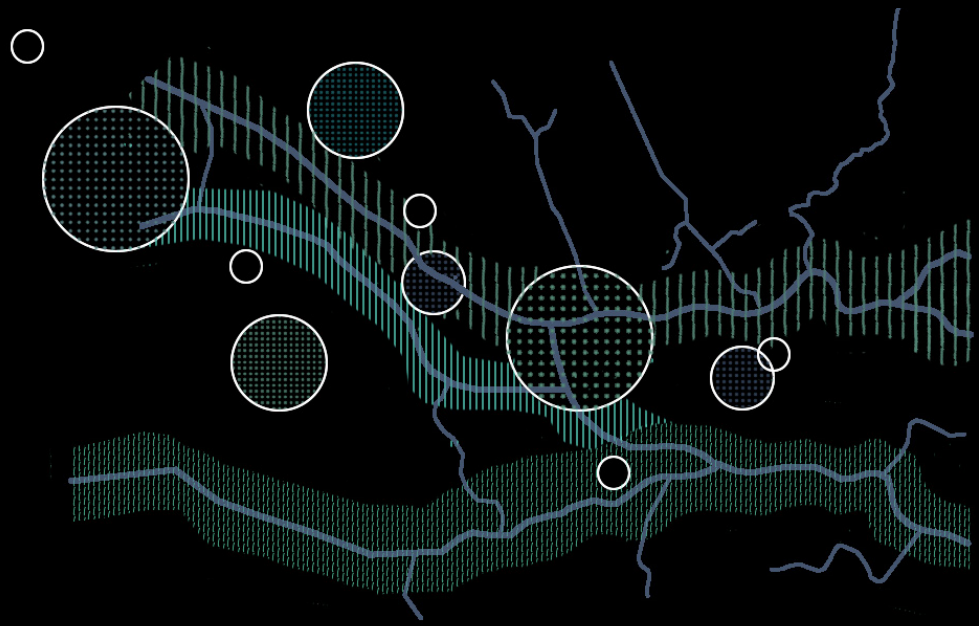

ENERGY HABITATS

transforming the port‘s material landscapes through a green-blue spine

Delft University of Technology - MSc Urbanism (Architecture, Urbanism and the Building Sciences)
Quarter 3 | AR2U086 R&D Studio - Spatial Strategies for the Global Metropolis
AR2U088 Research and Design Methodology for Urbanism

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Preface

In this report we propose a spatial vision and a strategy for the energy transition in the Port of Rotterdam that introduces a new paradigm for the spatial transformation of the fossil fuel drosscapes and the associated power dynamics towards a new era of symbiosis, circularity and social justice. The narrative is divided into six main parts that follow the process from the initial contact with the spatial and social conditions to the design steps and the final results.
Specifically, in the first part the reader can familiarise with the contextual setting of the current and future challenges of the port and its surrounding territory. The second part sets the conceptual framework that guides the process and defines an evaluation scheme. Following, the analysis attempts to decode the complexity of the recognised spatial challenges and their (in)tangible relations while documenting the current governance patterns to create a new narrative as the port's vision for 2070. This narrative is then broken down into the strategies, phases and policies that can ensure its realisation starting from the port communities towards the broader delta area. Finally, the last part attempts to assess the planning process based on the values set at the beginning of the project and its importance for future transitions.
We want to thank our tutors Verena and Nikos for their continued support, stimulating input and guidance throughout the process of developing our spatial vision and strategy for the Port and the Province. Furthermore, we also want to thank Roberto and Marcin for their interesting inputs during the Methodology class that inspired several in-depth discussions within our group and further shaped our understanding of the complexity of regional design.

We hope you enjoy the reading of our report,
Myrto, Nora, Shinnosuke & Yaxuan

Abstract

The first decades of the 21st century are defined by an expected shortage of fossil resources and an emerging climate crisis which make the transition towards renewable energy resources not only inevitable but also urgent. In the process of this transition, the Port of Rotterdam, associated with the biggest fossil fuel industry landscape in Europe, is confronted with the danger of becoming a drosscape. As the Province of Zuid Holland attempts to deal with this challenge under the umbrella of circularity, new issues regarding environmental and social justice in the whole area arise and call for a coordinated planning effort towards a just transition. This effort begins by answering how can the province use the obsolete fossil fuel infrastructure to transform the port‘s material landscapes fostering spatial justice and balancing the problematic relationship between natural and man-made systems.

Consequently, the project decodes the layers of the material, social and environmental dimensions investigating the critical issues that associate with the port‘s distinctive territories. In parallel, it defines the main concepts that can instruct this just transition arising from the fenced urban and port districts towards the whole province and combining top-down with bottom-up planning processes. As the project evolves in time, involving all the different actors, it takes the form of a central green-blue spine that meets Zuid-Holland‘s energy demands while embodying a redefined symbiosis between nature and human. The result defines a new paradigm for the energy transition and the remediation of fossil fuel drosscapes that incorporates material circularity, environmental and social justice under the concept of “Energy Habitat“.

KEYWORDS: energy habitat, energy transition, fossil fuel drosscape, material circularity, spatial justice, energy justice, Port of Rotterdam

Content

INTRODUCTION

Energy Transition in Zuid Holland

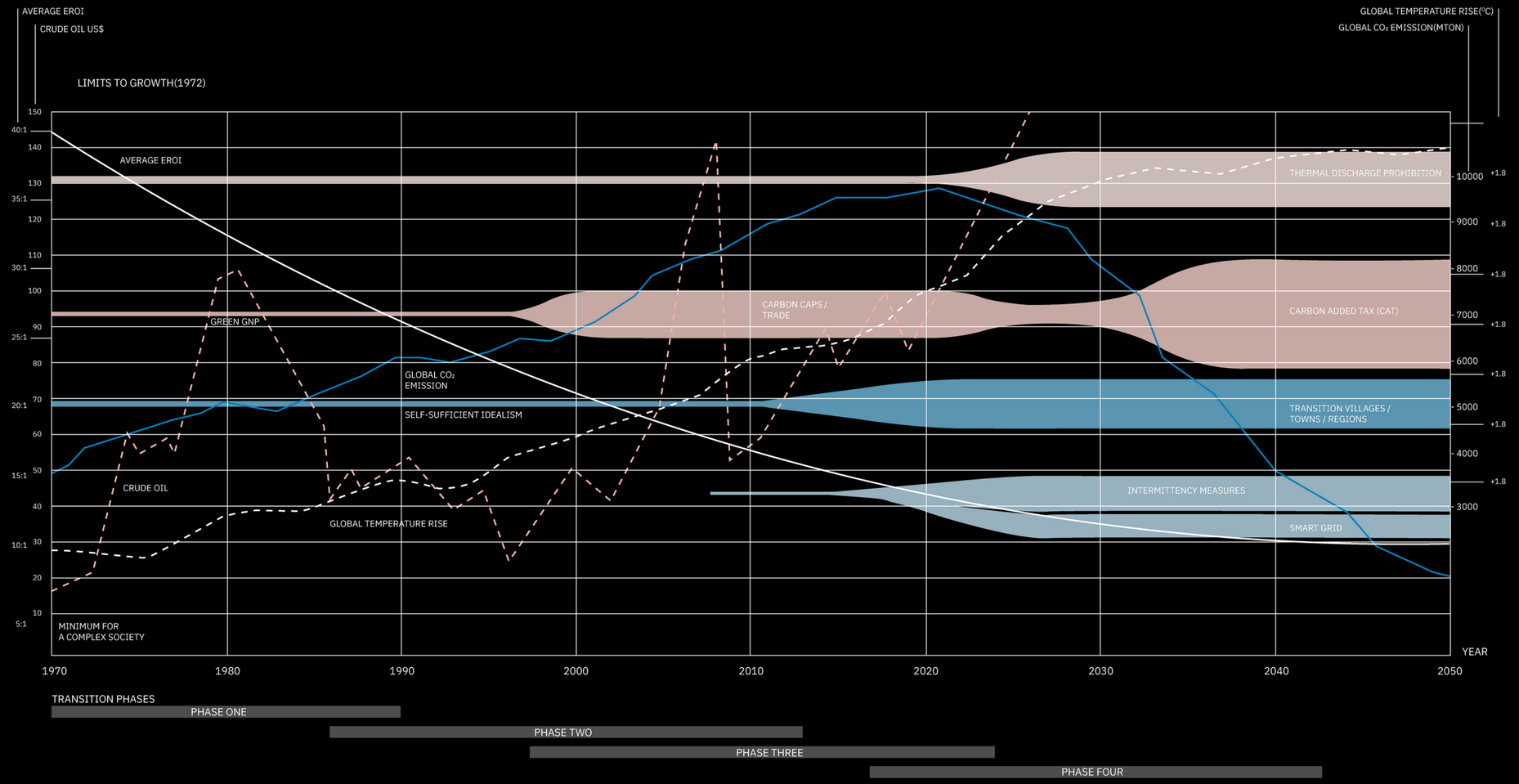
Energy Emergency

Fossil Fuel Dependency

In the beginning of the 21st century, the world is still part of the fossil fuel regime that has prevailed since the industrial revolution and the reorganisation of spatial and societal systems around this finite resource of energy. The term Fossil expressionism, used by the German philosopher Peter Sloterdijk to describe the historic period associated with the extraction, transportation, processing and distribution of this prevailing energy source, defines the last two centuries that have completely determined the human and natural habitat, way beyond the area that is considered urbanised or industrialised. The built environment that we live and work in, as well as our lifestyles and everyday habits, are completely adjusted to the fossil fuel-related processes and structures. (Sijmons et al.,2014)

Energy Transition

However, this adjustment is neither successful nor sustainable. On the contrary, the climate crisis with all the expected implications for species' lives is a by-product of this complete dependency on fossil fuel, while the overexploitation of available resources has also brought an evident deadline to its prevailing in the energy regimes. As these challenges arise and accelerate, it is becoming clear that the transition from fossil fuel to new cleaner and renewable energy resources becomes not only a necessity but also an emergency. (Sijmons et al.,2014) This energy transition, as introduced by the 2015 Paris Agreement and the 2019 European Green Deal, may start from the technical systems but needs to expand towards new spatial forms, processes and structures overcoming the carbon lock-in that currently characterises the urbanised landscape. (Bosman et al.,2018)



Energy Transition Diagram (Source: Adapted from Sijmons, D. et al. 2014, *Landscape and energy : designing transition*)

Energy Emergency

The Port of Rotterdam in the Energy Regime

Within the global distribution network, the Port of Rotterdam takes on the position of the biggest fossil fuel hub located in Europe, since over half of its distribution activity is related to fossil fuels, meeting over 50% of the demand in North-Western Europe and refining more than 21% of the relevant imports from its surrounding ports. (Bosman et al., 2018)

As illustrated in the following map, it is importing fossil fuels mainly from Russia, but also from England, Norway, the United States, Kazakhstan and Nigeria. (Simoes & Hidalgo, 2011) The magnitude of the fossil fuel transactions results in an increased dependency of the Province of Zuid Holland not only in terms of energy demand but also economically and spatially.

The energy transition, thus, requests a complete rebranding of the port of Rotterdam and a new role in the global and European connections. In the face of this effort, the port authority together with the research institute Drift has already initiated a management process in 2015 trying to coordinate necessary changes and develop strategies that will allow it to remain economically competitive and to become diverse, flexible and resilient. (Bosman et al., 2018)

As part of these strategies, it aims to become a pioneer in clean energy production and distribution systems focusing mainly on an ongoing process of electrification. While these solutions are vital for a gradual transition, it should be noted that they remain technical for the most part and fail to include the social, material and environmental dimension as well as their complex spatial implications. (Droubi et al., 2022)

Fossil Fuel Import Diagram (Source: Data from Observatory of Economic Complexity (OEC), 2020)

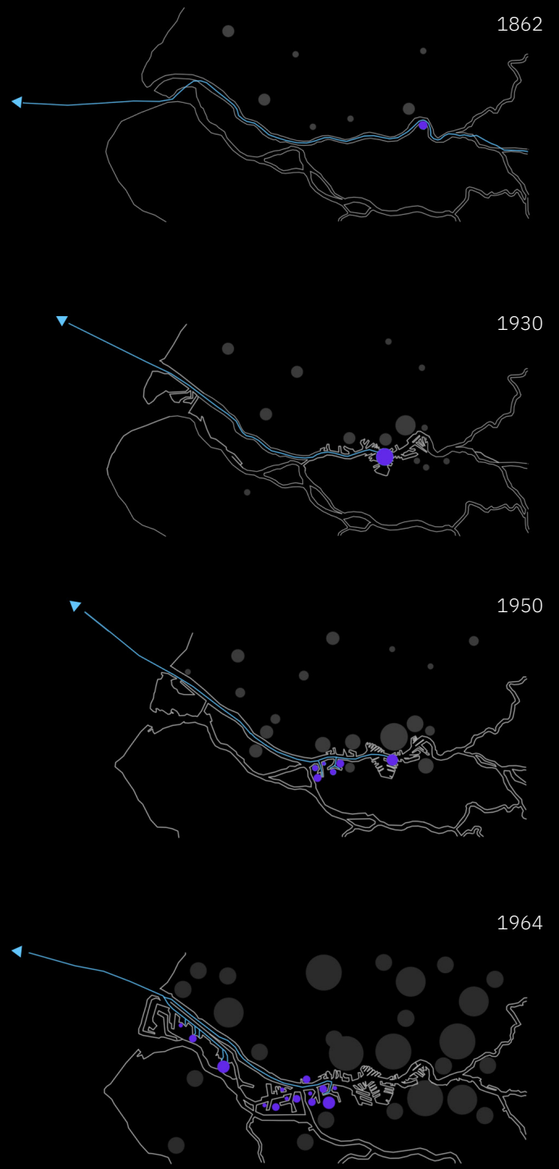
Fossil Fuel Drosscape

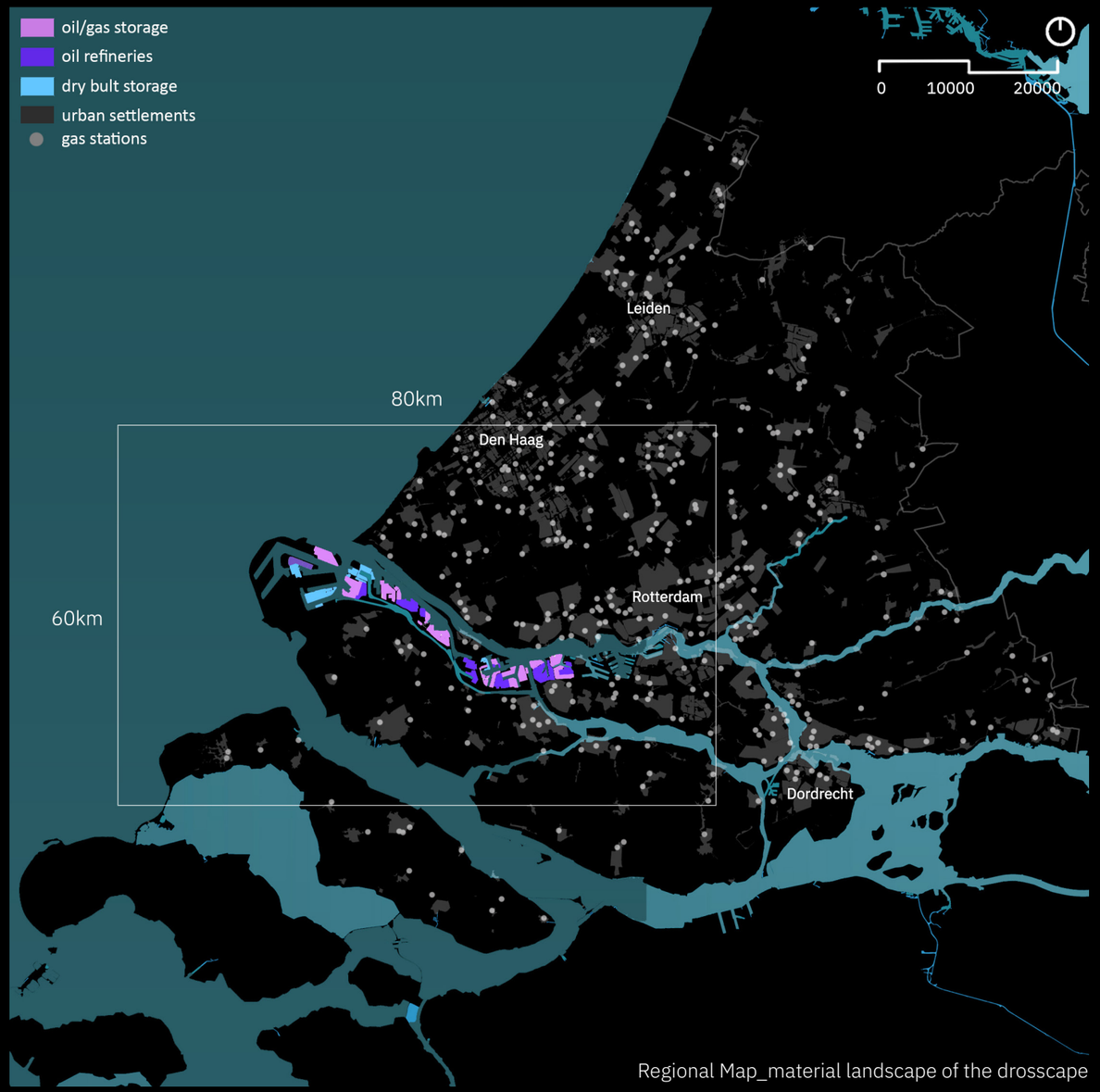
In fact, the phasing out of fossil fuel production and distribution in the Port of Rotterdam accounts for the most significant redevelopment of the 21st century not only for the Province of Zuid Holland but for the entire country. The area that is currently dedicated entirely to fossil fuel covers the biggest part of the port and consists of 79km2 of highly contaminated land, energy infrastructure and distribution networks that are expected to become obsolete in the next few decades.

The following map clearly illustrates the location of the fossil fuel material landscapes in the port of Rotterdam: the oil or gas storage areas, the dry bulk storage areas and the refineries, indicating the extensive petroleumscape that dominates space. In parallel, the representation of the gas stations in the broader territory of Zuid Holland attempts to grasp the invisible energy networks that define mobility energy requirements in the area.

Together they create the material map of the port indicating the existing stock of land and material that will turn into drosscape during the energy transition. This enormous drosscape becomes the object of a second transition, one toward a circular port economy that remains interwoven with the energy one trying to define existing spaces that can be reused, refurbished or recycled through a circular construction and demolition perspective.

At the same type, what becomes obsolete is also the current archetypal form of the energyscapes which is inextricably connected to the fossil fuel processes and structures. The table of fossil fuel landscapes found below attempts to visualise those forms that characterise the port becoming a significant part of the area's skyline and industrial heritage.

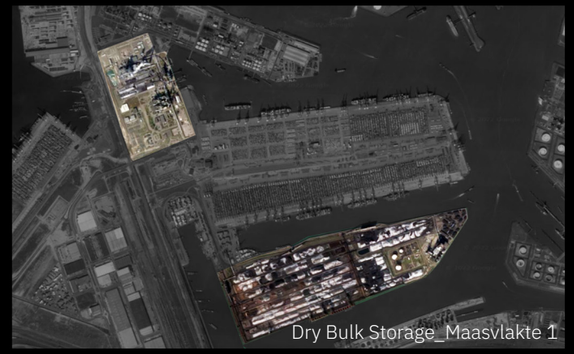




Regional Map_material landscape of the drosscape


Oil/Gas/Storage_Pernis


Oil/Gas/Storage_Botlek


Dry Bulk Storage_Maasvlakte 1


Refineries_Pernis


Oil/Gas/Storage_Rozenburg


Oil/Gas/Storage_Europoort


Dry Bulk Storage_Maasvlakte 1


Refineries_Botlek


Oil/Gas/Storage_Maasvlakte 1


Oil/Gas/Storage_ Maasvlakte 2


Dry Bulk Storage_Botlek


Refineries_Europoort

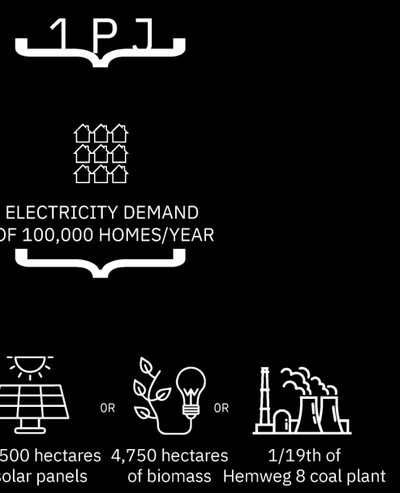
Competition for Space

In parallel, the introduction of renewable energy systems in a highly urbanised environment, like the one in the province of Zuid Holland, increases the spatial competition in an already exhausted land that barely manages to fit the growth of agricultural activity and the endless urban sprawl. Both the extraction, processing, storage and distribution systems that are associated with the energy transition and the new processes it initiates can't be limited only inside the port area but require a completely altered integration in the existing landscapes.

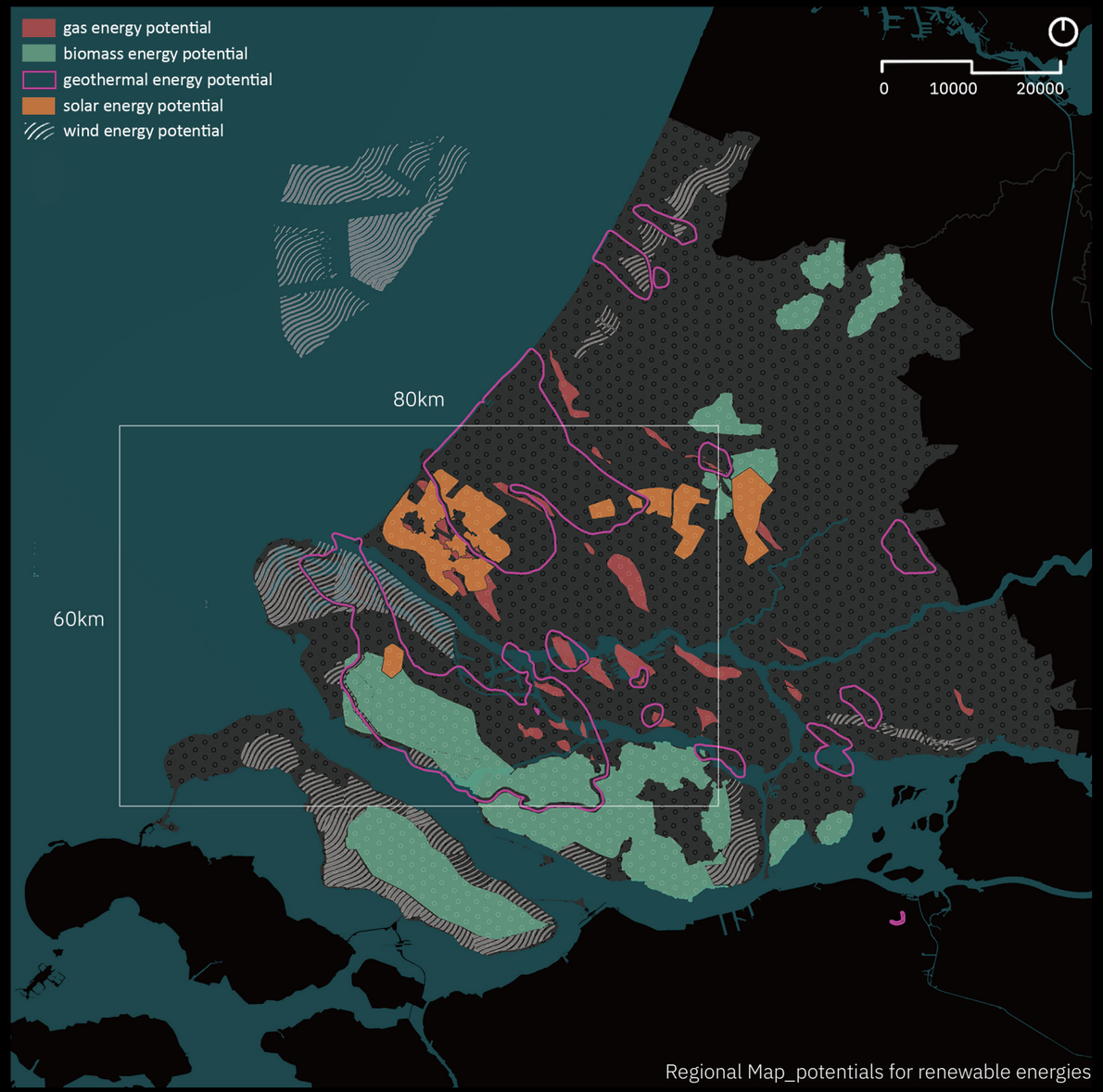
The following map attempts to reveal the magnitude of this spatial competition not only between the different land uses but also between the spaces and landscapes appropriate for the different energy types: the gas, the biomass, the geothermal, the solar, the wind. What becomes visible, beyond doubt, is that this energy transition cannot be contained and fenced inside the port area but, on the contrary, calls for a new thinking on the use of space.

In fact, renewable energy sources not only pose significant questions about a different use of space, both in size and space but also bring the energy harvesting processes in front of the average citizen's sight, breaking the illusion that our use of energy hasn't affected natural landscapes. Furthermore, renewable energy systems have a significantly larger spatial footprint than fossil fuels requiring entire areas for energy supply, mostly because of their decentralised nature and the reduced distance between energy production and consumption. (Sijmons et al.,2014)

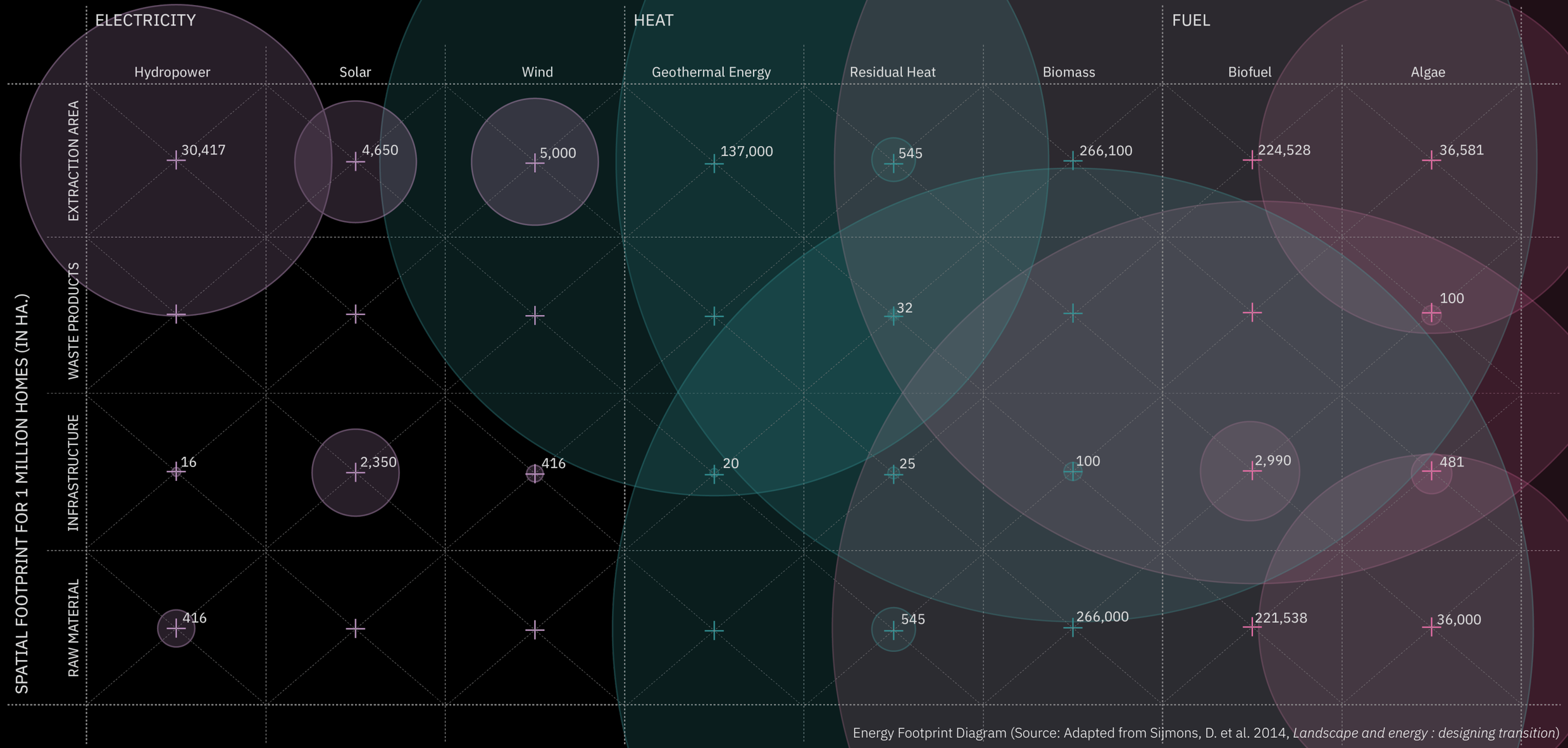
The catalogue below explores the spatial footprint of the most common renewable energy sources for the coverage of current energy demands in one million homes comparing not only the necessary space for the raw material but also the required infrastructure, the expected waste and the extraction areas. Studying it, it is becoming clear that the combination of centralised and decentralised energy systems becomes a necessity in the effort to actually perform the energy transition. At the same time, spatial footprints become relevant in the cases where the production of the raw materials necessary for the energy resources combines different uses. The energy transition, then, is not a linear process of compared calculations but requires an effort of creative combinations expressed in the spatial layout of the new energy systems.



