial and Water. However, it will be up to the communities to decide where exactly each typology is applied.

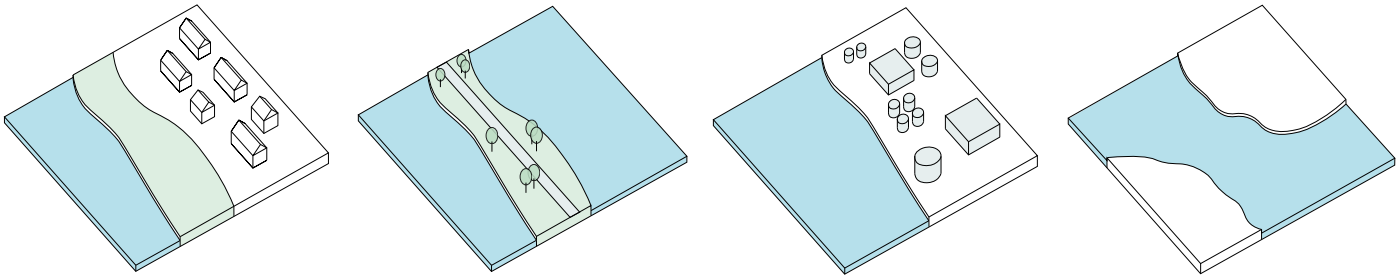


Fig. 45: *Current spatial typologies on the future corridor area*

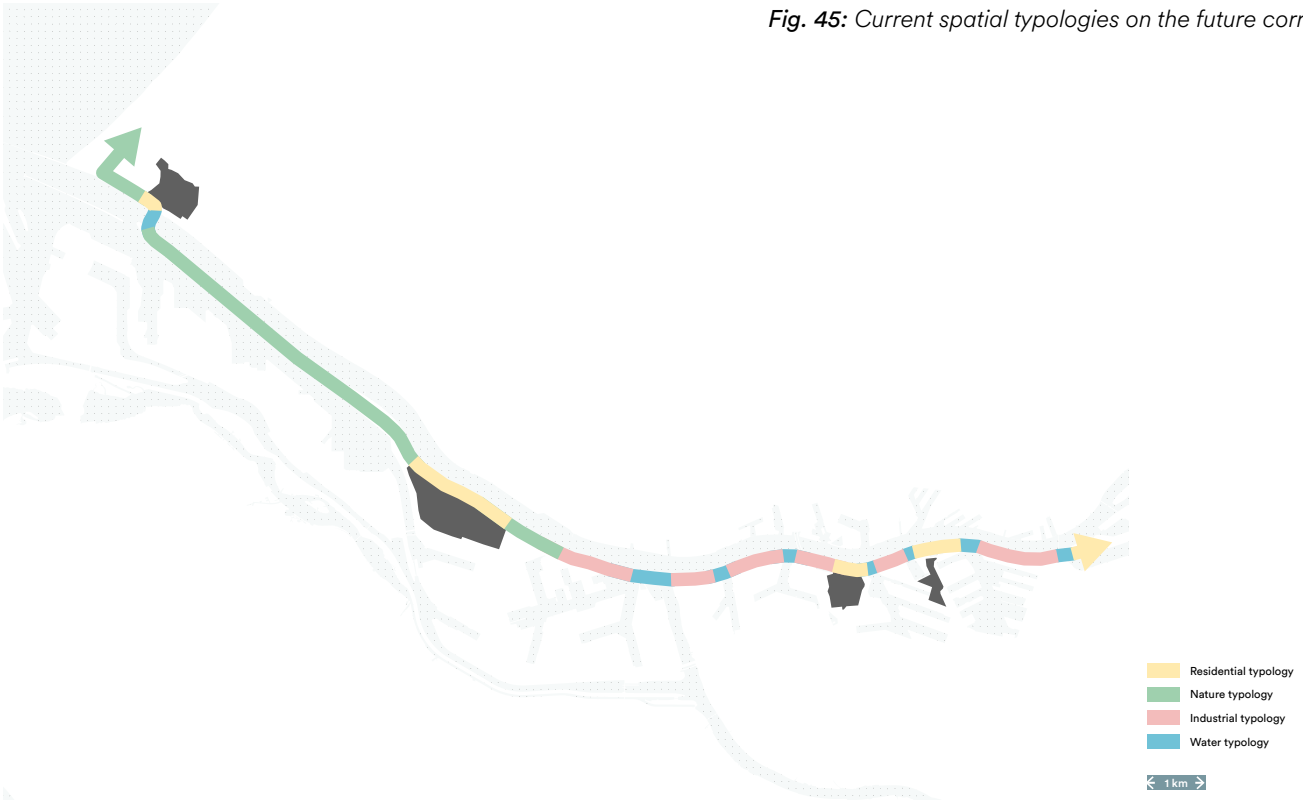
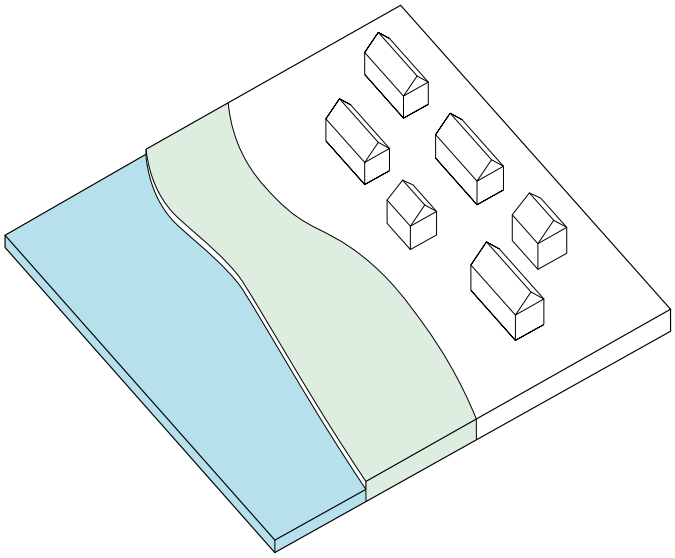
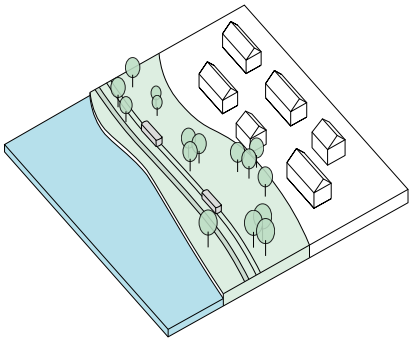


Fig. 46: *Map showing the location of the spatial typologies*



A) The Residential typology: There are stretches, all of them located in the Small Cores, where the land use is mainly residential and there is a close relationship with the water.



A1) The enhanced waterfront: For these sections, the objective is to improve the spatial quality of the waterfront through the corridor, increasing biodiversity and including active mobility and public transport axes.

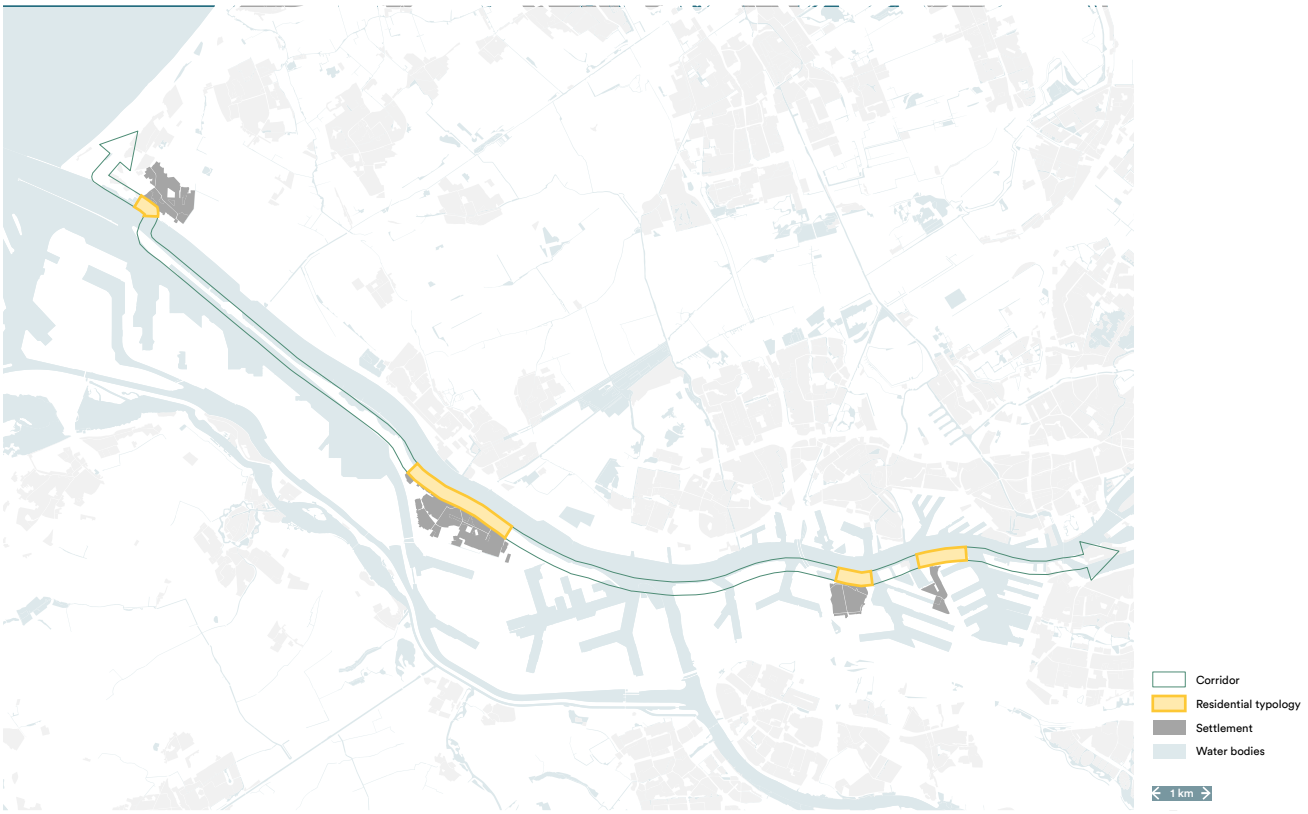
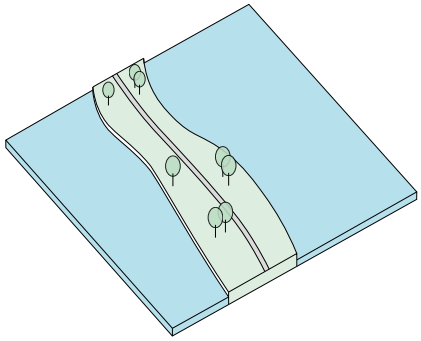
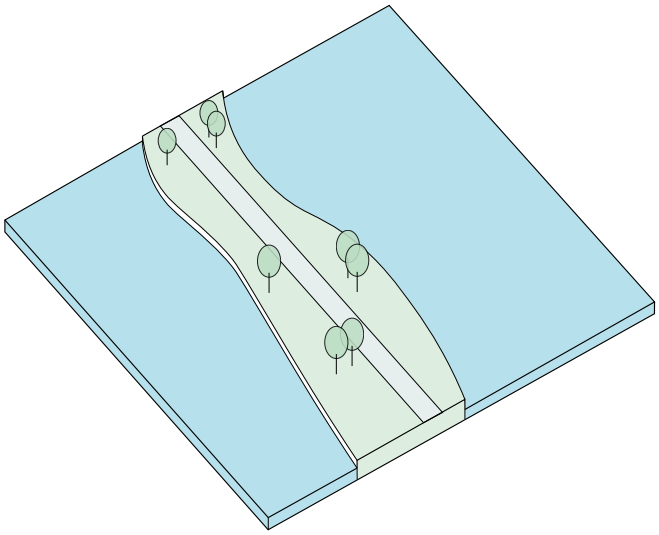


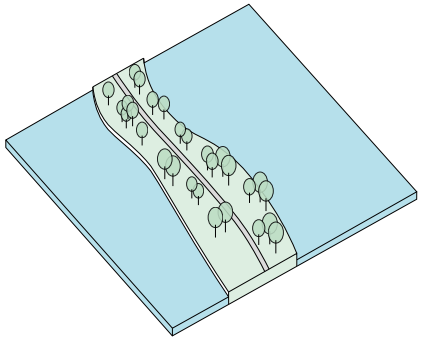
Fig. 47: Map showing the location of the Residential typology



B1) Keeping the current conditions: In some parts, biodiversity conditions are good, so in these cases the objective becomes to keep them that way.



B) The Nature typology: Other stretches have natural qualities that currently contribute to the quality of life of the inhabitants of some of the Small Cores. For these, two proposals were developed that maintain their condition as green areas.



B2) Biodiversity enhancement: Some other parts are already green areas, but they have poor qualities which could be deeply improved with the implementation of the corridor.

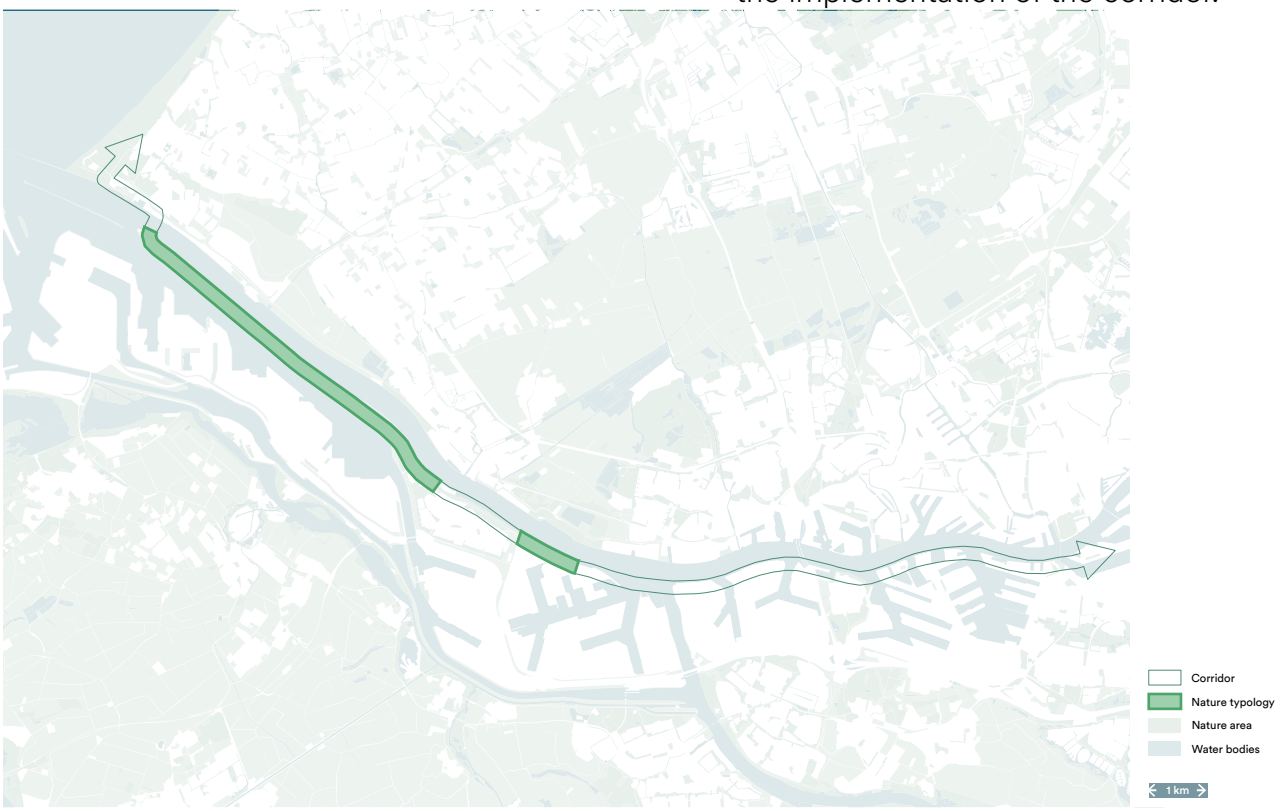
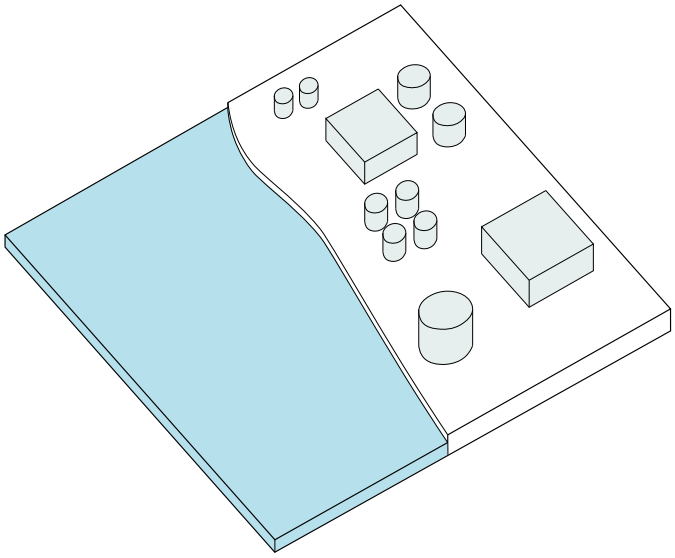
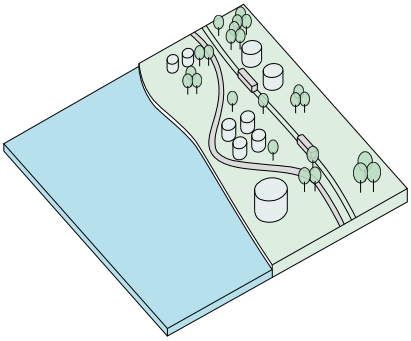


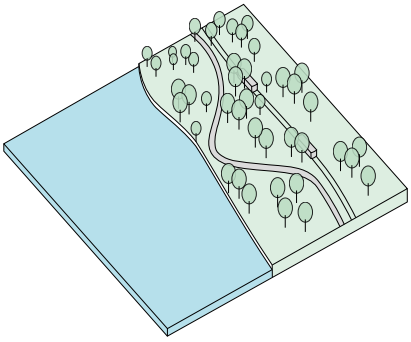
Fig. 48: Map showing the location of the Nature typology



C) The Industrial typology: A very direct relationship between water and industrial infrastructure characterizes this typology. For this typology, two different proposals were developed.



C1) Reuse of current infrastructure: In some points, we propose to maintain some elements of the industrial infrastructure as part of the memory of this area, making them an attractive element of the landscape.



C2) New green area: In other cases, it is necessary to free the area from the current industrial infrastructure in order to make the corridor a consolidated element, creating space for new green areas.