Source: Based on Sijmons, D. et al. 2014, *Landscape and energy : designing transition*



Regional Map_potentials for renewable energies



Energy Footprint Diagram (Source: Adapted from Sijmons, D. et al. 2014, *Landscape and energy : designing transition*)

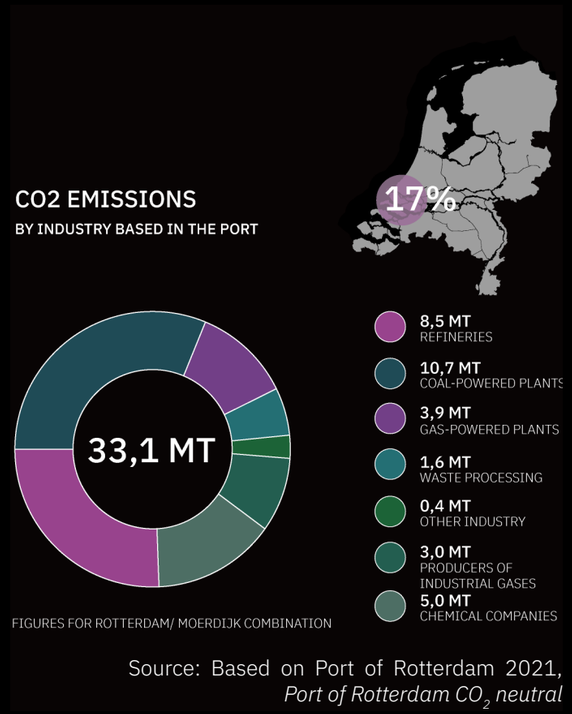
Spatial Injustice

By now, it has been established that the energy transition doesn't only concern the port area but the entire province and probably, by association, an even bigger territory. It is, however, important to realise that this was always the case. Although the port's material dimension and its related activities are distinct through fenced-off areas and structural borders, the surrounding space doesn't remain unaffected by the actions that take place there. (Ažman Momirski et al. 2021) Among them, the fossil fuel landscapes and processes define the whole area that is related to it either by proximity or through complex and largely intangible flows and networks.

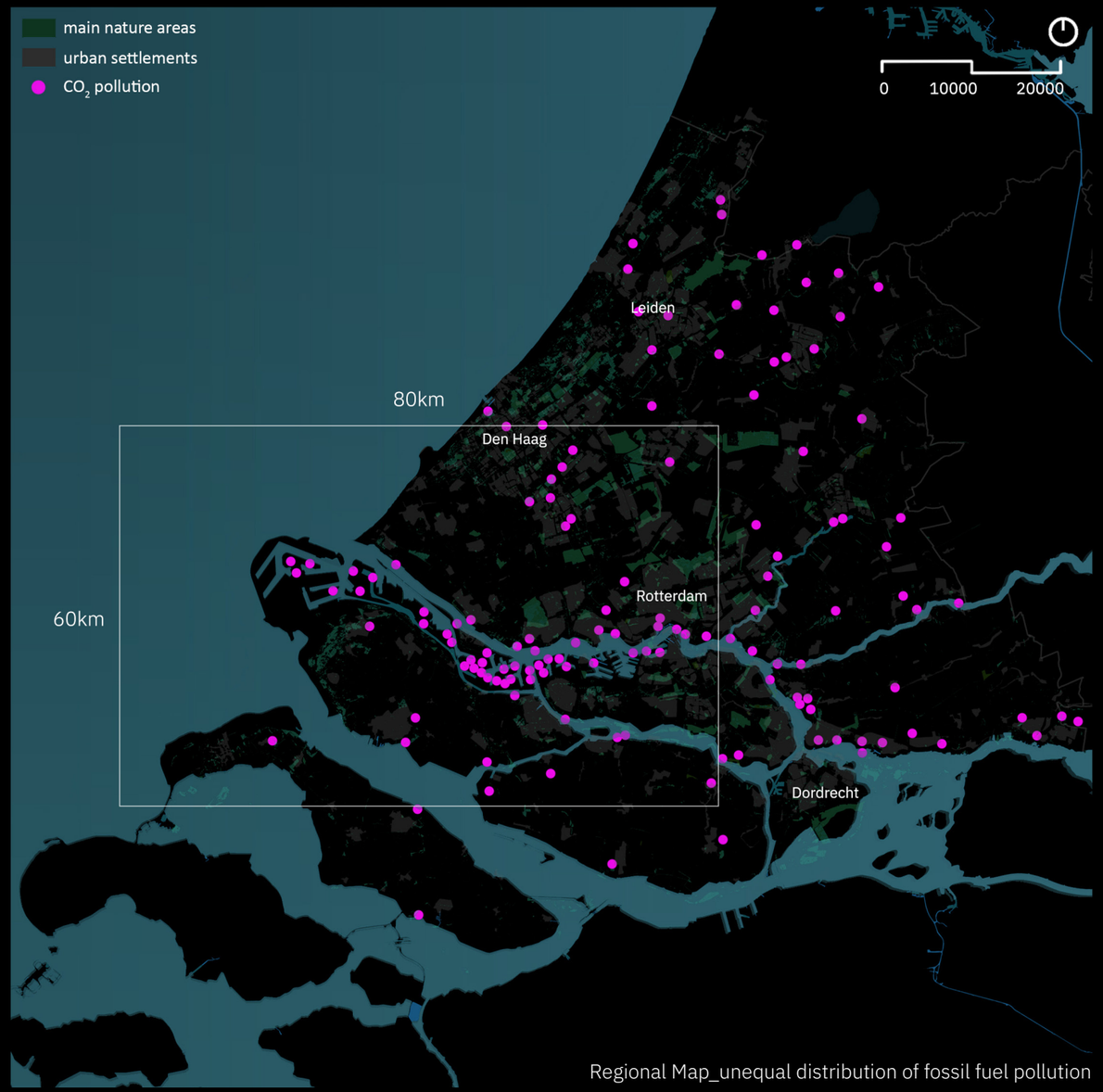
Probably one of the most evident consequences of fossil fuel energy systems is the severe pollution caused by the CO2 emissions. In fact, the Port of Rotterdam, and mainly its energy production companies, are responsible for 25,7 Mton of CO2, an amount that accounts for ¼ of the total emissions in the Netherlands. The attached map illustrates this excessive CO2 pollution and its uneven distribution in the natural habitats and the urban environments surrounding the port of Rotterdam. It is becoming instantly clear where the privileged and the underprivileged live in the Province of Zuid-Holland.

And although the Port of Rotterdam has realised the necessity to become CO2 neutral and to incorporate the notion of just transition in its vision for the future, the spatial layout of the fossil fuel energy hub and its deliberate enclosure remain a crucial factor of social segregation and division between natural and man-made systems. Structural borders, inaccessible industrial facilities, unfriendly water environments and endless areas of fences define the visitor's perception of the largest area in the Port of Rotterdam creating a spatial and visual border between energy production and energy consumption.

These borders and fences are emphasised in the following table that attempts to visualise the true separation between the port and the city and to reveal the port's identity as a demarcated structure, continuously perceived mostly by the water. (Ažman Momirski et al. 2021) It is in the face of transition that those fences and borders can be traced and challenged, repeating the same permeability of the land-water borders in the port's large technical systems. This permeability can then act as a guide in the effort towards social and environmental justice in its dual identity as procedural and distributive. (Soja, 2010)



Source: Based on Port of Rotterdam 2021, *Port of Rotterdam CO_2 neutral*



Regional Map_unequal distribution of fossil fuel pollution


Borders_Charlois


Borders_Schiedam

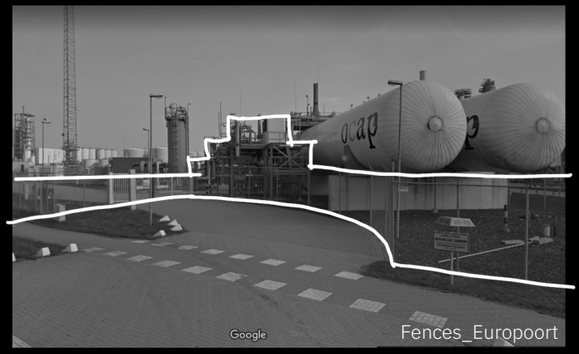

Borders_Pernis


Borders_Hoogvliet


Borders_Rozenburg


Borders_Vlaardingen

Fences_Maasvlakte



Fences_Europoort


Fences_Europoort


Fences_Pernis


Fences_Botlek


Fences_Vlaardingen

Behind the Fence

The first decades of the 21st century are defined by an expected depletion of fossil resources and an emerging climate crisis which make the replacement of the fossil fuel regime not only a necessity but also an emergency. In this context, the Port of Rotterdam, as one of the most important fossil fuel hubs in the world, is the first to navigate the upcoming transition and the following spatial reorganisation towards a new global role in renewable energy production and distribution. During the process, it is facing three main interconnected issues:

The Port as a Drosscape

First of all, the energy transition affects 79km2 of contaminated land, infrastructure and material that need to be phased out and integrated in a process of circular construction and demolition. **Dealing with the drosscape** implies not only repurposing, recycling, and reusing but also conserving and rethinking energyscapes.

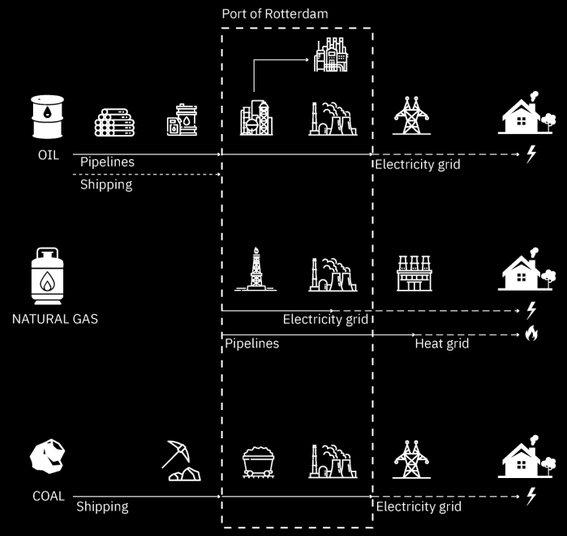
Competition for Space

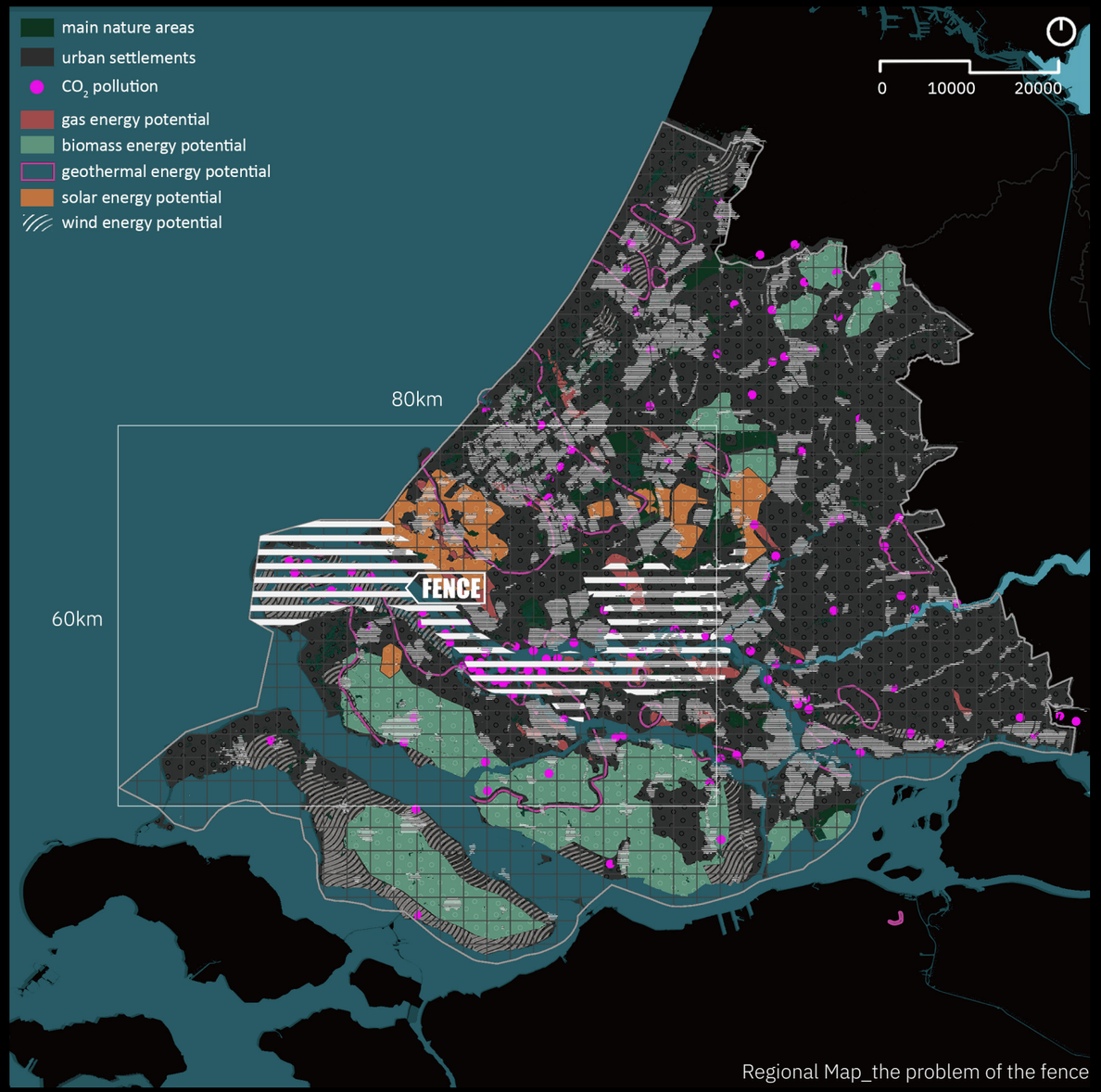
Following, the renewable energy systems have significantly **higher spatial requirements** than the fossil fuel infrastructure expanding in landscapes way beyond the traditional production and distribution areas in the port. Thus, except for the partial appropriation of fossil fuel infrastructure, the exploration of decentralised solutions and the development of a more energy sustainable lifestyle is required.

Spatial Injustice

Finally, the port territory and its surrounding environment is the embodiment of **structural injustices hidden beneath consecutive borders and fences**. Segregation, limited access to the riverfront and healthy recreation landscapes and unequal spatial distribution of burdens and benefits from the energy production characterise the settlements in the port territory while disrupted and polluted biotopes define the state of the natural processes.

The question of transition, then, does not only consist of the integration of a new technical system of energy production but rather a reconfiguration of the port's material landscapes fostering spatial justice and fixing the problematic relationship between natural and man-made systems. This requires above all an understanding of the spatial layout of the Port of Rotterdam beyond the fence that fragments its perception and its interpretation by designers, planners, and policy makers. Transcending the fence, then, begins from the spatial energy footprints but moves to the re-establishing of port city cultures and linkages.





Regional Map_the problem of the fence

METHODOLOGY

Instructions for a Just Transition

Transcending the Fence

Material dimension of drosscape

Circular use of existing fossil-related material and infrastructure in future sustainable developments

• How can existing primary and secondary infrastructure be repurposed for future renewable energy models?
• How can existing fossil-related material be re-used and recycled in new energy systems?

Renewable energy transition

Shift towards clean renewable energy alternatives

• How can renewable energy sources meet current energy demands?
• How can we shift from one prevailing energy system to an efficient combination of green energy types?

How can the infrastructure associated with energy transition reshape the port‘s spatial structures fostering spatial justice and fixing the problematic relationship between natural and manmade systems?

Social justice through energy transition

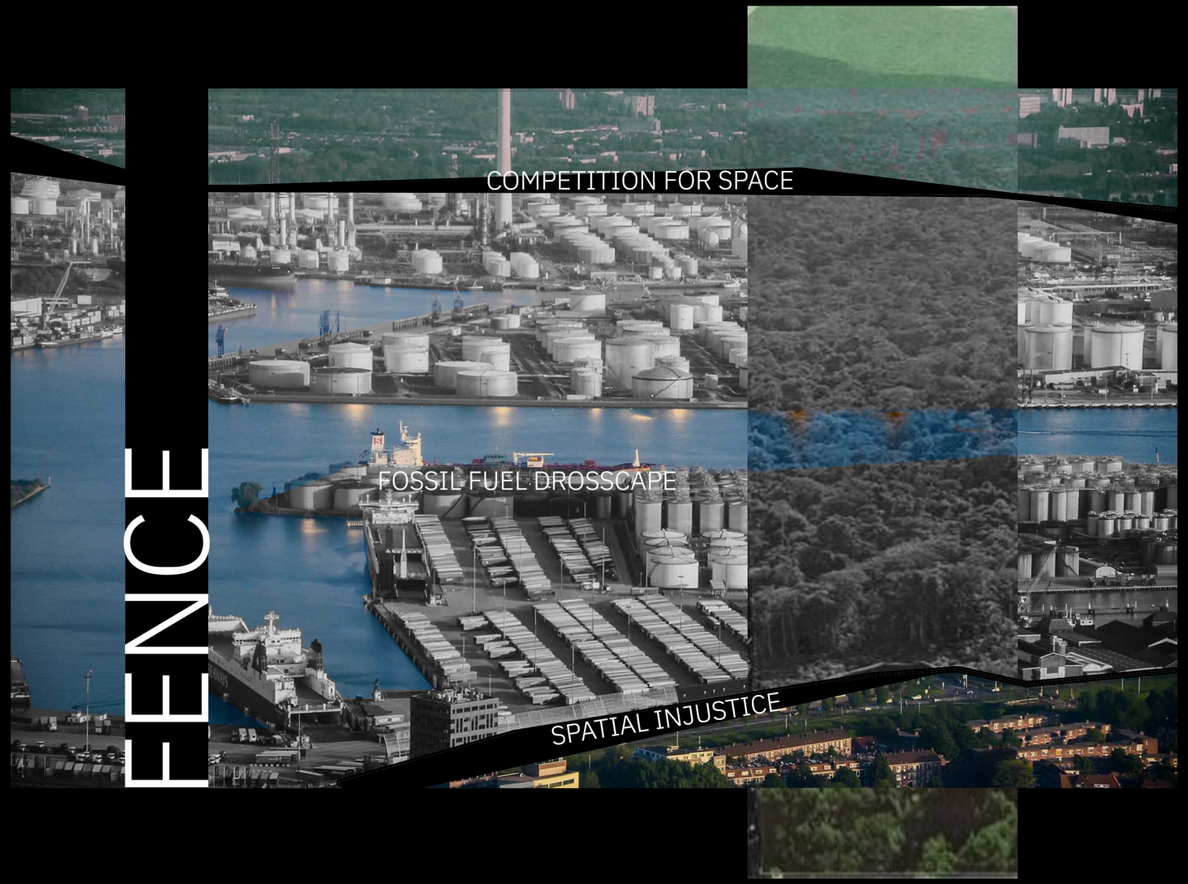
Just distribution of benefits and burdens of energy production

• How can the transition serve as an opportunity to improve living conditions of surrounding communities and achieve social justice?
• How can underprivileged communities participate in the energy transition and shape sustainable neighbourhoods of the future?

Environmental opportunities

Improved biodiversity, biotopes‘ protection and decontamination of polluted sites

• How can the energy transition serve as an opportunity to conserve existing natural landscapes while restoring compromised habitats?
• How can nature-based solutions reverse pollution caused by the fossil fuel industry?



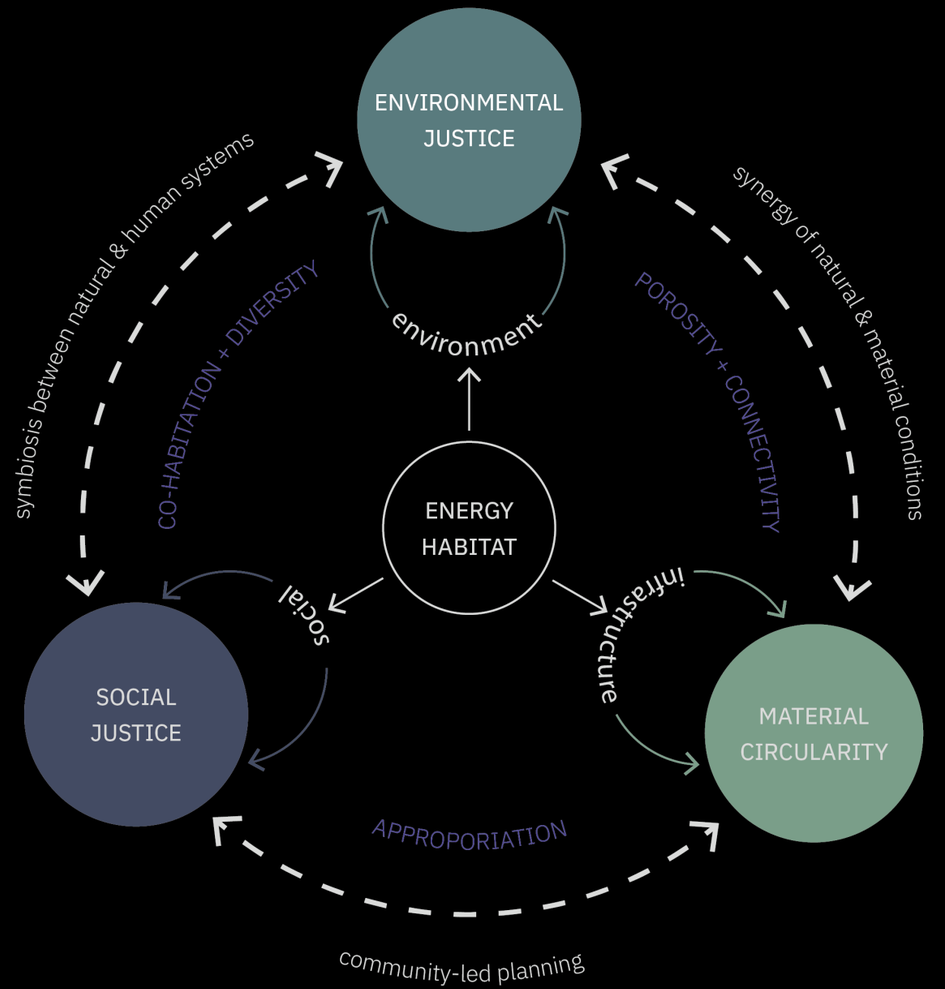
Defining Energy Habitat

In an attempt to answer the research question, the following conceptual framework was developed linking crucial ideas, variables and phenomena to the social, environmental and material dimensions of the upcoming energy transition. As a basis point, the **concept "Energy Habitat"** is introduced to reinterpret the "habitat" (the natural environment in which an animal or plant usually lives, Cambridge vocabulary) as a space structurally interconnected to energy production and distribution processes even in the natural context. Under this definition, the energy transition is understood not merely as a shift between different technical systems but as a potential redistribution of the sum total of energy resulting in a new balance between natural and man-made systems.

The "Energy Habitat" is built upon three main pillars; social justice, environmental justice and material circularity that tie the energy transition to the other three dimensions of the research question. The **social justice pillar** expresses the quest for equal access to facilities, resources and services, for a healthy living environment and for new employability opportunities in the face of the social transformations brought by the phasing out of the fossil fuel regime, emphasising the need to incorporate a parallel social transition in the planning process. The **environmental justice pillar** expands the focus of this social transition towards the natural environment stressing the need to secure biodiversity while energy systems threaten to consume the remaining natural landscapes extending the spatial footprint of human activities even further. As emphasised by the term habitat, it is the spatial dimension of both the energy transition and justice that mainly drive this research process; a fact that becomes even clearer with the introduction of the **material circularity pillar**, describing landscapes' metabolic processes.

The intersections of the aforementioned pillars describe the main guiding analysis and design concepts: **symbiosis between natural and man-made systems, synergy between natural and material conditions, and community-led planning** that relate the relevant literature to the research question and its sub-questions. Specifically, the **"Designing with nature" methodology**, defined by McHarg (1971), is adapted to relate social values, natural processes and material conditions of the Port's space in an analysis process that not only evaluates the current spatial configuration but also reveals opportunities for the implementation of synergies and symbiosis. In parallel, the meticulous study of both the horizontal and vertical dimension of governance uses the the power-interest analysis tools, defined by Ackermann & Eden (2011) in their book **"Making strategy: Mapping out strategic success"**, to stress the need to incorporate the concept of community-led planning as a crucial point in the transition from hierarchic to polycentric governance.

The introduction of these concepts is accompanied by their connection to a system of values derived from the qualification methodology introduced in the article "Qualifying Urban Landscapes" by Clemmensen, Duagard and Nielsen (2010) and assigned to the concepts as shown in the following diagram. The values of Porosity, Connectivity, Diversity, Cohabitation and Appropriation, then, define not only the main concepts but also the formation of the spatial vision and the subsequent planning strategies drawing from the transformative design concepts introduced by de Jonge and Middleton (2008) in their book **"Landscape architecture between politics and science : an integrative perspective on landscape planning and design in the network society"**.



Diagram_conceptual framework

Qualifying Energy Habitat

The previously mentioned values are described in more detail in the following diagram, as explained by Clemmensen et al. (2010) to provide an alternative to the planning and design principles dominating the built environment. They derive from the combination of the work conducted by Sieverts, Ascher, and Secchi and Vigano and their perception of the existing urban landscape and they not only provide an evaluation scheme for the current situation but also guide an assessment framework for the final vision and strategy.

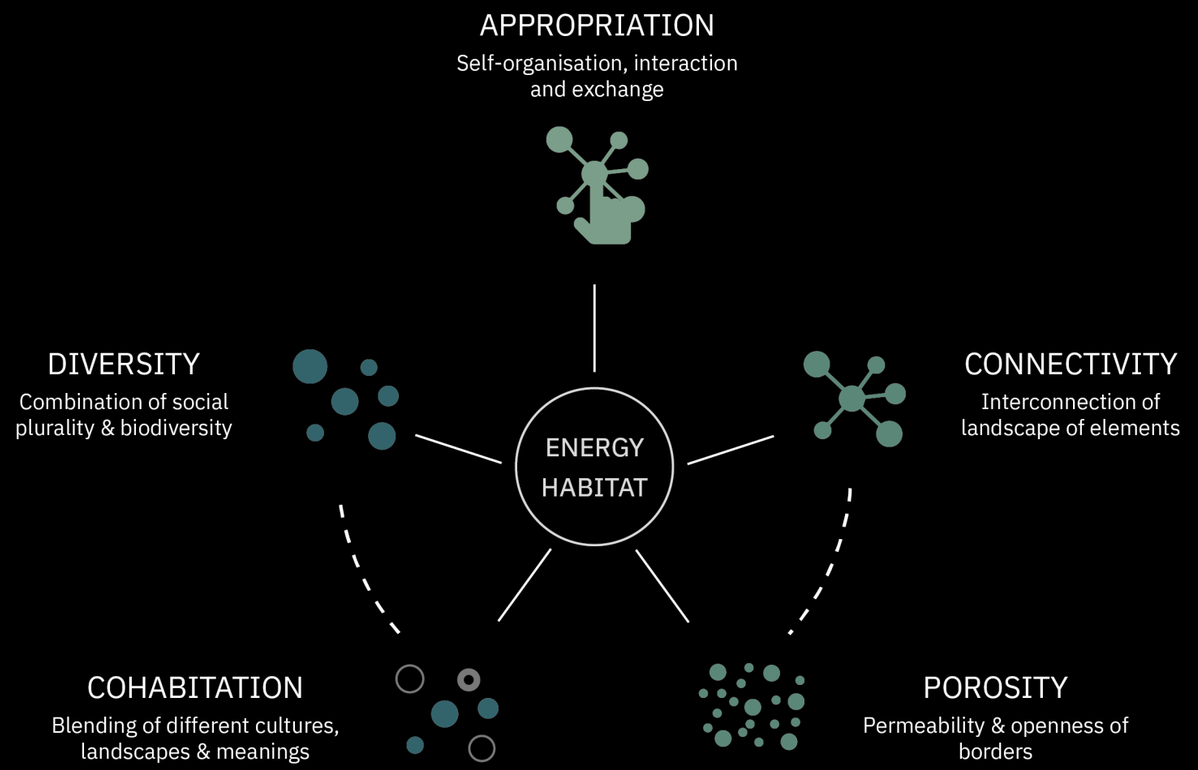
Co-Habitation
The co-habitation value expresses the spatial dimension of negotiation processes in the landscape battleground introducing the necessity for combination of different environments, meanings, cultures, activities, habits and interests. Cohabitation is a crucial element in the effort for symbiosis between natural and man-made systems.

Diversity
The diversity value implies the integration of natural and urban processes in the landscape combining social diversity with biodiversity and increasing accessibility. Diversity is also a precondition for the development of symbiotic processes.

Appropriation
The appropriation value refers to an essential degree of self-organization that allows interaction and exchange between the material landscapes and their users. Appropriation is structurally interconnected to an environment's potential to act as an aesthetically pleasing living lab forming responsibility ties with its inhabitants and is, thus, a fundamental part of the right to the city.

Porosity
The porosity value describes the capacity of indeterminacy and openness in the process of spatial transformation and adaptation. This permeability is opposed to the spatial organization in borders, fences and barriers that disrupts continuity and restricts natural processes and systems. Porosity becomes especially relevant in the space of the port that has evolved as a clearly demarcated structure where land use and land cover usually mismatch. In that sense, it is a key element in the effort of synergy between material and natural conditions.

Connectivity
Finally, the connectivity value defines the required landscape continuity through the interconnection of its different composing elements. Viewing the landscape as a system, instead of a demarcated territory, emphasizes its connectivity in different scales and settings moving from the local to the global context and tying it to the composition of synergies.



Diagram_qualifying values

ANALYSIS

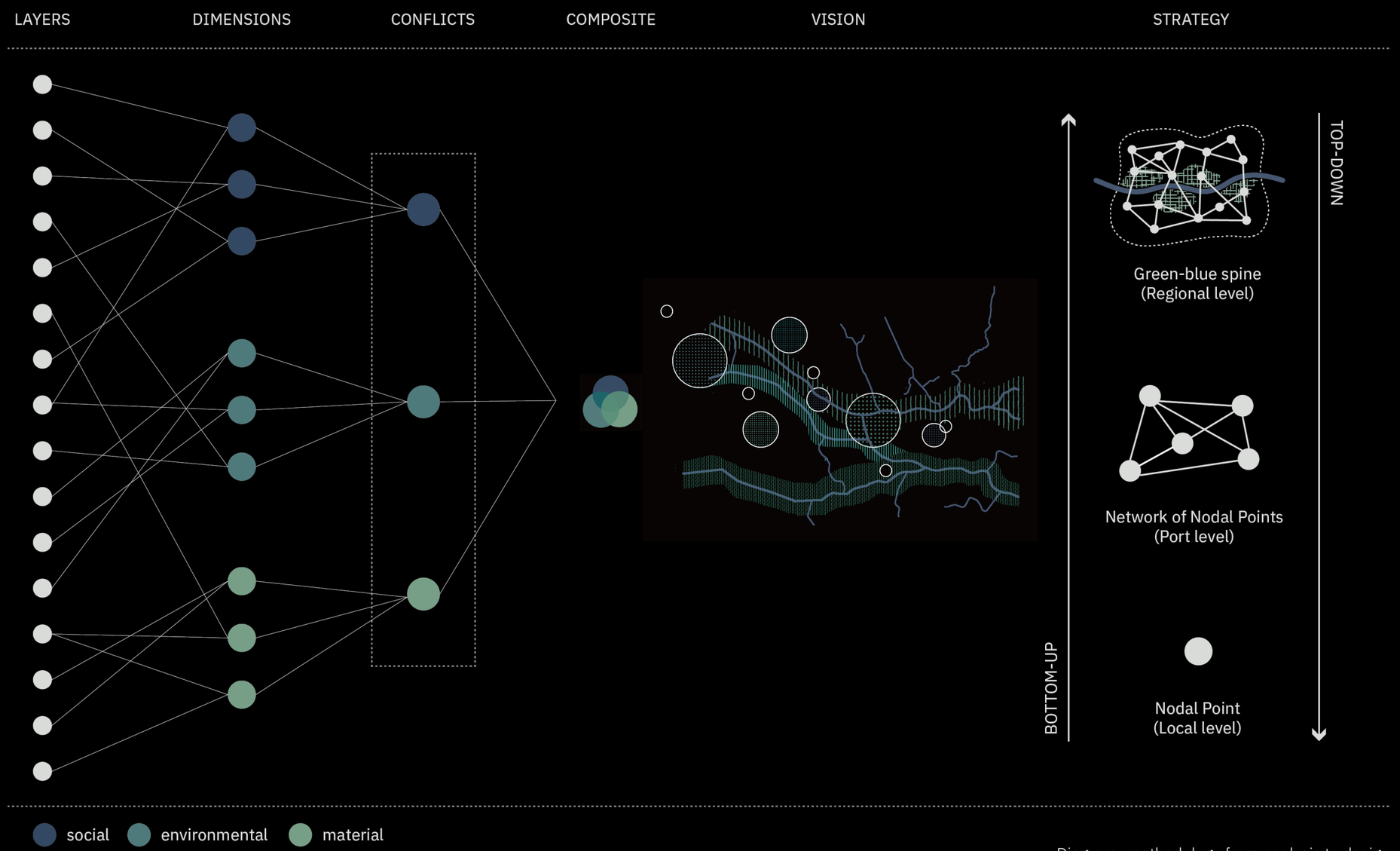
Multidimensional Port of Rotterdam

Diagnosis of the Port Territory

In this context, the spatial analysis of the Port of Rotterdam is lead by the methodology used by Ian McHarg in his book “Design with Nature” (1971) to reveal underlying structures and hidden relations associated with the land cover that can dictate design possibilities in symbiosis with natural processes and social values. The goal of this process is to decode conflicts taking place in the broader port area during the energy transition defining critical territories and spatial implications.

The first part of this method, as indicated by the following diagram, is the decoding of the individual spatial layers and their subsequent overlay under the social, environmental and material dimensions. This vertical analysis is, then, completed by a parallel horizontal superimposition of the conflicts that arise in these three dimensions. The result is a composite map that defines the most critical territories as interconnected islands that go beyond the initial perception of clearly defined urban, natural and infrastructural landscapes.

Beyond allowing a critical view of the spatial relationships, this method also identifies a network of nodal points that guide both the vision design process and the planning phases integrating top-down and bottom-up processes in the transition from the nodes to their networks and finally to the whole territory.



Diagram_methodology from analysis to design

Natural Processes & Social Values

As part of the decomposition of the spatial layers of the port of Rotterdam, the following maps illustrate the natural systems and processes that take place in the port of Rotterdam despite the intense industrial activity and the subsequent environmental destruction. Biotopes, natural and artificial dunes, protected natural habitats and invisible migration routes characterise the delta area of the Maas river attributing scenic values in the disappearing natural landscape.


Layer_topography


Layer_education levels


Layer_ethnicity mix

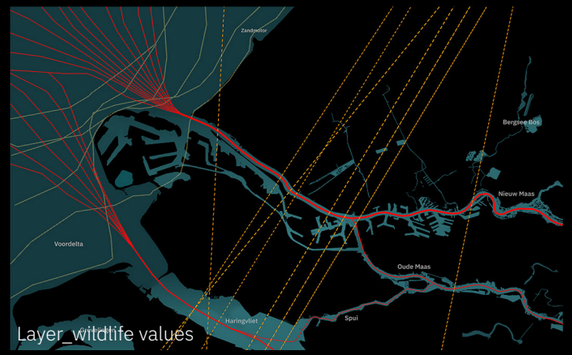
Layer_land & water values

Layer_forest values


Layer_income levels


Layer_density distribution

Layer_dunes values



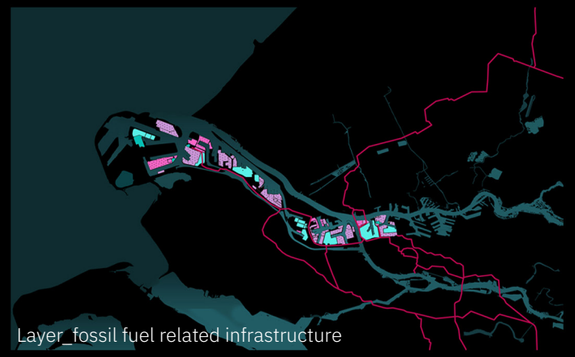
Layer_wildlife values

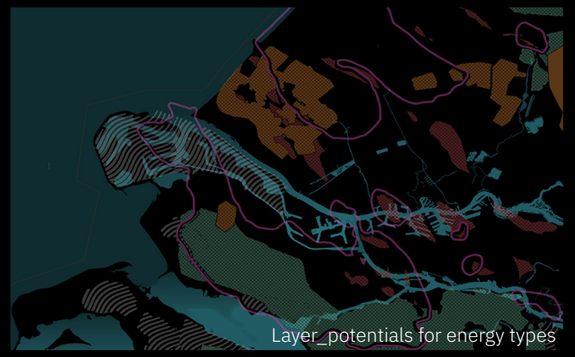

Layer_fossil fuel employment locations

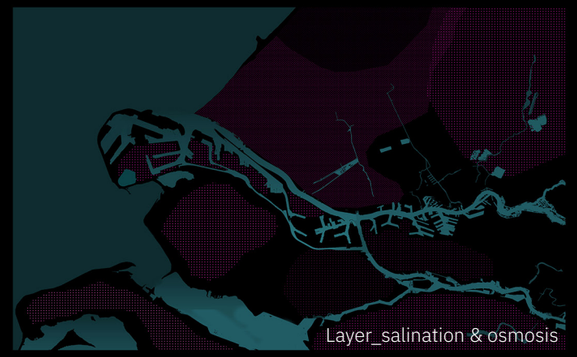
Continuing, the maps in this page attempt to grasp the key parameters that define the social dimension of the port. The breakdown of the relevant layers reveals that low income, high ethnicity mix and low literacy levels characterise the dispersed settlements around the port where most jobs relate to the fossil fuel industry. The administrative centres associated with the fossil fuel, of course, are located in the urban centres away from the port.

Current & Future Material Contitions

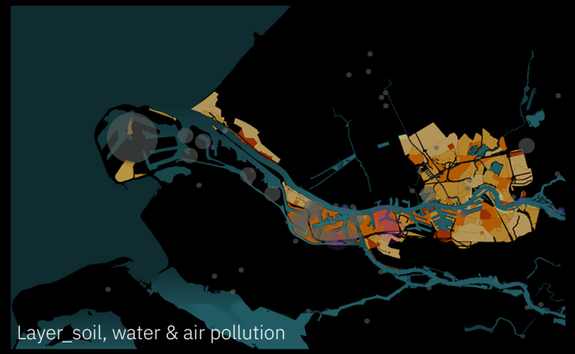
In this page, the layers concern the existing energy-scapes and the related systems in the Port of Rotterdam. Beyond the different fossil fuel sites, the distribution energy networks, the related industries in the region, the energy distribution networks and the contaminated water and soil sites constitute the fossil fuel regime that covers a significant area of the Province of Zuid Holland.

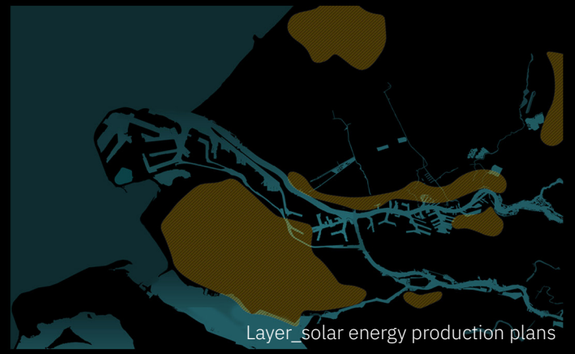

Layer_fossil fuel related infrastructure

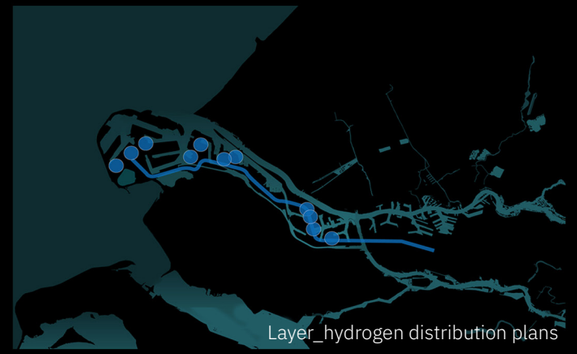

Layer_potentials for energy types


Layer_salination & osmosis


Layer_electricity infrastructure

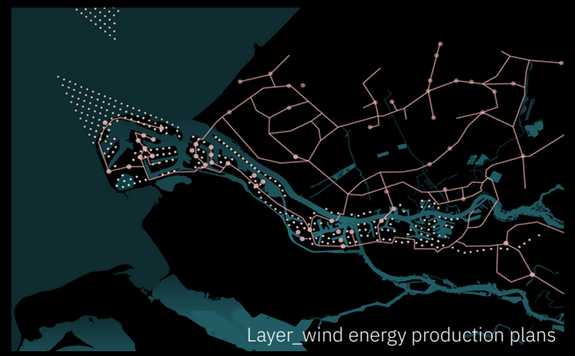

Layer_soil, water & air pollution


Layer_solar energy production plans


Layer_hydrogen distribution plans


Layer_related industries


Layer_transportation routes


Layer_wind energy production plans

This space, being the initial ground of the energy transition, is already dominated by the potential for the future energy systems or by existing plans for future energy-related developments. These new energyscapes, although invisible, are already crucial parts of the transition process.

Environmental Conflicts

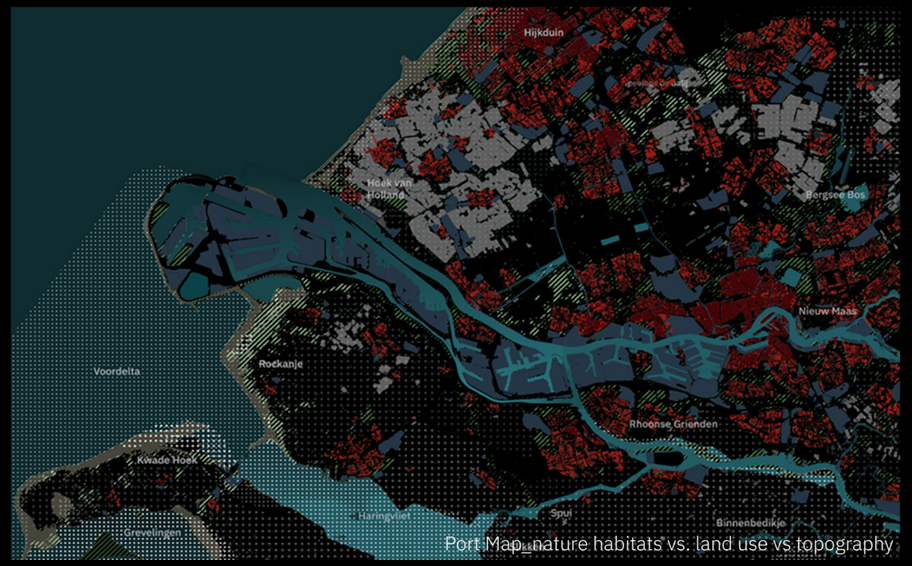
Following the decomposing process, the vertical analysis begins by searching for the environmental conflicts that arise from the coexistence of the individual spatial layers. Each research sub-question related to the environmental dimension is answered by an overlay of all the relevant layers producing a new set of complex maps that reveals the spatial aspects of the relevant issues. The selected results of this process are presented as examples of the investigation stages and the deriving answers.

Nature habitats vs Land use vs Topography
Human activity in its different manifestations (from agricultural land and industrial sites to expanding urban settlements) appears to threaten natural processes and habitats as it restricts them in very limited spaces. It is evident that there is stiff competition for space, especially on the safe higher grounds.

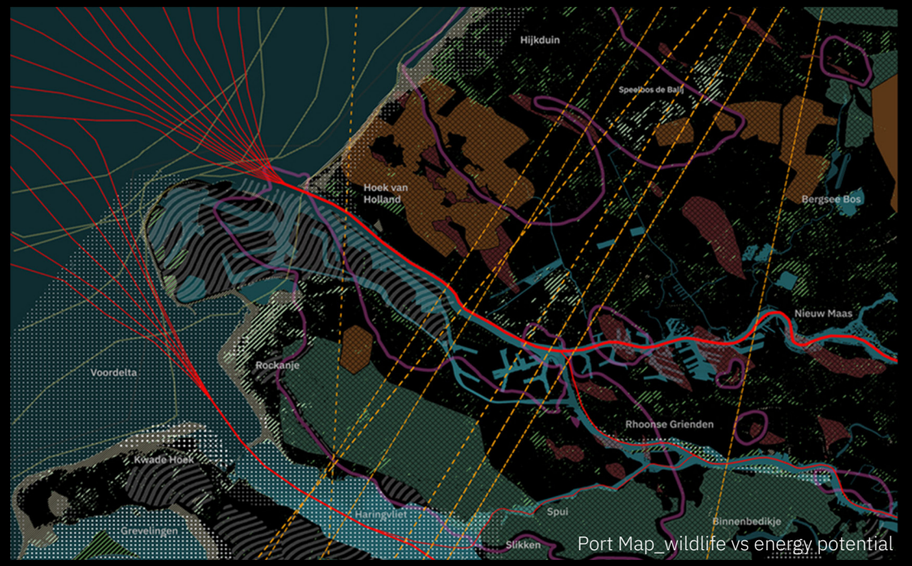
Wildlife vs Energy potential
The distribution of renewable energy generation potentials appears to coincide with locations for natural processes, habitats and wildlife migratory routes both on land and offshore.

Wildlife vs Pollution
Soil, water and air pollution resulting from the port's fossil fuel industry severely affects natural processes in the wider region. Its spatial footprint is the proof of fossil fuel's environmental externalities that extend way beyond the fenced port industrial area into the surrounding landscape.

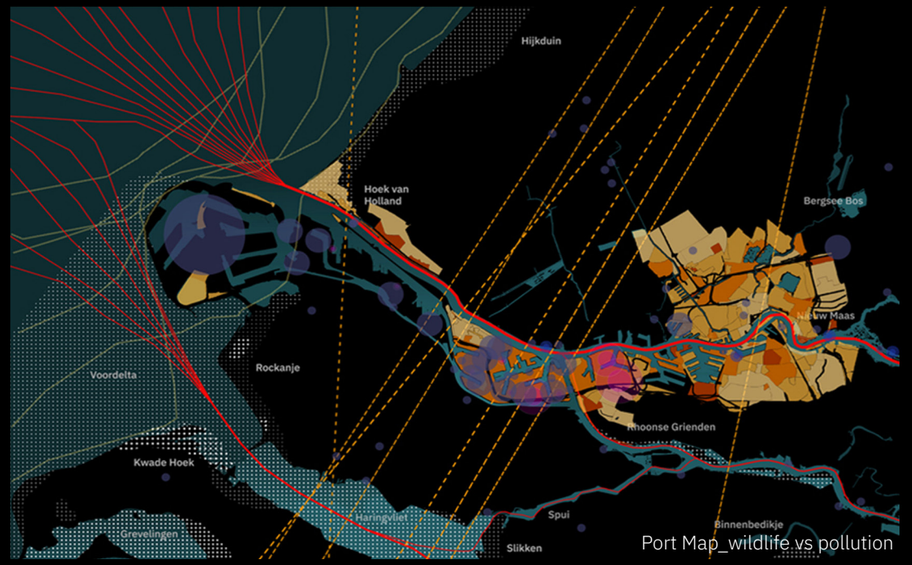
Protected sites vs topography-dredging
The Nieuwe and Oude Mass, although key routes for migratory salmon, constantly undergo dredging that threatens natural sedimentation processes and disrupts the fragile water ecosystem.



Port Map_nature habitats vs. land use vs topography



Port Map_wildlife vs energy potential

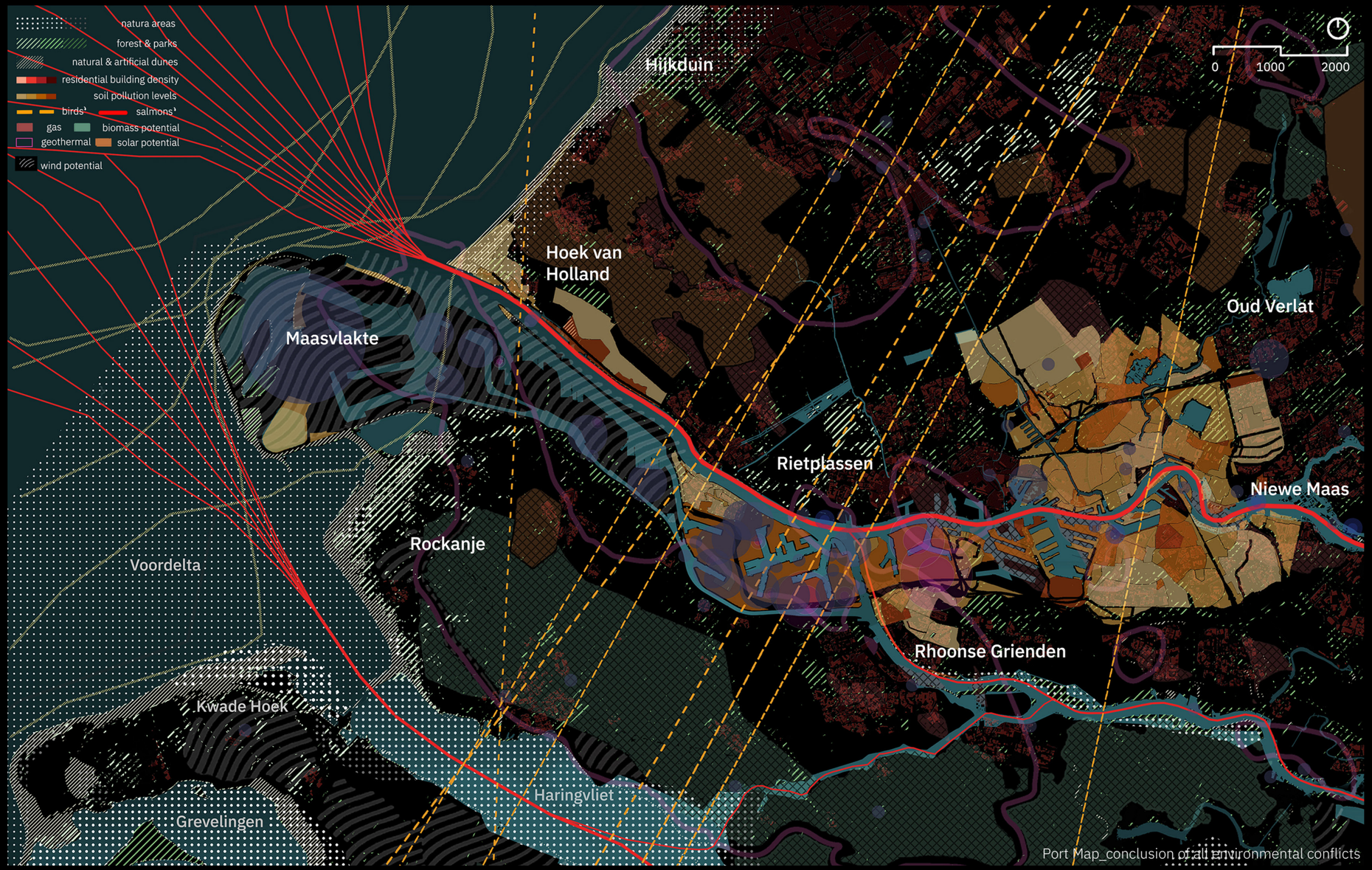


Port Map_wildlife vs pollution

Port Map_protected sites vs topography-dredging

Environmental Conflicts

The result is the following overlay map of all the environmental conflicts that establish friction between natural and human processes in the port region, notably in relation to the current and future energy systems. The energy transition, although associated with a decrease in the evidently problematic pollution levels, pose serious spatial threats to existing biotopes and biodiversity. In fact, whereas there exists vast potential for energy harnessing, renewable energy production, distribution and storage require significantly more land compared to fossil fuels outside of the port area. At the same time, the conservation of existing natura areas and the renaturation of compromised landscapes necessitates allocation of space for the environment in an era where urbanisation in the province of Zuid Holland is faster than ever. The complexity arises from the structural mismatch between land use and land cover that has defined the relationships between man and nature and requires an important reconfiguration of the port's spatial layout if it is to ever evolve from domination and dependency to symbiosis.



Port Map_conclusion of all environmental conflicts

Social Conflicts

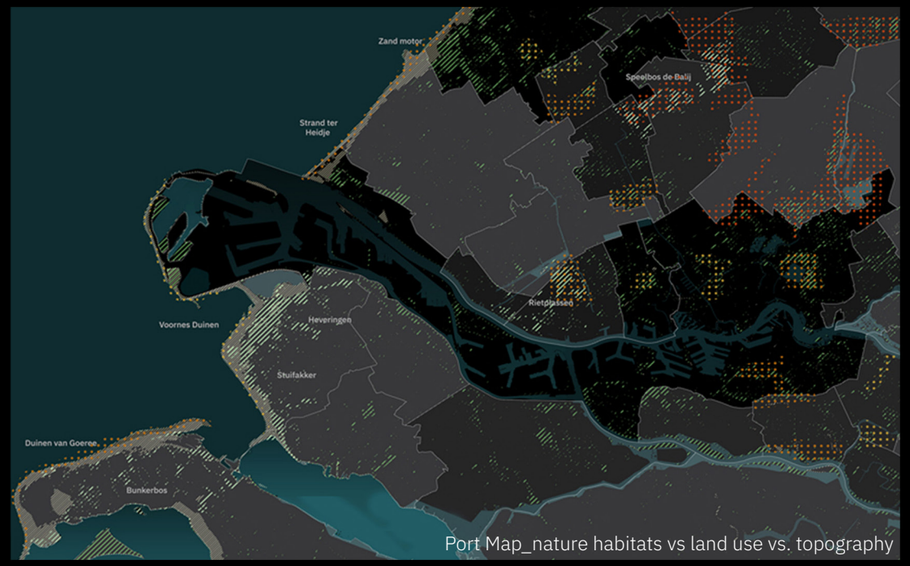
Similarly to the environmental conflicts, the investigation of the social conflicts consists of an overlay of all the individual layers that constitute their spatial manifestations producing a similar set of maps. The selected results of this process are presented as examples of the methodology followed.

Ethnicity mix and Income levels vs Recreation spaces and natural areas
Access to natural and recreational sites is limited in neighbourhoods with a richer ethnicity mix and lower incomes. On the contrary, residential areas in wealthier municipalities are in proximity to protected landscapes and to the coastline.

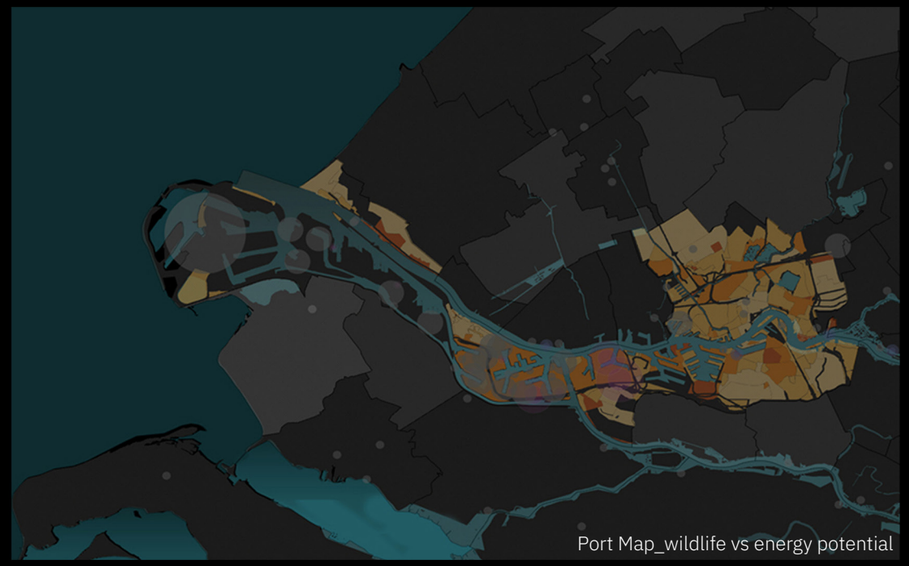
Income and ethnicity mix vs Pollution
There is a clear correlation between low income and high ethnicity mix and an evident concentration of underprivileged neighbourhoods in the highly polluted port area.

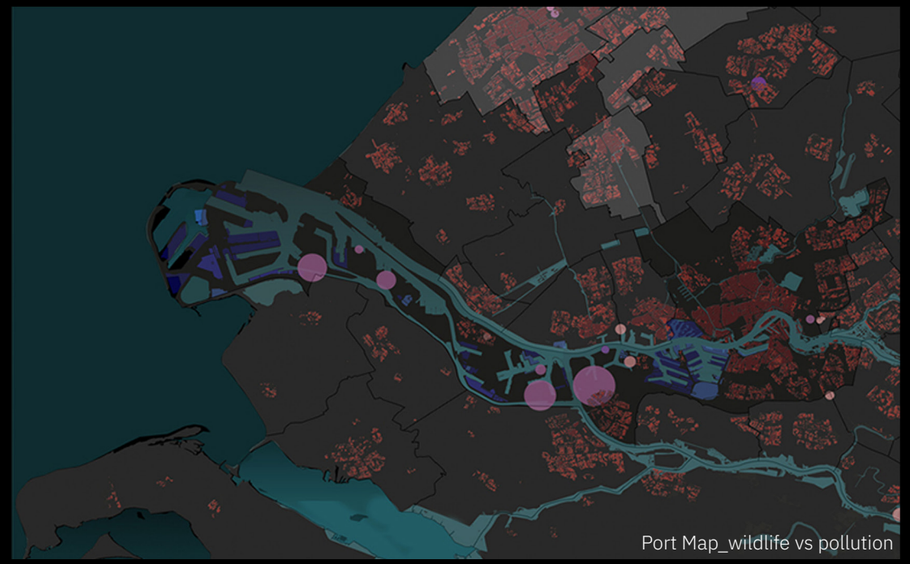
Educational levels vs Fossil fuel employment locations vs Density
The majority of jobs associated with the petrochemical industry are concentrated within the port, employing mainly low income and low education levels groups, while the headquarters located in Den Haag attracts higher education classes and the majority of educational institutions of the area.