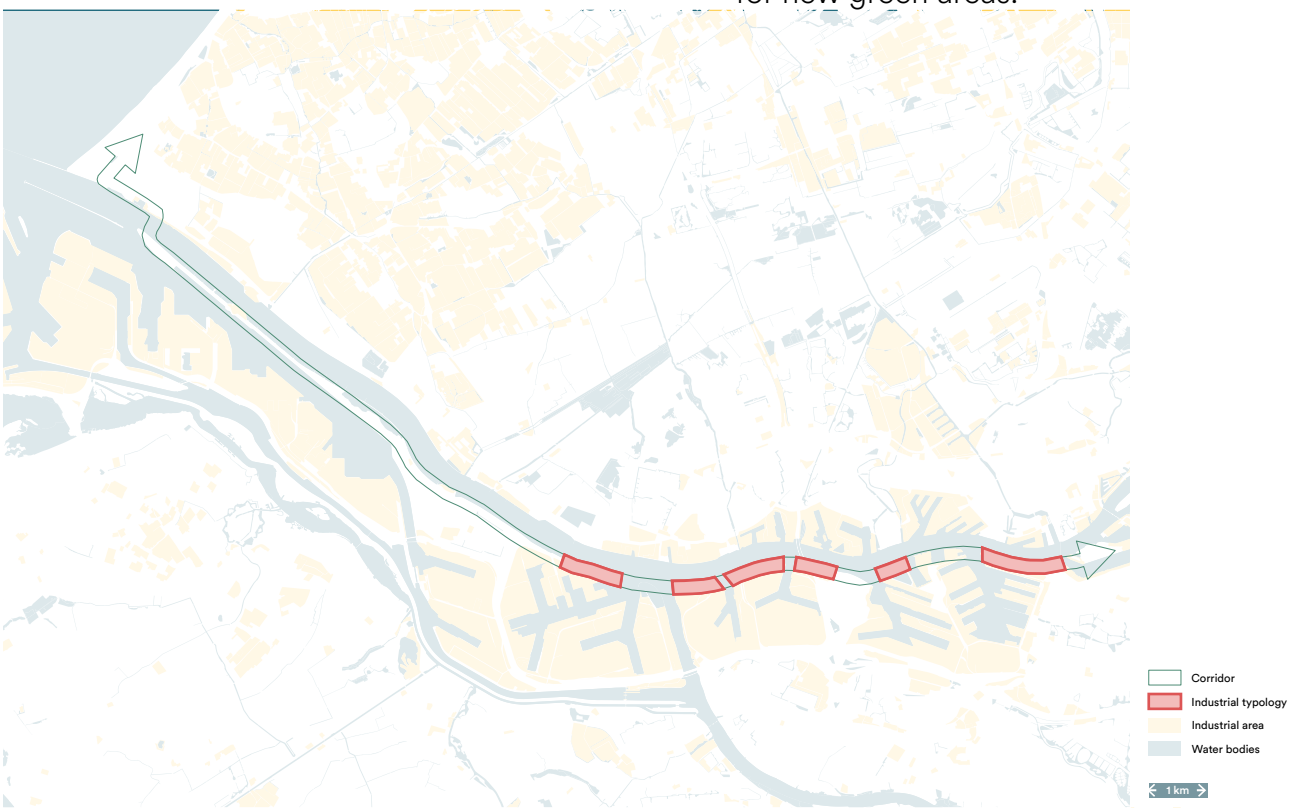
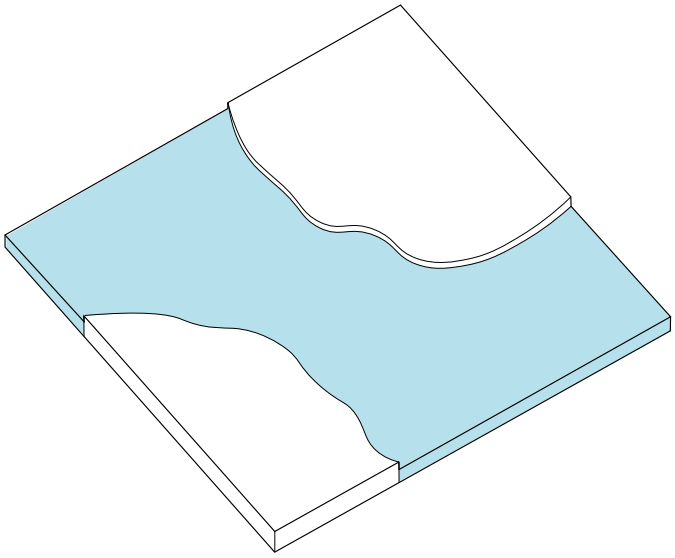
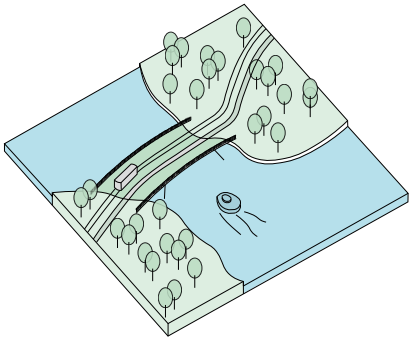


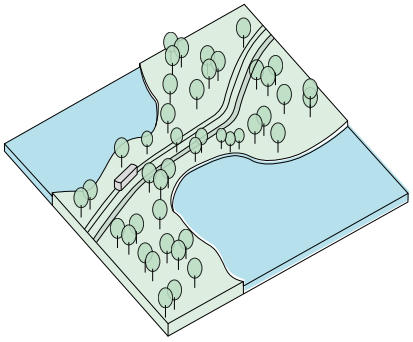
Fig. 49: Map showing the location of the Industry typology



D) The Water typology: Due to the number of quays in the Port of Rotterdam, there are several water sections that will need to be connected to consolidate the corridor.



D1) Bridges: In some cases it will be necessary to maintain the passage of medium and small ships through these sections, so we propose the creation of bridges.



D2) Dykes: This typology could be applied mainly to the entrance of smaller water bodies that will not be locations of maritime traffic in the future.

Fig. 50: Map showing the location of the Water typology

The corridor connects the four villages of our vision, but besides that it will operate as a connector to more areas. As visible in the map, the corridor makes use of current green area (for example the green area around Rozenburg, including the 'Landtong') and will connect to other green spaces in the surrounding area.

Besides the greater green connections, it will also function as a public transport connector. The corridor includes a light rail line until Rozenburg, and in Rozenburg will connect to the existing metro line that goes from Schiedam towards the beach in Hoek van Holland. In this way, the corridor makes sure that the four villages (and working spaces around the villages) are better connected.

Fig. 51: Map showing the mobility and green connections of the corridor

5.2.2 The Buffers

As seen in the vision maps and spatial sections, the existing industrial areas surrounding the Small Cores will function as a buffer area. The more industrial facilities (like for example the biomass powerplant) will be located in the middle of this area. The more you move towards the villages (either Rozenburg or Pernis) the less industrial the area becomes and the more residential the character will be. The buffer works in this way as a sort of gradient in the spatial environment.

Also, for Heijplaat, the buffer principle works to make sure that the industrial parts next to the existing villages are more accessible to make the village less isolated.

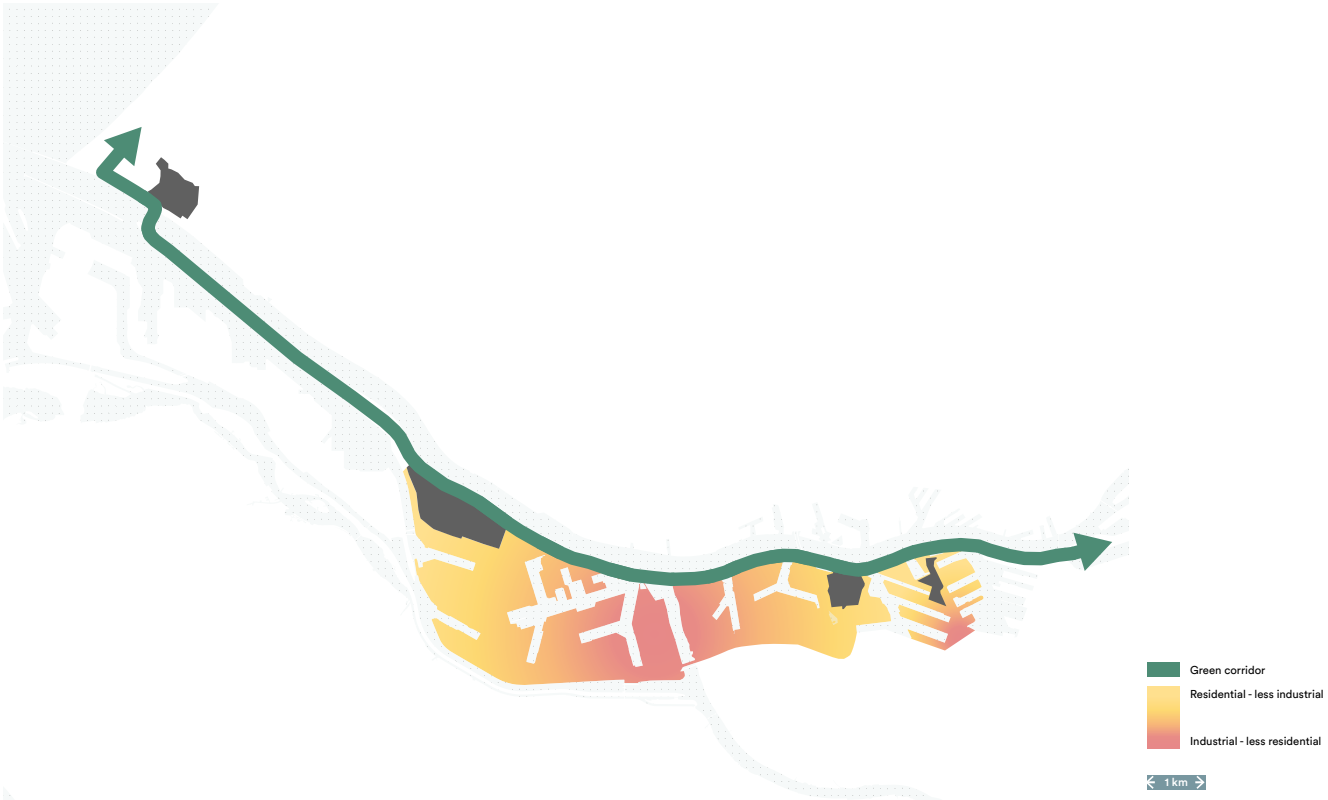
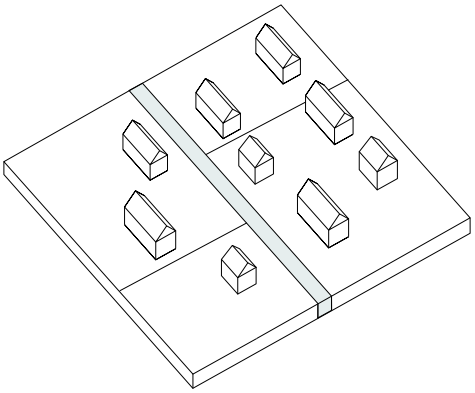
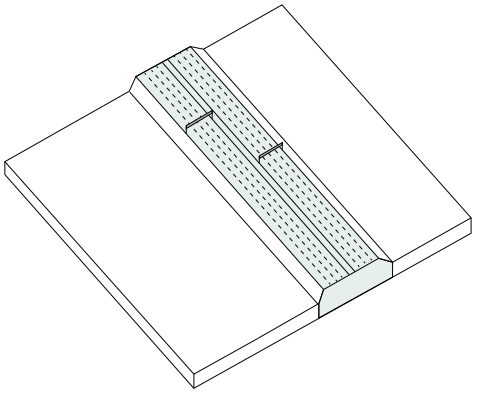


Fig. 52: Map showing the buffer principle

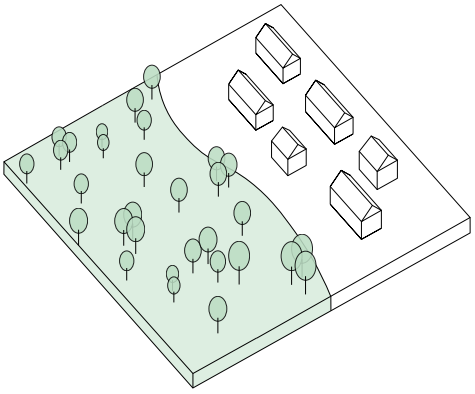
Following the same logic as with the green-blue corridor, the spatial typologies were identified in order to subsequently develop proposals for future uses for these spaces. In this case, the resulting typologies were as follows:



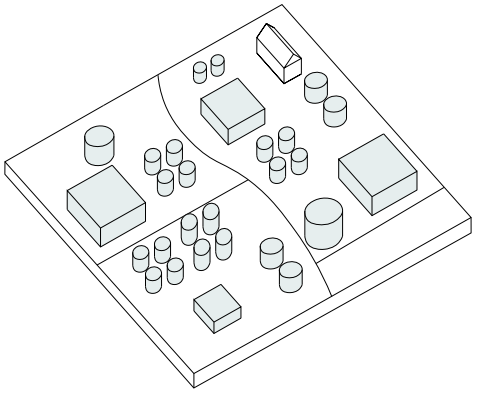
a) Residential area



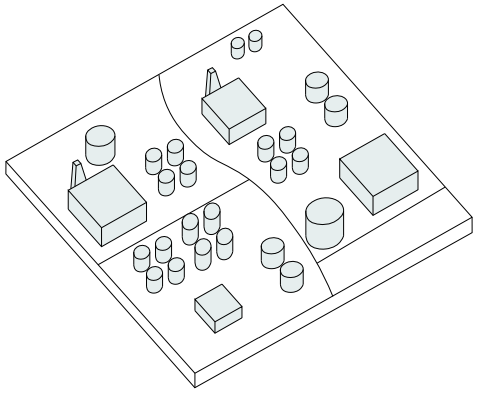
b) Transport infrastructure



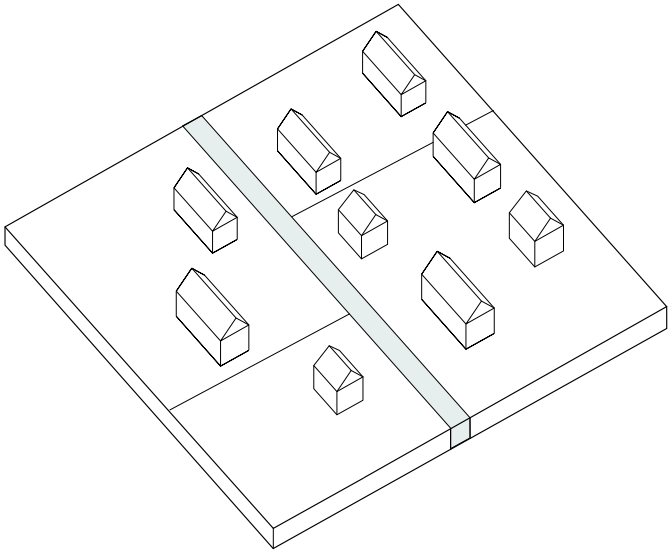
c) Green belt



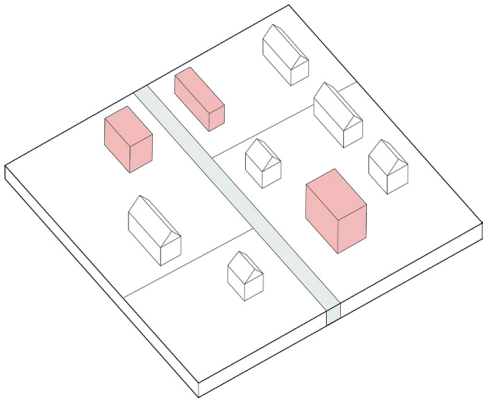
d) Industrial area with high potential for transformation



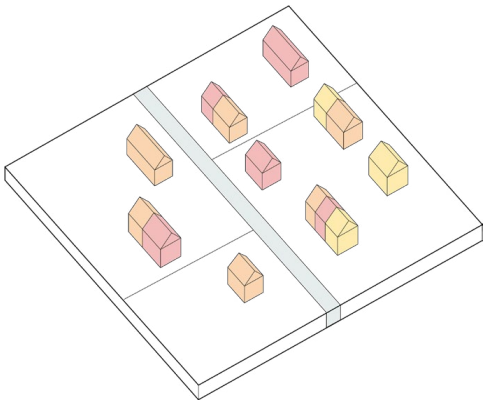
e) Industrial area with low potential for transformation



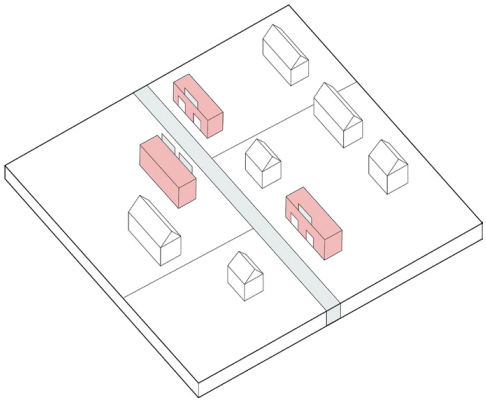
a) Residential area: This typology is found only within the boundaries of the Small Cores, and is characterized by a mixed but predominantly residential land use. The opportunities that this typology offers derive in the proposal of three actions, mainly focused on creating opportunities and attractiveness for living in these sites.



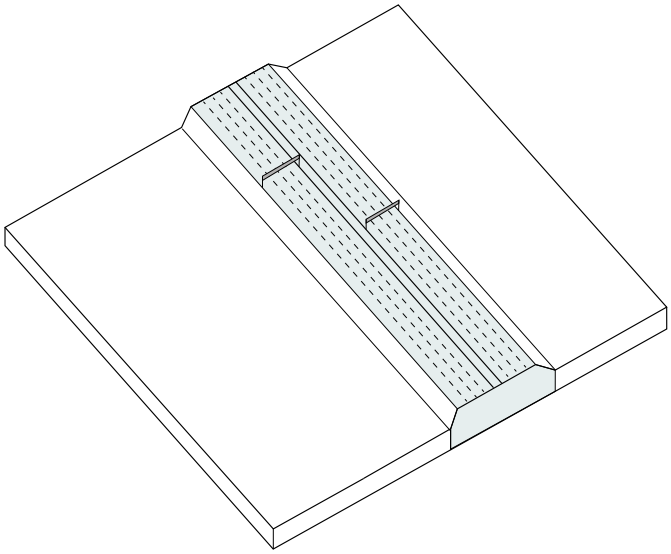
a1) Function diversification: The inclusion of services and amenities-especially along the main axes of these towns-can contribute to increased livability and vitality.



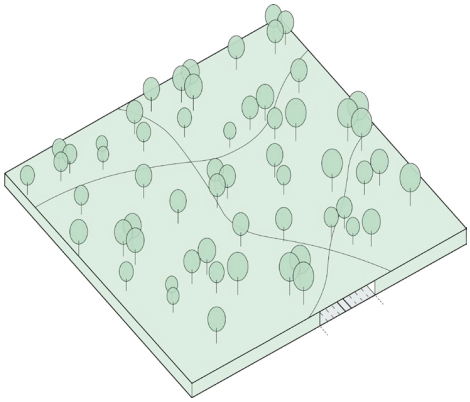
a2) Housing market diversification: The subdivision of housing units currently designed for large families can be subdivided into smaller units to meet the needs of the younger population, which nowadays generally forms smaller households.



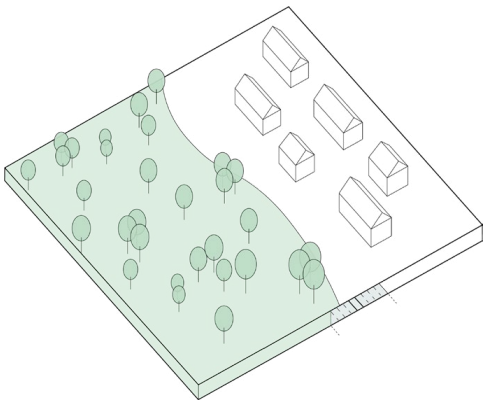
a3) Housing market update: Outdated buildings that can not be renovated can be demolished and on that ground new houses can arise, which will be more complement to the housing market.



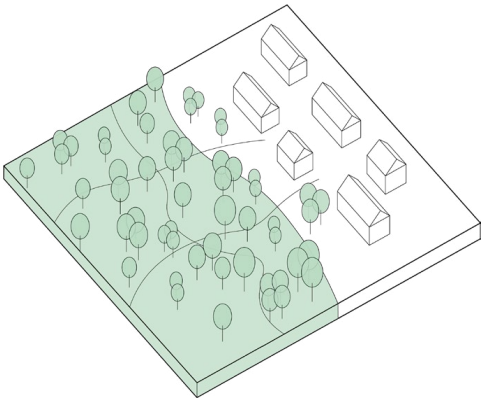
b) Transport infrastructure: A port of Rotterdam's magnitude requires infrastructure that connects it to the hinterland. This implies that a complex network of highways, roads and railways around the port area occupies a large amount of space. Putting this infrastructure underground offers a generous amount of space that can be used to the advantage of the Small Cores.