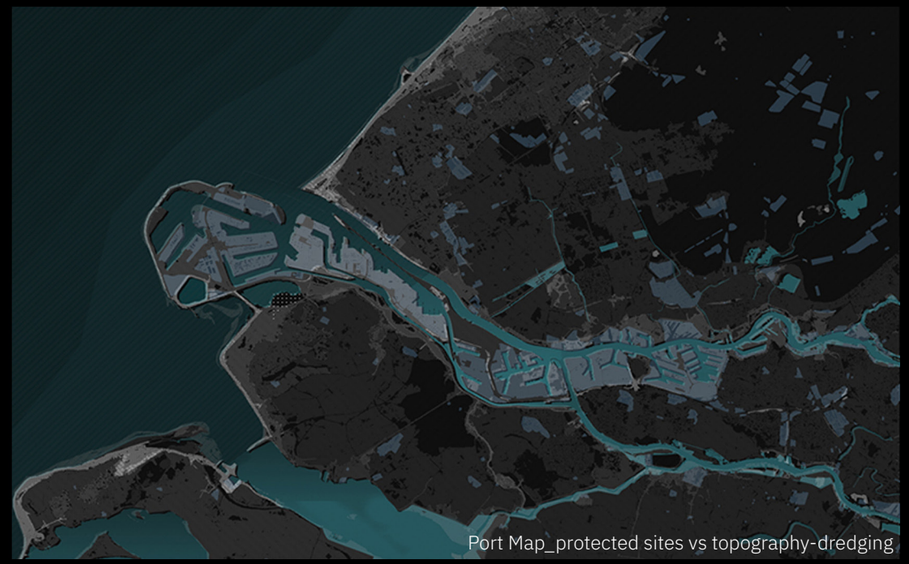
Topography-dredging vs Land use
The main body of the energy production companies, and specifically the one coinciding with the fossil fuel industries, is found in the province's higher grounds in the port area. The industry is therefore protected from floods and possible rising sea level but at the same time, surrounding neighbourhoods and other functions remain vulnerable.



Port Map_nature habitats vs land use vs. topography


Port Map_wildlife vs energy potential


Port Map_wildlife vs pollution


Port Map_protected sites vs topography-dredging

Social Conflicts

The result is the following overlay map of all the social conflicts that clearly exposes the imbalanced distribution of benefits and burdens in the current layout of the port in relation to the fossil fuel regime. Whereas low income groups live and work in heavily polluted areas characterised by restricted ‘rights to nature and to the port’, wealthier communities enjoy benefits of energy generation and scenic recreational landscapes, without facing many of the negative consequences of the process. For them, the systems associated with energy production, storage and distribution remain invisible and strengthen the illusion that humans haven’t significantly altered the landscapes associated with their activities. At the same time, as urban settlements and the related metabolic processes grow in a vulnerable territory susceptible to the consequences of the climate crisis, the spatial competition with the new energy production systems becomes even greater, requiring a partial decentralisation of energy systems.

Port Map_conclusion of all social conflicts

Material Conflicts

Following the exact same process, analysis of the material conflicts consists of an overlay of all the spatial characteristics that set the battleground of the energy transition and the subsequent transformation of the fossil fuel energyscapes to drosscapes. As with the previous chapters, selected overlay maps indicate some of the conclusions derived in the process.

Energy potential vs land uses
With already existing agriculture, residential, industrial and other functions in the region, a very limited space is available for the new infrastructure associated with renewable energy production and distribution, whereas they present an increased spatial footprint in comparison to the fossil fuel systems, at least in proximity to the spaces of energy consumption.

Future infrastructure vs Energy potential
Although existing plans for energy generation point mainly towards a centralised production system concentrated in the port, there is an evident mismatch between the locations of energy potential and the location of the future plans which broadened the already existing gap between the land use and the land cover.

Future infrastructure vs Land uses
As the land use patterns call for a highly packed territory, future infrastructure plans expand towards the sea and the urban settlements combining centralised with decentralised systems and increasing even further the human footprint.

Existing vs future infrastructure
The same point is illustrated by comparing existing infrastructure restricted and mainly fenced in the port area and future energy infrastructure expanding throughout the whole area and parasitizing settlements, natural lands and productive landscapes.


Port Map_nature habitats vs land use vs topography


Port Map_wildlife vs energy potential


Port Map_wildlife vs pollution


Port Map_protected sites vs topography-dredging

Material Conflicts

The result is the following overlaying of all the mentioned layers that reveal the competing key challenge of competing spatial and infrastructural needs of current and future power generation systems especially since the transition needs to redefine the space in which we live and work while we continue living and working in it. In that process, the existing fossil fuel energyscape, both a technical construction and a materialised cultural structure, places itself as an overlooked opportunity that will play a key role in upcoming renewable energy production, combined with the required decentralised energy systems that may allow renewable energy resources to meet current demands. This expansion of energy sites over the natural areas and the built environment require new material landscapes.

Port Map_conclusion of all material conflicts

Composite Conflicts

The preceding vertical analysis is completed by an horizontal process that compares the three types of conflicts: the environmental, the social and the material defining the critical territories of the underlying spatial structures as the first body of the transformation processes initiated by the energy transition. The following maps, then, present the four types: the environmentally critical, the socially critical, the materially critical and the composite critical territories that concentrate mainly in the port area. The composite territories are characterised by the intersection of issues present in two or more of the social, environmental and material dimensions and define the table below.

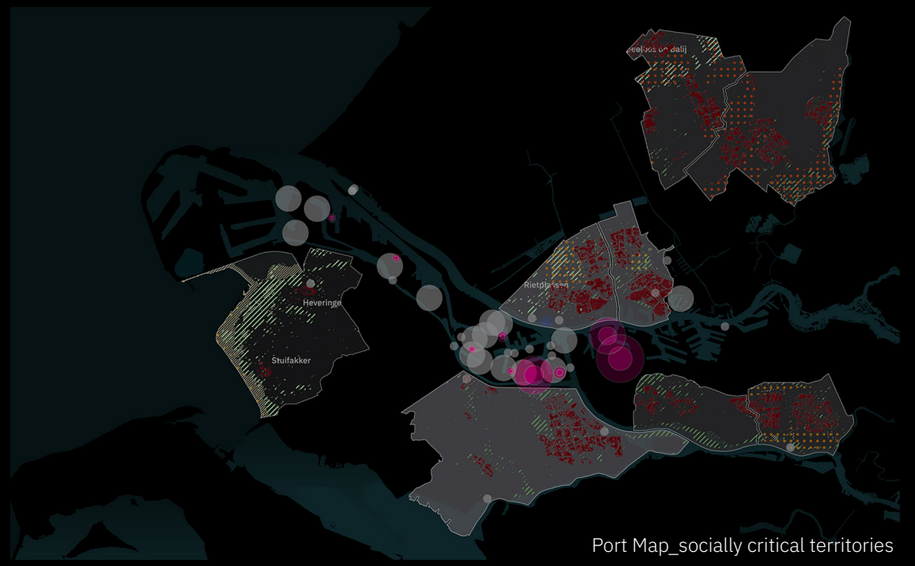
Critical Territories:

1. Environmental + social
    - Hoek van Holland - Westland
    - Hoogvliet - Rhoonse Grienden

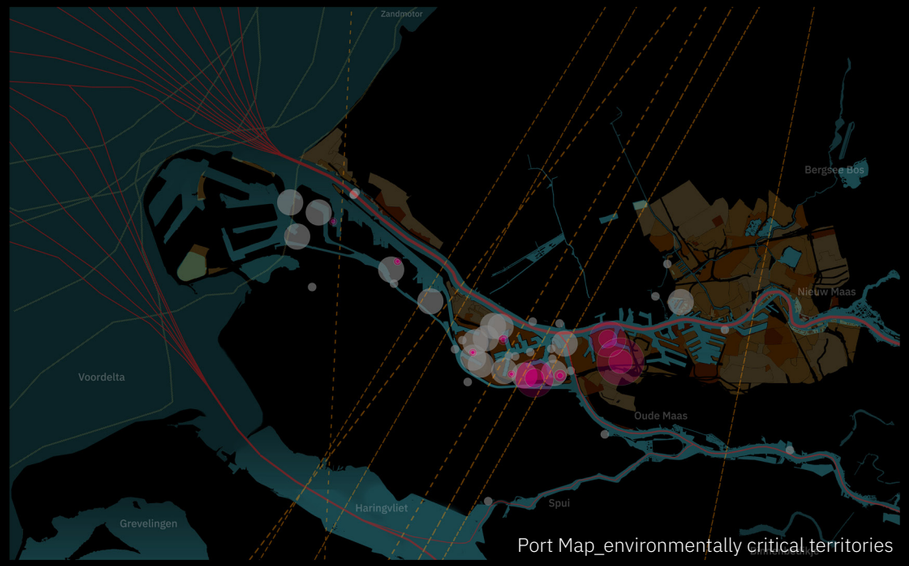
2.Material + social
    - Rozenburg - Botlek
    - Charlois

3. Environmental + material
    - Maasvlakte
    - Rockanje - Oostvoorne

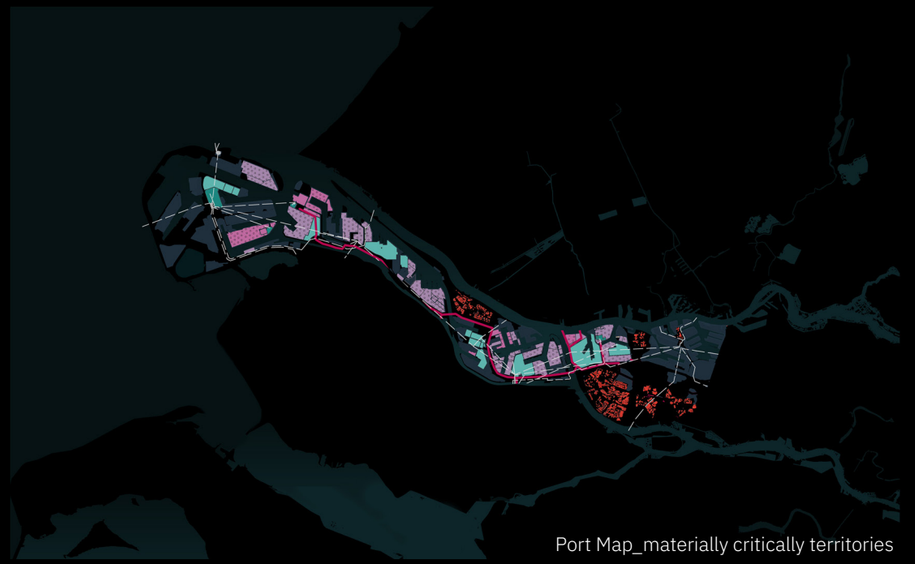
4. Environmental + social + material
    - Pernis
    - Vlaardingen - Rietplassen



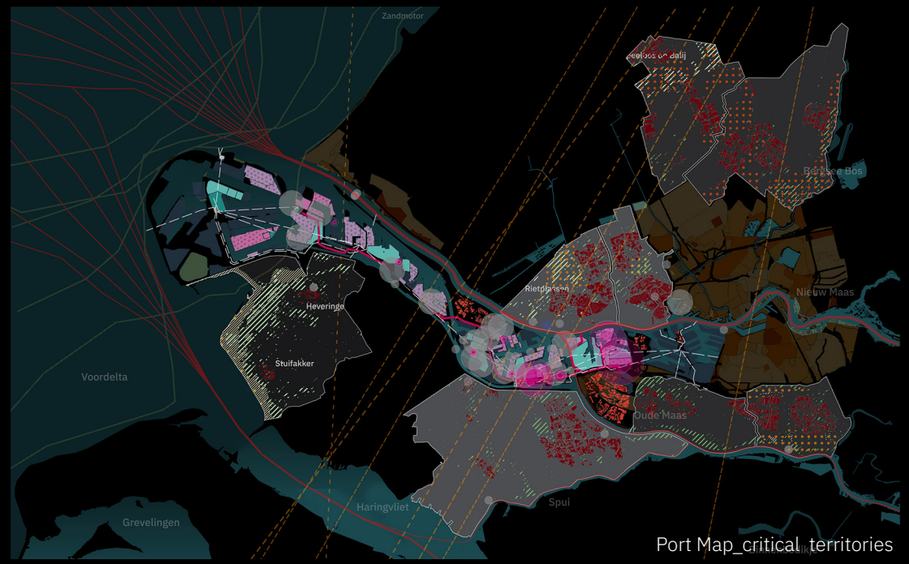
Port Map_socially critical territories



Port Map_environmentally critical territories



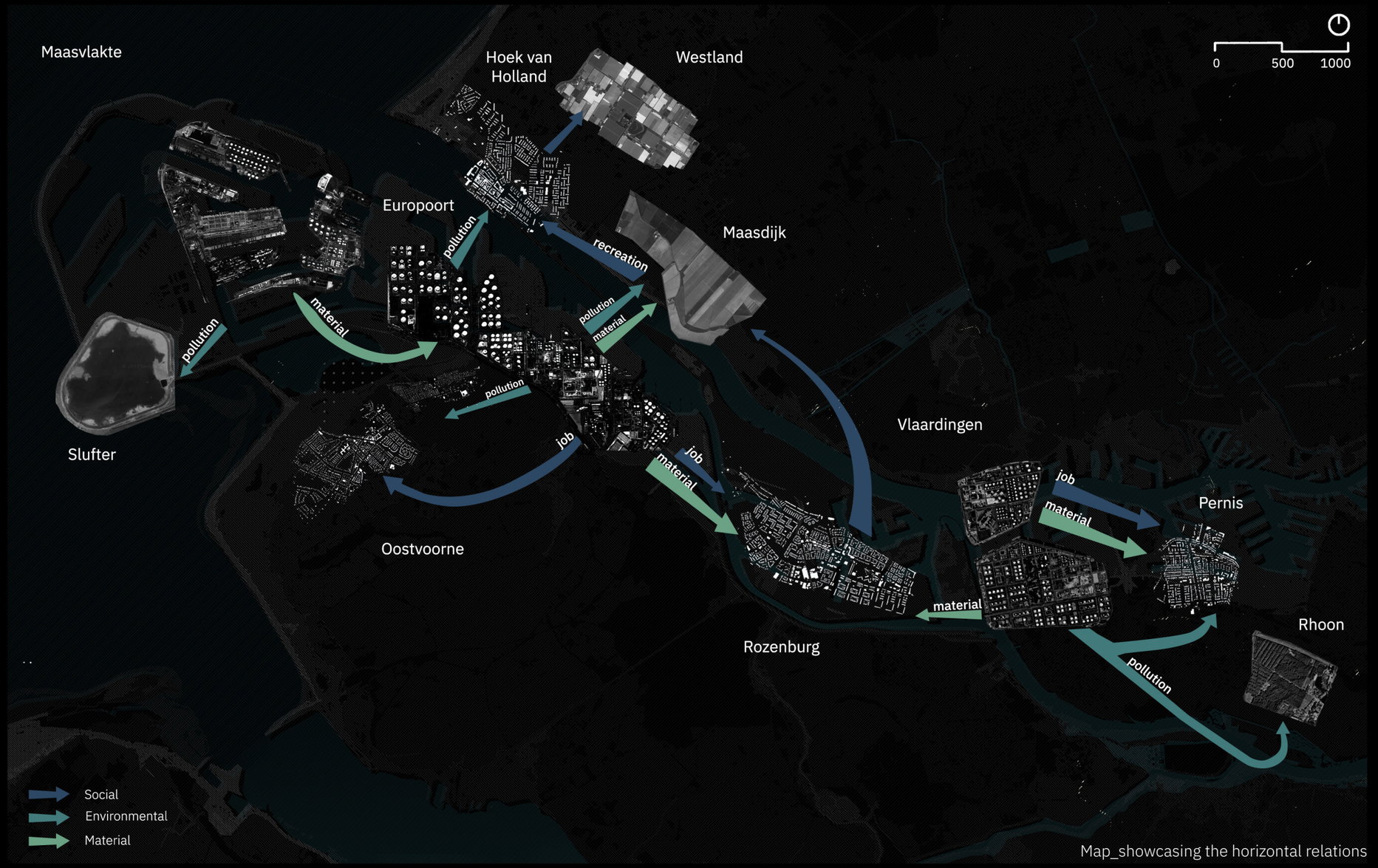
Port Map_materially critically territories



Port Map_critical territories

Composite Conflicts

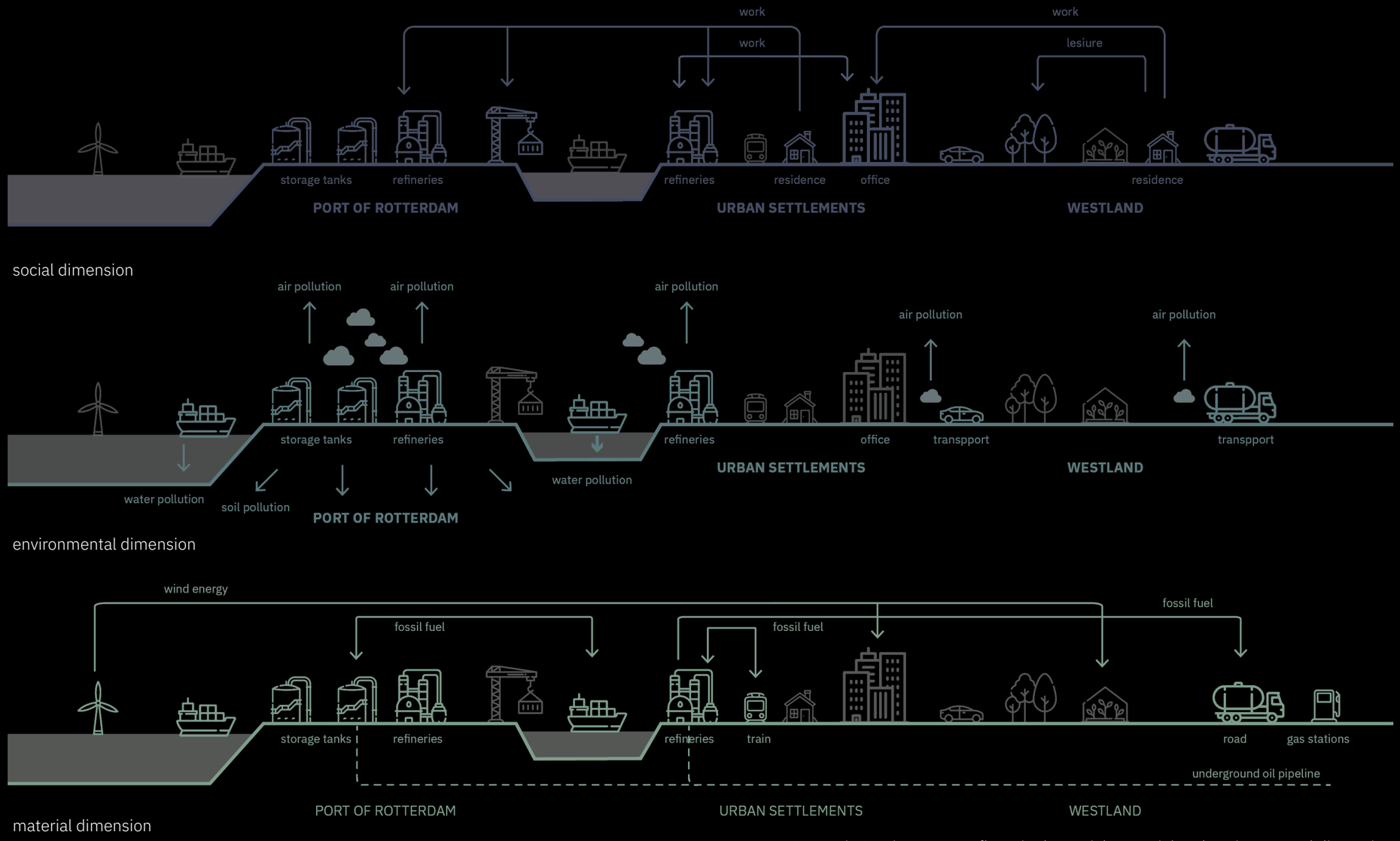
These critical territories are then interpreted as interconnected islands rather than segregated localities defined not only by proximities but also from an invisible network of flows. Inputs and outputs, in line with the three dimensions, are mapped between territories to establish both existing conflicts and possible future synergies that can reshape problematic relationships while harnessing untapped potentials within the port. Each island consists of different landscapes, cityscapes and energyscapes, currently fenced but structurally interconnected. These islands bring together the two readings of space, the one of the horizontal metropolis and the one of the abstract network of relations in an archipelago structure, that define our spatial approach in the following design process, as well as the focus in three scales: the islands as nodal points, their relations as a network and their expansions as the underlying continuous structure.



Map_showcasing the horizontal relations

Composite Conflicts

Trying to define the transition from the nodes to the network of nodal points, human movements, environmental externalities and material infrastructure are examined using the following systemic sections. Through a generalisation of existing energy production, distribution and processes; and associated flows, the system is again broken down into its social, environmental and material dimensions, that define power dynamics as the invisible planners of space.



Systemic Section_current flows in the social, material and environmental dimension

Power Relations in the Energy Transition

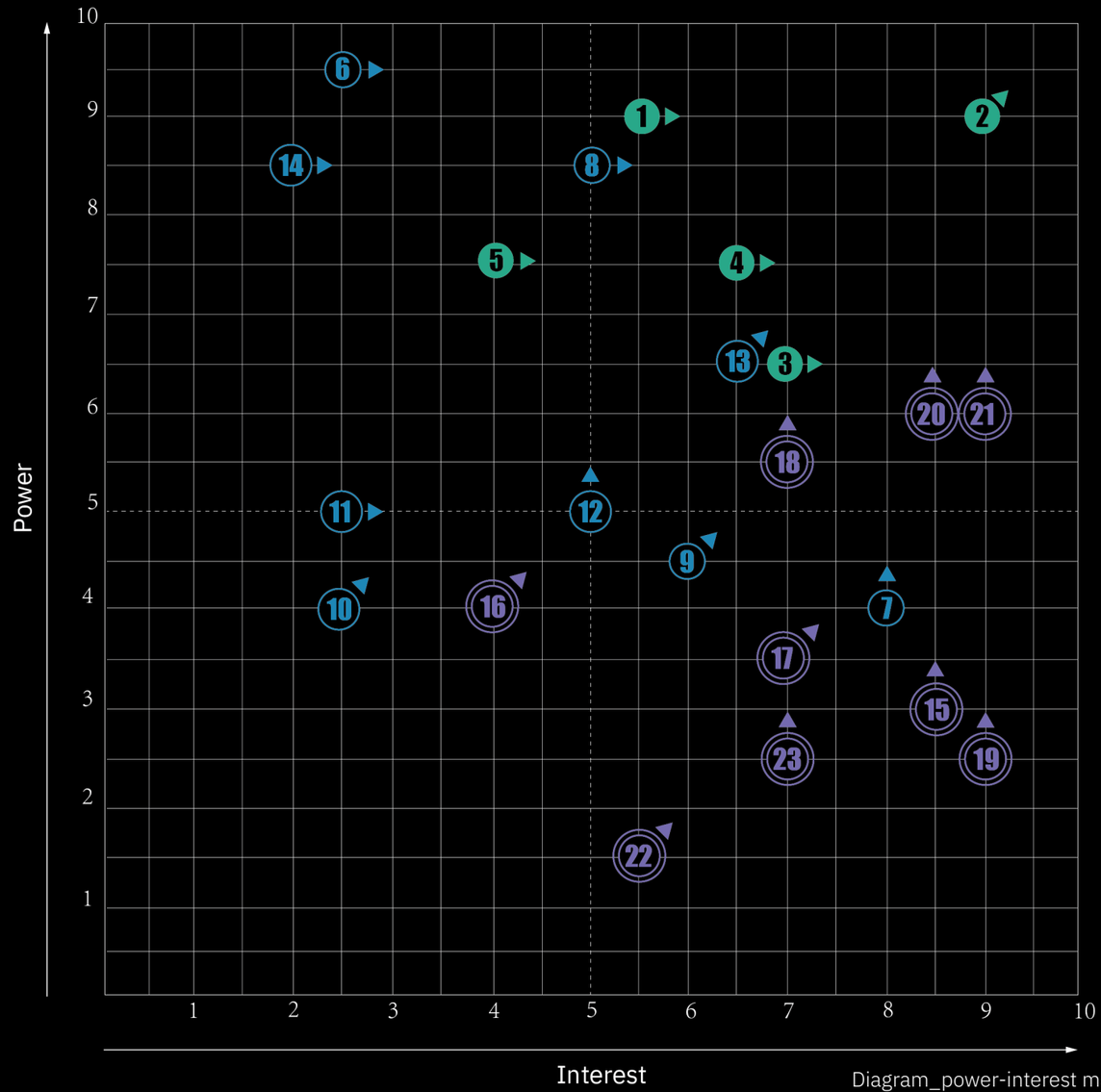
Thus, the analysis of the Port of Rotterdam shifts from the study of the spatial layout to an attempt to comprehend the underlying power dynamics that dictate the energy transition management and planning practices. This process begins by identifying the different actors with varying interests and powers that will be involved in the process. To get a better understanding of their position towards the transition and intention upon participating, the following tables, diagrams and maps are developed. In them, actors are presented as part of either the public or private sector, or the civil society and are mapped in the broader Province of Zuid Holland to visualise their spatial sphere of influence.

As a result of this process, presented in detail on the next pages, the power-interest matrix, adapted from the book "Making strategy: Mapping out strategic success" by Ackermann & Eden (2011), shows where the most relevant actors are located within the interrelation of power and interest regarding the energy transition, as well as where they are headed in the coming years. It becomes immediately obvious that the private sector, including the energy-related companies, is currently the most dominant factor, although its interest towards the energy and social transitions is questionable. At the same time, civil society signals a high interest in this transition but the power to act is judged as relatively low and definitely requires empowerment. The public sector appears to be somewhere in between holding a significant amount of power related to the transition management and showing the biggest interest in the implementation of the new energy systems. Their interest in the simultaneous social transition, though, is not clearly defined and requires more targeted policies, strategies and tools.

PUBLIC SECTOR
1 European Union
2 Dutch National Government
3 52 Municipalities
4 Port Authority
5 Rijkswaterstaat and Water boards

PRIVATE SECTOR
6 Fossil energy companies
7 Renewable energy companies
8 Electricity and gas suppliers
9 Agricultural companies
10 Transportation companies
11 Logistics companies
12 Port related companies
13 Recycling companies
14 Investors

CIVIL SOCIETY
15 Labour associations
16 Housing associations
17 Knowledge institutions
18 Innovation hubs
19 Environmental associations
20 Non-government Organisations
21 National Research Organizations
22 Energy Industry Workers
23 Inhabitants as Energy Communities

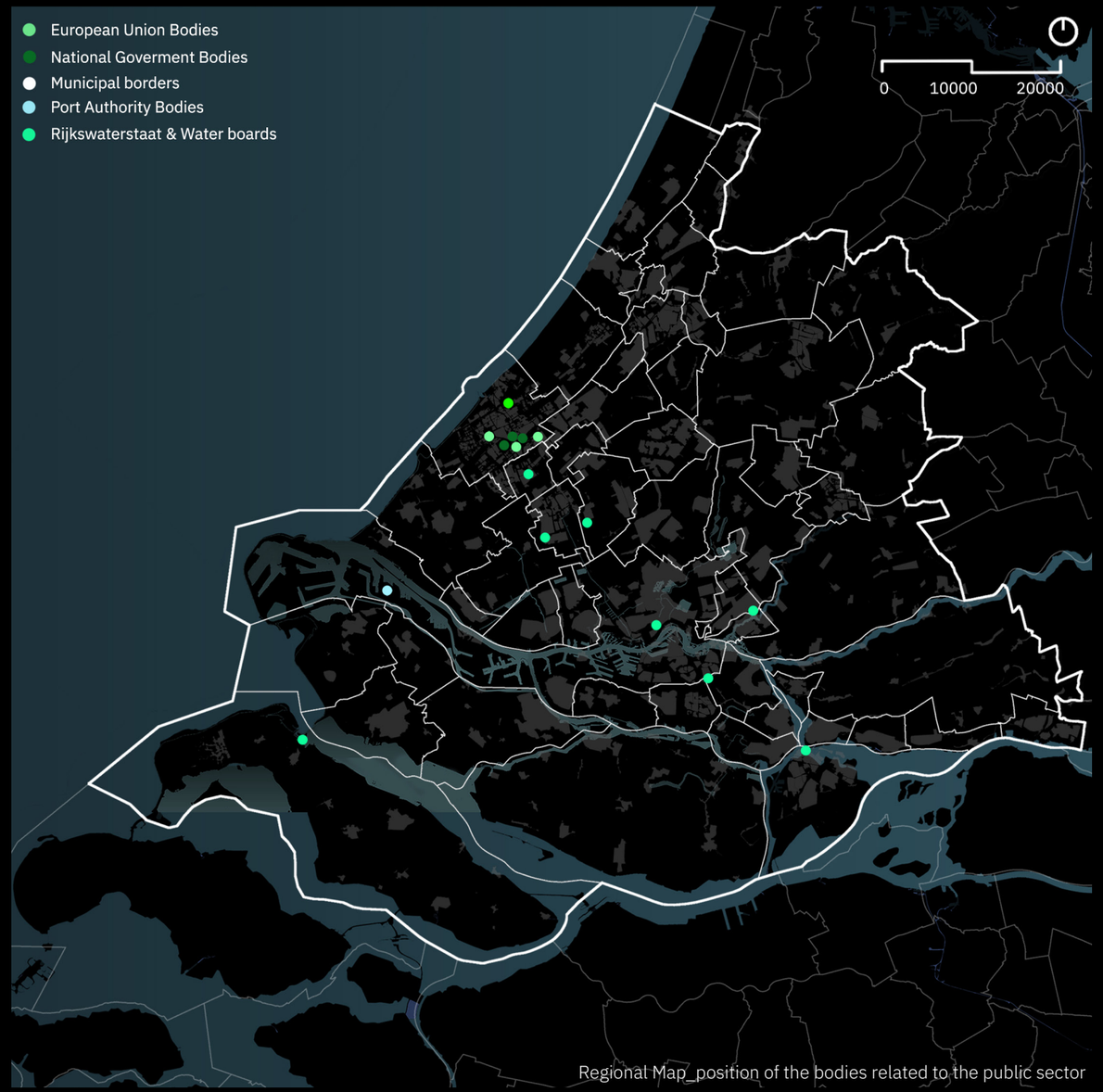


Diagram_power-interest matrix

Power Relations in the Energy Transition

Public sector

STAKEHOLDER/ ACTOR	TYPE OF INTEREST	TYPE OF POWER
European Union	Fulfillment of European visions (European Green Deal and Paris climate goals)	Providing funds Setting restrictions and fines Setting goals
Dutch National Government	Conservation of the central position in the economic life of Europe Improved living conditions	Formulating national laws Providing funds and subsidies Setting restrictions and fines Setting goals and visions
Province of Zuid Holland	Stable and competitive economy Improved living conditions Increased biodiversity Transition to circular economy	Formulating regional policies and strategies Planning spatial developments Distributing funds and subsidies Setting restictions and fines Setting goals and visions
52 Municipalities	Financial stability Increased investment Improved living conditions	Investing and funding Setting restrictions Setting goals and strategies Coordinating spatial developments Issuing development permits
Port Authority	Ensured companies interests Conservation of the port's position as the biggest port in Europe Gradual Digitization Transition to circular economy	Implementing governance codes and regulations Coordinating with international port laws and goals Supervising all port related actors
Rijkswaterstaat and Water boards	Increased water safety and flood resilience Improved water quality and accessibility Incorporation of water management on all levels	Regulating and coordinating water management

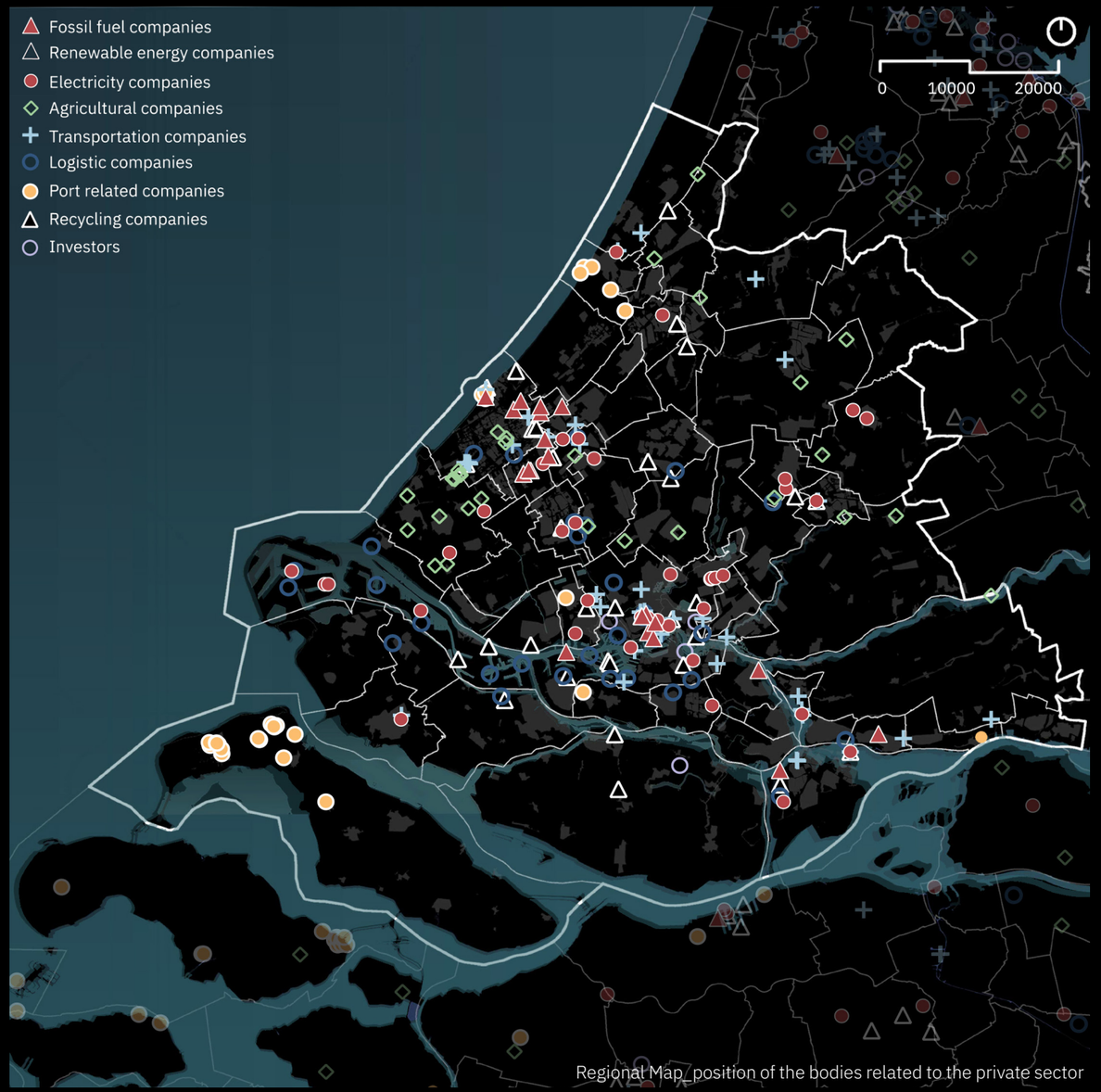


Regional Map_position of the bodies related to the public sector

Power Relations in the Energy Transition

Private sector

STAKEHOLDER/ ACTOR	TYPE OF INTEREST	TYPE OF POWER
Fossil energy companies (Shell, BP, Air Liquido, Enecogen, Uniper, Engie)	Economic advancement Maintenance of influential and powerful position in the energy sector	Meeting the current energy demands in the Netherlands and beyond Acting as main employer in the region Owning the biggest parts of the port's structure
Renewable energy companies (Sunstroom, Enercon, Vestas, Vopak)	Economic andvancement Increased power and influence in the energy sector Increased cooperations with knowledge institutions and innovation hubs	Growing as the future main energy providers Supporting the energy transition
Electricity and gas suppliers	Economic advancement Integration of new energy systems in their distribution networks Maintenance of position as main provider in the region Increased cooperations with knowledge institutions and innovation hubs	Owning the current fossil fuel related gas and electricity distribution network Retaining strong market position Influencing the future development (spatial layout) of distribution networks
Agricultural companies (Biomass producers, farmers)	Economic advancement Maintenance of space and land-use	Owning the biggest part of Zuid Hollands land
Transportation companies (NS, private companies)	Economic advancement Maintenance of position as the main providers of transport in the region Integration of new energy systems in the transportation network	Owning the current fossil fuel related transportation networks Retaining strong market position
Logistics companies	Economic advancement Improved efficiency of logistics services Increased digitization	Influencing the distribution of services and goods
Port related companies (Shipping, Fishing, Ship building)	Economic advancement Integration of new energy systems in the supply chains Improved efficiency of services Increased digitization	Maintaining the current position as key players in supply chains
Recycling companies	Economic advancement Increased cooperations with knowledge institutions and innovation hubs Transition to circular economy	Defining the potential for circularity Supporting the energy transition Growing as a future key player in the port's circularity
Investors/ Real Estate developers	Economic advancement Participation in profitable and secure developments	Influencing the realisation of projects and developments

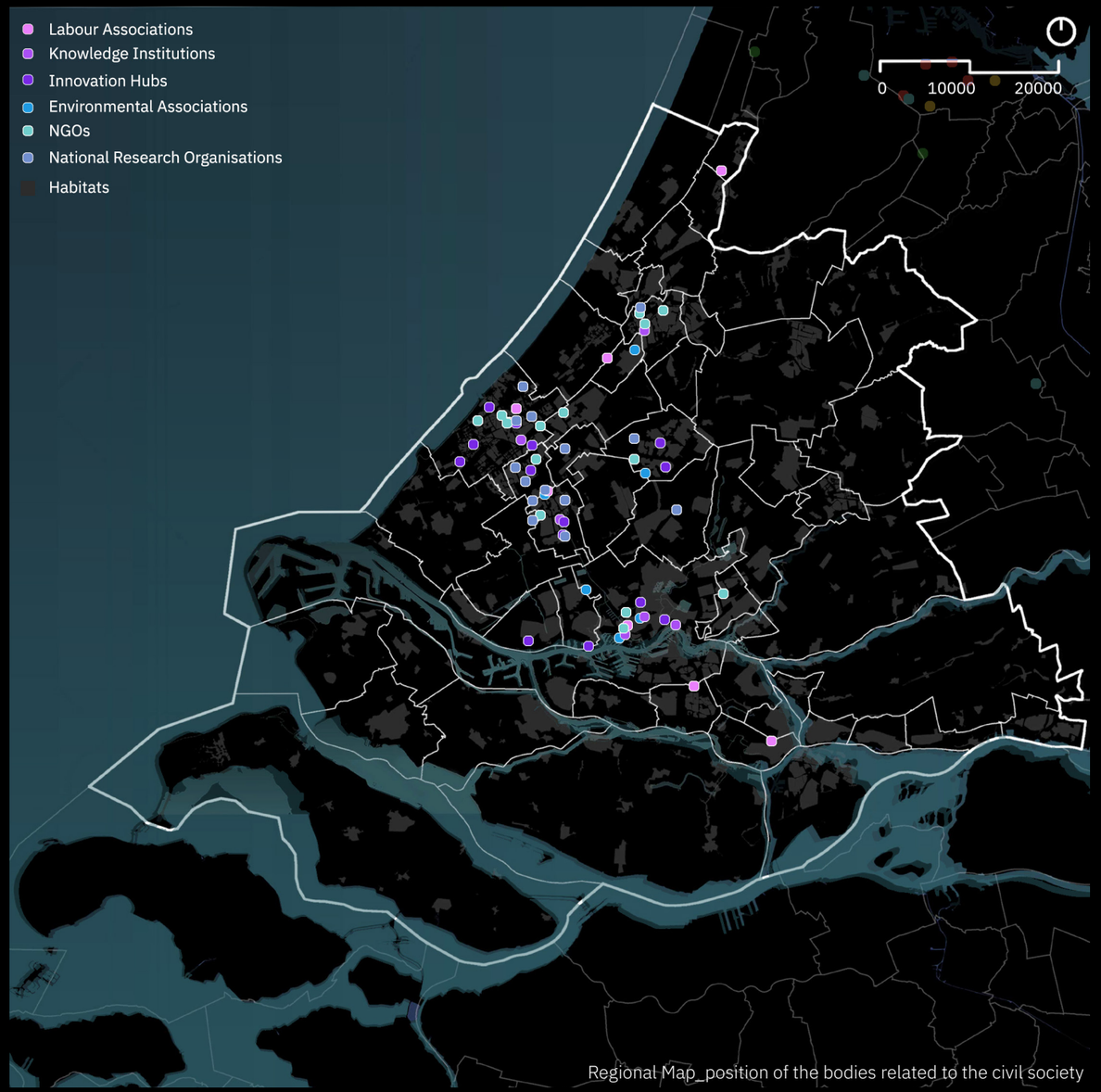


Regional Map, position of the bodies related to the private sector

Power Relations in the Energy Transition

Civil society

STAKEHOLDER/ ACTOR	TYPE OF INTEREST	TYPE OF POWER
Labour associations	Improved working conditions Maintenance of jobs and employability Protection of workers‘ rights	Confronting and controlling both the public and private sector regarding employing and working conditions
Housing associations	Improved living conditions and housing affordability Maintenance of low energy cost	Confronting and controlling both the public and private sector regarding living conditions and future developments
Knowledge institutions (Erasmus Rotterdam, Delft, Leiden)	Increased cooperations with the private and public sector for testing, experimentation and innovation	Providing knowledge to industries, policy makers, developers and the civil society
Innovation hubs RDM. Botlek	Increased cooperations with the private and public sector and knowledge institutions for testing, experimentation and innovation	Developing innovative technologies and providing them to industries, policy makers and knowledge institutions
Environmental associations	Decreased carbon emissions and dependency on fossil fuel Accountability of the private sector for its impact on the climate crisis Minimized negative environmental footprint of developments	Influencing the regulations regarding future visions, strategies and developments Pressing towards renewable and circular energy transition Controlling for potential violations
NGOs	Protection of human and environmental rights	Working with governmental institutions for better representation of civil society Controlling for potential violations Pressing towards a just energy transition
National Research Organizations (TNO, RIVM, NWO, KNAW)	Improved evidence	Assessing policies, strategies and visions Working with government for more informed decision making
Workers in the energy industry	Improved working conditions Maintenance of jobs and employability	Implementing or opposing central decisions
Workers in the agricultural industy	Improved working conditions Maintenance of jobs and employability	Implementing or opposing central decisions
Inhabitants as energy communities	Improved living conditions and housing affordability Maintenance of low energy cost	Implementing or opposing central decisions



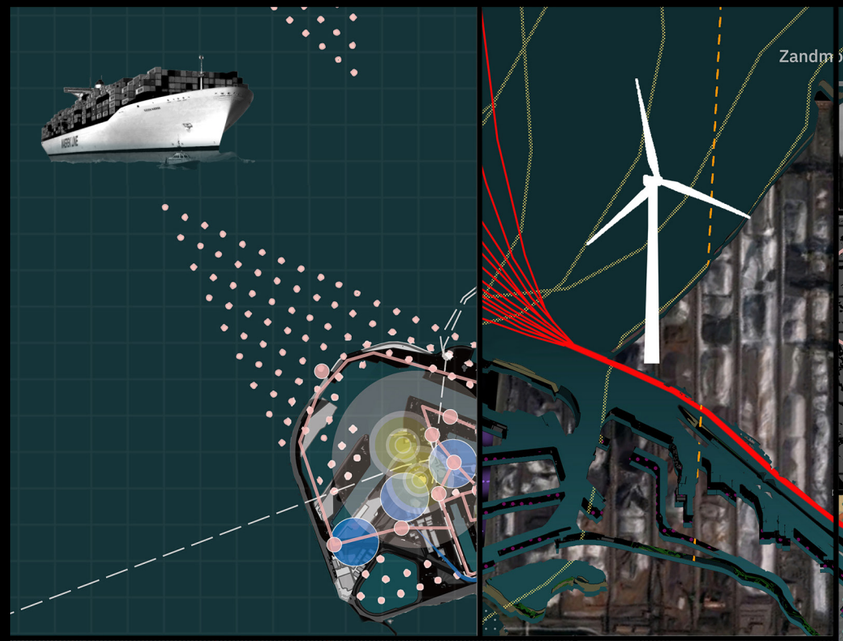
Regional Map_position of the bodies related to the civil society

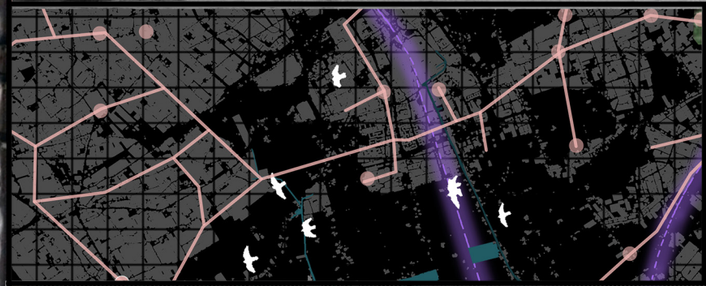
Diagnosis Results

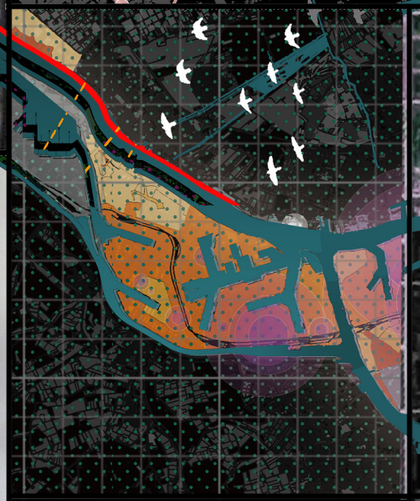
Overlapping issues and potentials:
The juxtaposition of the decomposed layers of the port's landscape, makes apparent intersections in issues and potentials in the three thematic dimensions, while at the same time revealing critical territories for the initial spatial interventions.

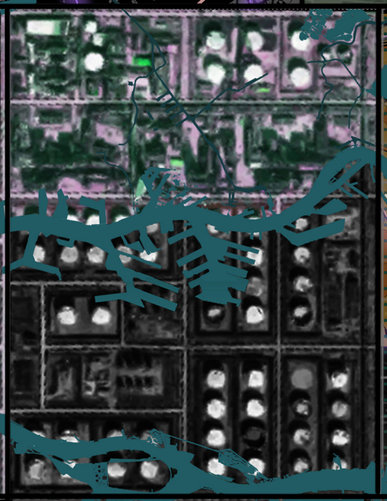
Territorial conflicts and synergies:
The horizontal analysis of inter-territorial inputs and outputs reveals hidden connections between the seemingly independent islands, characterised by conflicts and synergies that can be harnessed through a new symbiotic energy system.

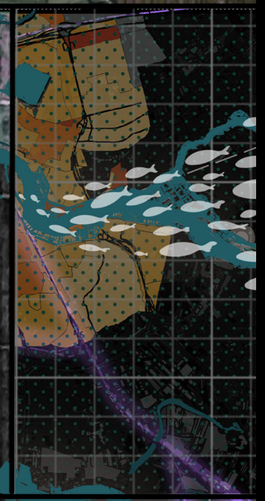
Systemic flows and power relations:
A generalisation of the current energy landscape and its consequent re-interpretation in the thematic dimensions, presents an opportunity for the energy transition to reconfigure not only existing spatial structures but also redefine invisible power relations in the future energy system. To avoid a solely top-down approach regarding planning decisions, participatory planning tools should be used to balance the process, while the private sector needs to be engaged in mutually beneficial synergies and cooperations.

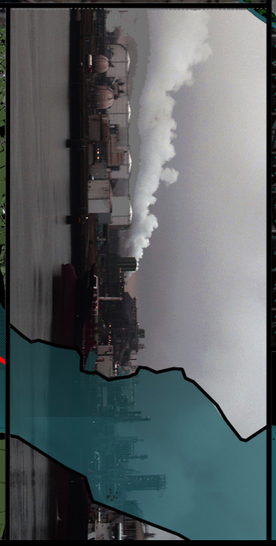


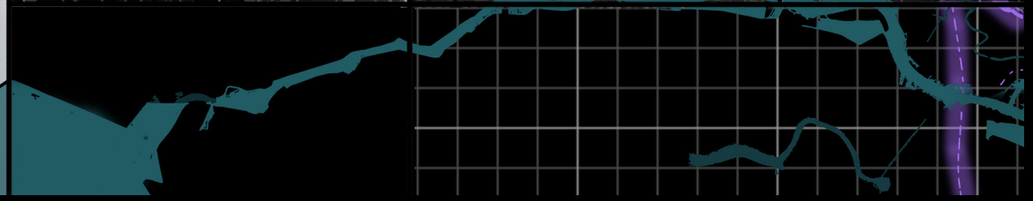












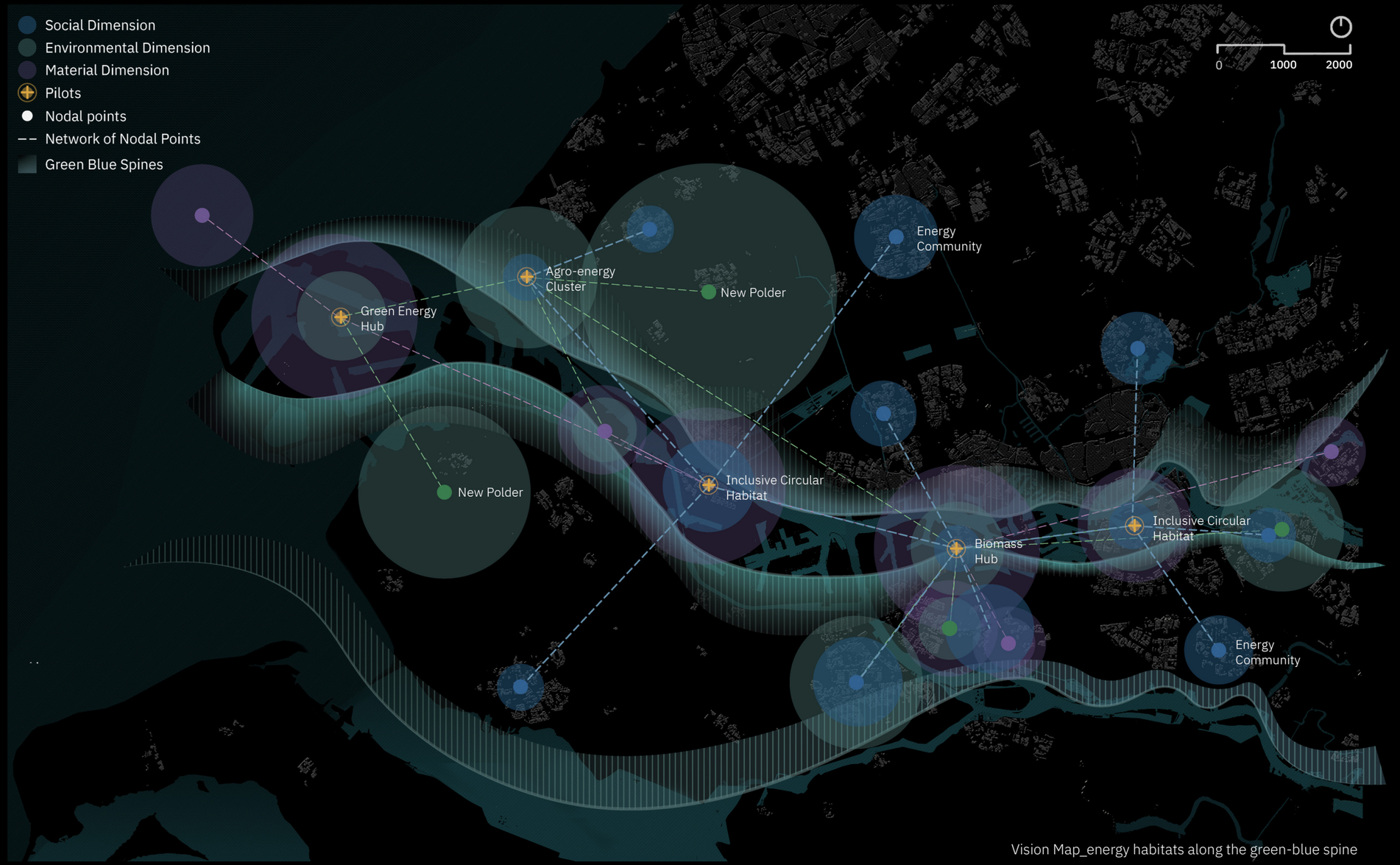
VISION

Towards an Energy Habitat in 2070

Energy Habitat

In 2070, the Port of Rotterdam will be a true **“Energy Habitat”** where natural and man-made systems coexist in symbiosis and form synergies through an innovative, viable, inclusive, and dynamic framework based on community-led planning. This energy habitat will have the form of a **just green-blue spine** that will restore the port’s identity as the delta area of Maas river through the gradual phasing out and repurposing of the energyscapes associated with the fossil fuel production, transportation and distribution, and the implementation of combined nature-based solutions.

This will be achieved through a strategy that firstly defines the most problematic areas of the port and then uses them as the **initial pilot cases** for the implementation of a bilateral process that incorporates **bottom-up and top-down** approaches in an effort to transform material landscapes combining renewable energy production systems with new natures. Subsequently, it upscales and multiplies the pilot cases creating an **interconnected network of nodal points** that reconfigure the spatial layout of the port of Rotterdam redistributing the burdens and benefits of the energy production processes. Finally, it connects the networks of nodal points through a continuous and porous green-blue spine that interweaves transitional energyscapes, cityscapes and biotopes improving living conditions in the broader port area for all species. The resulting spatial and social structure sets a new paradigm for the planning and management of a just energy and social transition.



Vision Map_energy habitats along the green-blue spine

Energy Habitat in the UN Context

As mentioned in the vision statement, the main goal of the "Energy Habitat" approach is to use the energy transition as an opportunity to improve spatial justice for all living species located in the Province of Zuid Holland. In that sense, the integration of the Sustainable Development Goals (SDGs) is structurally interconnected to the strategies, policies and actions, as explained in detail in the following diagram.

Connection to Social dimension
By improving living conditions in vulnerable settlements and transforming them into energy communities through the introduction of decentralised energy systems and depolluting measures, the vision links to the SDGs 3,6,7,10 and 11. Inequalities are being reduced as access to a healthy living environment and energy independence are increased, while the introduction of bottom-up processes ensures participation and representation of underprivileged groups. Overall, the reconfiguration of the Port achieves a redistribution of burdens and benefits.

Connection to environmental dimension
By restoring biotopes and constructing new natures through the implementation of combined innovative energy systems with depolluting solutions and the imposition of environmental restrictions, the project aligns with the SDGs 12,13,14 and 15. The development of the green-blue spine that ties to the Maas sancturary initiates processes of conservation and renaturation ensuring biodiversity.

Connection to material dimension
Finally, by dealing with the existing and future material landscapes through circular practices of reusing, repurposing and recycling, as well as innovative practices for the integration of renewable energy systems, the vision corresponds to the SDGs 7,9 and 12 which promote sustainable systems and circularity.

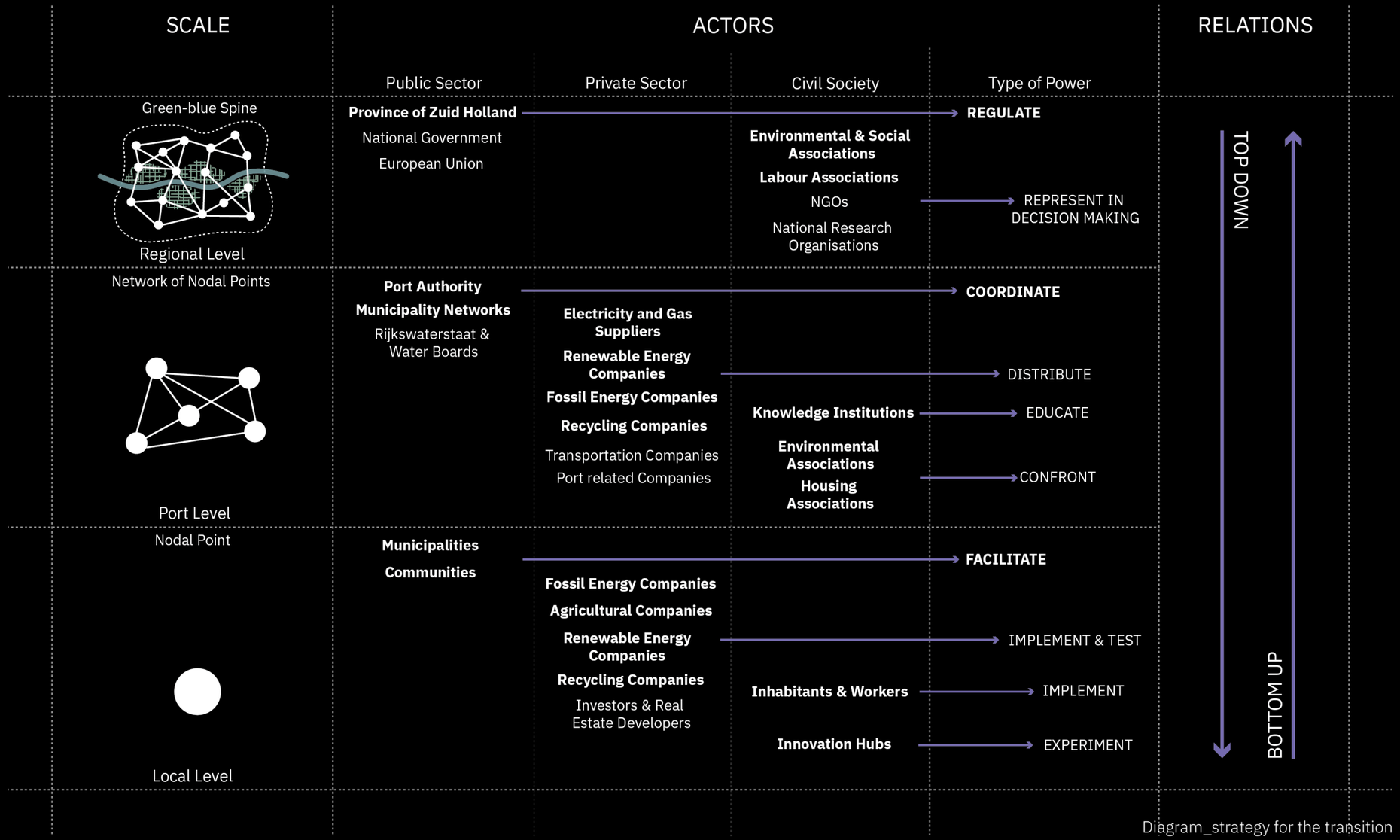
Diagram_relation in a broader context (Source: Data from United Nations: Department of Economic and Social Affairs, 2015)

STRATEGY

Construction of a green-blue Spine

Counterbalancing Transition

In this context, the vision of the “Energy Habitat” for the Province of Zuid Holland is translated into a strategy that follows a bilateral approach for implementation in terms of both scale and relations between involved actors, based on their type of power and means of action.
Concrete actions initially take place on the local level, facilitated and implemented through municipalities and communities. They follow regulations formulated on the regional level from the Province of Zuid Holland and contribute to the long-term creation of a green-blue spine in the Port territory. These places of action are called nodal points and function as experimental and testing pilot cases.
Throughout the transition these initial pilot cases upscale and multiply forming a network of nodal points that spread across the Port level. In that scale, exchange between local actors is coordinated by the Port Authority and municipal collaborations. Knowledge institutions play a key role not only for the exchange of knowledge related to the energy transition and the experiments, but also as spaces for cooperation between the private sector, public sector and civil society. This interaction is integral for the successful implementation of the vision since it engages the main actors affected by the energy transition, notably energy-producing companies, communities as current consumers and future prosumers, and governmental institutions in a process of negotiation that simultaneously empowers powerless stakeholders and controls possible power misuse.
Finally, as the expanded networks intersect they complete the growth of the green-blue spine in the regional level, according to the regulations set by the Province of Zuid Holland from the beginning of this process continuously incorporating new input from the gradual implementation in local communities through responsible environmental and social organisation and research institutes.