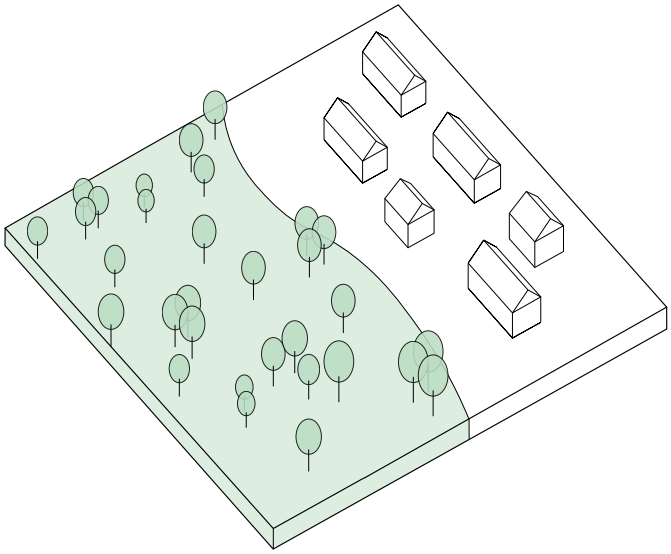
b1) New green area: The spatial reconfiguration around the Small Cores will require converting some green spaces into development areas to ensure the continuity of their urban fabric. In this sense, the space previously occupied by transportation infrastructure can be used to compensate for this measure and even increase the area of green infrastructure.



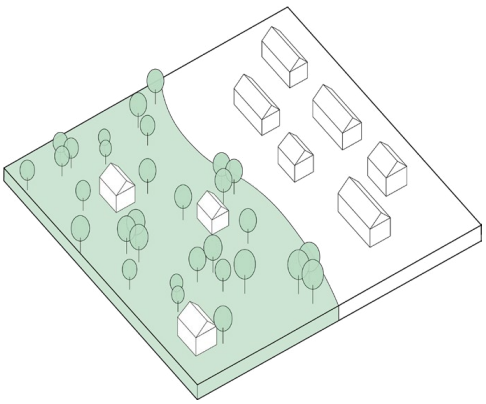
b2) New development area: As mentioned above, one of the principles for turning the Small Cores into more integrated areas with their surroundings is to maintain the continuity of the urban fabric. To this end, some of the areas currently occupied by transportation infrastructure will be converted into areas of new development that will connect towns to industry.



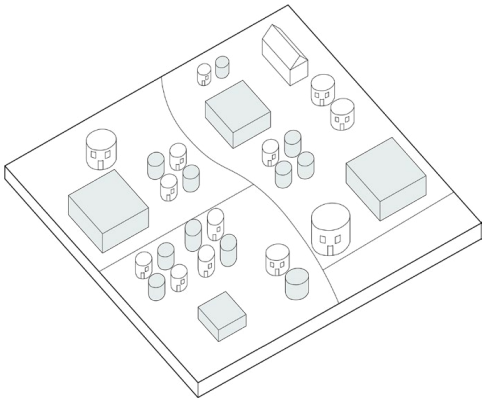
c1) Biodiversity enhancement: In cases where it is possible to maintain the quality of green areas in these spaces, the opportunity is taken to improve their spatial quality by enhancing biodiversity.



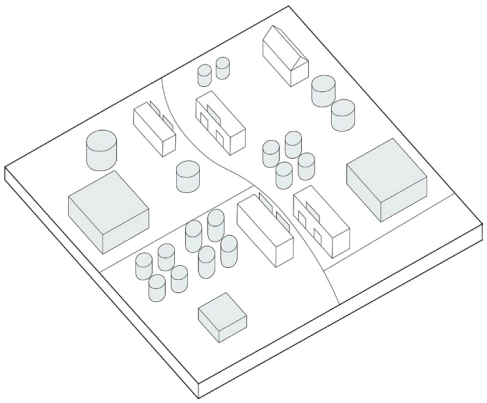
c) Green belt: As already mentioned during the analysis, some of the Small Cores are protected from the intense presence of industry by green cordons that buffer (at least visually and acoustically) its effects. For them, we propose two different tools, whose application will depend mainly on the location of these green areas and whether they constitute a barrier or not.



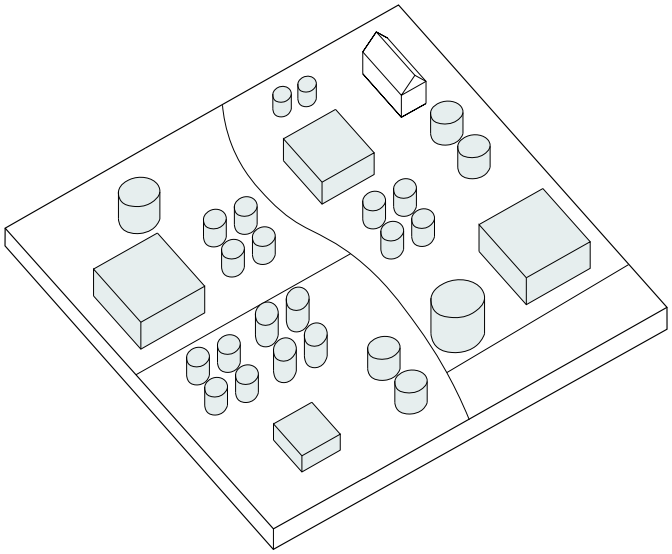
c2) New development area: Because the industrial space outside the greenbelts will be profoundly transformed and become accessible, it will no longer be necessary to have these green areas as buffers, but rather as distributed points in the space. This will allow the creation of areas of new development similar to those proposed in tool b2.



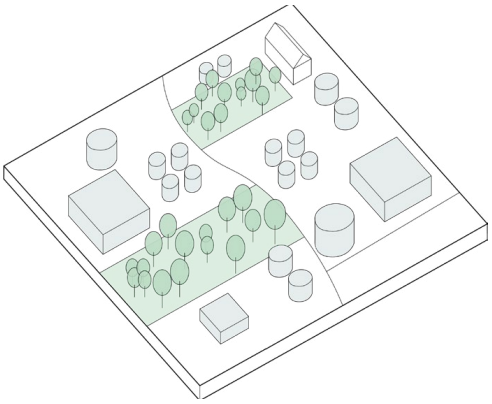
d1) Housing in former industrial infrastructure: In areas near Small Cores that also have infrastructure that can be relatively easily adapted (such as bulk liquid or gasoline storage tanks), we propose the reuse of this infrastructure as mixed housing and material storage buildings (e.g., biomass raw material).



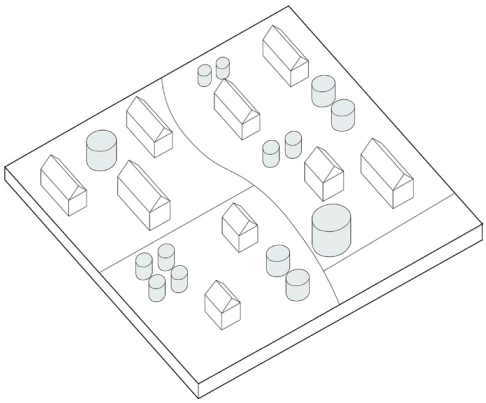
d2) New development in industrial area: In other cases, the conditions of the current industrial infrastructure do not facilitate its reuse, making it necessary to demolish it for the construction of new housing units.



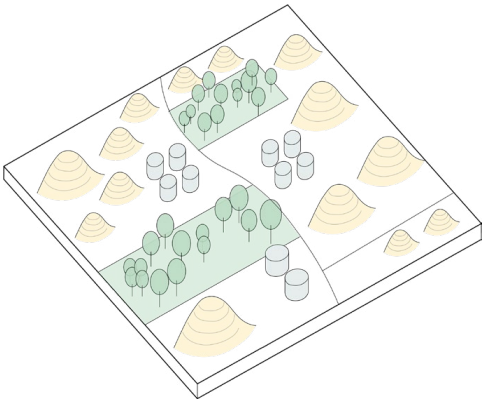
d) Industrial area with high potential for transformation: Some of the existing industrial areas around the Small Cores present a high potential for transformation, either because of their close location to residential areas, the qualities of their infrastructure, or both. In this regard, we propose four different options for these areas, ranging from the adaptation and reuse of this infrastructure to its demolition in some cases to free up space for new development.



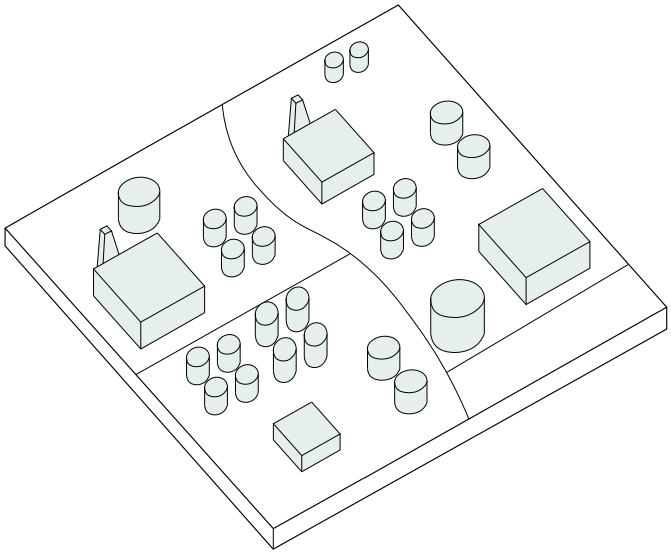
d3) New green infrastructure: For logical reasons, there are currently no green areas within the port's purely industrial zones. The transformation of these areas into mixed land use zones will require the implementation of new green areas that contribute to making these spaces habitable.



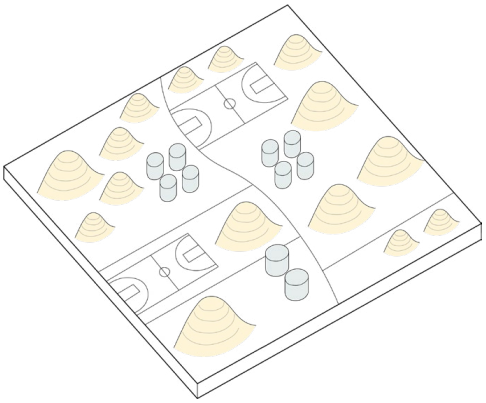
d4) Adding facilities: While the new neighborhoods will be mostly industrial, we also propose the implementation of facilities in new buildings to serve the inhabitants of these areas.



e1) Industrial green park: Some of the industrial zones offer opportunities to be converted into green-industrial areas, turning them into a new concept of urban area in which nature and lighter industrial uses coexist.



e) Industrial area with low potential for transformation: Other industrial areas, on the contrary, offer a low potential for transformation, either because of their location further away from the Small Cores or because of the type of infrastructure that makes them up. For them, we developed two types of tools that can be implemented with the objective of making them attractive areas for outdoor activities while maintaining their function as industrial zones.



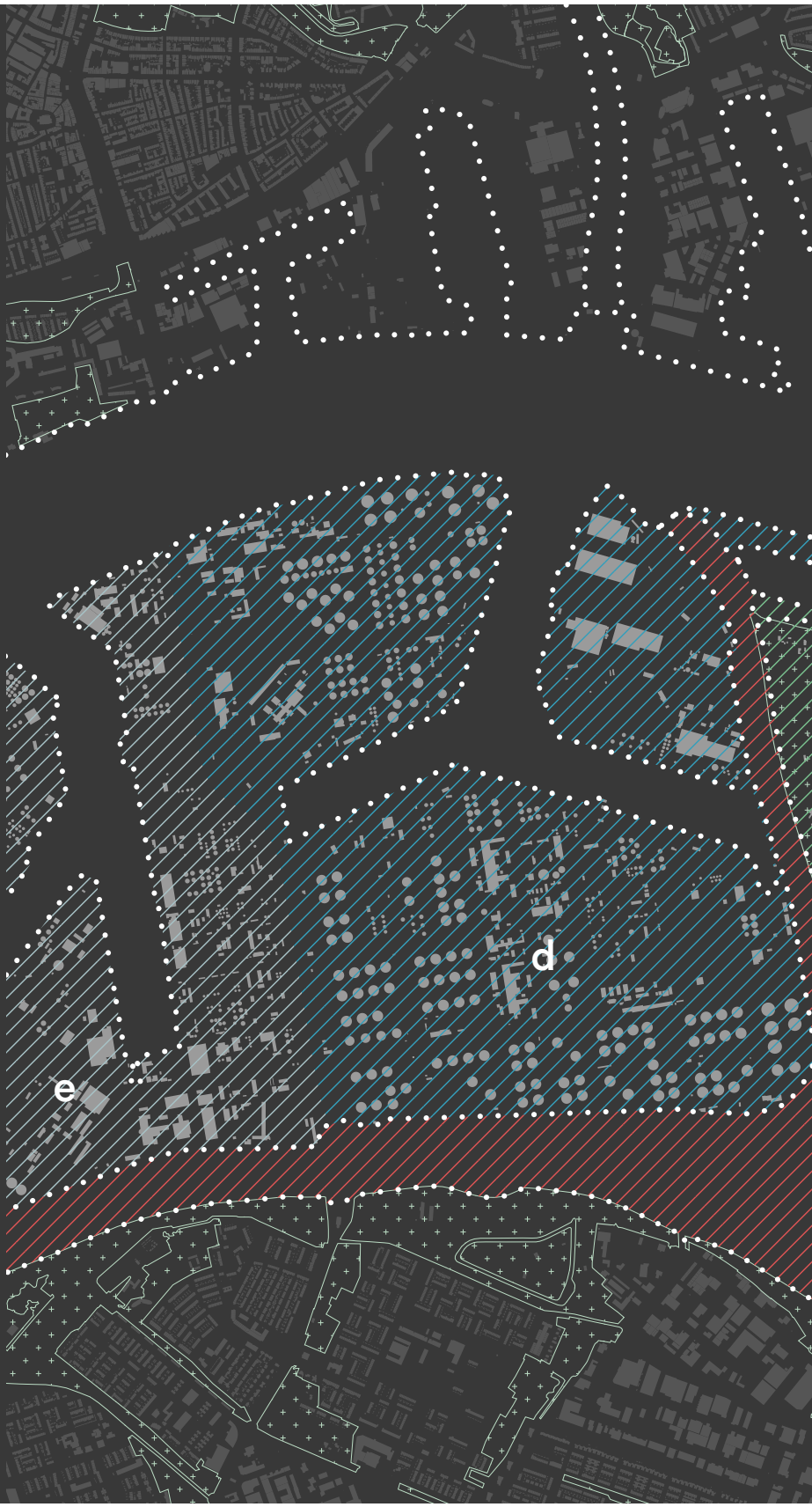
e2) Sports ground: Other industrial areas can become attractive zones through the implementation of sports facilities that serve the inhabitants of the Small Cores while fulfilling their function as storage areas, for example.

5.2.3 Exemplary Spatial Zoom-in

Main current spatial elements: To explain how the buffer and green-blue corridor principles are applied, it is first necessary to show in detail the current conditions of the pilot site of their application, which in this case are Pernis and Heijplaat. To do so, we started by identifying in a general way the configuration of the space in terms of land use and connectivity.

Fig. 53: Main current spatial elements map

Spatial barriers and transformation potential: By applying the list of spatial typologies developed in section 5.2.2, we identify the different types of space that configure the Small Cores and their surroundings, which allows us to determine which buffer typology could be proposed in each space to achieve this smooth gradient between villages and industry. Similarly, we identify the main spatial barriers that cause this strong fragmentation and sense of inaccessibility.



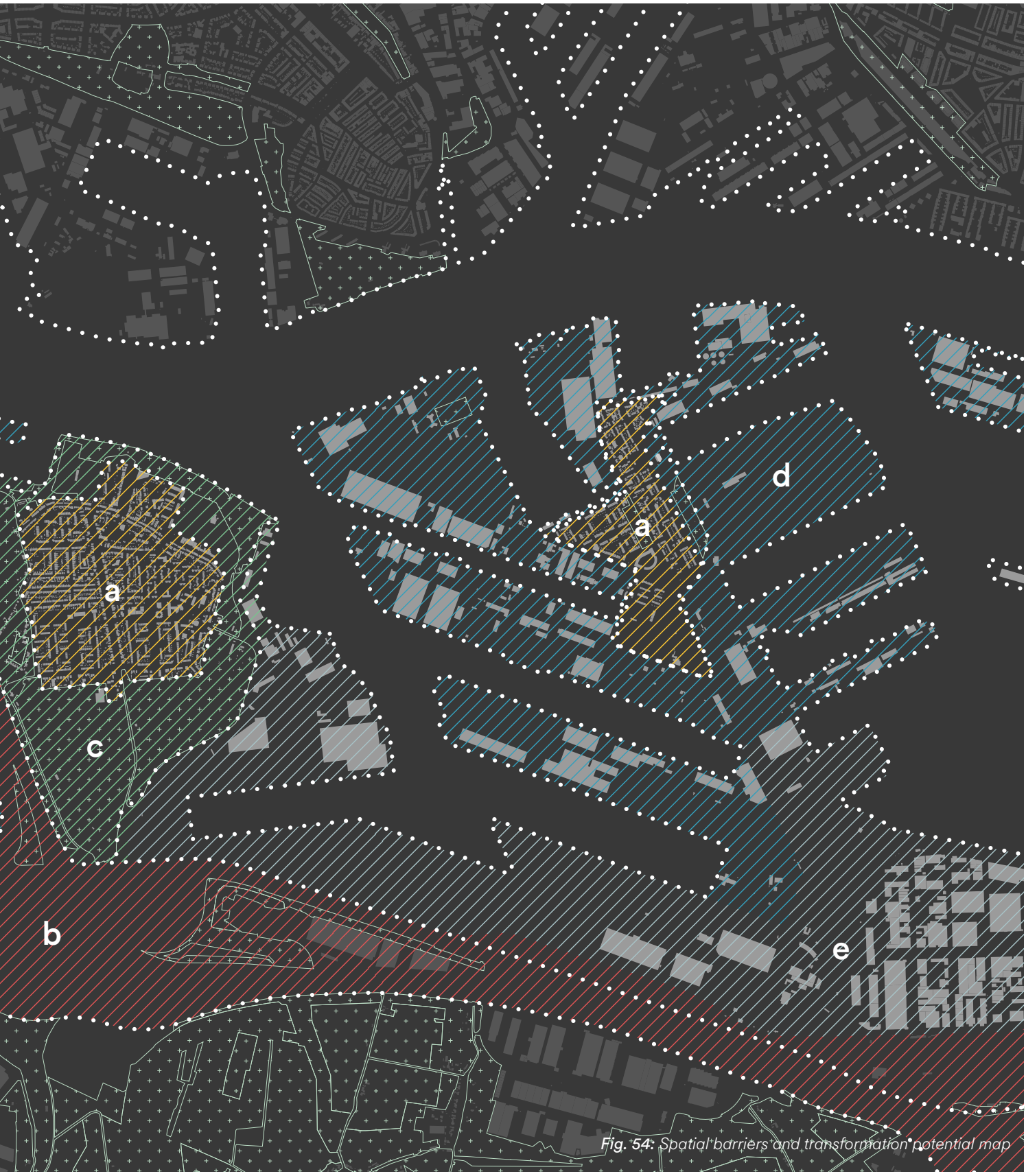
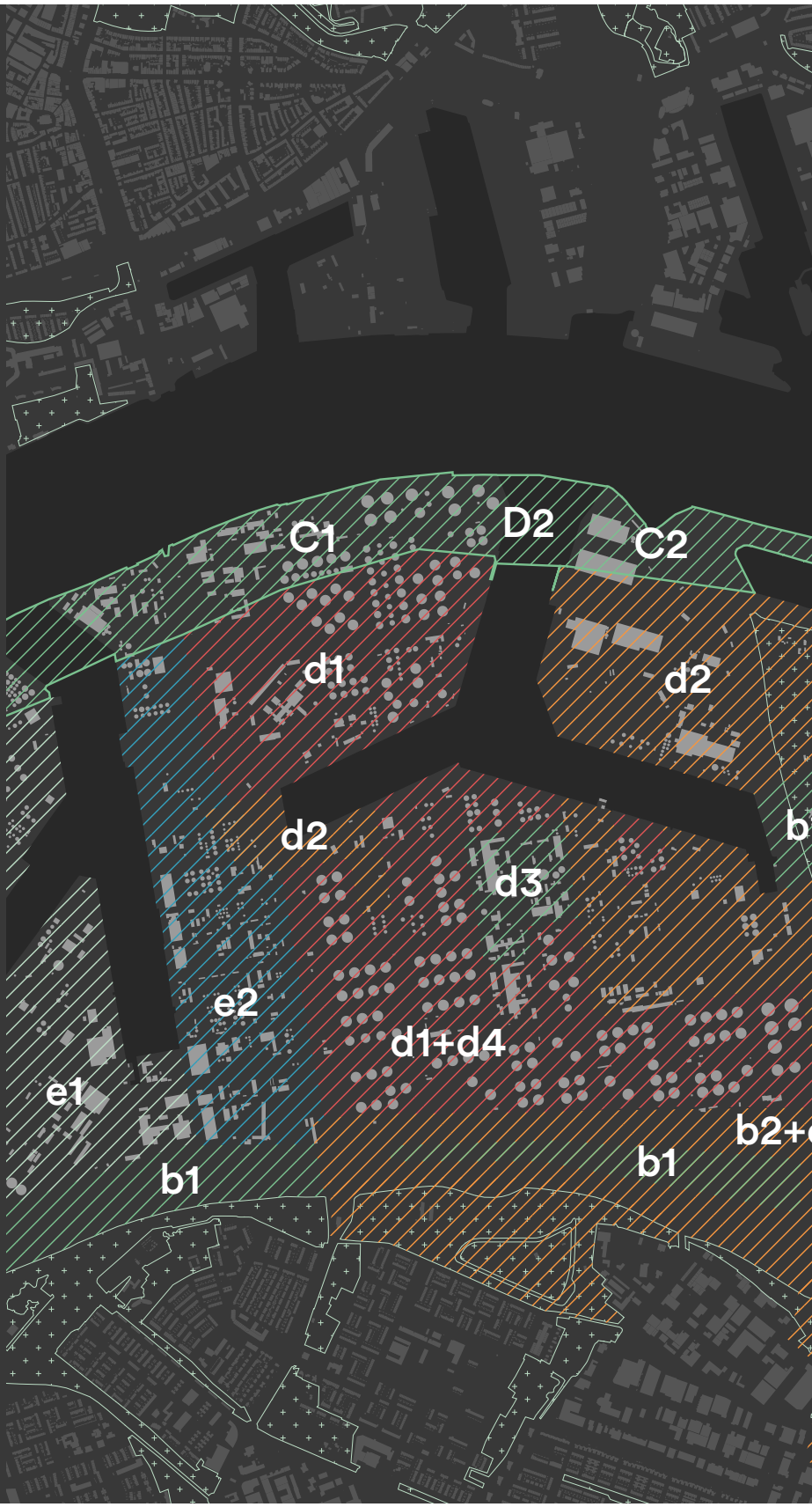