Diagram_strategy for the transition

Counterbalancing Transition

This strategy has led to the development of a specific set of policies, presented in the following page, that can be summarised under three main categories; shaping, encouraging and regulating.

Shaping describes the development of spatial plans including the spatial vision, zoning and land use plans, as well as the selection of territories as pilot locations for concrete implementation. While these spatial plans are initiated by the Province of Zuid Holland as top-down actions, the incorporation of participatory planning instruments like surveys, planning workshops and discussion rounds, ensures that actors of all sectors contribute to the creation of these spatial plans which makes them more inclusive and just.

Encouraging aims to motivate actors and facilitate the transition process by providing financial support and creating synergies. Zero-interest energy loans, funds and subsidies ease the implementation of new energy systems in the communities through pilot projects and initiatives while promoting the development of innovative ideas. The establishment of education hubs and strengthening of innovation hubs, enhances and creates networks between actors of all sectors at the same time promoting cooperation.

Regulating is used by the public sector to ensure the execution of structural changes that are necessary for the imminent transition. These restrictions consist of goals and regulations regarding the implementation of renewable energy systems, pollution fines and special permits to ease experimental and innovative energy production.

REGULATING
Taxes, Restrictions, Permits

Amid the urgent need for an energy transition the **Province of Zuid Holland** sets **restrictions** regarding the development and use of energy systems for **energy production and distribution companies** in the port territory and the region. The restrictions will be based on an **environmental impact assessment** of the various energy systems.

Existing **regulations** regarding the expected energy use and production in future urban developments or in renovations will be amplified by the **National Government**. Concrete **goals** for the amount of renewable energy systems to be implement will be defined. The process of implementation will be overseen by the respective **municipality**.

To ensure a fast and just transition away from fossil fuels and its polluting properties, the **Province of Zuid Holland** appoints the **depollution of compromised territories as a main priority** during the transition process. **Companies related to the transportation, logistics, energy production, agriculture and construction** located in the region and specifically in the port, will have to be aware of a **pollution fine** stipulated by the **National Government**.

Based on national regulations and in line with the vision towards a renewable energy transition, the **Province of Zuid Holland** provides **special permits** to **energy production companies and energy communities** to facilitate the testing of experimental energies.

ENCOURAGING
Synergies and Funds

Education hubs are developed along the nodal points as a synergy between the **energy companies, the port municipalities and the educational institutions** in order to provide the essential knowledge for the renewable energy transition to the new **energy communities** and to retrain **workers** for the new production means.

To stimulate the renewable energy transition, the **European Union and National Government** provide **funds** for the development of innovative recycling and energy systems. Together with the **Port Authority, the Province, knowledge institutions as well as recycling and energy production companies**, **innovation hubs** in the port territory will be strengthened to facilitate testing and experimenting.

To improve the condition of natural and social habitats in the port and its adjacent territory, the **European Union and the National Government** provide **funds to support projects and initiatives** developed in synergy among the **private sector, NGOs and knowledge/ research institutions** that aim to decontaminate and provide combined energy solutions.

The **European Union** and the **National Government** will provide **subsidies and funds** to support the **Province of Zuid Holland and the respective municipalities** to return land into their ownership that is either intended to be restored into a natural habitat or to be transformed into a new energy landscape.

Zero interest energy loans and subsidies are provided to the **energy communities** by the **National and Municipal Government** to enable the implementation of necessary decentralised renewable energy systems in a just way.

SHAPING
Spatial Plans

Participatory planning will be used by the **Province of Zuid Holland** during the development of **spatial plans** to involve the **civil society and members of the general public** in the planning process. By harnessing the power of tools like **surveys, planning workshops and discussion rounds**, and elevating the role of **environmental and social associations**, important additional knowledge about the spatial conditions will be accumulated while simultaneously adding a new perspective.

An **environmental zoning plan** for the green-blue spine that is developed through the involvement of **environmental associations, knowledge institutions and the port authority** will be laid down by the **Province of Zuid Holland** to establish new protection zones in the port while also appointing areas intended for renaturation.

As part of the **spatial vision** for the energy transition the **Province of Zuid Holland** provides a **land-use plan** to illustrate new and necessary changes that have to be made in regards to the spatial layout in the region. Due to the transition away from fossil fuels, a special attention will be given to the emerging fossil-fuel related drosscape in the port and its adjacent territories. Therefore, the plan will be developed together with the **port authority and related actors from the public sector and the civil society**.

In the initial phase of the transition towards energy habitats, **pilot territories will be selected** by the **Province of Zuid Holland**. They function as **testing sites for the implementation** of new energy systems and the transformation of energy landscapes to develop a **general guide for implementation**. The transition process will be supervised by a **local energy managers in the respective territories**, who will simultaneously be in constant exchange with other energy managers through a **knowledge hub**.

Growing the Spine

Tying back to the strategy, the following diagram explains how the “Energy Habitat“ vision, growing from initial nodal points to interconnected networks and finally to the blue-green spine, is phased through strategic goals and related actions in parallel to the energy transition.

Initiating through nodal points

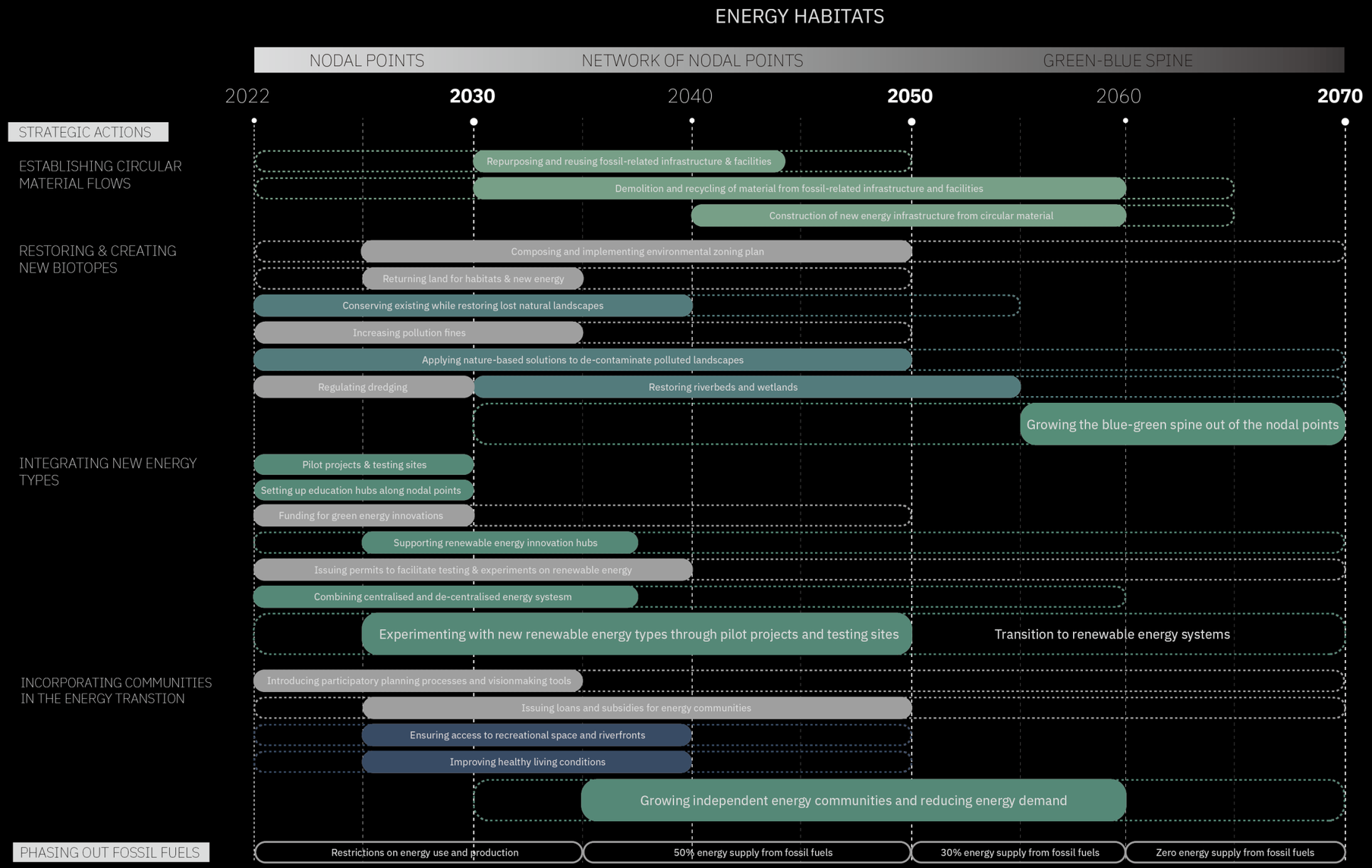
Based on Zuid Holland‘s vision for the transition, regulations and pilot projects are set in place. The main goals are the immediate start of testing and experimenting with renewable energy systems and integrative solutions, not only in innovation hubs but also in the emerging energy communities. Meanwhile, restrictions to protect natural landscapes are implemented and the continuous process of depollution is set into action.

Forming the network

Facilitated through newly established and strengthened education and innovation hubs, collaborative networks between the individual actors and territories emerge. Through the ongoing phase-out of fossil fuels, gradually more and more materials are to be repurposed and integrated into circular flows. The process of depollution is continuous and with the deconstruction of fossil fuel infrastructures and the spatial transformation of the Port territory, renaturation in these areas becomes possible. During this phase strategic goals and actions associated with the creation of nodal points are increased in parallel to the upscaling and multiplication of these nodes.

Evolving into the spine

Over time the separate interventions and actions together with the growing network evolve into the green-blue spine as the overarching structure that connects the emerging individual energy habitats, in its dual spatial and social identity. This last phase is characterised by a complete transition to renewable energy systems and full integration of construction and demolition circular flows in planning practices.



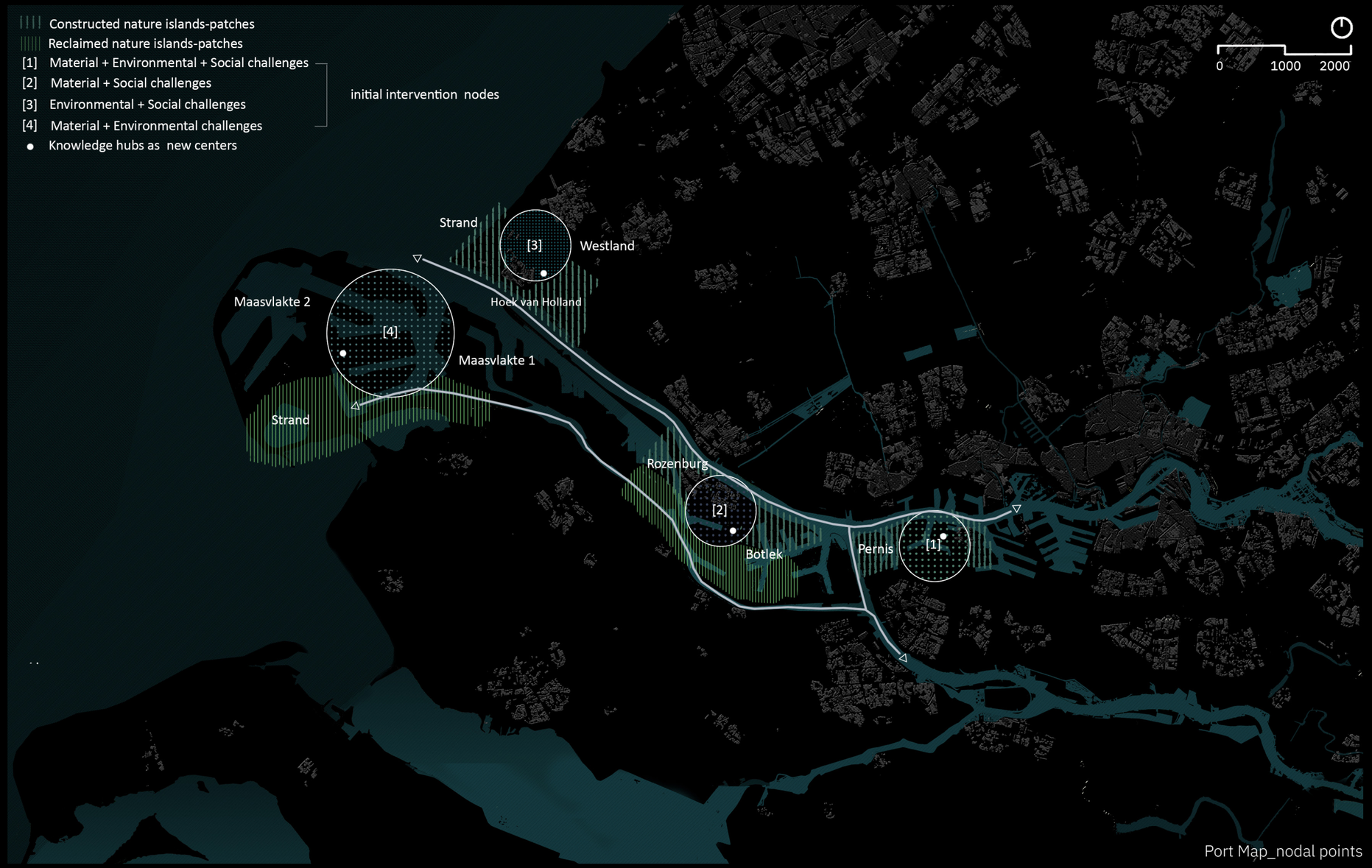
Diagram_phasing of the transition

Growing the Spine

Initiating through nodal points

The following map thus shows the first phase of the transition from an impending drosscape towards a green-blue spine in the Province of Zuid Holland. The four indicated nodal points are the most critical territories identified for the initial implementation, each representative of the overlaying challenges established during the analysis and of the different landscapes that can be found in the broader Port region. The indicated nature-island patches are activated by the nodal points and initiate the parallel development of the spine along the Nieuwe Maas river.

Specifically, the selected nodes consist of Hoek van Holland and Maasvlake, both positioned in the estuary of the Nieuwe Maas river, as well as Rozenburg and Botlek, forming an entity, and lastly Pernis on the outskirts of Rotterdam. As areas with different conflicts and critical conditions, they are chosen as the optimal testing locations for the implementation of experimental energy production types and innovative solutions. Each territory revolves around a newly introduced knowledge hub that aims to share knowledge on new energy systems related to the energy types with greatest potential in the specific landscapes. These hubs are focused on varying challenges that come with the impending energy transition. While they explore alternative solutions and test the immediate implementation on site, they are also intended as facilities to promote and encourage interaction between actors of all sectors.



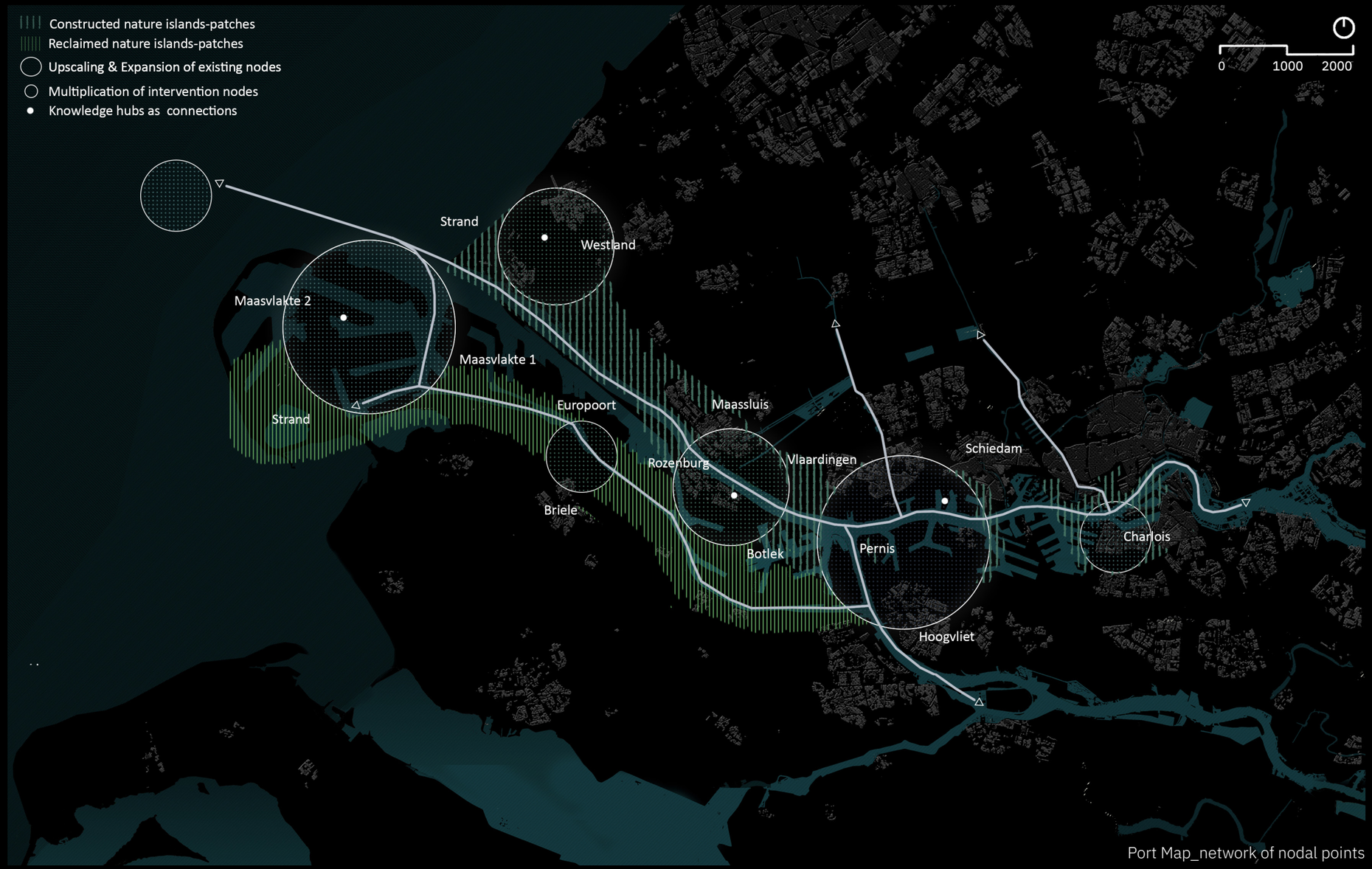
Port Map_nodal points

Growing the Spine

Forming the network

In the second phase, showcased in the following map, the structure of the green-blue spine already becomes dominant demonstrating how the dross-scape in the Port of Rotterdam is slowly transformed into a redefined spatial element that ties back to the water flows of the Maas delta area. Two distinctive corridors compose the spine, one created out of the restored biotopes along the southern riverbed, and one assembled out of the newly constructed material natures that participate in the energy transition.

At the same time, the initial nodal points expand into their adjacent territory upscaling through the formation of networks,while new nodal points emerge along the spine. These new locations can appropriate the knowledge and experiences of the initial territories using the already established knowledge and innovation hubs as meeting points to gather for and facilitate interconnection and exchange.



Port Map_network of nodal points

Growing the Spine

Evolving into the spine

The third and final phase, shown in the following map, marks the complete transformation of the Port of Rotterdam into a blue-green spine that expands in the Province of Zuid Holland following and conserving the delta water networks. The third phase signified the realisation of the narrative presented in the vision and the subsequent expansion and multiplication of nodal points outside the main port area and towards the green heart. The transition from the fossil fuel regime to renewable energy systems and social structures have been finalised. The new energy habitats are characterised by symbiosis between natural and man-made systems, synergies between natural and material conditions and innovative energy communities that actively participate in the transition management.

Port Map_green-blue spine

Transforming Territories

Examining further the implementation of the strategy in the nodal points, the chosen pilot cases of the first phase are described in the following pages showcasing how the strategies, goals and actions are adapted in the site-specific conditions of the selected territories introducing the new energy systems while constructing the green-blue spine through the individual material landscapes.

Pernis

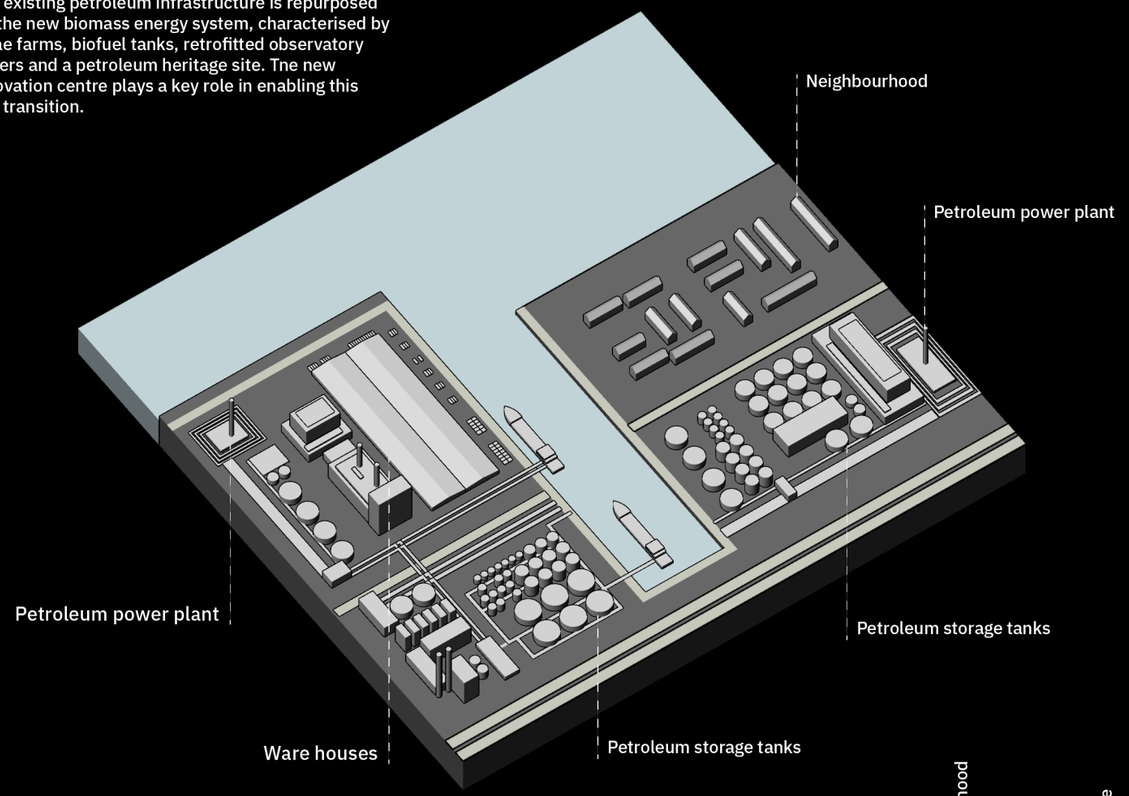
Following its identification in the analysis as a critical territory faced with social, environmental and material conflicts, Pernis is envisioned as an 'biomass hub' that aims to expand the already existing biomass energy systems incorporating algae farms that simultaneously create a new scenic energyscape in the remains of the petroleumscape. This is achieved mainly by repurposing existing petroleum tanks and refineries for biomass production, biofuel storage and processing. The algae farms again play multiple roles; producing biomass for energy production while depolluting the soils and sequestering greenhouse gases. In selected locations, old oil storage tanks will be preserved to form part of the area's industry heritage and in others, they will be accessible to the general public in the form of nature observatories with pleasant sceneries along the main immigration routes.

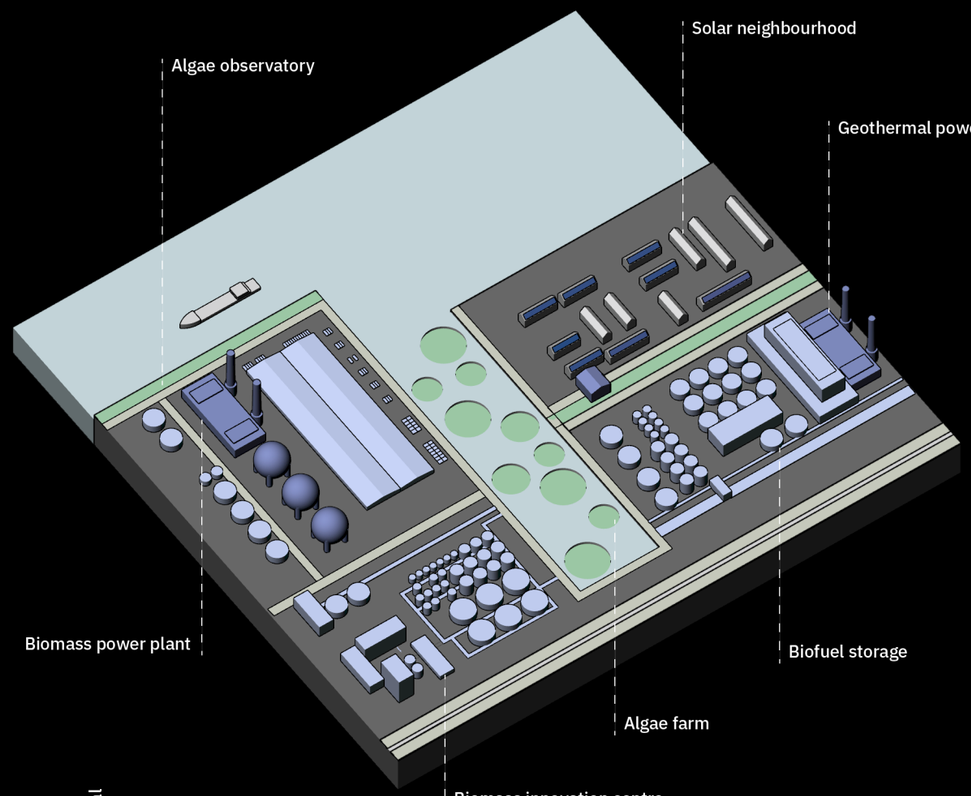
Territory Map_Pernis

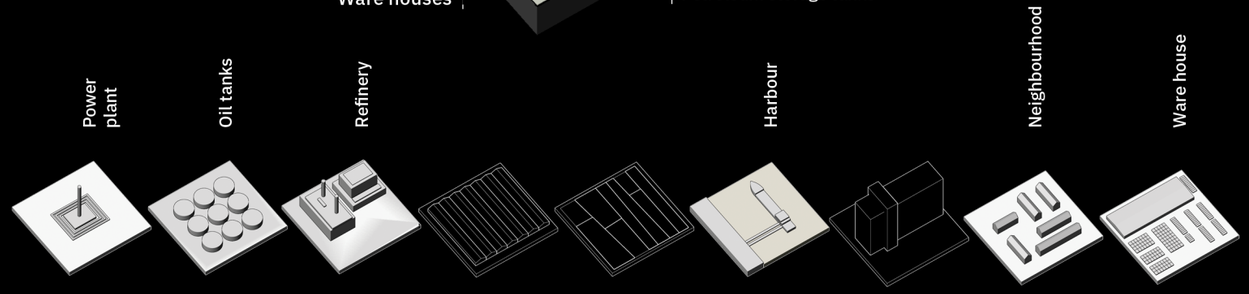
Transforming Territories

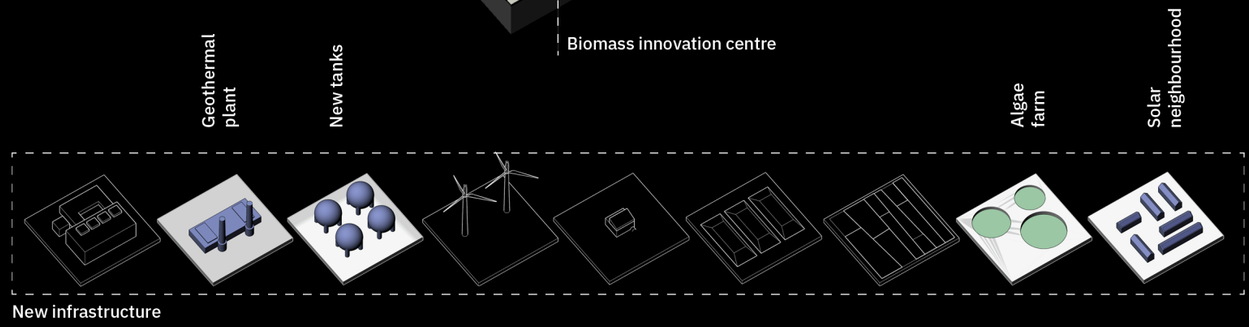
‘Scenic biomass hub’

The existing petroleum infrastructure is repurposed for the new biomass energy system, characterised by algae farms, biofuel tanks, retrofitted observatory towers and a petroleum heritage site. Tne new innovation centre plays a key role in enabling this just transition.









Transforming Territories

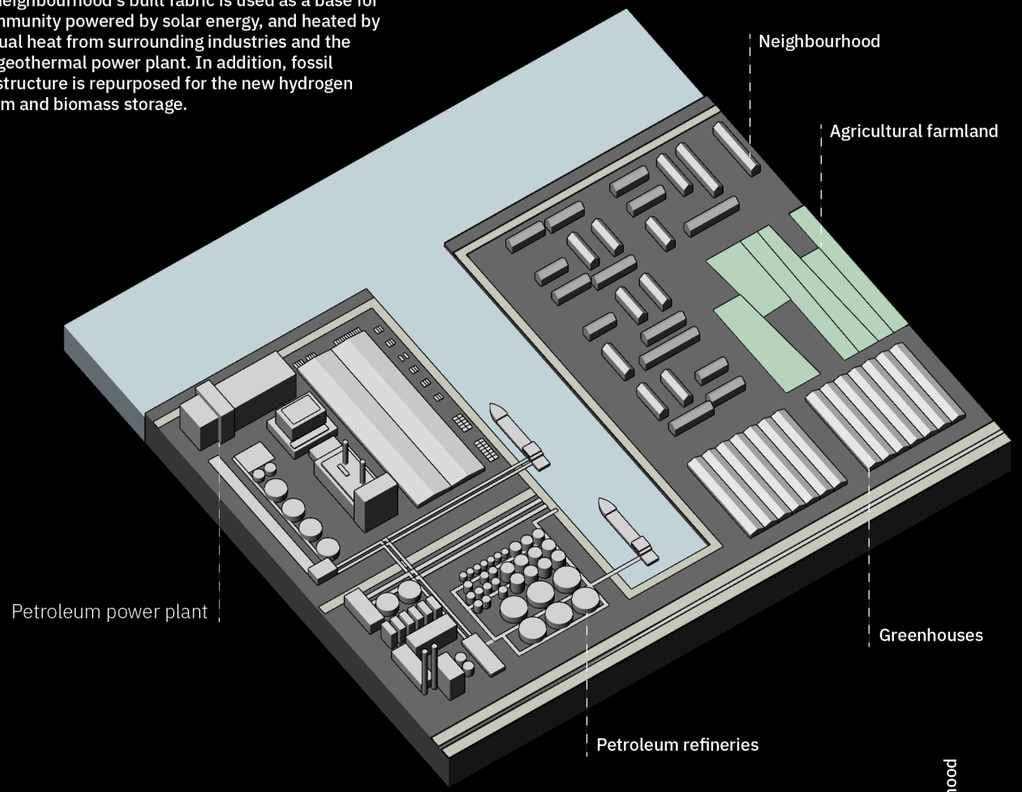
Rozenburg

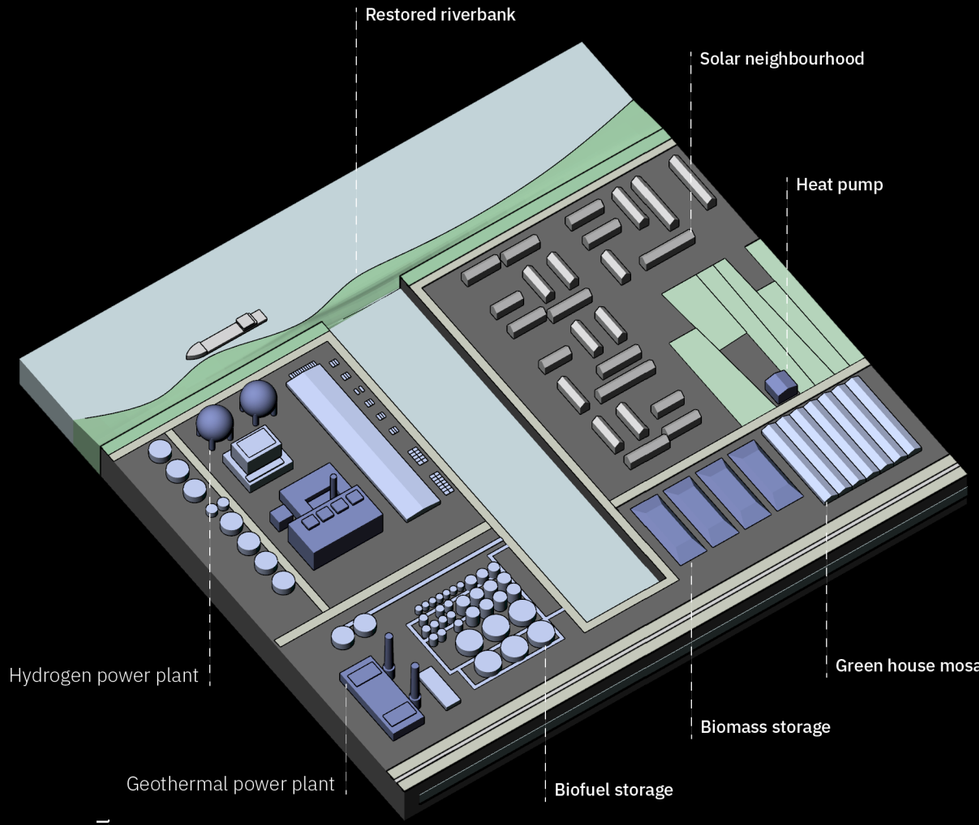
The analysis revealed Rozenburg's identity as a critical territory characterised by social and environmental conflicts. In light of this, it takes the shape of an 'inclusive circular habitat' that sets an example for other self-sufficient neighbourhoods, that are expected in time to meet their own energy and heat demands. This is achieved firstly by using the existing urban fabric as a base for establishing a new solar-power neighbourhood that upholds equal access to energy production and its associated processes regardless of income or social status. In addition, employment opportunities are made available to former fossil industry workers through a new knowledge and training centre where they will be equipped with skills pertaining to new energy technologies. By repurposing surrounding industries for hydrogen and biofuel production, the footprint of new energy landscapes is minimised, at the same time presenting new job opportunities. The same applies to the new geothermal energy plant in bordering Botlek, which together with existing industries in the vicinity will provide residual heat to meet the heating demands in the neighbourhood. Finally, the amplified nature trail serves as a public good, creating fair access to the waterfronts for recreation while framing scenic views of the landscapes across.

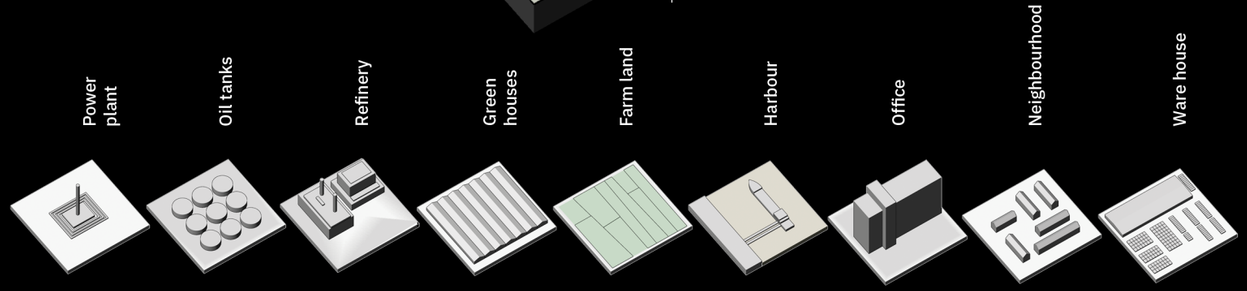
Transforming Territories

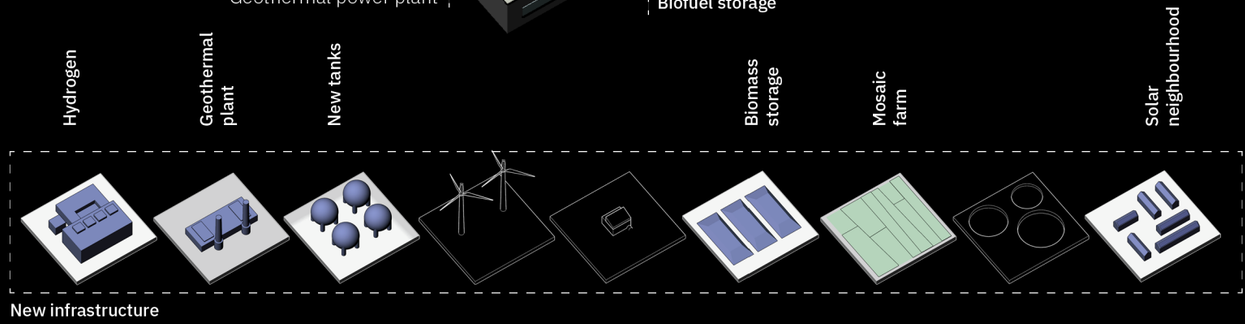
‘Inclusive circular habitat’

The neighbourhood’s built fabric is used as a base for a community powered by solar energy, and heated by residual heat from surrounding industries and the new geothermal power plant. In addition, fossil infrastructure is repurposed for the new hydrogen system and biomass storage.







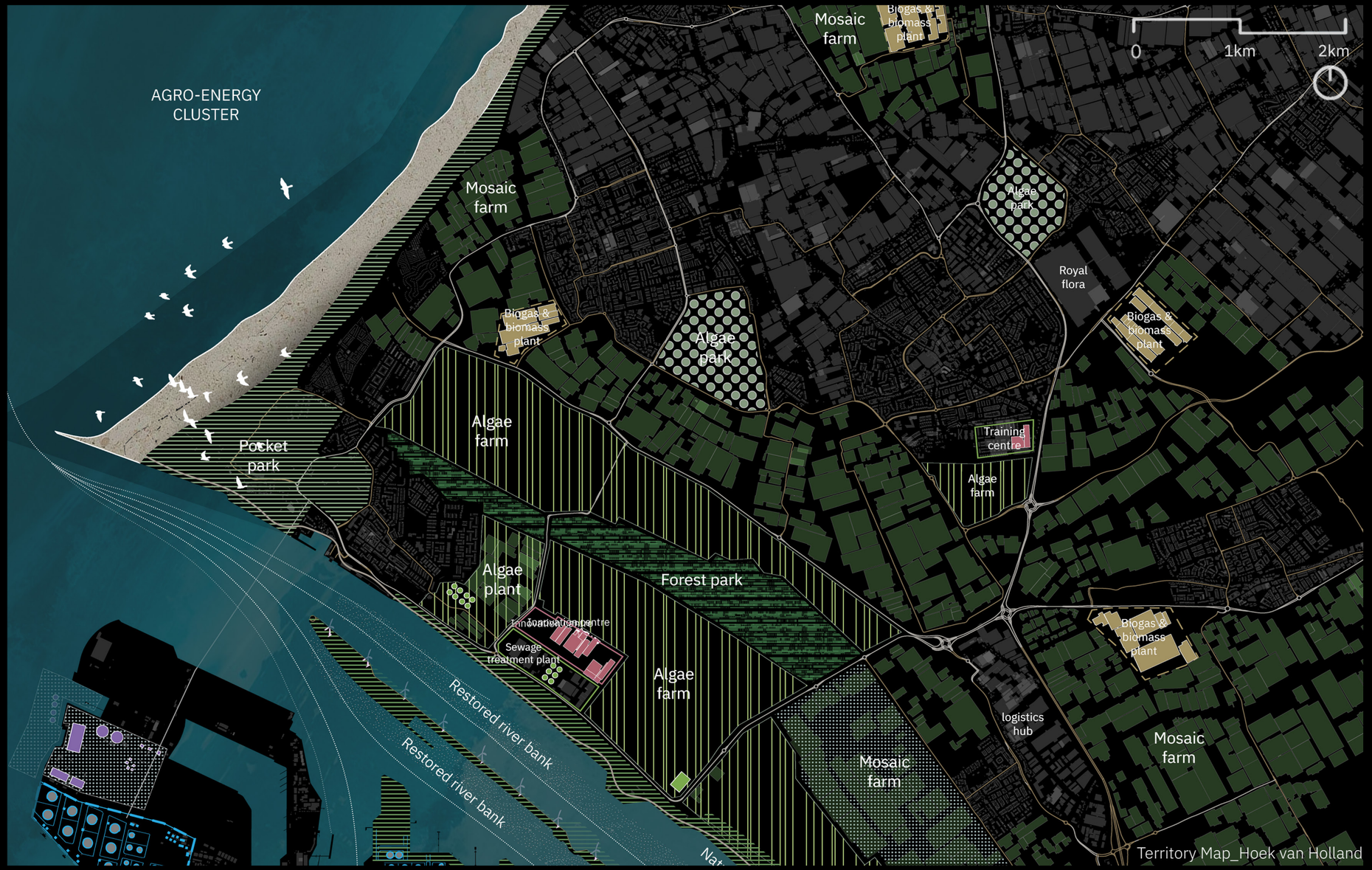


Transforming Territories

Transforming Territories

Hoek van Holland

Finally, following its identification in the analysis as a critical territory with particular regard to environmental and material issues, Hoek van Holland is envisioned as an ‘agro-energy cluster’ that aims to decontaminate polluted soils starting from the northern banks of Nieuwe Maas river. This is achieved by nature-based solutions notably the use of algae that possesses the ability to decompose chemical deposits in soil while absorbing carbon dioxide emitted by surrounding industries. In parallel, the introduction of mosaic farms that will appropriate existing greenhouses to combine aglae and food production, will create a new agro-energy landscape driven by the use of locally grown biomass for energy and biogas production to meet the energy demands of the territory. In addition to the expanded forest park bordering the algae farms, newly introduced pocket parks and nature trails along the riverbanks will not only create more space for biodiversity but also improve people’s ‘right to the port’, while forming part of the larger green-blue spine.

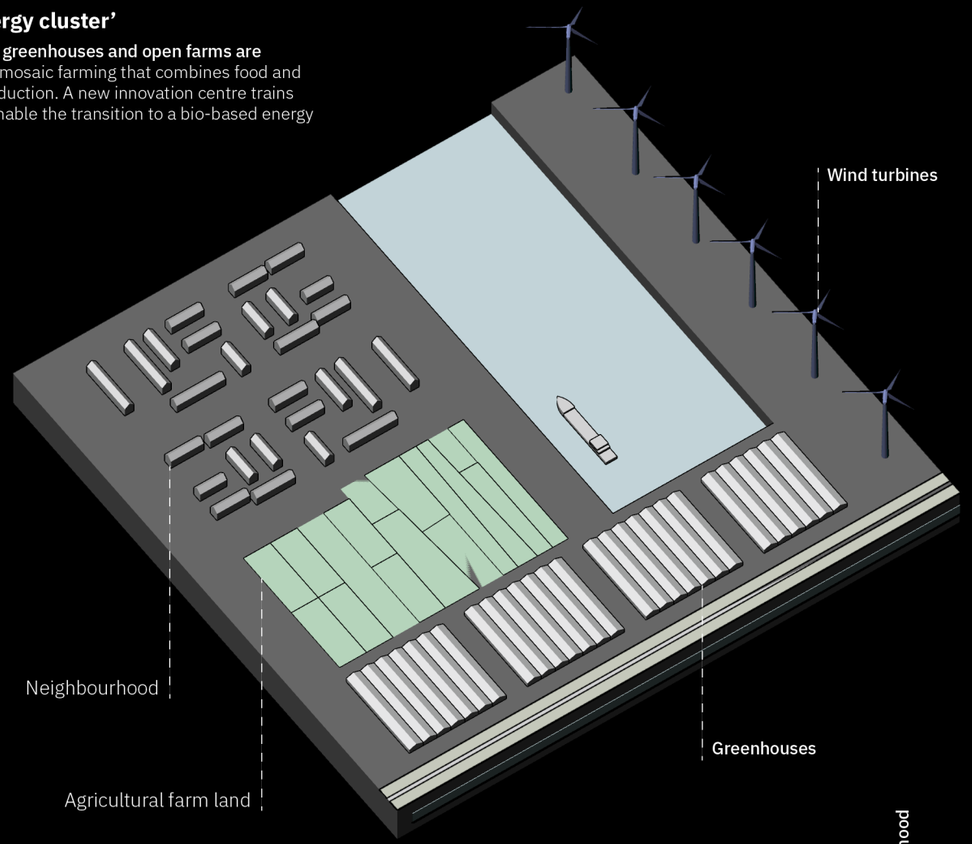


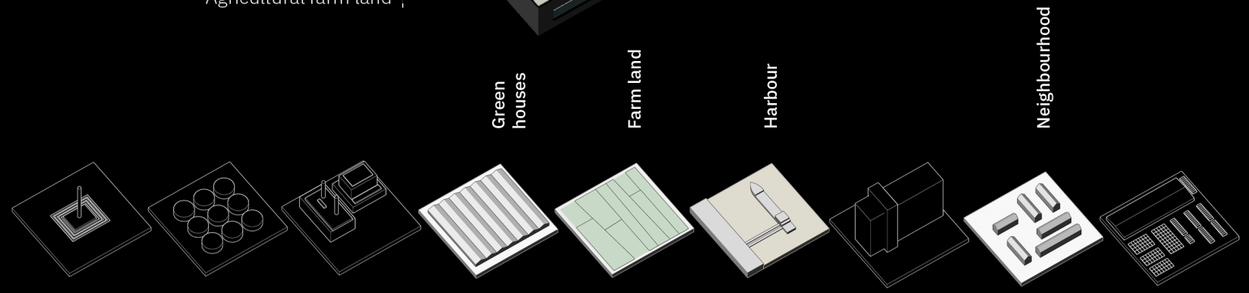
Territory Map_Hoek van Holland

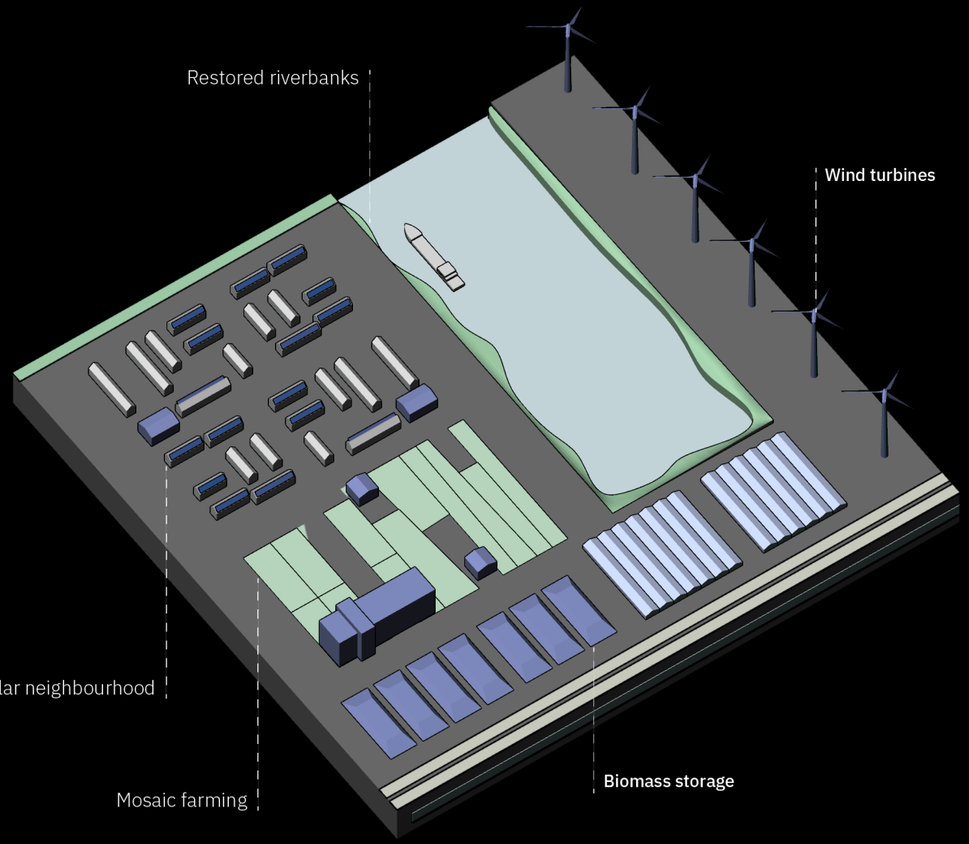
Transforming Territories

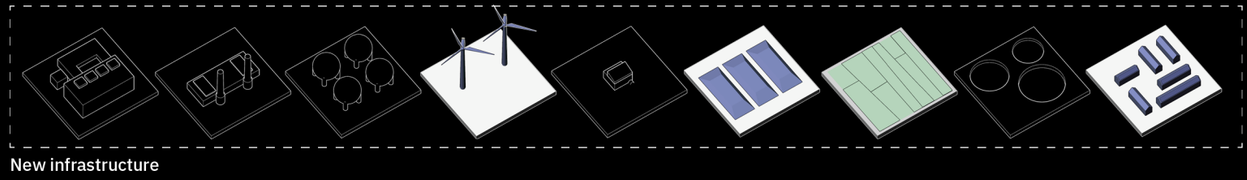
‘Agro-energy cluster’

The existing greenhouses and open farms are adapted for mosaic farming that combines food and biomass production. A new innovation centre trains farmers to enable the transition to a bio-based energy system.





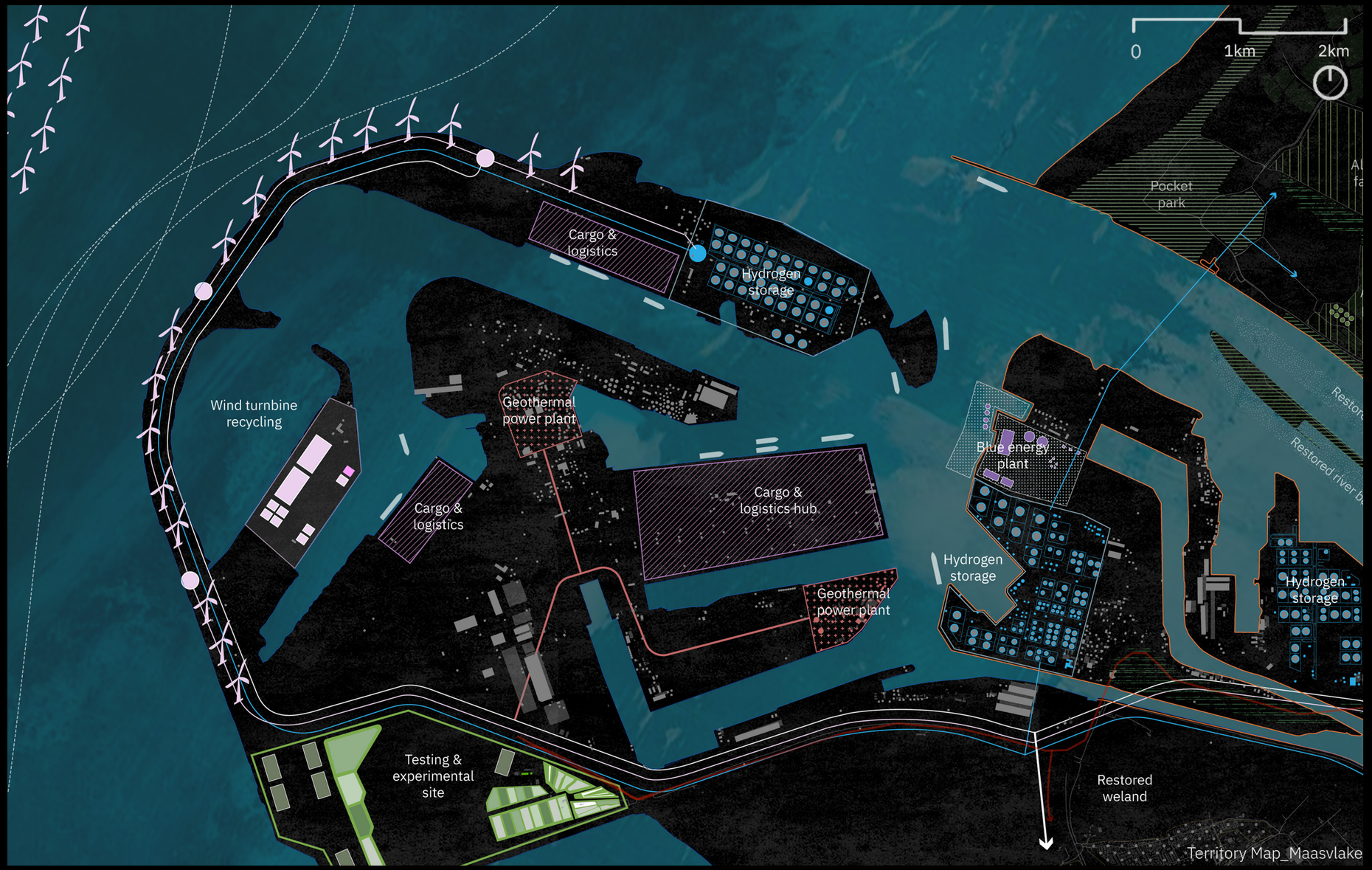




Transforming Territories

Maasvlakte

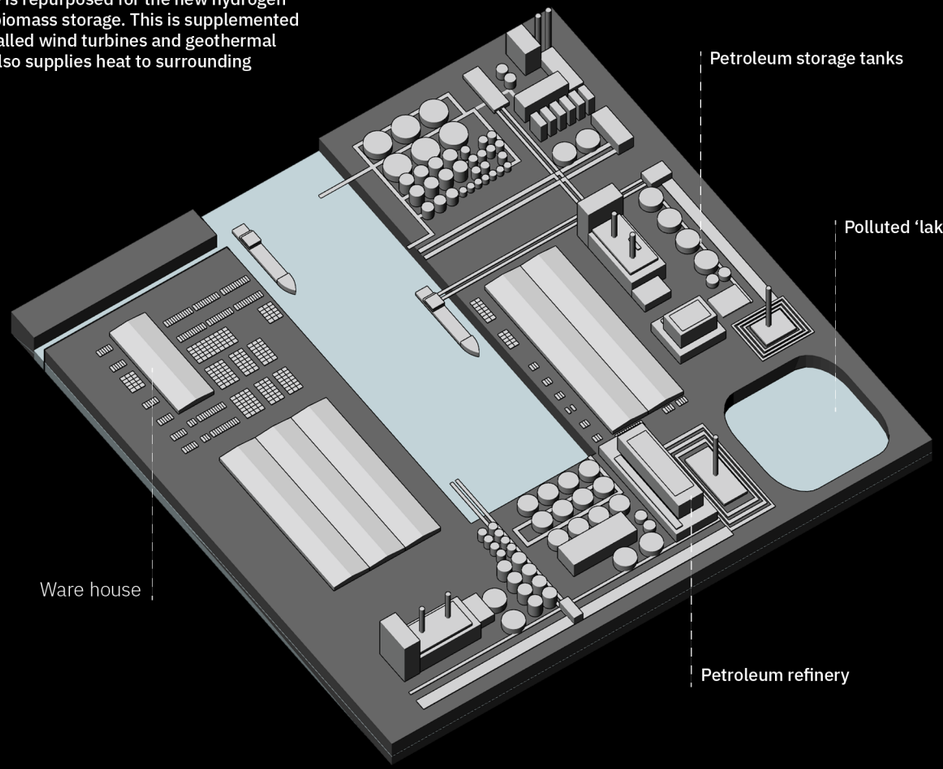
The analysis established Maasvlakte as a critical area faced with social and material conflicts. In the proposed vision, the territory takes the shape of a ‘green energy hub’ that aims to kickstart the renewable energy transition while setting the pace for new experimental energy solutions.This is achieved by combining a green mix of wind, hydrogen, geothermal and blue energy generation that depend on renewable sources, while maintaining Maasvlakte’s logistic functions that are key to the port’s identity and operation. Current oil storage tanks and refineries will be repurposed for the new hydrogen system while existing industries will accommodate recycling plants to ensure circular flows of material related to new energy-related infrastructure. The adoption of hydrogen will also enable the restoration of riverbeds since hydrogen carrying ship vessels are relatively small. This will in turn facilitate natural sedimentation processes and regulate salinity of waters, which is crucial for migratory fish and the production of blue energy. A network of riverfront and pocket parks on both sides of the Maas will grow to form part of the green-blue spine that identifies the port’s new energy landscape.