Fig. 54: Spatial barriers and transformation potential map

The buffer typologies: Having identified the typologies of the space around the Small Cores we propose a new zoning of the space making use of our toolkit, in which we take advantage of the potential that each current typology offers, either thanks to the existing infrastructure or to the open space condition. In the case of Pernis a new development zone is proposed towards the southwest, with the objective of connecting its urban area with that of Hoogvliet. While some current green areas are taken and transformed into development areas, the burying of the highway opens new opportunities for replacing the green areas that are urbanised.



Function diversification+housing market update
New development area
Industrial building reuse
Industrial+sports area
Industrial+green area
New green area
Green-blue corridor
Other green infrastructure

400 m

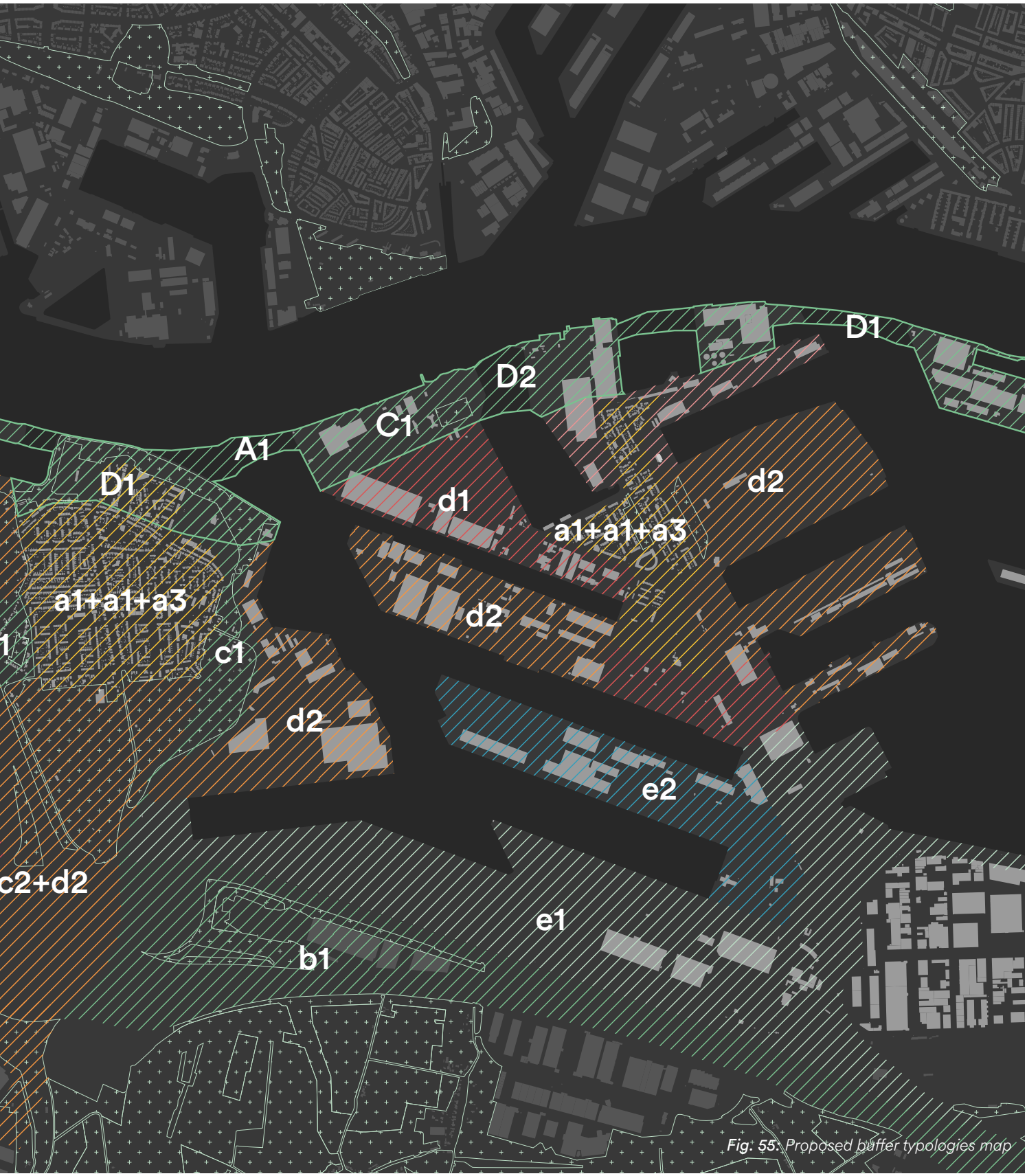
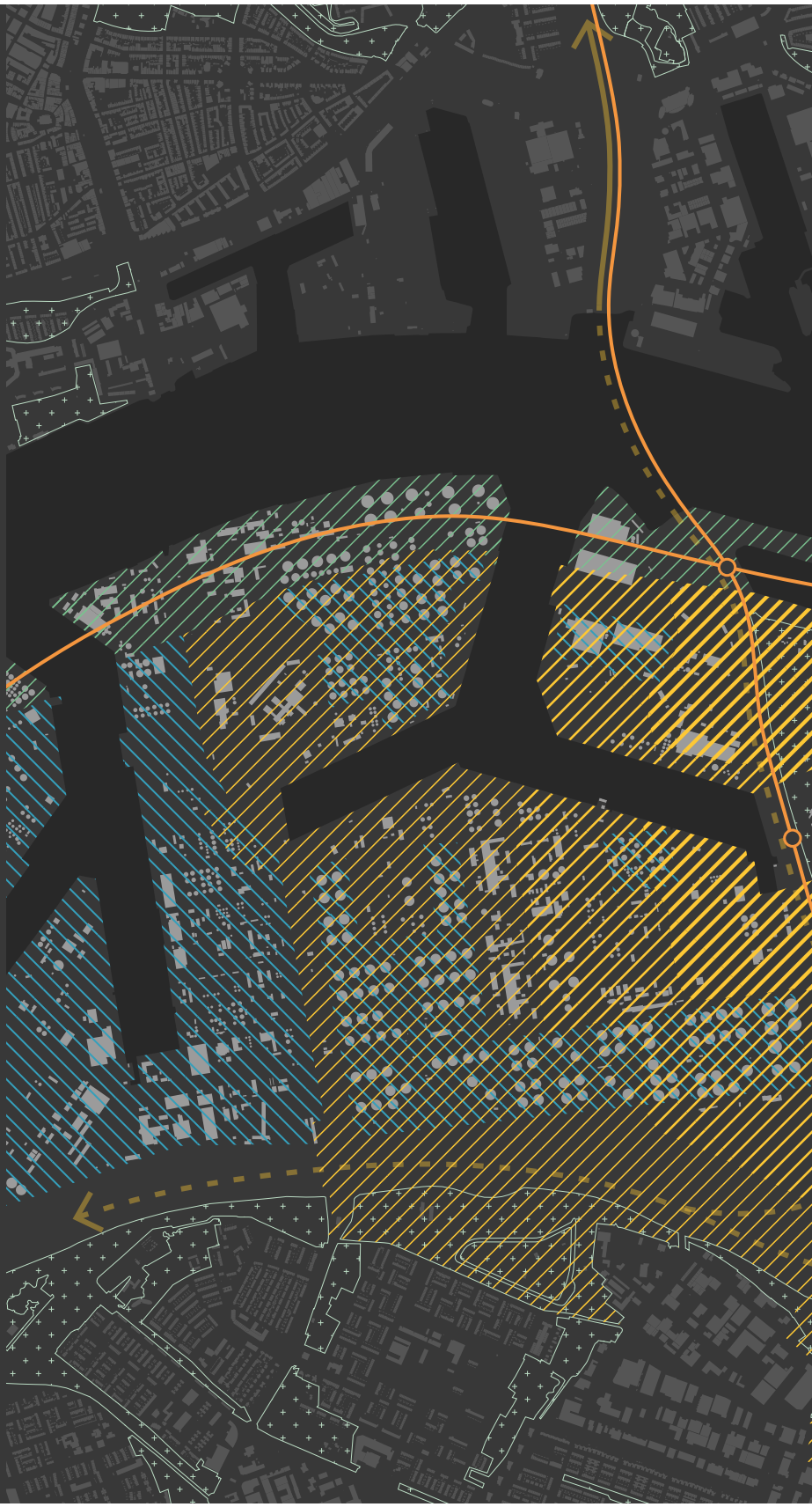


Fig. 55: Proposed buffer typologies map

The land use gradient: In this way, the buffer principle creates a land use gradient that takes the form of a new neighborhood model in which industry and residence coexist. The reuse of existing infrastructure allows for the creation of combined housing and industrial spaces (housing+storage in Pernis and housing+cargo in Heijplaat), and the new corridor serves as an articulating axis connecting the Small Cores to each other via an extension of the Rotterdam metro system, reducing their isolation.



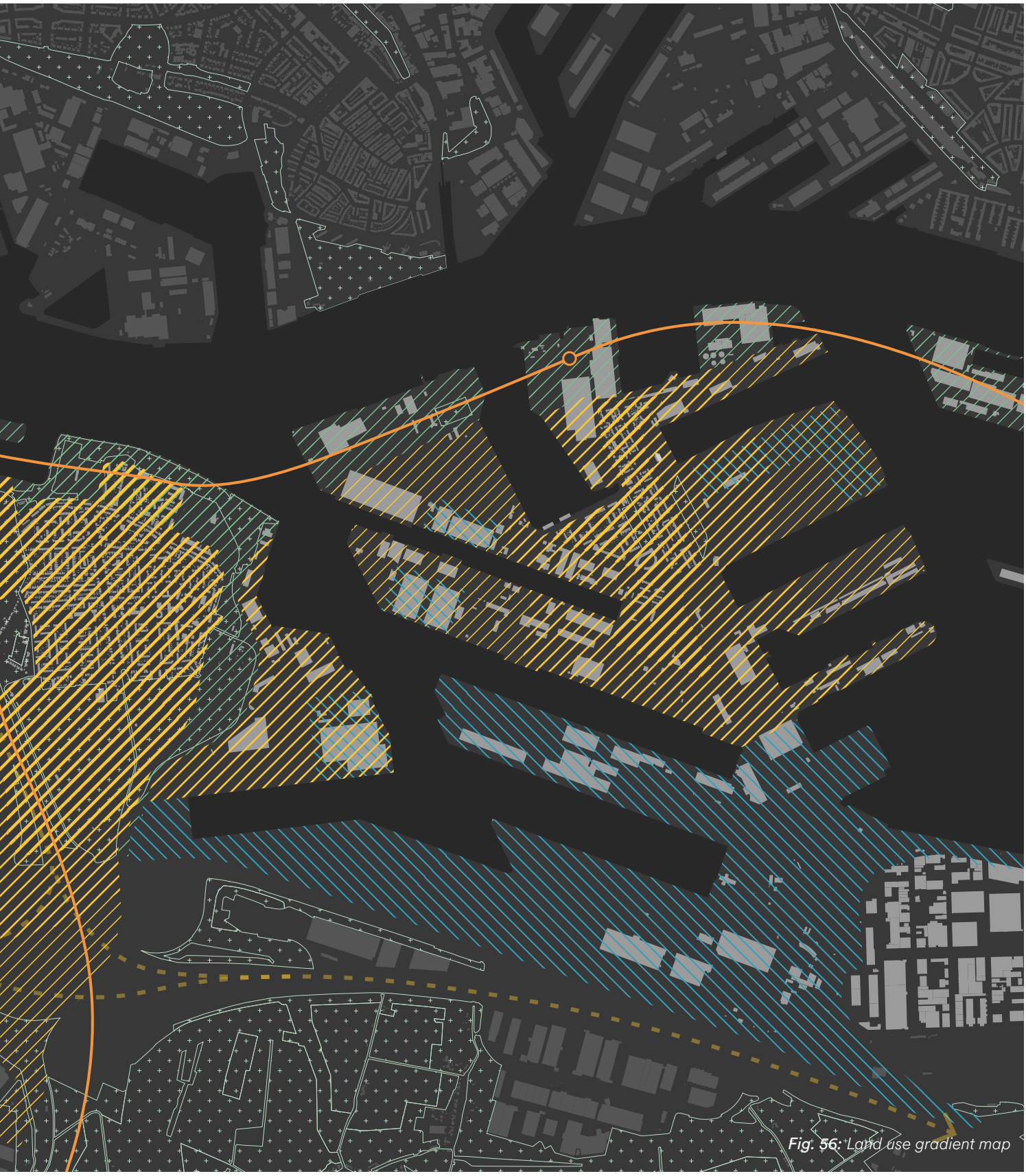


Fig. 56: Land use gradient map

PERNIS: THE BIOMASS NEIGHBOURHOOD

Image 4: Biomass neighborhood Pernis

HEIJPLAAT: THE CARGO NEIGHBOURHOOD

Image 5: Cargo neighborhood Heijplaat

THE GREEN-BLUE CORRI

DOR

Image 6: Green-blue corridor

5.3 Stakeholder Analysis

As we have seen in 'Chapter 3.4 Policy Analysis', there are various policies in action from various levels of governance to address the Port of Rotterdam's energy transition. By connecting these policies with an analysis of the stakeholders, who are affected by the changes of the Port of Rotterdam and our proposed vision, the following inventory of stakeholders can be identified as shown in Table 14.

	Stakeholder	Interest
1	Port communities	Improve the well-being conditions of their living places
2	Current employees	Ensuring job security for the future
3	Research institutions	Providing guidiance based on scientific foundations
4	Media	Media portrays the public opinion, so this can be positve when we talk about small core residents but also negative through employees, etc.
5	Climate activists	They want to reduce the climate change drivers and pollution
6	Energy cooperatives	Want to drive the energy transition and bring together civil society and local actors
7	Labour association	They portray the interest of the current fossil-fuel workers, who would like to have a job security
8	NGO's	NGO's often are in favour on the energy transition to reduce the human footprint
9	Logistic companies	Will have to buy new cargo ships and trucks to move away from a fossil-fuel fleet
10	Real estate investors (REI)	Expanding/changing the housing market
11	Refineries	Will have to change their set-up
12	Housing corporation	Expanding the housing market that is affordable
13	Farmers	Sell their waste as biomass for the industry & crop production for biofuels
14	Greenhouse owners	Sell their waste as biomass for the industry
15	Rail operators	Railway construction and sell transport services
16	Fossil companies	Keeping their power by transforming
17	Renewable energy industry (RED)	Renewable energy industry (RED)
18	Municipality	Keeping the port as an economic driver, ensuring jobs to their citizens
19	Port authority	Becoming the front-runner of sustainable port development while keeping a strong economy
20	Government	Achieving the national climate agreement of the Netherlands (2019)

Civil
Public
Private

Table 14: *List of civil, public and private stakeholders*

When positioning the possible relationships of the stakeholders to our proposed vision, we arrive at Figure 55. In the figure, the stakeholders are evaluated from both a power and interest perspective, categorising them into groups that should be managed, persuaded, engaged, or empowered (Balz, 2025). These effects can be achieved through stimulating, shaping, regulating, or capacity-building policies, which will be discussed in 'Chapter 5.4 Policy Framework'. Figure 55 also shows whether the interest and power of the stakeholders should change to achieve the proposed vision. From this analysis, we can conclude that most of the civil stakeholders should be empowered, while most of the private stakeholders need to become more interested.