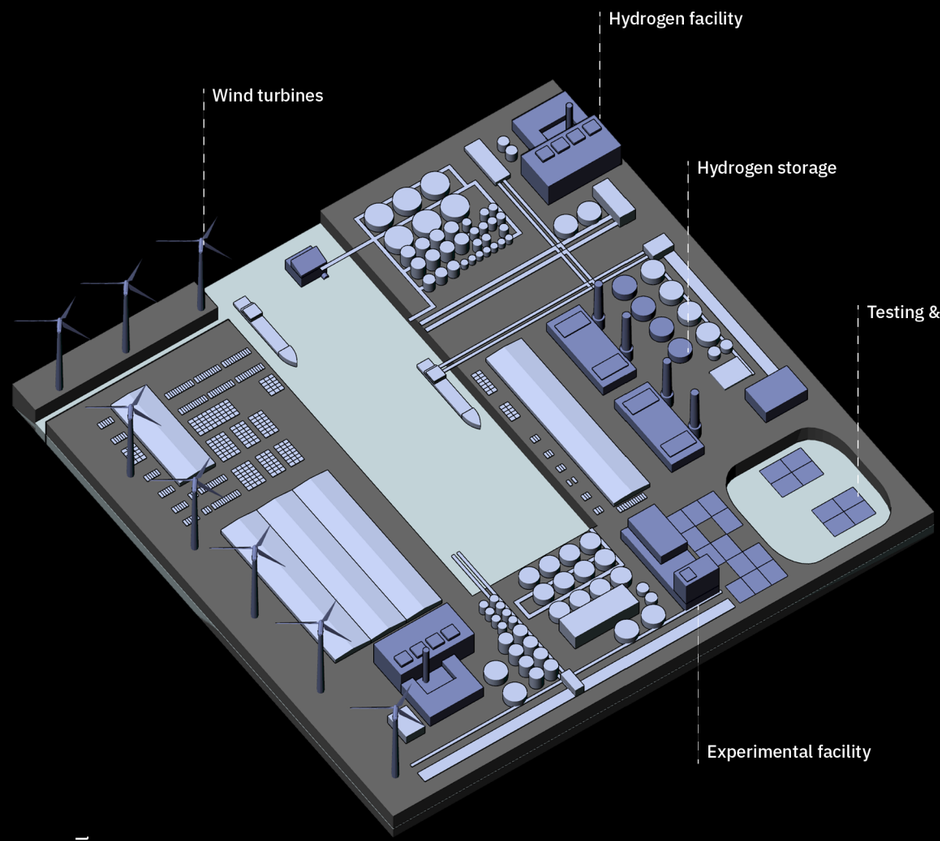


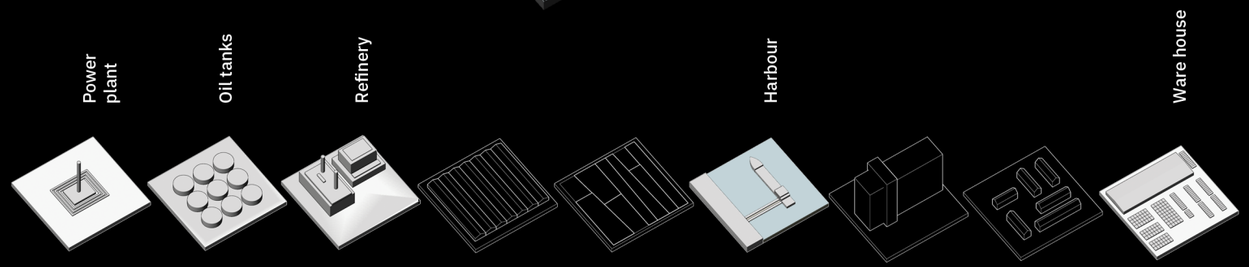
Transforming Territories

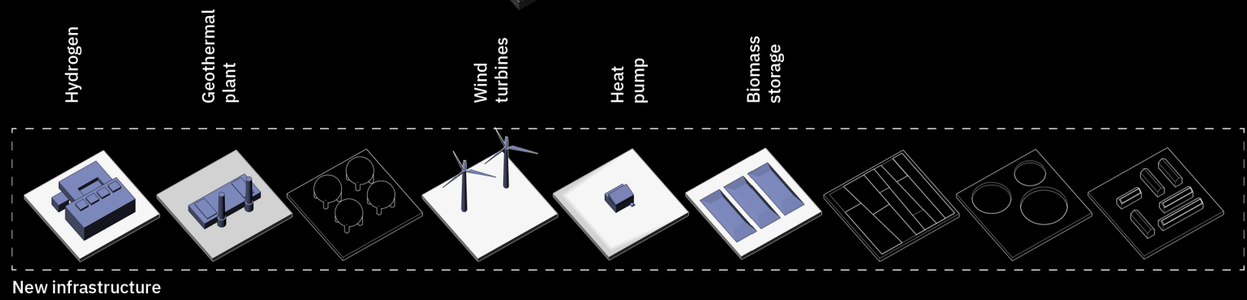
‘Green energy hub’

The existing petroleum-related material and infrastructure is repurposed for the new hydrogen system. and biomass storage. This is supplemented by newly installed wind turbines and geothermal plant which also supplies heat to surrounding industries.










LIQUIFIED HYDROGEN
NO SMOKING
LH2
SHJ

Finalising Transition

CONCLUSION

Potential Migration of Energy Habitats

Energy Habitat Assessment

With the implementation of “Energy Habitats” in the Province of Zuid Holland and the finalised transformation of the Port of Rotterdam and its surrounding territory into a green-blue spine, the project manages to introduce a new paradigm through a research-by-design experiment. In the presented narrative, the process of energy production and its associated material implications and infrastructures are no longer understood as an invasive and polluting component in the spatial configuration of the urbanised landscapes but rather as a tool that can generate a symbiosis between the natural and human systems and promote synergy between natural and material conditions. Community-led planning is the guiding concept to facilitate the involvement of all actors in the planning process and ensure that the actions taken contribute to public good. By solving social issues through a change in governance towards a balance of top-down and bottom-up approaches as well as concrete actions that introduce spatial reconfigurations, the contribution for the public good is upheld. In our case, public good implies fair and healthy living conditions for all, equal access and sharing of renewable energy systems and spatial configurations that ensure a fair socio-economic environment.

For the Port of Rotterdam this paradigm shift, enforced by the impending shortage of fossil fuel resources and its implied phase out of fossil fuel age, as well as the concrete threat of climate change and the urgent need to take action, expresses a necessary change of its self-conception and its position and understanding in the regional and global context. The vision for the “Energy Habitats” provides the opportunity for the Port to transform from being the biggest fossil fuel hub in Europe to being a prime example for sustainability and circularity while simultaneously creating spatial justice for the natural and human systems in its immediate setting.

Following the placement of the “Energy Habitat” in a broader context and its possible meaning for the Port of Rotterdam and the Province of Zuid Holland, we will now take a closer look at the actual spatial implications facilitated through the introduced strategies and how they relate to our five main values of Co-Habitation, Diversity, Appropriation, Porosity and Connectivity.

CO-HABITATION in the Energy Habitat
The title of “Energy Habitat” already indicates that the project aims to use the energy transition to improve the living environment of both nature and humans within the region. As the main strategies of symbiosis, synergy and community-led planning imply, this improvement includes the aspect of balanced and shared land-use as well as the simultaneity of systems in the same space, giving special attention to the division between dynamic and static systems that require a double velocity design. In this context, any action that affects the material conditions iin the spatial configuration of the Port and its neighbouring territory is planned to always serve more than one purpose and contribute to goals of spatial justice and material circularity.

DIVERSITY in the Energy Habitat
By introducing the concept of symbiosis between natural and human systems in the vision, the “Energy Habitat” provides spaces or better habitats for diverse forms of life. Spatial interventions like the restoration of natural landscapes and actions aimed to depollute contaminated land ensure the preservation of biodiversity while the integration of energy production systems in various forms of land-uses facilitates new landscape types with varying natural and recreational qualities. While the focus of proposed interventions is laid on the transformation of the material conditions within the context of the energy transition, the resulting changes in the urban settlements, namely the transformation towards self-sufficient and depolluted energy communities in the port area, in the long run also create healthy and desirable living conditions that enhance social diversity in equal temrs.

APPROPRIATION in the Energy Habitat
With community-led planning implemented as one of the main concepts for the process of a just transition, the vision aims to contribute to the value of appropriation. The inhabitants of the region and especially in the port area are not just bystanders of the transition but rather an integral part of its success, organising their local communities. Participation in the initial planning process and later the implementation of the new forms of energy production in their communities, promotes a close identification and feeling of belonging within the inhabitants leading to the appropriation of their own “Energy Habitat”.

POROSITY in the Energy Habitat
An important objective of the “Energy Habitat” vision is the aspect of transcending the fence, the fence in this instance being the enclosed territory of the Port of Rotterdam. Through the transformation of the fossil fuel infrastructure towards a diverse energy producing landscape, that is not only circular and sustainable but also provides depolluting qualities at the same time, the borders between the territories are softened and become permeable. Beyond that, the green-blue spine, as an overarching spatial structure, connects the different areas further and facilitates network exchange within the three dimensions.

CONNECTIVITY in the Energy Habitat
Finally, the strategy for transitioning towards the “Energy Habitats” through the implementation of a green-blue spine is heavily focused on the creation of networks between species -tying into the continuity of existing water structures- as well as flows of materials and knowledge. In that regard new and existing innovation hubs and knowledge centres facilitate interaction and exchange while the spine as a natural corridor ensures continuous migration routes for the natural system. Although the vision focuses mainly on the spatial and material implications following the impending energy transition, over time, the paradigm of the “Energy Habitats” will initiate further reconfigurations of the spatial layout in the region that will build upon the emerging networks and strengthen the connection between individual territories and new landscapes.

Seeing how the paradigm of the “Energy Habitats” responds not only to the urgent need for a transition towards sustainable, non-invasive, and circular energy production but also to the remaining polluted drosscapes and materials in the Port of Rotterdam, its relevance in territories that face similar problem, especially in the face of the global upcoming energy and social transition, becomes evident. At the same time, it ties in the UN guidelines about sustainable developments, a fact that allows its appropriation in the global context and its subsequent adaptation to different local contexts, always connected to the site-specific practices and transformative processes.

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APPENDIX

Individual Reflection

INDIVIDUAL REFLECTION - MYRTO

“The architect is confronted with the need to question the meaning of what she/he does, on the framework in which she/he exercises, on the stye she/he elaborates, and the values she/he represents. This is why her/his work is always a political position, as it questions norms, including those of aesthetics. Any aesthetic, as Charles Baudelaire said, is both moral and political – and vice versa. Any stylistic choice is a standpoint, a point of view on what is, what is hoped for, what is refused.”

Thomas Paturet, Atlas of Places

For me personally, the effort to understand portscapes, had started a while before the beginning of the “Spatial Strategies and the Global Metropolis” Studio and, thus, the introduction of the maritime territory of South-Holland with focus on the port of Rotterdam as the location of our regional design project was greeted with great enthusiasm. At the same time, the connection to the circular port economy context and the selected thematic sub-topic - the material dimension of the energy transition- signified the beginning of a very challenging 8 week-period during which we, as a group, struggled to comprehend the previously unknown, and mainly fenced, elements, structures, landscapes, and processes of the energy transition in relation to its social, economic, and spatial implications.

In that effort, which was everything but linear, it became clear that, beneath the spatial research investigation that had to grasp the dual identity of the port of Rotterdam both as a multilayered territory and as a metropolitan landscape defined by its (in)tangible flows and relational crossovers, a parallel study of the associated actors and the produced power relations had to be conducted to transform existing development paths. Among the two, I must admit that the decoding of the stakeholder constellation was the biggest challenge for our group and although the tools provided by “Research & Design Methodology for Urbanism” course and the SDS sessions were indeed a helpful start to indicate necessary steps, they were sometimes restrictive in the attempt to define our own personalised path, or they underestimated the time we needed to actually finalise them.

On the contrary, experimenting with “Designing with nature” methodology, as explained by Ian McHarg, was helpful in bringing together our different interests, areas of focus and lessons gained from the Capita Selecta and SDS sessions motivating us to not only stay in the analysis of the evidence but to really become critical using even our conflicts as a tool for debate and stakeholder representation during the planning process towards a just energy transition. In parallel, the conceptual framework, developed during the first weeks of the quarter and revised constantly afterwards, was a true guide in our goal to transcend the port’s fence initiating the construction of an assessment scheme both for the current situation and envisioning future narratives that tried to summarise the spatial principles presented on the lectures under the combined values of Sieverts’, Ascher’s and Secchi and Vigano’s works, as developed by Thomas Juel Clemmensen, Morten Daugaard & Tom Nielsen in their article “Qualifying urban landscapes”.

However, when we tried to embody our analysis and goals in a set of scenarios that would lead to our vision, we realised the true difficulty of the regional design since the complexity of evidence, the crucial element of time and the interwoven uncertainties seemed impossible to define a linear narrative for the future that would lead to an efficient spatial representation. As a result, the process of creating a vision extended throughout the whole quarter with it being constantly altered and updated to only reach its complete state after we had defined a concrete strategy plan and its phasing. In retrospect, the vision tool was always supposed to be a circular process leading regional design while being its by-product. Realising that, was a pivotal point in our group work taking the focus from the spatial characteristics back to the planning aspect and specifically the policies associated with the social transition of the circular port and the phasing of our vision.

This part was probably the hardest for me and yet the one that gave me the most important lessons about the regional scale and about the importance of working in a group with different input and areas of expertise. Although it probably took twice the time that was expected to determine and articulate the policies, and it required an excessive research on phasing of projects related to natural processes (since none in the group had previous experience working with urbanised landscapes), using the approach investigated in the project “Plan Ooievaar” by Deltametropool helped us continue the effort established during the research to plan not only for dynamic man-made systems but also for static natural ones. Thus, we managed to efficiently coordinate the last part of our process that moves from the vision and its phases to the strategy and the pilot interventions and then back to the vision and the overall picture.

Overall, during the past eight weeks I had the opportunity to explore the regional scale, the portscapes and the spatial aspect of the energy transition, three subjects that were largely unknown and challenging for me, simultaneously trying to establish fitting frameworks, aesthetic styles, and values together with my group. Working together, even with its occasional miscommunications, debates, and differences in designing or representational approaches, was one of the most interesting lessons of this quarter and it added value in the results. We were all motivated, focused, and democratic, pushing each other to be critical while coordinating the different roles we needed to follow during the process, always under the helpful feedback provided by our tutors.

Individual Reflection

INDIVIDUAL REFLECTION - NORA

Upon the Quarter 3 of the MSc. Urbanism programme coming to an end, it is time to reflect on the work that has been done. For me personally, coming from an architectural background, the scale and complexity of regional design was challenging in the beginning although I have already had some previous experience, mainly regarding regional management related to the LEADER-programme, through an earlier internship. Therefore, particularly the SDS lectures provided helpful tools to break down the complexity of regional structures and interconnections and give guidance for developing a spatial vision for the region. Furthermore, the lectures helped me to realise the importance and power of regional design and the need for vision making, especially when confronted with the global challenges our societies are facing today and their urgent call to act.

While I enjoyed the lecture block of “Capita Selecta” in the beginning of the quarter as an introduction, reflecting upon it now, I think it would have been even more helpful for me and my group if some of the lectures had taken place at a later point in the quarter when the understanding of certain structures and the region in general became clearer. Mainly, due to the tight schedule of the quarter’s programme, re-watching with a more focused view proved to be difficult to manage timewise. In terms of the lecture’s content, I would have liked to, in addition to the perspective of the Province of Zuid Holland and the Port authority, also have an insight from the port-related companies and the port residents. Apart from that the provided material, meaning the access to data and presented literature as well as the set lectures both from Capita Selecta and the Methodology classes, gave a wholesome overview of the topic and were a good starting point to dive into further research.

Moving on to the R&D Studio, I want to say that I immensely enjoyed working with my fellow teammates Myrto, Yaxuan and Shinno. While it initially took us some time to get acquainted with the regional complexity of Zuid Holland and especially the understanding of our focus topic, being “the material side of the energy transition”, with the help and insight of our tutors as well as their useful recommendations for literature we were able clarify our understanding and proceed with the development of our vision and strategy. In particular, the recommendation of the book “Design by Nature” by Ian McHarg, turned out to be fruitful since it provided us with the methodological approach that guided our analysis. Furthermore, “Energy Landscapes” by Dirk Sijmons was crucial for us to understand the spatial implications of energy production.

I can say that my understanding of complex urban and regional structures and relations has improved immensely, and the importance of methodological approaches and research became apparent. To sum it up, this quarter has taught me a lot and provided various insights and methods that will be helpful when I start working on my Master project in the second year.

INDIVIDUAL REFLECTION - SHINNOSUKE

Having previously worked on smaller scales, this project has been a deep plunge into unfamiliar waters. Drowning in an overload of information and struggling to find a sense of direction at the beginning of the course, I gradually got a grasp of the complexities and uncertainties of regional design only as the quarter came to an end. Although I am still far from being an expert at this scale, I have immensely appreciated how global trends and invisible flows are closely interlinked not only to national and regional economies, but also to our everyday lives. Current metabolism patterns and flows have been long established over the past centuries, and it is pertinent for us as urban designers to be cognisant of these as we make spatial interventions.

Shaping of spatial visions and strategies, in collaboration with multiple actors, is a new phenomenon to me considering my background from a country with a pre-dominantly top-down governance. Based on a good understanding of the myriad of stakeholders directly or indirectly affected by any project and their power relations, I have learned that more inclusive and just societal transformations can be achieved. It has also become clear that as much as community-led bottom-up approaches play a big role at the scale of the community, top-down measures help to create a concerted and coordinated effort to achieve impact at larger municipal and regional scales.

Given the complexity and grand nature of regional scale projects, it is apparent that clear and understandable strategies are developed so that they can be comprehended by all actors, some of whom are not technically conversant. Furthermore, these strategies need to be coordinated across different scales of implementation, each with sometimes varying actors and locations. In parallel, the long-term nature of these projects calls for a breakdown of these strategies into measurable actions with clear timelines spanning the entire project.

Amid the complex processes of regional design, the SDS and Capita Selecta lectures were informative especially in gaining a practical overview of Dutch planning tools and processes. Although I personally struggled to correlate them directly with the design studio, broader policies like the European Green deal and UN SDGs seemed easier to interpret and adopt in our thematic topic. Lectures introducing material flows in Rotterdam and Circular Port Cities were very helpful in gaining a deeper understanding of the current port landscape, as well as ongoing efforts and research. Our tutors, Verena and Nikos, supplemented this knowledge by providing insightful feedback and useful reading material.

Working in a group of people from diverse backgrounds and cultures was a pleasant experience that transcended academic tasks into exchange of cultures, languages and food. As a team, we were able to harness each other’s strengthens while compensating weaknesses, as evident in this final report which I am very proud of. I learned the important lesson of using differences as an opportunity to learn from others and improve myself.

Individual Reflection

INDIVIDUAL REFLECTION - YAXUAN

At the beginning of this quarter, regional planning was a relatively unfamiliar field for me. The SDS lectures and workshops on urban analytical tools, analysis methods and the regional planning process were beneficial, and I got a more holistic view of regional planning. As mentioned in the lecture, the dynamics of interaction between intertwined processes of spatial-functional, political-institutional and cultural-symbolic integration across urban regions transform fragmented territories into coherent metropolitan systems.

After the series Capita Selecta, I gained a deeper understanding of the energy transition process and the current development of the circular economy in the Netherlands. Although we all know very little about energy topics, the energy transition is an essential context for urban development, and more materials need to be recycled as existing fossil energy sources are phased out. At the same time, the competition for space is intensifying. It is necessary to involve architects and planners in how the Port of Rotterdam, as an important border of the province of South Holland, can be reconstructed and connected to other territories.

The lecture on methodology was very enlightening for me regarding social justice and democracy. It is very important to ensure rational resource allocation, multi-stakeholder participation and coordination in regional planning. Reflected in our project, we redefine spatial justice in the context of the energy transition, intervening in its impact on society andthe natural environment from a planner‘s perspective. We explore the possibilities of complex land use for energyscapes in the spatial and temporal dimensions, implementing regional planning strategies and managing milestones.

It is worth mentioning that we have also made a lot of experimental attempts in the project. Personally, my previous understanding of urban design was to design a paradigm that could guide the city‘s development rather than a plan that already makes all the decisions. In the same way, our project introduced a new paradigm through a research-by-design experiment. We tried to use overlapping cartography and value judgement as the analysis methodology. The planning strategy uses the critical territories obtained in the analysis section as pilot points. It develops a planning strategy from nodal points to a nodal network that eventually spreads to the entire region.

This project also reminds me that policy is important for regional planning, and even though we are always discussing the necessity for more bottom-up planning processes, there remains an overall need for top-down control, with laws and policies that regulate or encourage multi-stakeholder participation and alignment of interests. We want to achieve a balance between top-down and bottom-up approaches to governance by changing the way we govern and taking concrete action to solve social problems.

But at the same time, I am also aware that democracy does not necessarily mean justice. And the concept of liberal democracy for individuals and local communities in Western countries is centred on the right to participate in energy system decisions, which may increase injustice, especially elsewhere. It may also delay the transition to a more just and low-carbon economy. For energy justice, we need to consider more low-income groups in terms of social justice and the sustainability of nature in terms of environmental justice, which inspires me to think in a multi-dimensional way from a higher level.

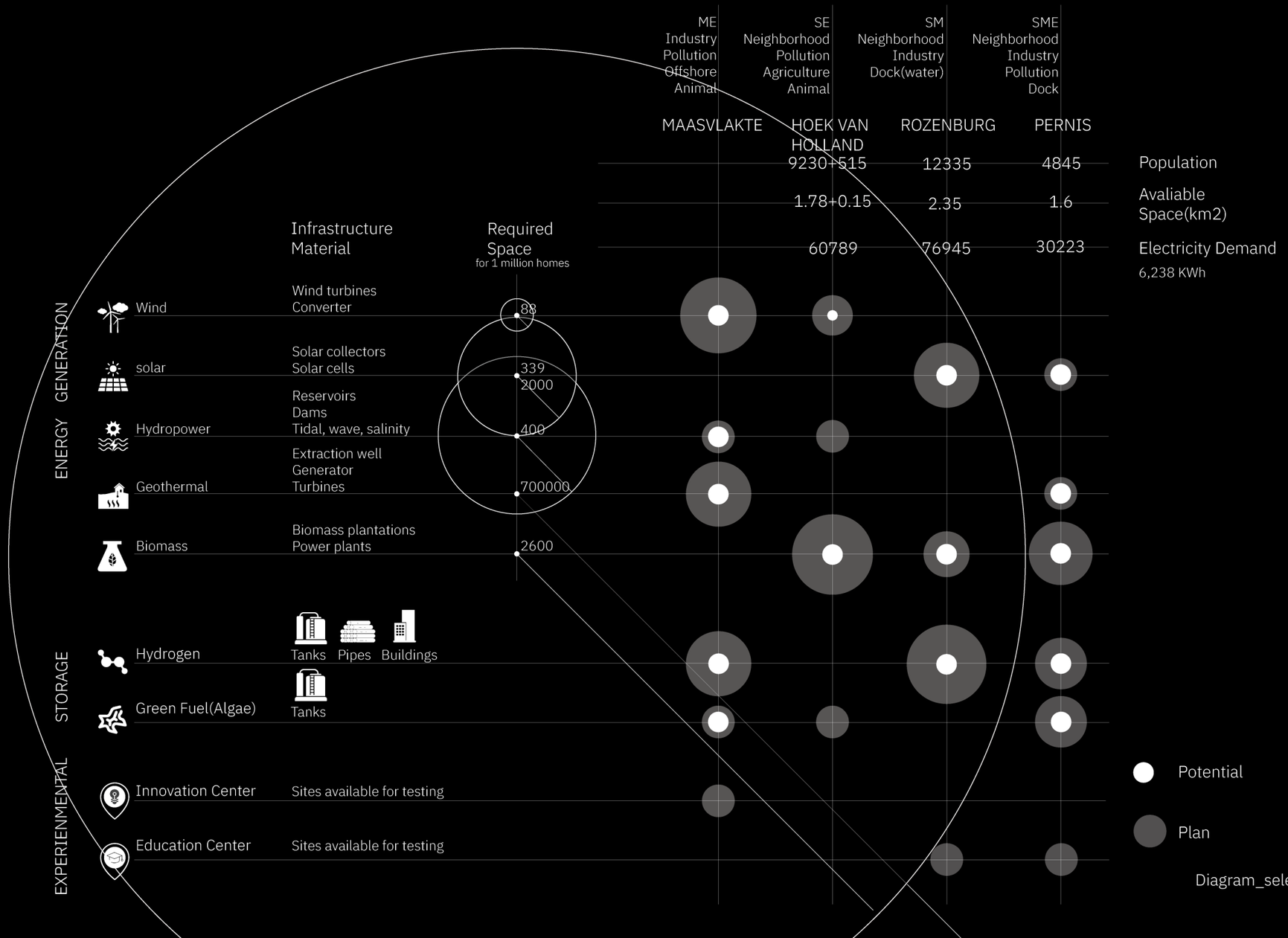
SWOT

STENGTHS	OPPORTUNITIES
- Existing offshore and inland ecological systems and a variety of landscapes (dunes, forest areas, delta area, natural habitats, river floodplains, polders) that accommodate biodiversity and provide recreational activities or scenic values	- New natures that can improve living conditions for all species re-spatializing the current distribution of benefits and burdens.
- Ongoing renewable energy initiatives (solar and wind farms) that serve as models to be adopted more widely	- Existing fossil fuel infrastructure (storage tanks, pipelines, refineries, logistics areas, transport networks, fuel stations) that can be repurposed to provide the necessary spaces for the new energyscapes, landscapes and cityscapes. - Existing material that can be recycled to provide the essential raw materials for the energy transition. - Essential conditions and potentials for new and experimental renewable sources (solar, wind, geothermal, algae, tidal, kinetic blue energy).
- Knowledge institutions (RDM, Erasmus University, TU Delft, Leiden University, OnePlant, BlueCity) that constantly improve energy production and distribution systems - Existing circular urban developments and transformations (Merwe-Vierhaven, Green Village Delft, Heijplaat) that serve as case studies for sustainable settlements - Strong port city culture and identity that facilitates transformation as a practice towards resilience	- Dynamic centres for education in new energy production and distribution systems that can provide new job opportunities. - Land use porosity that can challenge the existing fences and destroy the separation between port and city. - Strategic connection on the north sea and inner Europe that can magnify the port's role as a pioneer in energy transition.

WEAKNESSES	THREATS
- Extended water, air and soil pollution caused by fossil fuel infrastructure that restricts future land uses and spatializes structural injustices concerning fragile wildlife and unprivileged groups.	- Rising sea levels and water related disasters that could submerge the existing port area and related infrastructure. - Limitations of new energy infrastructure that could possibly endanger natural habitats and biodiversity.
- Obsolete large technical systems and transport infrastructure associated with the existing petroleumscape that restrict transformation acting as persistent material structures which only allows certain socio-spatial relations. - Increased spatial needs of renewable energy sources for production compared to the fossil fuel infrastructure.	- Overdependence on imported fossil fuels that could delay the energy transition. - Overdependence on rare and critical metals that could prevent the energy transition towards renewable resources.
- The prevailing of the petroleumscape as the archetype of the energy landscape that defines the current culture accompanying the energy transition. - Mismatch between the existing land cover and the land uses defined by the hidden economic structure of the fossil fuel production and distribution that define the port as a demarked territory and isolates it from the city.	- Increased urbanisation and consequently increased energy demand in nearby cities that could lead to even greater spatial competition for different land uses. - Increased automation and digitization in new energy production and distribution systems that could lead to loss of jobs and more inequality.

SWOT

TOWS Analysis	Weaknesses	Strengths
External threats	-WT - Mini-mini WITHSTAND - By increasing the role of existing knowledge institutions and innovation hubs in the energy transition creating new job opportunities and planning for the expected losses. - By reusing and repurposing existing infrastructure to accommodate the expanding competition for spatial needs. - By recycling all critical material that can be found in the existing infrastructure to reduce new material requirements. - By providing space in the port's higher grounds for urban developments and new biotopes facing the rising sea-level challenge. - By re-orienting the existing transportation networks to better accommodate mobility requirements of the expanding urban developments.	ST - Maxi-minI ADAPT - By enhancing the role of the varied landscapes re-introducing the Maas river as a complex multifunctional nature corridor with a dual identity as scenic nature and biotopos. - By using the knowledge centres to develop ideas and strategies to increase efficiency in energy production, to effectively harvest experimental clean energy sources and to invent new methods for mass recycling of critical material. - By developing strategies to recycle energy between creating an independent circular region.
Opportunities	WO - Mini-maxi INTEGRATE - By using the different energy types in its maximum potential to overcome the land shortage. By combining smart, innovative and nature-based technological solutions for depollution and recreational landscapes. - By repurposing existing logistic areas to create new circular developments that produce energy through decentralised systems and decrease needs for central production and distribution systems. - By reconstructing the archetypical image of the energyscapes through the implementation of metamorphosing processes.	SO -Maxi-maxi INTEGRATE - By matching the land cover to future land uses and increasing porosity through mixture and openness - By extending the existing electricity infrastructure to incorporate renewable energy sources. - By making the port of Rotterdam an international paradigm towards renewable energy & circularity - By seeing the transition as an opportunity to reconstruct a more just society through the reconfiguration of space as to equally distribute burdens and benefits.



Diagram_selection toolkit for energy types