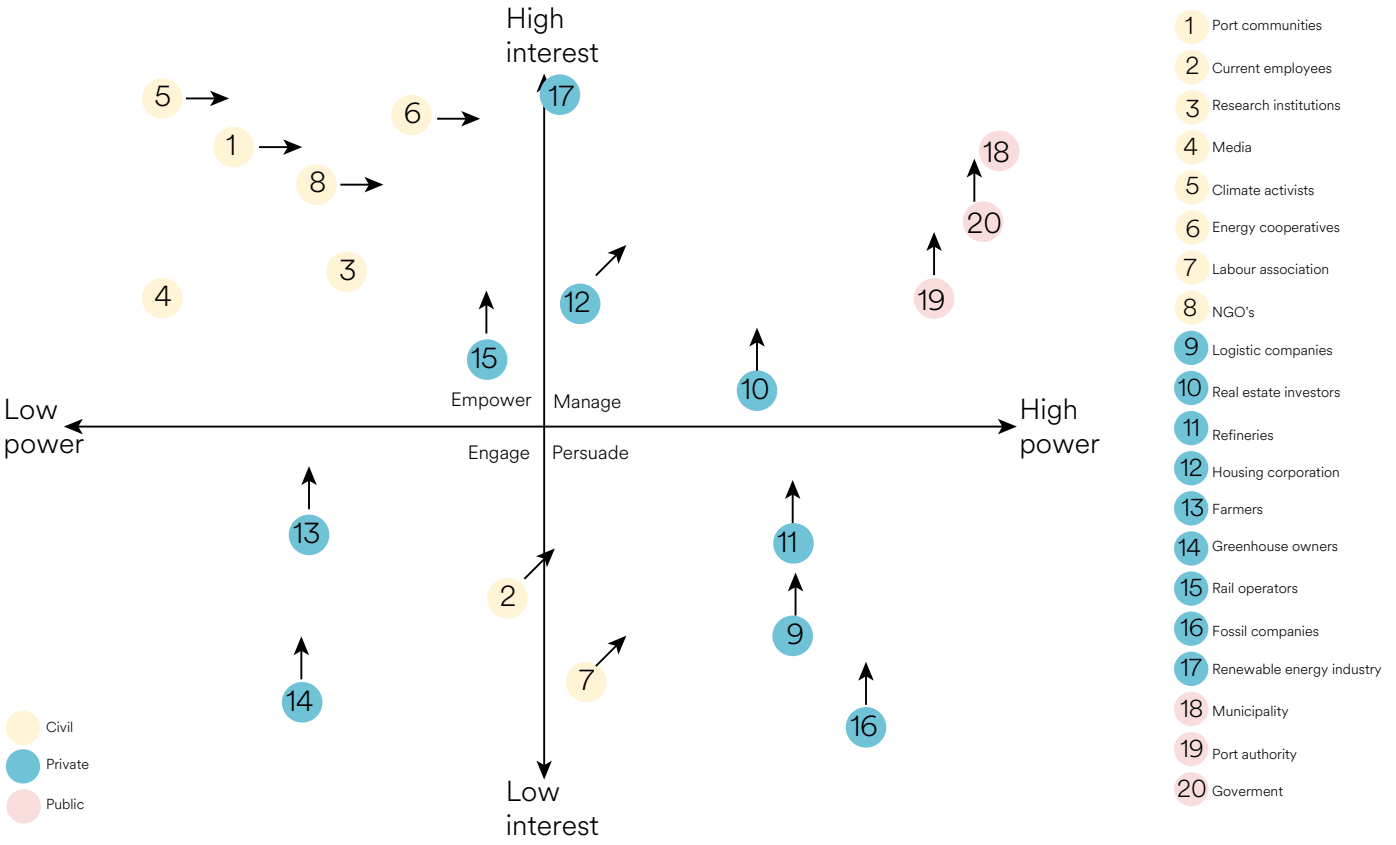


Figure 55: *Power-interest matrix*

When positioning the stakeholders as proponents, opponents, or fence-sitters, we arrive at Figure 56. Private stakeholders, such as fossil companies and current stakeholders in the port, are opposing the vision due to the changes they would need to make. From the power-attitude stakeholder matrix we can also see that it is the civil actors who we try to favour with the proposed vision.

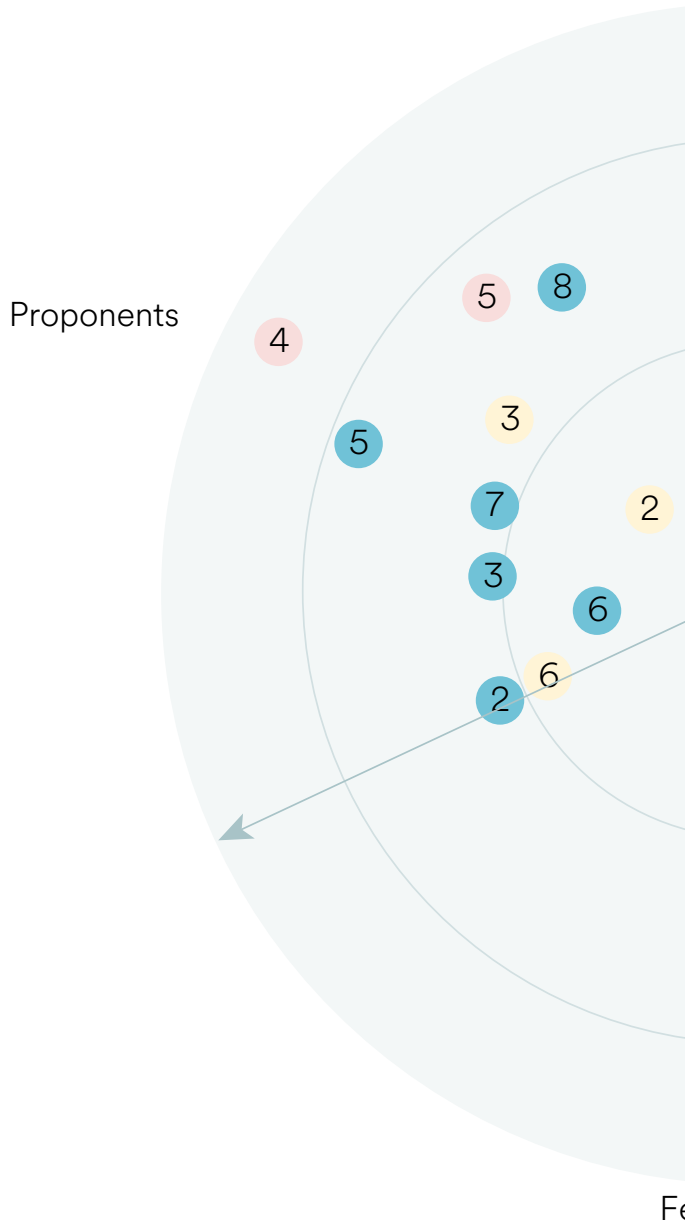
The stakeholders are categorised by the type of power they have, which gives an additional layer of insight, showing the types of power that oppose or are in favour of the proposed vision. We have defined the powers as follows:

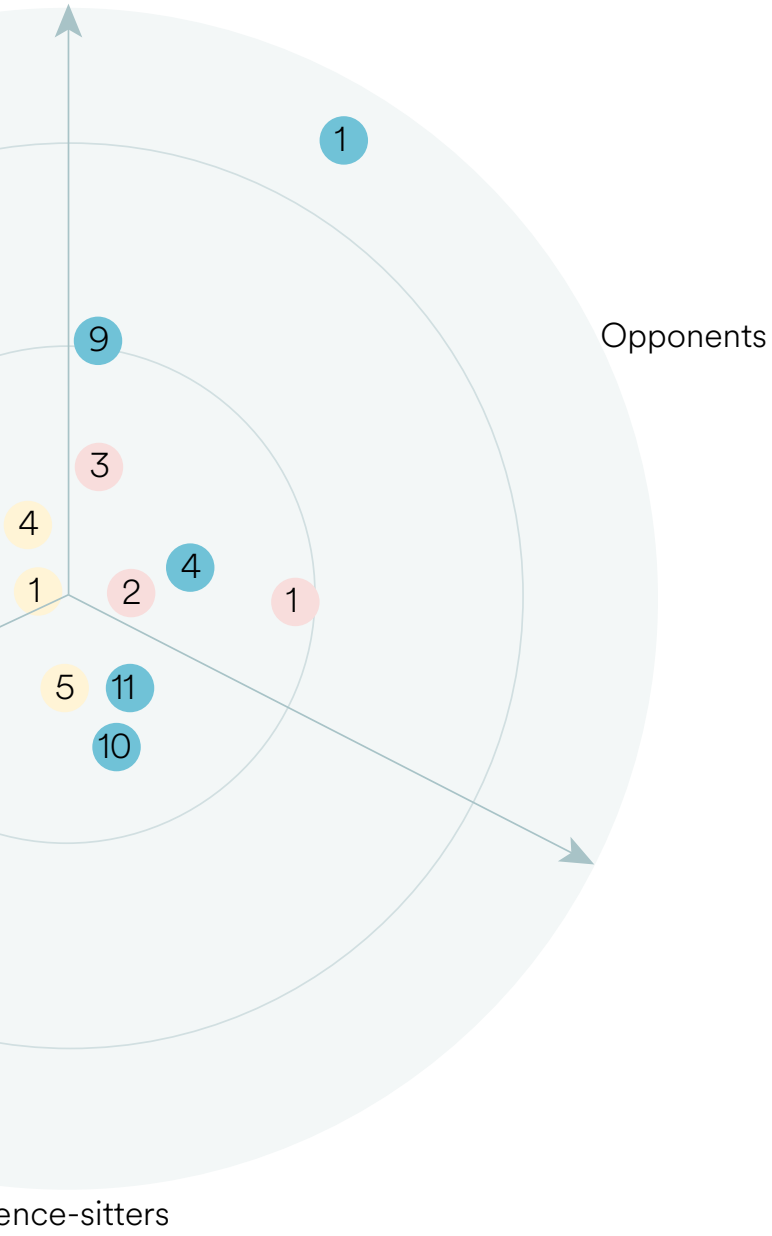
Production Power: Production power refers to the ability of an actor to produce something. This could mean that they are needed to provide resources, goods, services, or ideas that is needed to realise the vision. Stakeholders with production power can drive or enable change because they have a key role in producing something critical for the success of the vision.

Blocking Power: Blocking power refers to the ability to prevent or obstruct an action or decision. Stakeholders with blocking power can stop actions or slow down progress.

Diffused Power: Diffused power refers to a power that is spread out across many actors or levels. This type of power is more indirect and comes from the collective influence of many smaller actors, rather than a single powerful entity.

From the power-attitude stakeholder matrix and power-interest stakeholder matrix we can conclude which kinds of policies (stimulating, shaping, regulating, or capacity-building) are needed for each stakeholder to make the proposed vision work. This will be discussed in the following 'Chapter 5.4. Policy Framework'.





Actors with production power

1. Fossil companies
2. Rail operators
3. Real estate investors
4. Logistic companies
5. Renewable energy industry
6. Research institutions
7. Housing corporation
8. Port authority
9. Refineries
10. Greenhouse owners
11. Farmers

Actors with blocking power

1. Labour association
2. Current employees
3. Greenhouse owners
4. Municipality
5. Goverment

Actors with diffused power

1. Climate activists
2. NGO's
3. Energy cooperatives
4. Port communities
5. Media
6. Research institutions

Figure 56: *Power-attitude stakeholder diagram*

5.4 Policy Framework

5.4.1 Translating our Vision into Policies

As mentioned in 'Chapter 3.4 Policy Analysis', there are multiple policies in place driving current and future changes. When diving deeper into the various policies, we can ground the proposed vision in current plans and analyse existing policy gaps.

From Table 15 we can identify that there are two kinds of policies in effect:

1. **Textual policies:** Policies thar are expressed in only words
2. **Spatial policies:** Policies that express spatial interventions with maps

Similar to our vision, the textual policies regarding the energy transition are in favour of the energy transition and therefore align with our vision. The policies we want to introduce are building on and do not contradict with current textual energy transition policies. Nevertheless, some policies are more relevant to the proposed vision than others, ranking them from high to low. Also shown in Table 15, some of the spatial policies mentioned in the port vision (Port of Rotterdam, 2024) and RES (Provincie Zuid-Holland, 2021) contradict our vision.

The following overview mentions key takeaways from positioning the proposed vision within current policies:

Our vision is in line with the ideas of the following policies:

- Development Perspective: NOVEX Area - Collaborating on the Future of the Rotterdam Port Area
- CO_2next Project (CO_2 Storage)
- EU Guidelines for Biomass with specific sustainability criteria
- National Heat Vision
- Municipality of Rotterdam Vision 2021

Our vision contradicts with the ideas of the following policies:

- RES & Port Vision 2030

Summarized, there are a lot of textual policies in support of the energy transition; however, they do lack inclusion of the port communities. Regarding the spatial policies, some empower and some contradict our proposed vision.

Policy anno 2025	Relevance to vision	Relevance	Regarded group	Level of governance	Main stake-holder(s)
Shaping					
Development Perspective: NOVEX Area Collaborating on the Future of the Rotterdam Port Area	High	The plans propose different spatial ideas specifically for the port, while largely ignoring the villages surrounding it.			Port of Rotter-dam, Municipality, RED
Rotterdam Hydrogen Hub & Network	High	The plan drives the narrative of a hydrogen-powered country, with Rotterdam as an important hub.			Goverment, RED
Small core approach	High	Our vision is the second step of the small core approach aimed at improving the livability and vitality of the small cores			Municipality
Regulating					
Coal Combustion Ban (from 2030)	Moderate	The Coal Combustion Ban An important incentive for the port to allocate space to different fuel industries or other land use. This open space can be used for expansions and re-spatializing the port.			Fossil companies
Stricter Environmental Regulations	Moderate	Stricter regulations create urgency for stakeholders in the port to innovate and comply with health concerns for citizens.			Fossil companies RED
Regional Agreement Framework for Noise and Spatial Development	Moderate	The policy aligns with our buffer zones to prevent noisy industries from being situated near residential areas.			Fossil companies RED
Stimulating					
Shore Power Subsidies	Low	Shore power subsidies are relevant for reducing emission pollution that can affect citizens' health.			Port of Rotterdam
CO_2 next Project (CO_2 Storage)	High	CO_2 storage is very important, as the green corridor will be integrated with the pipes transporting CO_2.			Port of Rotterdam RED
Funding for Sustainable Fuels SDE++ The Energy Investment Deduction (EIA) Reduced BTW Rate (9%) for Solar Panels	Low	SDE++, EIA, and the reduced VAT rate stimulate investment in sustainable projects.			RED
EU Guidelines for Biomass for specefic sustainability criteria	High	Biomass from greenhouses for bio refineries should follow specific guidelines to maximize its use.			RED refineries
National heat vision	Moderate	Stimulates the use of geothermal energy in the Rotterdam port area.			RED

Spatial policy					
Green connection through rozenburg + attention to cultural heritage + connecting Rozenburg to Hoekse Lijn public transport (Municipality Rotterdam vision, 2021)	Positive	Multiple spatial ideas are included in our vision			Municipality
Maasvlakte extension, greenhouses + port synergie + using soft industry around towns (Development Perspective: NOVEX Rotterdam port Area 2023)	Positive	Multiple spatial ideas are included in our vision			Port of Rotterdam, Municipality
Hydrogenhub and building on Maasvlakteand west side of the port (Energy Transition Progress Report (2024)	Positive	Multiple spatial ideas are included in our vision			Port of Rotterdam, RED
Port projects (Energy Transition Progress Report, 2024) ●Increase capacity electricity grid ●Shore power	Positive	Multiple spatial ideas are included in our vision			Port of Rotterdam, Municipality
Wind turbines through the whole port (RES & Port Vision 2030)	Negative	In our vision, we do not have wind turbines throughout the entire port, as this is based on the preferences of the port communities.			RED, Municipality, Port of Rotterdam
Extending the heatwaste network to Leiden (RES)	Negative	In our vision, we aim to scale down the heat network by extending it only to the port communities, while utilizing geothermal energy for both existing and new homes connected to the network.			RED, Municipality Port of Rotterdam

Table 15: *Positioning of relevant policies to out vision*

5.4.2 Introducing complementary policies for the vision

After positioning the stakeholders in 'Chapter 5.3 Analysis of Stakeholders' and current policies in 'Chapter 5.4.1 Translating our Vision into Policies' in relation to the proposed vision, various policies have been structured and categorised from shaping, stimulating, regulating, to capacity building to make the vision work and the stakeholders work in favour of the proposed vision.

Stimulating: The stimulating policies are in place to persuade or engage stakeholders who have a low interest in the effects of the proposed vision. For example, ST1 stimulates greenhouses to install solar panels or e.g. ST4 rewards all Renewable Energy Developers (RED) with a positive label in case of achieving certain climate goals. The number of new stimulating policies introduced is limited, due to the presence of existing measures already in place, which is visible in 'Chapter 5.4.1 Translating our Vision into Policies'.

Shaping: The shaping policies are giving various parts of the vision a legal grounding in the desired spatial effect. SH1, SH2, SH5, SH6, SH7 and SH9 are the most important ones, mentioning the buffer, corridor, connectivity, Small Cores and local synergy between stakeholders. Interestingly, most shaping policies are related to the municipality. Considering the municipality directly engages with the local community, has the power to form policies and serve as a bridge between the local community and higher levels of governance, they act as an authority and representative to guide the spatial development in favour of the people and the economy.

Regulating: The regulating policies are in place to manage stakeholders to achieve the proposed goals of our vision and perform essential activities for the proposed vision. The regulating policies represent the largest share of the proposed policies, because they are essential in the following ways:

- The proposed vision has high standards regarding the impact of industry on the port communities. To realise this, regulating policies are needed.

- The use of renewable energy is a new phase for the port with uncertainties. To keep control of the change, regulating policies are needed.

- Certain projects in place would only work if the stakeholders collaborated on essential activities, for example the biomass train, which involves the greenhouses and RED. Other examples are the recycling of CO2 by the greenhouses produced by the RED, or the usage of solar energy with solar panels. To make the stakeholders collaborate, regulating policies are needed

Capacity building: The capacity building is compared to the previous ones focused on individuals within organisations. Making stakeholders follow trainings, meetings or collaborations. The policy emphasises on the port community and making the voices heard of stakeholders having less power. Policy C1 is an important policy, making the port community more empowered and making them influential on decisions. Policy C1 is further explained in 'Chapter 5.5 Participation - Community Engagement'. Besides making the port communities empowered, the capacity building policies focus on educating and socially connecting stakeholders.

Shaping

- SH1 — Creating a green connecting corridor between the vilages — Municipality, rail operaters
- SH2 — Developing residential-friendly industries around the villages and in expansion areas — Municipality, fossil companies, refinaries, RED
- SH3 — Transforming Rotterdam into a hydrogen hub, with an expanded Maasvlakte — Port of Roterdam, fossil companies, REI
- SH4 — Integrating Hoek van Holland's tourism into the energy transition — Municipality, rail operaters
- SH5 — Improve slow and fast mobility between the Small Cores — Municipality, rail operaters, Small Cores
- SH6 — Remove spatial borders — Municipality, rail operaters, current employees
- SH7 — Revitalising small cores — Municipality, current employees
- SH8 — Geothermal heat replaces mostly the residual heat — RED, REI, housing corporation
- SH9 — Biomass and CO2 exchange between green-houses and biofuel refineries — Greenhouses, refineries
- SH10 — RED use innovative spatial interventions — RED

Stimulating

- ST1 — Subsidies for solar panels on green houses — RED, REI
- ST2 — Subsidies for Renewable energy companies that bring CO2 to green houses — RED, greenhouses
- ST3 — Free public transport for port employees — RED, greenhouses, current employees
- ST4 — Renewable energy companies should be rewarded with a positive label when meeting climate milestone goals — RED
- ST5 — Farmers who utilize residues from biofuel refineries as fertilizer, get a positive label — RED, farmers

Regulating

- R1A — 2/3 of greenhouse roofs should be covered with solar panels — RED, greenhouses
- R1B — 2/3 of residential roofs should be covered with solar panels — RED, REI
- R2 — Buildings should rely on renewable energy sources — RED, REI
- R3 — Greenhouses have to separate their biomass for better management — Greenhouses
- R4 — Biofuel refineries have to keep their residues as fertilizer for farmers — RED, farmers, refineries
- R5 — 50% of new houses should be designated as social housing — REI, housing corporation
- R6 — No hard industries allowed around villages — REI, RED, port communities
- R7 — No gas use in renovated buildings — REI, fossil companies, housing cooperation, refineries
- R8 — RED should include the whishes and safety of the port communities — RED, port communities
- R9 — RED should meet climate goals, ensure net-zero CO2, and minimize environmental harm. — RED
- R10 — RED should get a BREAM or LEEM certificate — RED
- R11 — RED should use the newest and safest technology for people and nature — RED
- R12 — RED should be fined when not meeting climate goals — RED, port of rotterdam
- R13 — RED have to at least send 75% of their produced CO2 emissions to greenhouses — RED, greenhouses
- R14 — Greenhouses have to utilize all of the received CO2 emissions from the RED — RED, greenhouses
- R15 — Greenhouses and farmers have to at least send 80% of their produced biomass waste to RED — RED, greenhouses, farmers
- R16 — RED have to utilize all of the received biomass from the greenhouses and farmers — RED, greenhouses
- R17 — No fossil refineries in bufferzone in 2030 — RED, fossil companies, refineries

Capacity building

- C1 — A platform where the portcommunities can co-decide on important matters — Port communities, port of Rotterdam, RED, REI, municipality, fossil companies
- C2 — Rising awareness among RED about the existence concerns of the port communities. With the goal to integrate the port communities with there planmaking — RED
- C3 — Providing training to the port communities on how to express and communicate their needs. With the goal to make the port communities able to participate and express theire voice — Port communities
- C4 — Offering training to port communities on the impact/know-how of the port industries with the aim to understand the current industry dynamics and how they shift in the future — Port communities
- C5 — NGO's should be able to give input en feedback to plans, and at lest certain input should be met — NGO's
- C6 — Each port community should have an independent energy cooperative to produce and consume renewable energy, ensuring direct benefits from the energy transition. They should have a platform with the stakeholders involved — Energy cooperatives, the port of rotterdam, municipality and RED
- C7 — Labour associations should be engaged to ensure job security. They should have their own platform with the port of Rotterdam, municipality, RED and fossil companies — Energy cooperatives, the port of rotterdam, municipality and RED
- C8 — A platform where port communities and engaged citizens can connect with all involved stakeholders to foster mutual understanding, synergy, and shared values — Port communities, port of Rotterdam, RED, REI, municipality, fossil companies
- C9 — Climate activist should be able to have a voice in the climate policy of the municipality — Climate activist, the municipality
- C10 — Current employees should be re-educated to be able to keep working in the port — Current emplyees, RED, port communities

Figure 57: Complimentary policies to our vision and the position that needs to be taken

5.5 Shared vision making

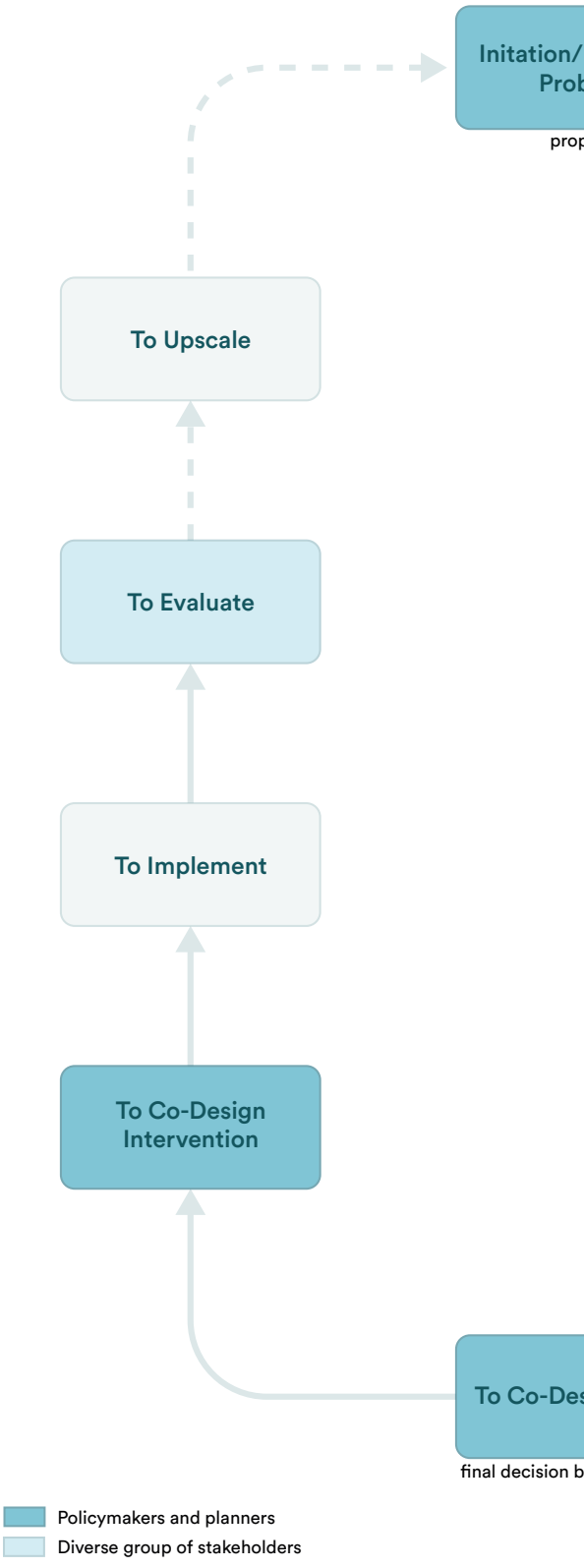
In the context of establishing vital port communities, our shared vision-making process, adapted from the 'TU Delft Strategic Planning Cycle' by Rocco et al. (2024), is used as a tool to integrate the diverse interests and perspectives of local stakeholders. In the past, the Netherlands has utilised the Decide-Announce-Defend approach (DAD-approach), which often resulted in dissatisfaction of the impacted stakeholders and residents because they felt powerless and unfairly impacted by these top-down decisions (van de Grift et al., 2020). Therefore, our shared vision-making process is supposed to ensure that the energy transition is a just transition process by bringing together residents, local stakeholders and experts to exchange their needs and concerns. Our aim is to ensure that the energy transition not only focuses on environmental goals but also secures the cultural identity, economic stability and improves the well-being of Rotterdam's port communities. A description of the steps proposed on the road to achieving this objective follows.

Step 1: Initiation/ Define Problem

To address the challenges and opportunities presented by the energy transition of the Port of Rotterdam, focusing on the port communities (cultural significance) and a resilient port for the future (socio-economic condition). This is done by utilizing media analysis and the creation of participation of different stakeholders through surveys. After this step the policymakers will create a first proposal of policies and interventions, which are supposed to balance environmental, societal and economic perspectives.

Step 2: To Engage Stakeholders

This step will help us to understand the role, interest and influence of the local stakeholders in the planning process and help us to make sure we have a diverse group in terms of perspectives.



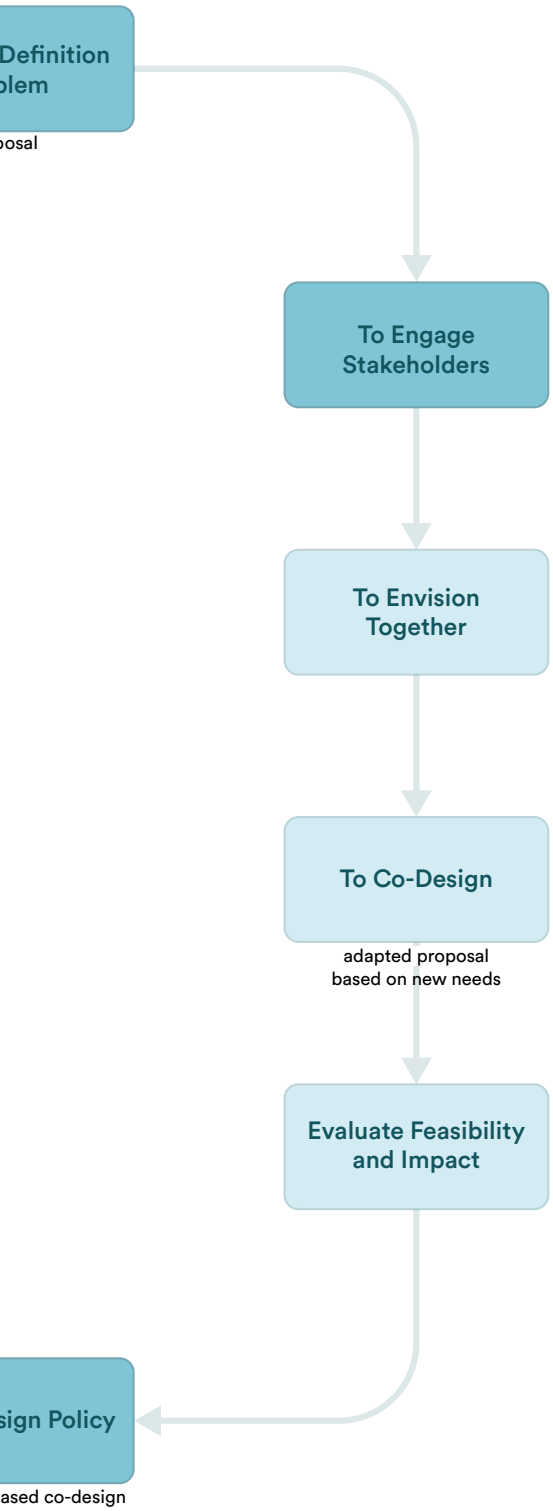


Figure 58: Shared vision making process diagram

To do so, we will make use of our stakeholder mapping to create an effective engagement strategy so that the power structure of the diverse stakeholders is in equilibrium and none doesn't overpowers the others.

Step 3: To Envision Together

Now that we have investigated the stakeholders, we want to bring them together in a shared vision-making process to foster mutual understanding and create a consensus in the planning approach. In this step, we want to make use of interactive workshops with collages for collective visioning and stakeholder role exchange dialogues. This is supposed to create awareness and a feeling of urgency for the participants.

Step 4: To Co-Design

In this step, we want to co-design the future of the Port of Rotterdam through diverse groups of local stakeholders, depending on the scale, either buffer or corridor stakeholders. By doing so, we want to create a shared vision through which stakeholders are empowered by contributing to the change of the Port of Rotterdam and its surroundings. Here we want to utilize our 'tile tools', for the stakeholders to decide where to place which tile and what might be missing. After this step, the policy and intervention proposal from the 'To define the problem' will be adapted.

Step 5: Evaluate Feasibility and Impact

Now the adapted policy and intervention proposal will be evaluated based on its feasibility and impact. Here, the diverse stakeholder groups assess the long-term impacts of their proposed spatial interventions and policies would have based on financial, technical and capacity feasibility. In this step, we want to utilize a scenario analysis tool, which would project the different

scenarios and layers that can be turned on and off by the participants. To visualise the opportunities and challenges of the spatial interventions and policies.

Step 6: To Co-Design Policy

To co-design policies that align with the shared vision and the identified challenges during the evaluation process. This is mainly done by policymakers and planners who were also present in the previous steps. In this step, the final decision will be made on policies for the interventions.

Step 7: To Co-Design Interventions

Design strategic interventions based on the defined policies that align with the shared vision and the identified challenges during the evaluation process.

Step 8: To Implement

The implementation is following a clear action plan based on the consensus of the shared vision for progress.

Step 9: To Evaluate

The evaluation process of the previously implemented intervention is used to assess the opportunities and challenges indicated in the previous step and to optimise these. For full transparency, the diverse groups are again invited to give their feedback on the implementation process.

Step 10: To Upscale

In case the evaluation process concludes that the implementation can be improved, the shared vision-making cycle will be repeated.

5.6 Phasing: The Project Roadmap

For the proposed vision, the timeline in Table 16 has been created, combining the different steps of the vision with the proposed policies. The timeline is divided into six main sections:

- Fossil Industry
- Hydrogen
- Biomass
- Corridor
- Buffer
- Other (Including various projects outside the previously named sections, such as wind farms, algae farms, the use of geothermal energy, and the implementation of solar panels)

Every section, except for the fossil industry section, has milestones celebrating the completion of the projects. The timeline is further divided into 3 stages

Foundations and transformation

- Spatial: This stage focuses on beginning big projects like the expansion of Maasvlakte III, the wind farm, biomass train rail and transforming current greenhouses and buildings.
- Capacity building: This stage focuses on educating specific stakeholders, creating a social environment and deciding on the first steps regarding the corridor and buffer.

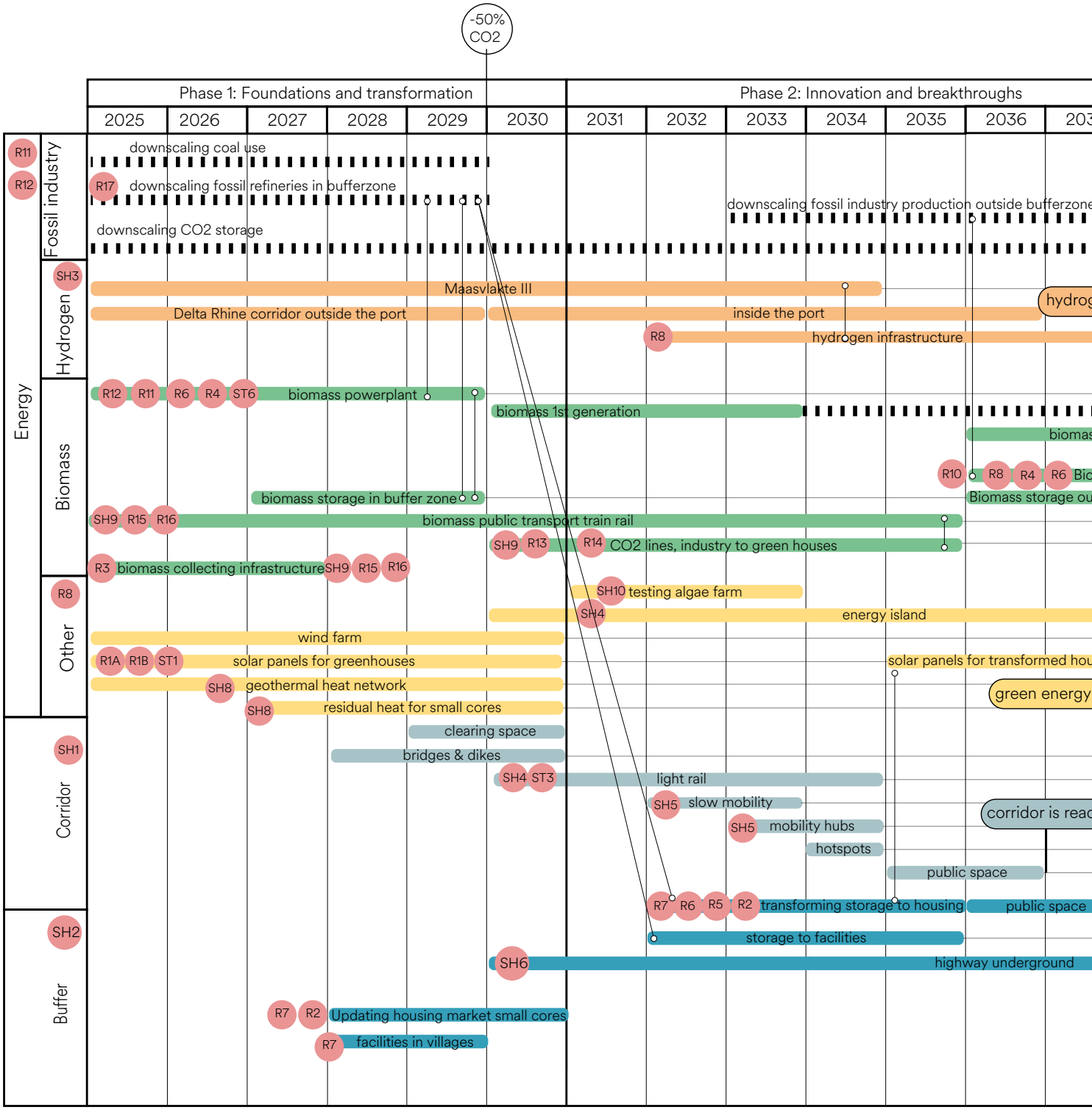
Innovation and breakthroughs

- Spatial: This stage focuses on reaching various milestones, creating big spatial effects with the corridor and buffer and using innovative solutions like biofuel refineries and the energy island.
- Capacity building: This stage focuses on educating current employees towards the hydrogen industry and strengthening social connections between stakeholders while also preparing the empowered stakeholders for decision-making for the next stage.

Completion and visionary growth

- Spatial: This stage focuses on completing projects started in the first two stages and already implementing new projects, for example new houses and completing the downscaling of the fossil industry.
- Capacity building: This stage focuses on evaluating the realisation of the vision, and setting new goals, ideas and initiatives for the future

In the timeline we envision a CO2 reduction of 50% in 2030 and a 100% CO2 reduction in 2050, which is in line with the conclusion of the climate goals, stated in ‘Chapter 3.4 Policy Analysis’.



project Implementation

Continuation

Phasing out

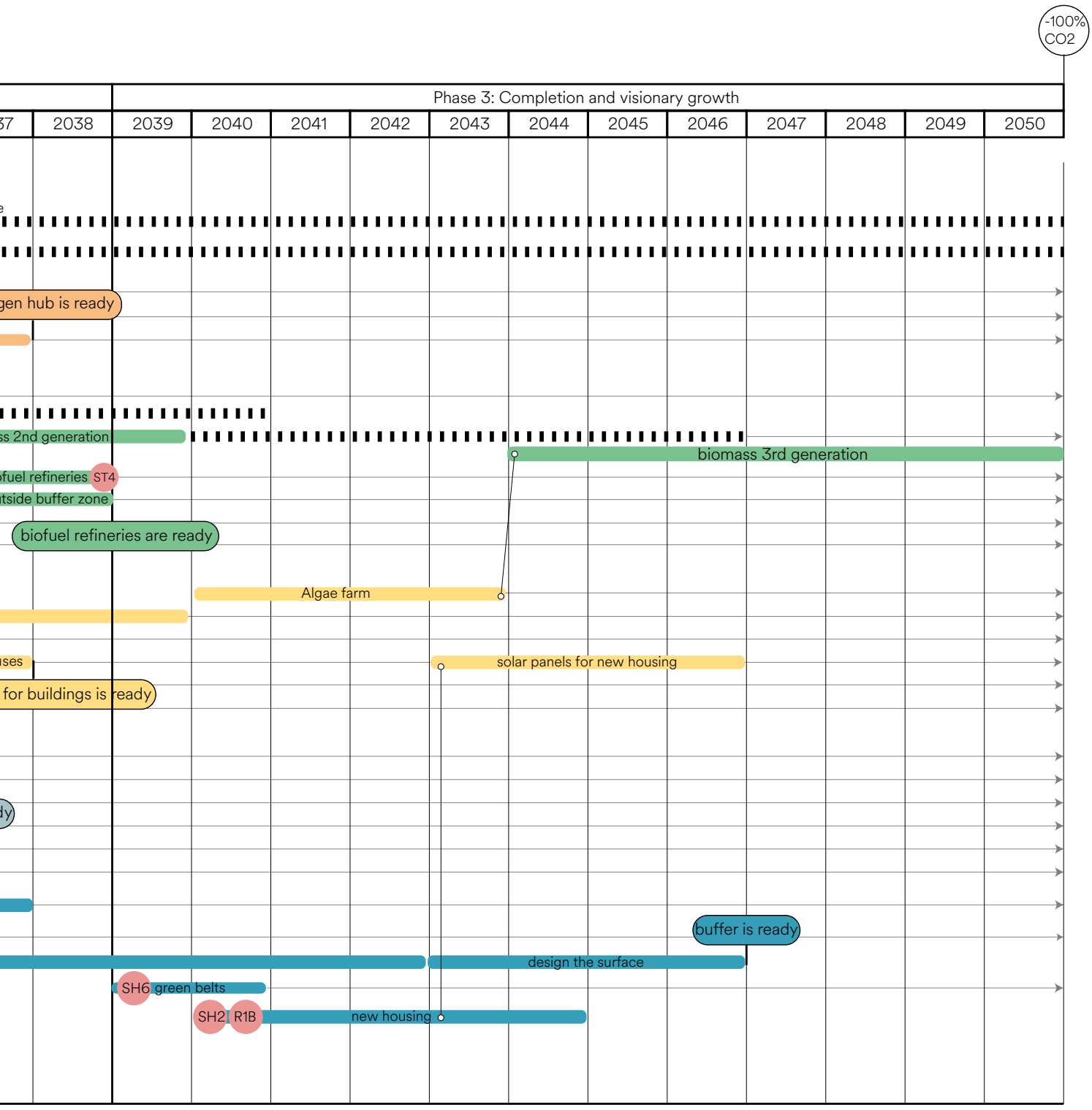
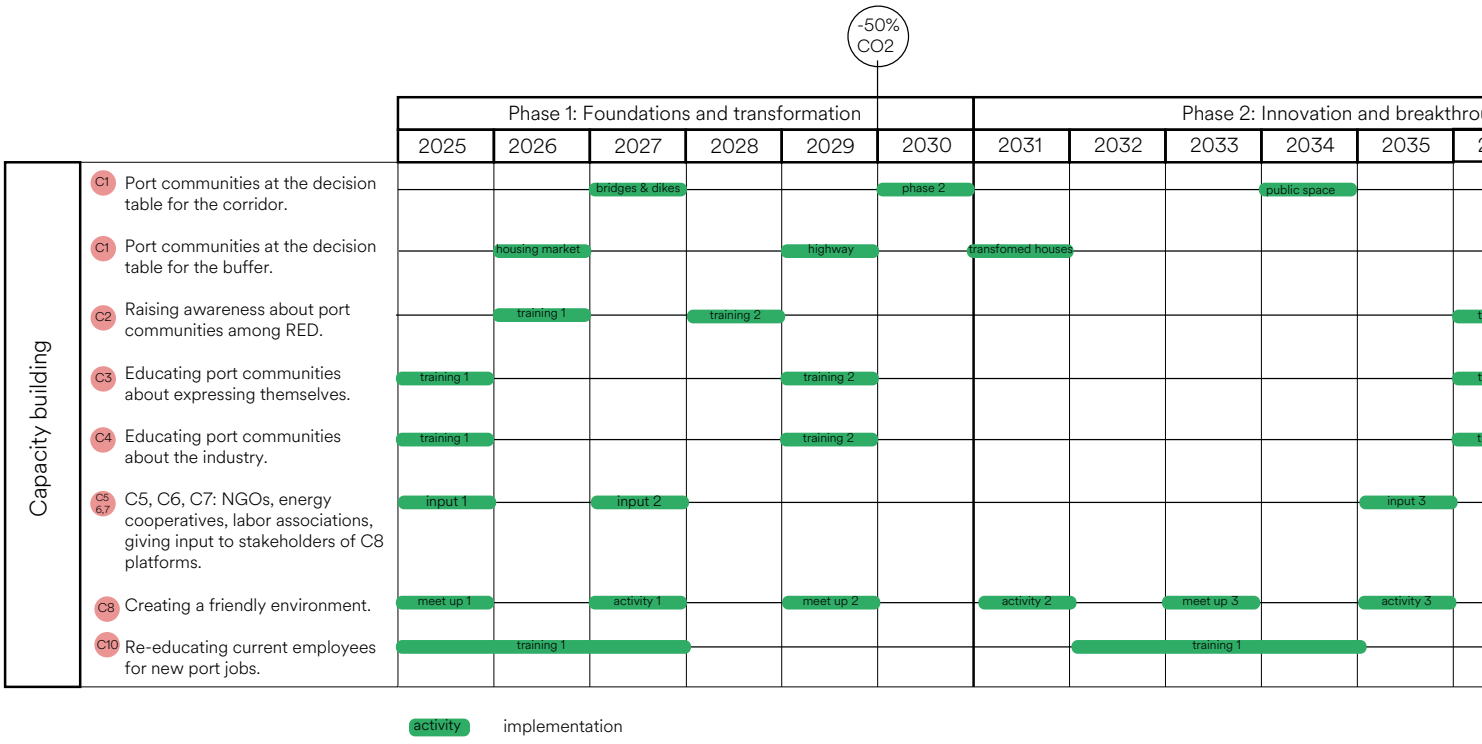


Table 16: *Vision timeline*

In the Table 17, we see the capacity building policies in time. C1 is an important policy which involves community engagement. The decision moments are based on different starts of the projects in the timeline. Based on the decision moments, the policies C2, C3, C4, C5, C6, C7, C8, C10 that include trainings, input moments, meet ups and other activities, are placed on the timeline. These moments always take place before the decision moments, so the trainings are a preparation to make good decisions.



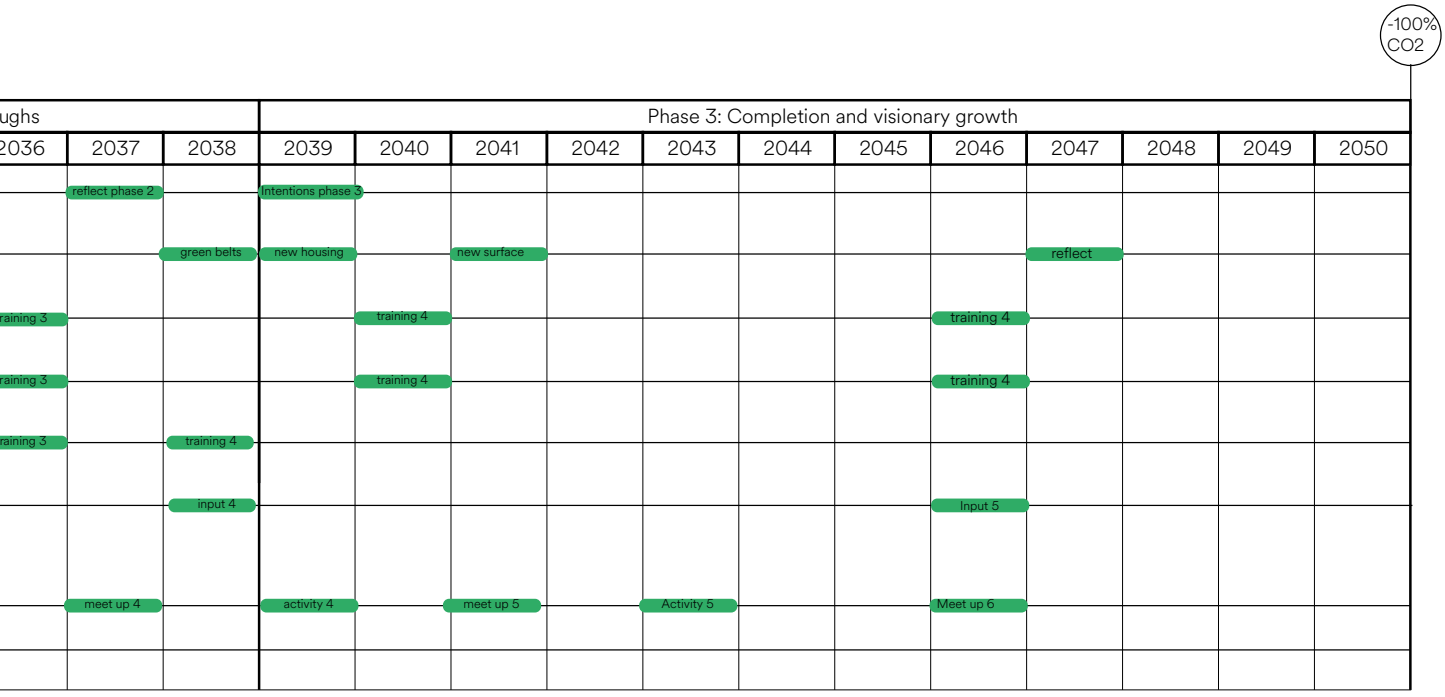


Table 17: Capacity building policies timeline

5.7 Exemplary site

5.7.1 Exemplary Phasing

As an exemplary site we choose the area around Pernis and Heijplaat. We chose this particular area, because of certain characteristics of this place. The buffer areas, both in between Rozenburg and Pernis, but also around Heijplaat are clearly visible in this zoom-in, while some other interventions can be shown on this more detailed level. Think of the highway around Pernis, the corridor at the waterfront and the storage/residential area in the buffer zone. In this section we zoom-in on this particular area to show the phasing on this level.

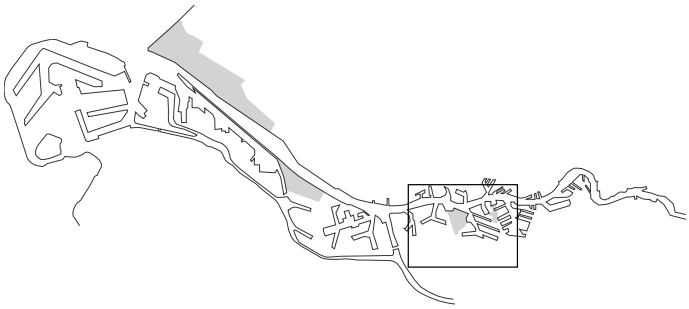


Figure 58: *Location of the exemplary phasing*

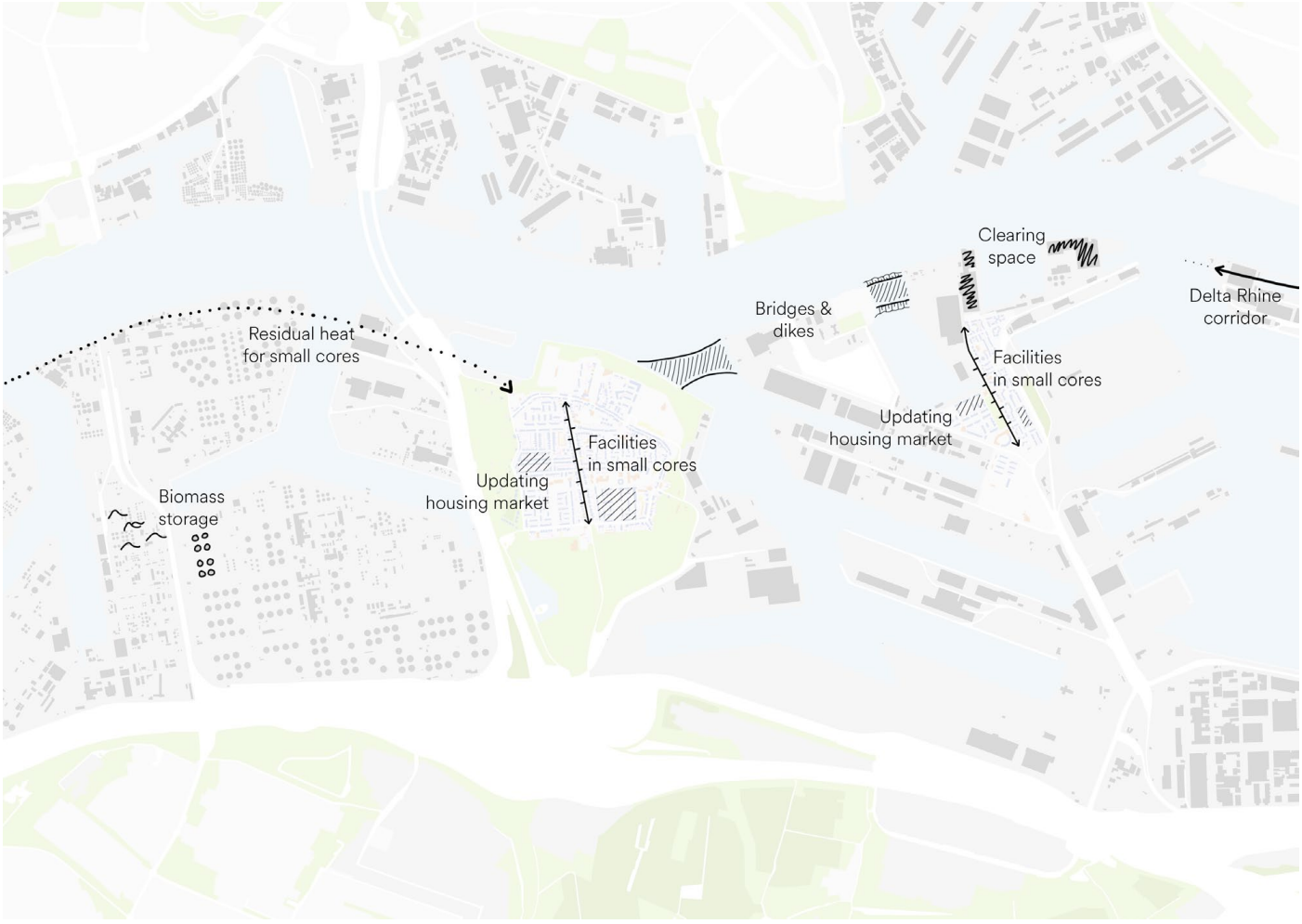


Figure 59: *Phase 1 sketch*

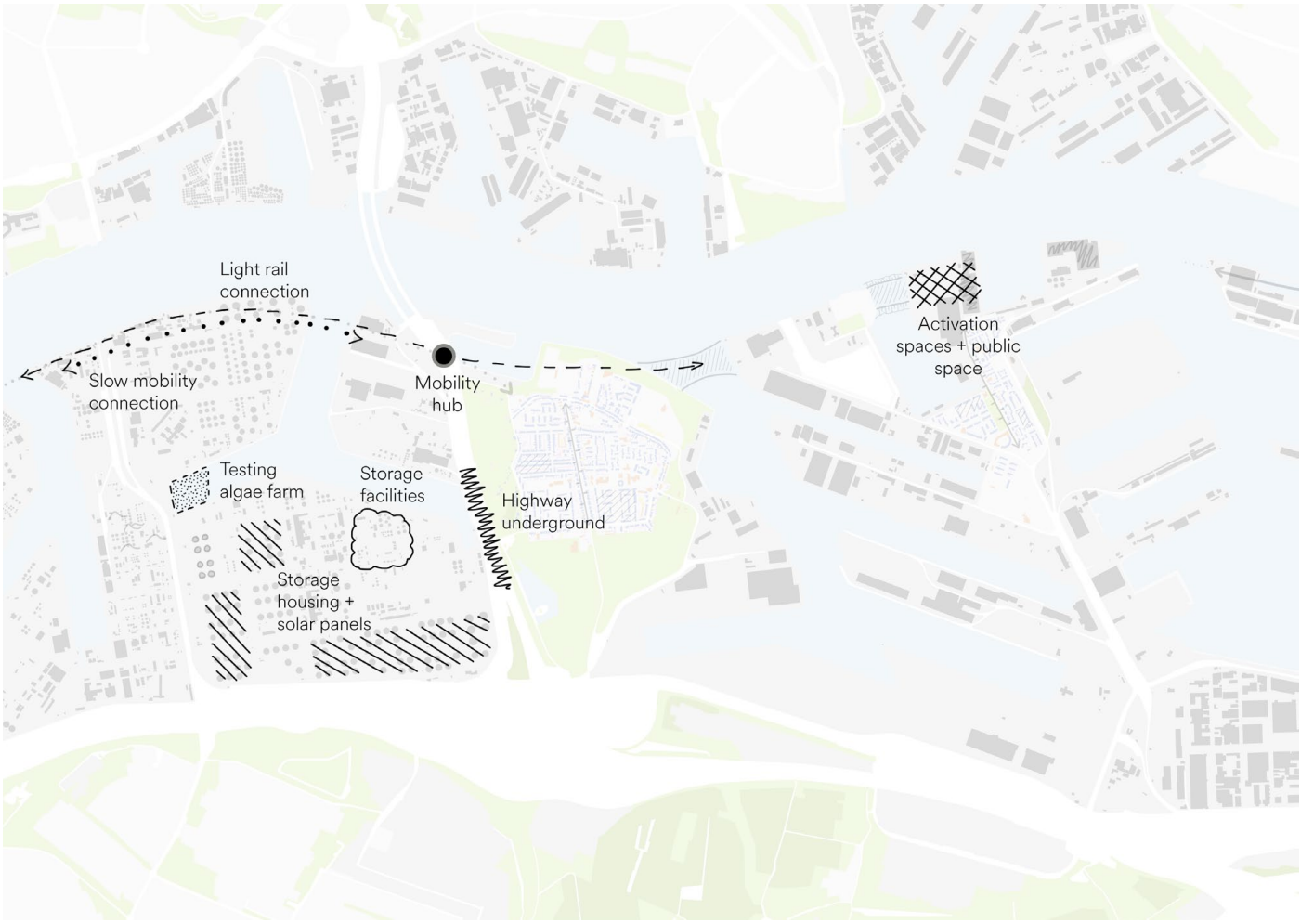


Figure 60: *Phase 2 sketch*

Figure 61: *Phase 3 sketch*

06

CONCLUSION

‘How can port communities in Rotterdam be revitalised through the energy transition without erasing the cultural significance of the port, while improving their well-being?’

The main objective of our project is to transform the port communities of Rotterdam from isolated and overlooked areas into well-connected, integrated, and future-proof places. By implementing a series of spatial, social, and ecological interventions, we aim to create a new energy hub in the port of Rotterdam that supports a just and inclusive energy transition - one that respects the area’s cultural legacy while improving quality of life for local residents.

Revitalisation of the Villages

The Small Core villages are currently facing a decline in population, a stagnating housing market, and a diminishing appeal to new residents. Our strategy addresses these issues through targeted revitalisation. A key intervention is the creation of a regional corridor that links the city of Rotterdam with the port and extends to the coast at Hoek van Holland. This multimodal connection, supporting both slow mobility and light rail, improves access for residents, employees, and tourists alike.
Within the villages, we propose updating the existing housing stock with a focus on social housing and adding public facilities that can attract and retain a more diverse population. These actions are designed to breathe new life into the villages, making them attractive, inclusive, and resilient for the years ahead.

Energy Transition

The port is undergoing a crucial transformation - from a fossil fuel-dependent zone to a leading example of a sustainable energy hub. Our vision integrates hydrogen infrastructure and regional biomass flows into a circular energy system. In doing so, the Small Core villages also directly benefit through connection to a residual heat network, improving their energy efficiency and affordability. Meanwhile, nearby located big cities transition to geothermal energy, enhancing regional sustainability. This energy shift not only reduces environmental pressure but also offers new employment opportunities within cleaner industries.

Remaining Cultural Significance – Economic Stability

As fossil-based industries gradually phase out, it is essential to preserve the cultural identity and history of the port communities. The identity of the Small Cores is deeply rooted in the industrial heritage of the port, and we aim to honour this by fostering open, accessible industry zones and incorporating heritage elements into public space. By doing so, we ensure that the communities’ historical connection to the port remains visible and valued. At the same time, economic resilience is strengthened by maintaining and diversifying employment opportunities. Our strategy improves both access to and conditions within the port area, contributing to long-term economic stability without compromising environmental or social values.

Improving the Well-being

With the introduction of cleaner industries, the environmental quality of the region will improve substantially. Reduced emissions will lead to better air quality, while noise and smell will diminish. Moreover, the creation of the regional corridor enhances biodiversity by linking existing green

structures, offering ecological and recreational benefits. Together, these improvements contribute to healthier, more resilient living environments for all communities in and around the port.

Shared-Vision Making

An essential part of our project is the development of a shared vision with the communities. Inclusive decision-making processes ensure that the transition does not reinforce existing inequalities. By actively involving local stakeholders, especially marginalised groups, we work towards a more just and equitable future. This approach is embedded in our policy framework, which aims to balance power dynamics and ensure that all voices are heard in the planning and implementation stages.

The implementation of our vision follows a phased strategy over a 25-year period until 2050:

- Short term (1–5 years): Fashing out fossil industries, initial sustainable developments, community engagement.
- Midterm (5–15 years): Corridor construction, buffer implementation, further development energy system and revitalisation of public space.
- Long term (15+ years): Full realisation of the green energy hub, final steps in construction of mayor projects and visionary growth.

This project proposes a comprehensive, inclusive, and forward-looking approach to revitalising Rotterdam's port communities, ensuring they are not left behind, but rather placed at the centre of a just and sustainable transition.

07

REFLECTION

7.1 Discussion

7.1.1 Limitations

The report indicates limitations that need to be considered. The foundation of this research is based on a case study of Rotterdam's port communities with a dependency on qualitative data; the accuracy of the report might be limited based on the interviews conducted and the media analysis. Even though we use quantitative data for our GIS research on the port historic evolution and environmental impact, our data on the needs and concerns of the port communities, which laid the foundation of our research, focuses predominantly on qualitative data—media, the Small Core Approach, newspaper articles, and semi-structured street interviews—which might present biased views. In particular, the interviews we conducted during our fieldwork. In total, we had the opportunity to conduct six interviews; however, this is not enough to gain a deeper understanding of the needs and concerns of the port communities' residents, since this only represents a small group from two out of the four villages, Rozenburg and Pernis.

One limitation of this report is the transferability of our results. Considering that our proposed vision and strategy are tailored to the Rotterdam port communities, this can be used as a case example for other port cities with similar problems. Nevertheless, the transferability is also limited by the unique governance structure of Rotterdam and the specific needs and concerns of these port communities. Even throughout our research process, we could investigate differences between the four villages of the Small Core approach. Therefore, the transferability to other port communities outside of Rotterdam might be even more limited. Our report is not only limited in spatial transferability but also in time transferability. Since our research scope focuses on the needs and concerns of the port community at the current time, this report risks becoming outdated in the future due to societal and political changes, resulting in new wishes and concerns of society.

Another limitation of our proposed project is feasibility, as this is only a proposal; we, the authors, lack the ability to bring these implementations into being. Therefore, this report can be viewed as a proposal for policymakers, who can bring the proposed vision into reality. We mention that the government is supporting the energy transition of the port, which also aligns with the related policy documents we analysed. However, looking at the current Dutch government and its stance towards the energy transition, this support might slow down the phasing of our proposal or even weaken the energy transition process entirely (Krumpelmann, 2024). Because this proposal considers a rapid and urgent implementation scenario, the feasibility of creating a carbon-neutral Port of Rotterdam by 2050, based on our proposal, might be too optimistic given the current political dynamics. Another factor that might slow this proposal down is the communities' involvement, which might take more time than we estimate. The outcome of the communities' involvement can be unpredictable, and due to being unable to do in-depth research on the needs and wishes of residents, because of time constraints, there might be factors we have not addressed or may have overlooked.

Feasibility is also in question when looking at energy justice, considering that we want to involve a diverse group of stakeholders, which requires the participation of representatives for each stakeholder group to avoid unequal distribution of burdens and benefits and to promote social inclusion. However, we cannot predict the participation willingness or ability of all affected stakeholders, leading to a possible unequal influence of certain stakeholders over others.

As mentioned previously, due to the limited time given by this course, this proposal faces the risk of being oversimplified when determining the community perspectives and the policy and stakeholder analysis, considering that we based it on the policies in place, but not the geopolitical dynamics.

We, as Urbanism students and Metropolitan Analysis, Design and Engineering students, try to be as objective as possible; however, there is an ever-present risk of subconsciously having subjective views of the research, which we aimed to limit by peer reviewing each other's work and referring to relevant literature.

7.1.2 Scientific Relevance

This report contributes to the growing amount of research on just energy transitions, spatial justice and sustainable urban development. By focusing on the Port of Rotterdam as a research area, our project addresses the complex interdependencies between industrial transformation, inequality and environmental resilience. In particular, the Port of Rotterdam serves as a valuable study area for the impact of the energy transition on its adjacent port communities. In our field study, we identified the concerns of these port communities, which are often not addressed in previous studies, which mainly focus on the technical and political perspectives. Therefore, our proposal aims to fill the research gap on how the revitalization of these port communities can be a simultaneous process to the energy transition.

The approach of integrating the energy transition with spatial revitalisation of marginalised and left-behind communities offers a model for how large-scale infrastructure shifts can be leveraged to promote inclusive urban development.
Furthermore, the report builds on theories of participatory governance and shared vision-making to balance economic development, cultural preservation and social equity. This process aims to mitigate the dissatisfaction and scepticism of the local stakeholders by using the proposed shared vision-making process instead of the traditional decide-announce-defend model. We hope to limit negative societal impacts by introducing this approach to improve the empowerment of civil society and mutual understanding between the stakeholders.
Given the long-term nature of such an extensive proposal, the feasibility of the recommended interventions should be continuously re-evaluated over time based on the needs and concerns of the transition communities.

The framework outlined in this report offers valuable insights for future research on equitable governance in transitioning industrial regions, particularly within the context of climate and energy policy.

7.1.3 Ethical Reflection and Societal Impact

The transition to a sustainable, carbon-neutral future is a complex system that presents different ethical challenges. In particular, in our proposal, we try to balance the local well-being with a global sustainability movement. As we learned from the Methodology lectures, we as urbanists are expected to be honest, just, fair, and inclusive.

Considering that our proposal focuses on the port communities for a global issue, the question arises whether this proposal is too focused on the societal impact of these port communities instead of the greater good of society. This chapter will assess the ethical implications and societal impact of this proposal.

As mentioned previously, our proposal focuses on the revitalisation of the port communities in Rotterdam. Therefore, we propose to implement less radical industry changes. For example, we rely in our proposal on biofuels instead of radically shifting the industry entirely to hydrogen storage. We chose this approach due to the concerns raised by the port communities about the safety of hydrogen. Even though biofuels are considered a renewable energy source, the combustion of biofuels emits GHGs, which are being captured in a CO_2 storage and recycled by the greenhouses. However, the combustion of biofuels from moving vehicles such as cars and trucks will continue to emit GHG emissions into the atmosphere. In comparison, the combustion of hydrogen emits water vapour, which has fewer environmental risks than GHGs. To revert to the question about whether we are too focused on the local well-being rather than the global energy transition, answering this question is quite complex. But considering that Rotterdam is an important energy hub for North-Western Europe, having drastic changes in the energy production of the Port of Rotterdam might nudge other industries that rely on the energy supply of the port to transition more rapidly. Nevertheless, the societal impact on these port communities would be unfair, considering their concerns about the safety of hydrogen. Additionally, the balancing of benefits and burdens would be unequally distributed and contradict our approach to create a just energy transition of the Port of Rotterdam that meets the climate goals and the local residents' needs.

Another ethical concern is the sustainability of the energy transition. We (the humankind) tend to jump to conclusions when we hear the word 'Renewable Energy'. Renewable energy is often associated with the words clean, less polluting, and the improvement of environmental quality. But is this the case? Looking at our port communities, that might be the case, considering that we transform heavily polluting industries to renewable energy sources that contribute to less pollution. But how can we ensure that the decisions we are proposing do not appear somewhere else, also referred to as the waterbed effect? For example, what is happening to the leaving fossil fuel companies? Are they going to appear somewhere else, or are they stopping fossil fuel production completely? This waterbed effect can also appear for renewable energy. The production of renewable energy sources, such as wind turbines, solar panels, hydropower islands, and hydrogen storage, is quite resource-intensive, particularly for metals. But how do we know that the mining of these resources is socially equitable and inclusive, especially since the mining of metals is often in controversy about human rights, in terms of workers' safety and the environmental impact of mining? This raises questions about the sustainability and justice of our approach, whether we are simply shifting environmental and social impacts from the port communities to another region, and calling it progress? As urbanists, we

are interested in a just and fair transition, the challenge is not only to tackle the local scale but also the broader supply chains and global inequalities of the energy transition. While we acknowledge the ethical challenges of renewable energy sources, our research focus is based on the societal impacts of the current port industries of Rotterdam on its neighbouring villages.

Even though our proposal focuses on the port communities and seeks to mitigate the negative societal impacts of the energy transition on these areas, ethical challenges remain that must be addressed during the implementation and shared vision-making process. These challenges include risks of unequal access to benefits, gentrification, and job displacement. For example, through the revitalisation and increasing the accessibility of these neighbourhoods, there might be a rise in property value, which might threaten the affordability of these villages, leading to gentrification and the displacement of the current port communities. Additionally, the phasing out of the fossil-based industries will result in unemployment of the current workers skilled in the fossil fuel sector, who might face job insecurity due to the industry shift. These ethical challenges relate to SDG 10 (Reduced Inequalities) and SDG 8 (Decent Work and Economic Growth), highlighting the importance of protecting marginalised groups and ensuring that current workers do not face unemployment but are rather reskilled to be able to participate in the new industry.

Our proposal also has the potential for positive societal impacts by empowering the port communities, ensuring economic stability, reducing environmental impacts, and creating a mutual understanding between stakeholders. Through the prioritisation of community engagement and mutual understanding between stakeholders, we aim to create resilient port communities, which relates to SDG 11 (Sustainable Cities and Communities) and SDG 10 (Reduced Inequalities). The implementation of renewable technologies and green infrastructure supports SDG 7 (Affordable and Clean Energy) and SDG 9 (Industry, Innovation and Infrastructure).

Although we recognise the ethical challenges and the social impact of our proposal, it is important to remember that the real-world condition is more complex and needs to be adapted based on political and societal dynamics. By recognising these ethical challenges beforehand, we want to enable inclusion to guarantee a sustainable energy transition of the Port of Rotterdam and create vital future port communities.

7.2 Collective reflection

At the start of the project, our group struggled with dynamics and collaboration. Initially, we worked too much as individuals rather than as a cohesive team. This was evident in both our vision and narrative, as well as in our graphics and design language, which differed significantly from one another. Additionally, we focused too much on our own specific tasks and issues, which meant not everyone was fully aware of the entire story of the project.
After the midterm, we held a group discussion to address these challenges and made several key agreements. We realized that we needed to better utilize the unique skills and strengths of each team member. Some members had more expertise in graphic design, while others were more focused on the theoretical aspects of the project. After the discussion, we feel we made better use of everyone's strengths, especially as we approached the final deadline.

We are aware that we are four different students that bring various personal biases into the project. Although we are a culturally rich team from four different cultural backgrounds, we are aware that we have made decisions coming from our view. Next to our personal biases, the studio pushes a certain approach with focus points and methods, which also has an impact on the proposed vision and strategy.

Reflecting on our initial goals, we believe we delivered a solid narrative with an appropriate design and strategy. While there was still much more we could have added, time constraints prevented us from creating all the intended products. For example, we chose to focus on the zoomed-in area of Rozenburg-Pernis, but ideally, we would have liked to zoom in on each of the Small Core villages to create a comprehensive narrative for each of the port communities.

Overall, we are satisfied with the final report, though we recognize that there is always room for improvement.

7.3 Individual Reflections

7.3.1 Caya

Coming from an environmental sciences background, which focuses a lot on the impacts of the energy transition on humans and their surroundings based on scientific and grey literature, going into the project, I was thinking on a broader scale than the other people in my group who have a design background. Even though we did have our challenges, I believe having this interdisciplinary group helped us to see different perspectives and exchange knowledge. Considering I already had quite some knowledge of renewable energy technologies, governance structures and human behaviour patterns, we could make use of this in our vision development of the new energy system and the strategy planning. However, I also gained new knowledge and approaches on how to identify the challenges transition communities face based on spatial analysis. While I always relied on literature to identify challenges and opportunities, I learned new approaches on how to identify these based on analysing maps of these areas, like in 'Chapter 3.3.1. Borders'. I also learned how illustrations can improve the readability of your project. The utilisation of spatial analysis limited our report to be less broad and more fitting to Rotterdam. We first analysed the spatial structures to get a better understanding of these port communities before looking at case studies from other port communities that might have different needs and concerns. However, the spatial aspect also challenged me, considering I had no experience in creating these types of illustrations. Additionally, we were struggling as a group with communication in the beginning. It was difficult for me to contribute meaningfully to the report since I lacked the design skills. However, I was able to help with the policy and stakeholder analysis, and the vision in terms of background knowledge of renewable energy systems and their implementation.

In environmental sciences, we often focus on the theory and are seen as advisors. In this R&D studio course, the outcome of this report focused on the implementation side, which was a growing experience for me as I tend to look from a broader scale and create different scenarios. So this group work was challenging for me since it is more about making decisions and proposing a clear and defined idea rather than looking at trade-offs and opportunities of different scenarios. While I do think focusing on a smaller scale is more insightful to see the spatial strengths and weaknesses of our case, I do think that our report has some missed opportunities due to time constraints. One of these missed opportunities was not creating a more in-depth shared vision-making approach. In this report, it functions more as a concept that can be utilised later on, but it does not describe in detail the different levels of decision-making based on individual interventions for the buffer or the corridor. Another missed opportunity was to investigate the feasibility of this proposal. As mentioned in 'Chapter 7.1.1. Limitations,' we chose to use a rapid and urgent proposal, which might be too optimistic based on current societal and political dynamics. We also did not address in the report the financial feasibility and the energy security. Questions that are not addressed for the financial feasibility are: "Who is paying for this change? If the government pays, can it afford it without neglecting other sectors?" Looking at energy security, this report lacks proof that this energy hub can meet the future energy demand of the region that it has been supplying in the past.

7.3.2 Hamza

This quarter has been an exciting and challenging experience. The energy transition and the regional scale we needed to work on were both new for me and outside my comfort zone. Nevertheless, I learned a lot!

Starting the project not from our own ideas but from those of a community was a mindset shift, which was very helpful in entering the broad challenge of the energy transition with a scope. The SDS workshops focused on thinking about different communities were very helpful in understanding the diverse ways people are affected by the transition. Nonetheless in one of the Capital Selecta presentations, a key takeaway showed that we can use the energy transition in favour of the communities, which became an inspiration and foundation for our vision.

In one of the SDS workshops, we learned about the powerful role media analysis can play. This was impressive and eye-opening. While newspapers do have limitations in representing the overall narrative about a theme, it was very valuable to understand the context we were working in and the experiences of the communities.

Over time, as the voices of the community became our own, it was easier to integrate their wishes into the larger vision. However, the question arises how much we should approach this broad challenge solely from a community perspective. There are so many communities, each with relevant proposals and wishes, that only focusing on one would be ethically unjust to the others.

Before this course the energy transition seemed like a vague, top-down policy expressed only in text. However, translating the wishes of the communities regarding the energy transition, bottom-up, into spatial ideas were making the energy transition more understandable for me.

When translating the results of the analysis into a spatial vision, I struggled to understand the level of detail needed, or how schematic or conceptual it could be. From one day to the next, we adopted a more zoomed-in approach than the other groups, which made it more challenging to understand the information required at this scale at first.

Next to the scale, the strategy part was very new. From my design background, I always had an interest in power dynamics and governance, but I never learned much about it during my bachelor's. During this course, I was excited to learn more about it. Learning about the relevant positions stakeholders must hold to make visions work is now clearer than ever. Additionally, I now understand that different kinds of policies are needed to change the behaviour or attitudes of stakeholders in favour of a vision.

However, I felt the tools we were given to create these policies were nice but not in-depth enough. It would have been great to learn how to precisely formulate a policy rather than just understanding the type of the policy that is needed. part of the strategy was creating a timeline, which was fun to make, it gave a clear overview of all the things that need to happen when you unpack your vison, I realised how big these visons or projects can be as urbanist. Nonetheless the scale was also overwhelming which made me question how fixed a timeline can or should be.

7.3.3 Jorn

This quarter was a new and enriching experience for me in many ways. Having previously worked primarily on neighbourhood-scale designs - or even more zoomed-in interventions - this course expanded my understanding and equipped me with valuable insights that will help me grow as an urbanist. We began by defining the area and identifying our target community. Each group member was encouraged to share their interests, which led us to focus on affected port communities. I found it particularly interesting to approach the project from this perspective, rather than immediately thinking about what we, as designers, wanted to create. We greatly benefited from the existing publication on the Small Core Approach, which provided important insights into the lived experiences of residents in these villages. This helped us ground our vision in the community's needs and perspectives.

However, we initially struggled to scale up our vision. Our focus remained largely on the port area of Rotterdam, which was closely tied to our chosen community. This limited our understanding of the broader regional context. Over time, and especially during the final weeks, we began to make meaningful connections between our local interventions and the larger regional systems. By zooming out and identifying broader implications, we finally managed to build a more comprehensive regional vision. Once we clarified this vision, developing a coherent strategy became much more manageable.

The topic of the energy transition was also particularly interesting and highly relevant. I gained valuable knowledge about energy systems, especially in the context of port areas. Beyond the technical aspects, I came to realize the significant role that we, as designers and urbanists, can and should play in this transition. As seen in the national government, energy policies and visions often shift dramatically every few years. In contrast, our profession has the responsibility to maintain a consistent, long-term perspective. We must continue working toward broader, future-oriented goals, regardless of short-term political changes. I believe this is one of our core responsibilities as urbanists.

One of the key takeaways for me came from the stakeholder engagement workshops. In previous projects, I rarely considered which stakeholders would be impacted, let alone how to engage, activate, or empower them. This course made me realize how essential stakeholder involvement is to the success of a project. I'll definitely carry this lesson with me into future work. I also found the Methodology course to be incredibly useful. Coming from a more practical background, having completed a bachelor's degree at a university of applied sciences ('HBO') and working primarily in practice, I had limited exposure to the theoretical side of urban design. Learning how to conduct proper research and engage with academic literature was an important step in my personal development. My group members, who had more experience in this area, also contributed a lot to my learning process.

As a group, we faced some challenges, especially in the beginning of the project. We struggled to leverage the diverse strengths of each member and often worked in isolation, mirroring the fragmented nature of our project site. Over time, though, we learned how to collaborate more effectively and integrate our individual skills. By the end of the course, I believe we were making the most of everyone's abilities. For me personally, it was particularly valuable to move beyond intuition or basic spatial analysis and instead begin grounding my design decisions in theory and evidence.

7.3.4 Martin

With my previous training as an architect and subsequent experience working on projects that addressed various urban issues at a neighborhood and even micro scale, I must admit that the image that this quarter projected at the beginning of the period was very challenging. The scale of work of this project was something totally new to me, and as if that wasn't enough, the stated need to develop the project taking into account the perspective of the communities under a complex context of energy transition made the work we were about to start sound like something totally alien to everything I knew. And so it was. However, while at the beginning of the quarter I felt that I was several times on the verge of drowning in the sea of information and uncertainty that the complexity of the regional scale implies, the lectures and tutoring sessions were like small swimming lessons that helped me overcome the initial difficulty.

Being aware that this was only my first experience working in regional planning and that there is still a lot to learn, I can affirm that I finish this quarter with the feeling of having acquired a new perspective that I believe is only possible to develop when working at this scale. Working using the Port of Rotterdam as a case study allowed me to have a greater understanding of the spatial, social and environmental implications that the production, flow and storage of energy has. That energy on which contemporary societies depend now more than ever, and which we use in our daily lives generally without even the slightest questioning of where it comes from, or at what cost (not only economic) it is coming to us.

In this sense, focusing specifically on the port communities of Rotterdam allowed me to verify on site one of the main theories studied in the methodology course, which is also a cross-cutting concept in the energy transition: the inequitable distribution of burdens and benefits, which prevails as a global trend in the production of resources and more specifically, of energy. It is precisely this trend that gives rise to the need to leave behind the popular and widespread but very harmful (exclusively) top-down planning model, to move towards fairer regional planning and policy-making models that are open, that offer more opportunities for participation to a greater diversity of stakeholders and, above all, that ensure that the weakest voices are also heard. Only in this way is it possible to build truly sustainable solutions, not only in the economic and environmental aspects, but also in the social aspect.

Therefore, I've learned that the essence of our role as planners in this process lies in the ability to understand the comprehensiveness and natural complexity that the regional scale puts in front of us, not only spatially, but also in terms of existing policies and plans at different levels (which I personally would like to explore and strengthen in the future) that allow these solutions to be possible. In this way we can be an active part of the collective construction of comprehensive solutions that effectively address the challenges posed by the urgent need for a just energy transition.

08

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